Section/division AIID

Form Number: CA 12-12a

AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:	CA18/2/3/8567		
Aircraft Registration	**ZS-JZF**	**Date of Accident**	21 October 2008		**Time of Accident**	0609Z	
Type of Aircraft	Piper PA32R-300		**Type of Operation**		Private		
Pilot-in-command Licence Type		Private	**Age**	55	**Licence Valid**	Yes	
Pilot-in-command Flying Experience		Total Flying Hours	297.29		Hours on Type	176.29	
Last point of departure	Rand Aerodrome (FAGM) Gauteng.						
Next point of intended landing	Ficksburg Aerodrome (FAFB) Free State Province.						
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)							
Wesbank Raceway, approximately 2km north of Rand Aerodrome near Germiston (GPS Positions: S25˚ 13.957 E028˚ 07.960)							
Meteorological Information	Fine weather conditions; No clouds; Temperature; 18℃; Wind: 360˚/10kt.						
Number of people on board	1 + 5	**No. of people injured**	0	**No. of people killed**	1+5		

Synopsis

On 21 October 2008, the pilot accompanied by 5 passengers took off from Runway 35 at Rand Aerodrome at approximately 0609Z for the intended flight to Ficksburg Aerodrome (FAFB). The aircraft was fuelled to full capacity of 94 US gallons the previous day for the intended flight.

Shortly after the aircraft became airborne, the pilot retracted the undercarriage and executed a left-hand turn in a westerly direction. The pilot then made a transmission call on radio VHF frequency 118.7MHz to the Air Traffic Controller (ATC) at Rand Aerodrome and requested permission to execute an emergency landing. There was no further communication. During the left-hand turn with the undercarriage extended, the aircraft lost height and the left-hand wing and nose wheel impacted with a heap of rubble just prior to an open grass/sand area at the Wesbank Raceway area near Gosforth Park, approximately 1.9km (1.1nm) to the west of the threshold of Runway 17 at Rand Aerodrome.

During the impact sequence, the aircraft cart-wheeled and burst into flames approximately 56 metres from the initial impact point.

The aircraft was destroyed by fire that erupted and all occupants on board were fatally injured.

Probable Cause

The aircraft failed to gain sufficient height after it became airborne, with the aircraft in a high nose-up attitude towards the end of Runway 35. The pilot was unable to correct the situation by lowering the nose of the aircraft as there were obstacles ahead such as trees, high tension wires and buildings. Runway 29 would have been a better option since it is 5446 ft long which is 646ft longer than that of Runway 35 without any obstacles ahead. Contributory Factor: The aircraft was overloaded by approximately 260 lbs.

ARB Date		Release Date	

AIRCRAFT ACCIDENT REPORT

Name of Owner/Operator	**:** PH Wittstock
Manufacturer	**:** Piper Aircraft Corporation
Model	**:** Piper PA32R-300
Nationality	**:** South African
Registration Marks	**:** ZS-JZF
Place	**:** Wesbank Raceway near Germiston.
Date	**:** 21 October 2008
Time	**:** 0609Z

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 given without prejudice to the rights of the CAA, which are reserved.

1. FACTUAL INFORMATION

1.1 History of Flight

1.1.1 On 21 October 2008, the pilot telephonically filed a Visual Flight Rule (VFR) flight plan for a private flight from Rand Aerodrome to Ficksburg Aerodrome (FAFB). After the flight plan was filed, the pilot, accompanied by 5 passengers, took off from Runway 35 at Rand Aerodrome at approximately 0609Z for the intended flight to Ficksburg. The aircraft was fuelled to the full capacity of 94 US gallons the previous day for the intended flight.

1.1.2 Shortly after the aircraft became airborne, the pilot retracted the undercarriage and executed a left-hand turn in a westerly direction. The pilot then made a transmission call on radio VHF frequency 118.7MHz to the Air Traffic Controller (ATC) at Rand Aerodrome and requested permission to execute an emergency landing. There was no further communication. During the left-hand turn with the undercarriage extended, the aircraft lost height and the left-hand wing and nose wheel impacted a heap of rubble just prior to an open grass/sand area at the Wesbank Raceway near Gosforth Park, approximately 1.9km (1.1nm) to the west of the threshold of Runway 17 at Rand Aerodrome.

PHOTO1: VIEW OF RUBBLE WHICH WAS IMPACTED BY NOSE LANDING GEAR DURING AN EMERGENCY LANDING.

1.1.3 During the impact sequence, the aircraft cart-wheeled and burst into flames approximately 56 metres from the initial impact point. The aircraft was destroyed by the fire that erupted. All occupants on board the aircraft were fatally injured.

1.1.4 According to a witness who was standing outside a hangar, close to the threshold of Runway 17 at Rand Aerodrome, the aircraft became airborne towards the end of Runway 35 in a high nose-up attitude. It appeared that the flaps were in the up position during take-off and as soon as the aircraft became airborne, the undercarriage was retracted.

1.1.5 Another witness, who is a construction worker at the Wesbank Raceway at Gosforth Park, stated that he saw the aircraft turning to the left, back towards the Aerodrome whilst descending, when the left-hand wing and the nose landing gear wheels impacted with rocks (rubble) and shortly thereafter, burst into flames.

1.2 Injuries to Persons

Injuries	Pilot	Crew	Pass.	Other
Fatal	1	-	5	-
Serious	-	-	-	-
Minor	-	-	-	-
None	-	-	-	-

1.3 Damage to Aircraft

1.3.1 The aircraft was destroyed on impact and by the post-impact fire that erupted.

PHOTO2 : VIEW OF AIRCRAFT WRECKAGE DESTROYED BY THE POST-IMPACT FIRE

1.4 Other Damage

1.4.1 There was no other damage caused to property on the ground during the accident sequence.

1.5 Personnel Information

Nationality	South African	Gender	Male	Age	55
Licence Number	------------------	Licence Type	Private		
Licence valid	Yes	Type Endorsed	Yes		
Ratings	Night Rating.				
Medical Expiry Date	31 August 2009				
Restrictions	See 1.5.3 & 1.5.4 for information.				
Previous Accidents	None				

Flying Experience:

Total Hours	297.29
Total Past 90 Days	30.0
Total on Type Past 90 Days	30.0
Total on Type	176.29

1.5.1 The pilot was the holder of a private pilot's licence that was issued on 24 October 2006. He started flying the accident aircraft on 16 November 2006 which consisted of conversion training that was completed on 5 December 2006, during which time he accrued 11.8 flying hours. His pilot's logbook also indicated that a flight check was carried out on 01 August 2008 which was certified by the Royal Victorian Aero Club in Australia. The flight check was conducted in a Piper PA28R-200, registration VH-SGE for the duration of 1.2 flying hours at the location, YMMB.

1.5.2 According to the records of the SACAA, a registered letter dated 05 December 2007 was sent by the Licensing Section to the pilot under the heading "*Medical Certificate from the Institute for Aviation Medicine*". In this letter, the Licensing Section notified the pilot that his medical certificate dated 13 November 2007, received from the Institute for Aviation Medicine (IAM), indicated he had been declared "Temporarily Medically Unfit" from 16 October 2007.

1.5.3 The Medical Report indicated that on 24 December 2007, a medical report was received in which the pilot was declared medically fit from 24 December 2007 to 31 July 2008 as a private pilot.

1.5.4 According to the last Aviation Medical Certificate Class 2, the pilot was declared medically fit from 04 August 2008 to 31 August 2009 without any restrictions.

1.6 Aircraft Information

1.6.1 **Airframe:**

Type	Piper PA32R 300	
Serial Number	32R-7780024	
Manufacturer	Piper Aircraft Corporation	
Year of Manufacture	1977	
Total Airframe Hours (At time of Accident)	2811.81	
Last MPI (Hours & Date)	2765.82	26 May 2008
Hours since Last MPI	45.99	
C of A (Issue Date)	08 November 1976	
C of R (Issue Date) (Present owner)	27 June 1979	
Operating Categories	Standard	

1.6.2 Engine:

Type	Lycoming IO-540 KID5G
Serial Number	L15415-48A
Hours since New	2811.81
Hours since Overhaul	945.29

1.6.3 Propeller:

Type	Hartzell HC – C3YR-IRF
Serial Number	DY3582A
Hours since New	571.31
Hours since Overhaul	Not yet reached

1.6.4 Mass and Balance

1.6.4.1 The Maximum Allowable Take-off weight (MTOW) for the aircraft is 3600 lbs. The calculated take-off weight was determined as approximately 3860.7 lbs. Refer Table I below.

1.6.4.2 The takeoff mass of the aircraft therefore exceeded the maximum certificated mass aircraft.

1.6.4.3 The Centre of Gravity (CG) for the aircraft of 93.28 inches was found within the C.G. forward and aft range of 91.2 – 95.0

Table I : Mass and Balance calculation

	WEIGHT (LBS)	ARM AFT DATUM (INCHES)	MOMENT IN-LBS
Basic Empty Weight	2300.7	81.8	188,197.26
Pilot & Front passenger	353.0	85.5	30,181.5
Passengers (Centre Seats- Aft facing)	330.0	119.1	39,303.0
Passengers (Rear Seats)	297.0	157.6	46,807.2
Passengers (Jump Seat-Optional)			
Fuel (Full Tanks 94 US gallons) x 6.0 = Lbs	564.0	93.6	52790.4
Baggage (Forward)	0	0	0
Baggage (Aft)	16.0	178.7	2859.2
Moment due to Retraction of Undercarriage			
Total Loaded Airplane	3860.7	93.28	360138.6
Maximum Allowable Take-off Weight	**3600**		

1.7 Meteorological Information.

1.7.1 The Meteorological Information provided by the South African Weather Services concluded the following weather conditions at the time of the accident.

1.7.1.1 Surface Analysis: (0600Z on 21 October 2008)

A high pressure system was ridging south of the country, feeding moist air onto the eastern part of the country. A trough of low pressure was present over the central interior of the country.

1.7.1.2 Upper Air.

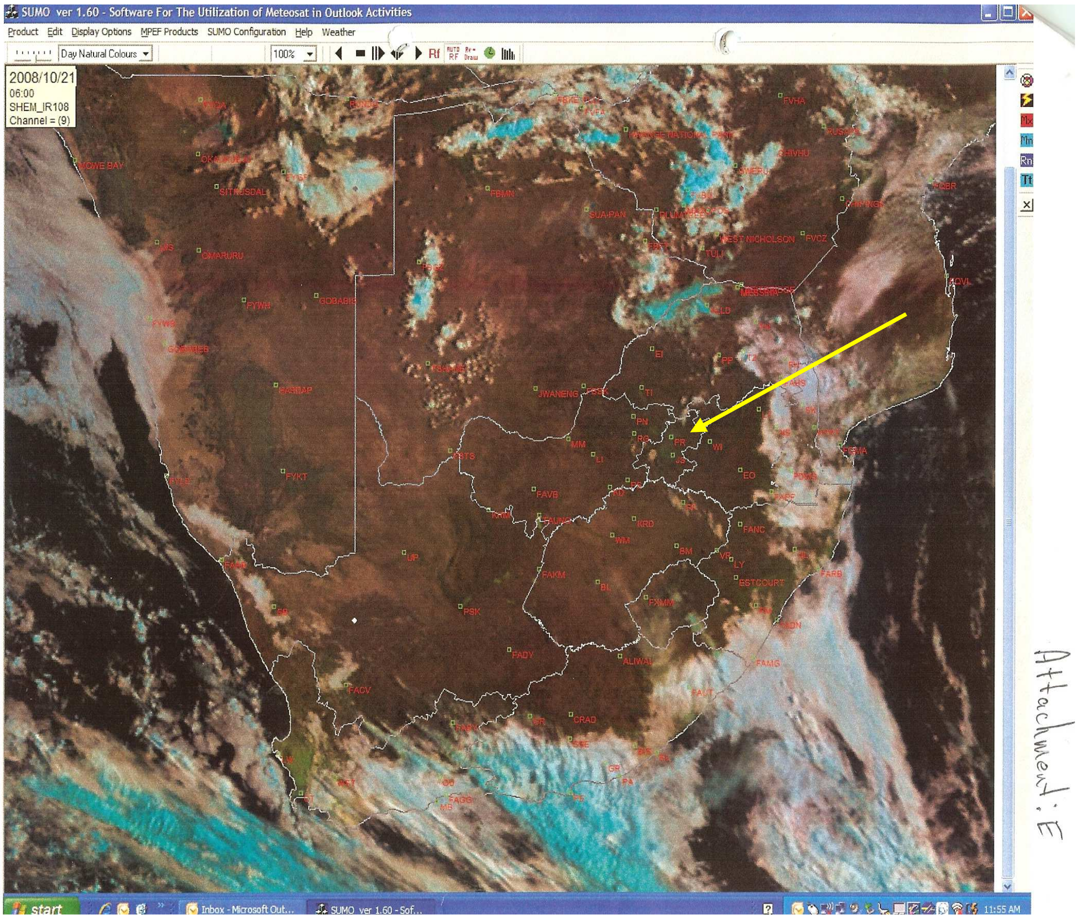
At 500hPa a high pressure system was present over the central interior with a moderate southerly wind in the Johannesburg area.

1.7.1.3 Satellite Imagery.

The 0600Z visual satellite imagery shows no cloudy conditions in the Rand Aerodrome area.

1.7.1.4 Weather Conditions in the vicinity of the accident.

At 0600Z, the ATC at Rand Aerodrome reported the following METAR:
METAR FAGM 210600Z 360/10KT CAVOK 18/12 Q1023=



SATELLITE IMAGERY SHOWS NO CLOUDY CONDITIONS AT RAND AERODROME AREA

1.8 Aids to Navigation

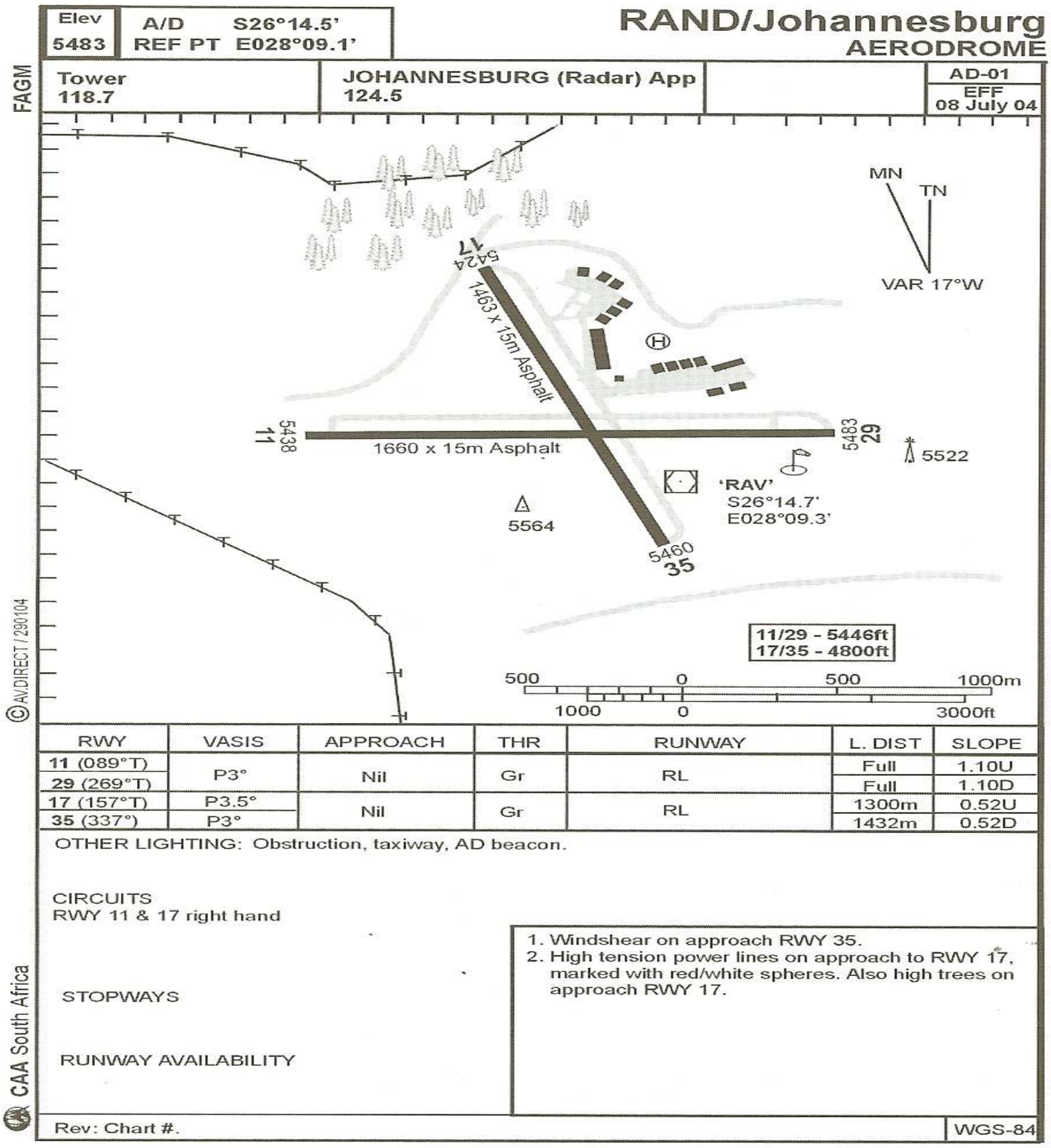
1.8.1 The aircraft was equipped with the standard navigational equipment for the flight that was serviceable at the time of the accident.

1.9 Communications

1.9.1 Rand Aerodrome (FAGM) was manned at the time of the accident. Shortly after the aircraft took off from Runway 35 at Rand Aerodrome, the pilot made a radio transmission call on VHF frequency, 118.7MHz and requested permission to execute an emergency landing. There was no further communication after this. The communication equipment was serviceable at the time of the accident.

1.10 Aerodrome Information

1.10.1 The pilot took off from Runway 35 at Rand Aerodrome (FAGM) and attempted to execute an emergency landing shortly after the aircraft became airborne, approximately 1.1 nm north-west of the threshold of Runway 17.



RWY	VASIS	APPROACH	THR	RUNWAY	L. DIST	SLOPE
11 (089°T)	P3°	Nil	Gr	RL	Full	1.10U
29 (269°T)					Full	1.10D
17 (157°T)	P3.5°	Nil	Gr	RL	1300m	0.52U
35 (337°)	P3°				1432m	0.52D

OTHER LIGHTING: Obstruction, taxiway, AD beacon.

CIRCUITS
RWY 11 & 17 right hand

STOPWAYS

RUNWAY AVAILABILITY

1. Windshear on approach RWY 35.
2. High tension power lines on approach to RWY 17, marked with red/white spheres. Also high trees on approach RWY 17.

Rev: Chart #. WGS-84

1.10.2 Rand Aerodrome (FAGM) is located in the vicinity of a golf course. The Airport/Facility Directory establishes the airport elevation at 5 483 ft above mean sea level (AMSL) and two runways are available. These are oriented in a north-south direction (runways 35 and 17) and an east-west direction (runways 11 and 29). The bottom end of runway 35 borders a golf course that has large trees as well as large electricity pylons surrounding the golf course.

1.10.3 The advisory note 2 on the aerodrome information warns of high-tension power lines as well as high trees on approach to runway 17.

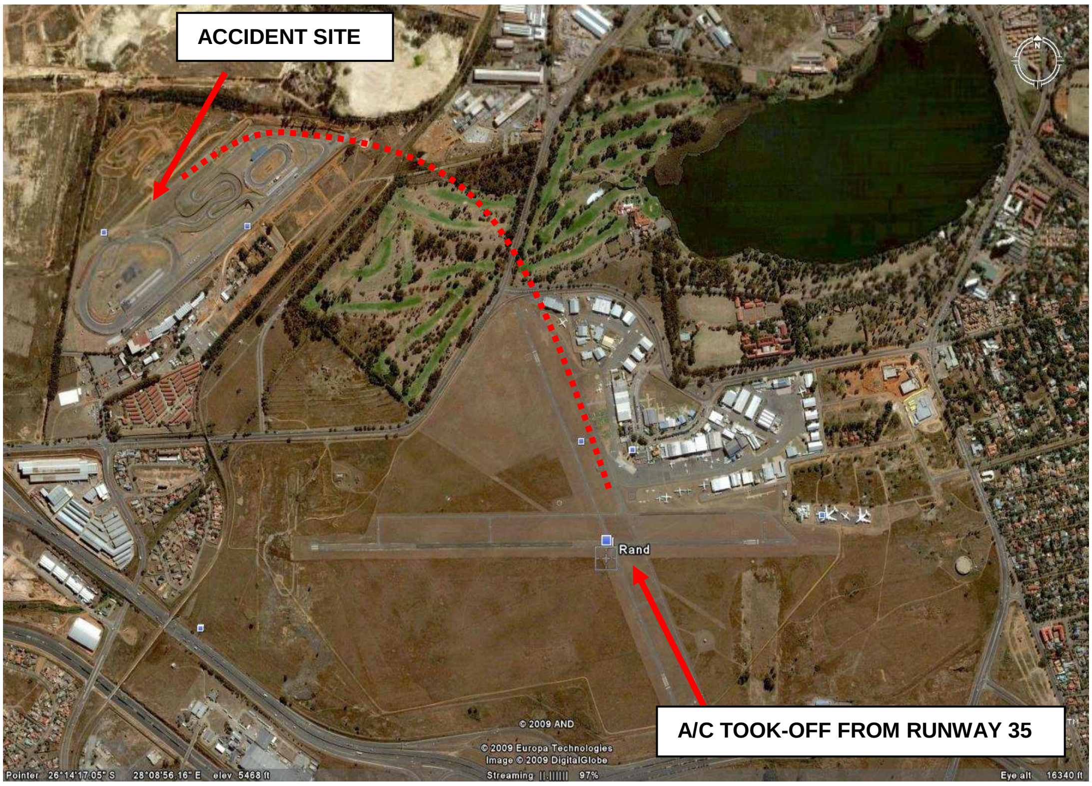
1.10.4 There have been a number of accidents involving unsuccessful takeoffs in the use of runway 35 through the years.

1.10.5 The advantages and disadvantages in the use of the available runways at FAGM can be summarized as listed below. The proximity of FAGM to FAJS does have a major influence.

- Runway 29 from Pilots and ATC point of view - best runway for takeoff.
- Runway 29 is worst for landing and circuit traffic for ATC because of the proximity of the final approach paths into FAJS.

- Runway 11 from Pilots and ATC point of view - best runway for landing

- Runway 11 not the best for takeoff because of uphill. Also the wind very rarely favours Runway 11. The takeoff flight path also encroaches on the approach flight path for FAJS runway 03L.



VIEW OF RAND AERODROME RWY 35 FROM WHERE A/C TOOK OFF & WHERE ACCIDENT OCCURRED.

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 aircraft's nose landing gear and left-hand wing impacted with a heap of rubble on a heading of approximately 170˚M just prior to an open grass/sandy area at the Wesbank Raceway near Gosforth Park, approximately 1.9km (1.1nm) to the west of the threshold of Runway 17 at Rand Aerodrome. During the impact sequence, the nose wheel broke off and the aircraft subsequently cart-wheeled before coming to rest approximately 56 metres from the initial impact point.

1.13 Medical and Pathological Information

1.13.1 A medico-legal autopsy was performed on the deceased pilot and passengers after the accident. The results of the post-mortem report and toxicology tests were not available at the time when the report was compiled. If any results received later on show that medical aspects may have affected the performance of the pilot-in-command, this will be considered as new evidence and the investigation re-opened.

1.14 Fire

1.14.1 A post-impact fire erupted during the impact sequence and the aircraft was destroyed by the ensuing fire.

1.15 Survival Aspects

1.15.1 The Emergency Services responded immediately after the accident occurred, but due to trenches dug near the accident site, the aircraft was already consumed by the ensuing fire that erupted by the time that they arrived on the scene.

1.16 Tests and Research

1.16.1 The engine and all the engine components were recovered for further investigation and examination at an approved Aircraft Engine Overhaul shop at Wonderboom Aerodrome. The 'Rajay' Turbo-chargers which were installed on the engine and refurbished by Kelly Aviation were submitted for metallurgical examination by an approved metallurgical analyst in order to determine the condition of the turbochargers. Please find Annexure 'A' and Annexure 'B' attached to this report.

1.16.2 The engine was disassembled at an Engine Overhaul Facility and close attention was paid to possible parts that could have failed and caused the engine not to deliver the required engine power. No such defects were identified during the engine disassembly.

- The spark plugs (type-RHM 40E) were all found intact and appeared to have been in proper working condition prior to the accident. Soot and FOD found on the spark plugs were post-accident material.

- The magnetos could not be bench-tested due to excessive fire damage, but no apparent defects as a result of failed parts were found.

- The fuel pump and all other engine components were found excessively damaged due to the fire and subsequently no tests could be carried out.

- The oil pump was disassembled and inspected and no internal damage was noted on the body and oil pump drive gears.

- The Hartzell propeller governor, serial No. B1200U was bench-tested and was found to be within the manufacturer's specifications.

- High Compression Pistons Part No. LW10207 were found fitted to the engine. Note: Turbo-charged engines are normally fitted with Low Compression pistons, part No.LW10545 and not with High Compressor pistons.

- It appears that the engine had had an STC (Supplemental Type Certificate) being carried out to make it a “Turbo-normalized” engine and not a full “Turbo-charged engine”. The Data plate on the engine indicates the engine as an IO-540 and not a TIO-540 Engine.

- The engine was completely disassembled and no broken or failed parts were found.

- Regarding the parts and accessories that were inspected, no mechanical defects were found that could have caused the engine to fail in flight.

1.16.3 The turbochargers found fitted to the engine were examined by a qualified Physical Metallurgist. The visual inspection revealed severe impact and post-impact fire damage.

- The left-hand turbocharger revealed impact marks resulting in a tear in the exhaust outlet duct. No clear evidence of pre-impact damages to the exhaust inlet and air outlet ducts could be detected.

- The right-hand turbocharger revealed a fracture in the exhaust outlet duct. Decolourisation in the adjacent areas to the fracture indicates exposure over a period of time to the high temperature exhaust gases. Taking into account that the exhaust inlet duct was fractured on impact, it can be assumed that the exposure of the exhaust outlet duct to exhaust gases was prior to final impact.

- On tear-down of the turbocharger, foreign matter was detected entrapped in the hot cycle turbine. The foreign matter was most probably ingested after impact, indicating that the engine was operating on impact. The cold cycle turbine appeared to be in good condition. The bearing proved to be sticky, but this can be attributed to post-impact ingested matter as well as lubrication break-down during the post-impact fire. The inner area of the exhaust outlet duct revealed severe wear due to high temperature exhaust gas exposure during operation.

- The Scanning Electron Microscope (SEM) investigation revealed signs of flaking adjacent to the original fracture. The X-ray Energy Dispersive Analytical System (EDS) results showed that these areas exposed by the flaking, as well as the majority of the investigated area adjacent to the original fracture, were covered by exhaust residue with a high lead (Pb) content. This proves that these flaked areas were exposed to leaking exhaust gases over a period of time. The fracture surface from the original fracture shows some residue build-up as well as geometry comparable with a slow propagating fracture.

- The total effect of a ruptured turbocharger exhaust outlet duct on the overall performance of the engine, except resulting in higher noise levels, should be minimal.

1.17 Organisational and Management Information

1.17.1 According to available information, this was a private flight, flown by the pilot who was also the owner of the aircraft.

1.17.2 The last MPI was certified by AMO (Aircraft Maintenance Organisation), No. 107 on 26 May 2008 at a total of 2765.82 airframe hours.

1.18 Additional Information

1.18.1 In accordance with Civil Aviation Regulations, 1997, the duties of the pilot-in-command regarding flight preparation are defined in Chapter 91.02.7, which reads

(1): The pilot-in-command of an aircraft shall not commence a flight unless he or she is satisfied that –

(a) The aircraft is airworthy;

(b) The instruments and equipment required for the particular type of operation to be undertaken, are installed and are serviceable, except as provided for in the MEL, if any;

(c) The aircraft has been released to service in accordance with Part 43;

(d) The mass of the aircraft does not exceed the maximum certificated mass calculated from the performance information provided in the aircraft flight manual referred to in Regulation 91.03.2, in terms of which the operating limitations referred to in subpart 9 are complied with;

(e) The load carried by the aircraft is properly secured, fit to be conveyed in accordance with Part 92 and is so distributed that the centre of gravity is within the limits prescribed in the aircraft flight manual referred to in Regulation 91.03.2.

Further and according to the Pilot's Operating Handbook, Weight and Balance, Section 6.1, in order to achieve the performance and good flying characteristics which are designed into the airplane, it must be flown with the weight and centre of gravity (CG) position within the approved operating range (envelope). Although the airplane provided flexibility in loading, it cannot be flown with the maximum number of adult passengers, full fuel tanks and maximum baggage without exceeding the Maximum allowable takeoff weight. With the flexibility comes responsibility that the pilot must ensure that the airplane is loaded within the loading envelope before he commences a take-off.

1.18.2 Incorrect loading carries consequences for any aircraft. An overloaded airplane will not perform, climb or cruise as well as a properly loaded one. The heavier the airplane is loaded, the less climb performance it will have.

1.18.3 Centre of gravity is a determining factor in flight characteristics. If the C.G. is too far forward, in any airplane, it may be difficult to rotate for take off or landing. If the C.G. is too far aft, the airplane may rotate prematurely on take-off or tends to pitch up during climb. Longitudinal stability will be reduced. This can lead to inadvertent stalls and even spins; and spin recovery becomes more difficult as the centre of gravity moves aft of the approved limit.

1.18.4 A properly loaded airplane, however, will perform as intended. Before the airplane is licensed, it is weighed and a basic empty weight and C.G. location is computed (basic empty weight consists of the standard empty weight of the airplane plus the optional equipment). Using the basic empty weight and C.G. location, the pilot can easily determine the weight and C.G position for the loaded airplane by computing the total weight and moment and then determining whether they are within the approved envelope.

1.18.5 The basic empty weight and C.G. location are recorded in the Weight and Balance Data Form and the Weight and Balance Record. The current values should always be used. Whenever new equipment is added or any modification work is done, the mechanic responsible for the work is responsible to compute a new basic empty weight and C.G. position and to write these in the Aircraft Logbook and the Weight and Balance Record. The owner should make sure that it is done.

1.18.6 A weight and Balance calculation is necessary in determining how much fuel or baggage can be loaded so as to keep within allowable limits. Check calculations prior to adding fuel to ensure against overloading.

1.19 Useful or Effective Investigation Techniques

1.19.1 None.

2. ANALYSIS

2.1 The pilot and 5 passengers on board the aircraft took off from Runway 35 at FAGM with full tanks for a VFR private flight to Ficksburg.

2.2 Runway 29 would have been a better option as Runway 29 is 5446 ft long which is 646ft longer than that of Runway 35 without any obstacles ahead. Whilst it is the PICs responsibility to ensure that the runway is suitable, and if a pilot does not consider the runway allocation by ATC to enable a safe takeoff he has every right to query the instruction and request an alternate runway. The decision rests with the pilot in command, as he/she is ultimately responsible for the safety of the flight, but lots of pilots and students don't know that, or feel intimidated by ATC, so do not question their instructions.

2.3 The aircraft became airborne towards the end of Runway 35 with the flaps retracted and the aircraft in a high nose-up attitude. The pilot retracted the undercarriage and executed a left- hand turn in a westerly direction, but shortly thereafter he requested permission to execute an emergency landing. During the left-hand turn, however, with the undercarriage extended, the aircraft lost height and the left-hand wing and nose landing gear impacted with a heap of rubble just prior to an open grass/sandy area, approximately 1.9km (1.1nm) to the west of the threshold of Runway 17 at Rand Aerodrome.

2.4 During the impact sequence, the aircraft subsequently cart-wheeled and burst into flames approximately 56 metres from the initial impact point. The aircraft was destroyed by the fire that erupted. All occupants on board the aircraft were fatally injured.

2.5 The pilot most likely found himself in a precarious situation as the aircraft became airborne at a latter stage on the runway with the aircraft in a high nose-up attitude. It was thus not possible for the pilot to lower the nose of the aircraft to gain more speed, with trees and high tension wires and buildings ahead.

2.6 This high nose-up attitude probably meant that the aircraft was being flown on the wrong side of the drag curve with the resultant inability to increase speed or height. This prompted the pilot to attempt to execute a landing in an open area which was not successful.

2.7 The aircraft was serviceable for the flight and no reported defects or malfunctions were noted that could have contributed to the cause of the accident.

2.8 The engine was recovered to an Approved Engine Overhaul Workshop for examination. The engine was disassembled and close attention was paid to possible parts that could have failed and caused the engine not to deliver the required engine power. No such problem was encountered during the engine disassembly.

2.9 A metallurgical analysis was performed on the turbochargers that were installed on the engine. Apart from severe impact and post-impact fire damage, the total effect of the ruptured turbocharger exhaust outlet duct on the overall performance of the engine was considered minimal. It was recommended by Crash-Lab that the engine and all its components to be scrutinized for any defects that may have contributed to this accident. This was not possible as some components sustained impact and severe fire damage.

3. CONCLUSION

3.1 Findings

3.1.1 The pilot was the holder of a valid private pilot's licence and the aircraft type was endorsed on his licence.

3.1.2 The aircraft was serviceable prior to the accident with no defects or malfunctions recorded that could have contributed to the cause of the accident.

3.1.3 Weather conditions were fine at the time of the accident with the temperature 18℃, the surface wind 360˚/10kt and the visibility CAVOK.

3.1.4 The aircraft's maximum certified take-off weight is 3600 lbs. The calculated take-off weight during take-off from Runway 35 at Rand Aerodrome was approximately 3860.7 lbs.

3.1.5 The aircraft failed to gain sufficient height after it became airborne, with the aircraft in a high nose-up attitude towards the end of Runway 35. The pilot was unable to correct the situation by lowering the nose of the aircraft as there were obstacles ahead such as trees, high tension wires and buildings.

3.1.6 This high nose-up attitude probably meant that the aircraft was being flown on the wrong side of the drag curve with the resultant inability to increase speed or height. This prompted the pilot to attempt to execute a landing in an open area which was not successful.

3.1.7 Use of runway 29 would have been a better choice by the pilot considering the heavy loading of the aircraft.

3.1.8 The engine was disassembled at an Approved Engine Overhaul Shop and close attention was paid to parts that could have failed, but no visible defects were found. Refer Appendix A.

3.2 Probable Cause/s

1.1.1 The aircraft failed to gain sufficient height after it became airborne, with the aircraft in a high nose-up attitude towards the end of Runway 35. The pilot was unable to correct the situation by lowering the nose of the aircraft as there were obstacles ahead such as trees, high tension wires and buildings. Runway 29 would have been a better option as Runway 29 is 5446 ft long which is 646ft longer than that of Runway 35 without any obstacles ahead.

1.1.2 Contributory Factor:

The aircraft was overloaded by approximately 260 lbs

4. SAFETY RECOMMENDATIONS

4.1 It is recommended that the CCA:

Conducts a review and develop requirements and guidance in respect of the use of Runway 35 at FAGM.

5. APPENDICES

5.1 APCO Engine Examination Report.
CrashLab Metallurgical Report.

Report reviewed and amended by the Advisory Safety Panel on 19 January 2010

-END-

APPENDIX 'A'

APCO

Aircraft Powerplant Company (Pty) Ltd

COMPANY REGISTRATION No: 2001 / 016447 / 07

Engine, Component and Engineering Division

FAX TRANSMITTAL

TO: SACAA
FAX: debruynf@caa.co.za
RE: ZS - JZF
DATE: 21 Nov 2008
PAGES: 3
ATT: Mr. Frans de Bruyn
REF: ZS-JZF engine report - JC 35165

Without prejudice

Sir,

On the 20 of November 2008 a Lycoming IO-540 K1G5D engine serial number L-15415-48A from ZS-JZF was received at our premises
for complete tear down and report.
The engine was received with the following components fitted: Servo Unit RSA 10ED1 s/n 59289, Governor F-4-11B serial number
B1200U, Dual magneto 10-682560-13 s/n R8496K, AC fuel pump - damage due to fire, R/H Oil Cooler 8534108 s/n A2A - 212, Flow
Divider 2524232-2 s/n 73324 and Vacuum pump - no data tag - damaged by fire.
The L/H Oil cooler, starter, Alternator and Two Turbos were not with the engine at time of tear down.
The engine was disassembled and close attention paid to possible parts that could of have failed and cause the engine not to deliver the
required power. No such problem was encountered during engine disassembly.
The spark plugs RHM 40E were all intact and appeared to have been in a proper working condition prior to the accident. Soot and FOD found on the plugs are post accident material. (See attached Photo)

Directors: H. Joubert - A. Rodrigues

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The oil pump was inspected and no internal damage found on gears , body and oil pump drive

PHOTO :THE SPARK PLUGS RHM 40E WERE ALL FOUND INTACT AND IN PROPER WORKING ORDER

PHOTO: The oil pump was inspected and no internal damage found on gears , body and oil pump drive gear. (see attached photo

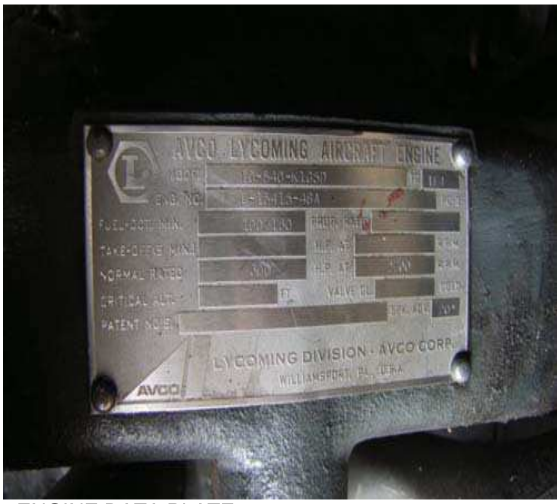
PHOTOS:The magneto was unable to be bench tested due to excessive fire damage, but no apparent defects due to failed parts was found.

PHOTOS: The AC type fuel pump was excessively damaged due to fire, so no further test or inspections were carried out. (see attached photo)

The Servo Unit s/n 59289 was not bench tested due to the heat damage that destroyed the fuel and air diaphragms

The Hartzell Governor s/n B 1200U was bench tested and met manufacturers specifications.

The engine was further dismantled and no broken or failed parts found.



ENGINE DATA PLATE

LEFT - SAMPLE - NORMAL PISTON
RIGHT- SAMPLE - HIGH COMPRESSION PISTON

The pistons part number LW 10207 (High Compression) were found fitted into this machine. Turbo charged engines are fitted with pistons part number LW 10545 (Low Compression) - see attached photos. It is my considered opinion that this engine has had an STC carried out to it making it a " turbo - normalized " engine and not a full " Turbocharged " engine. The data plate on the engine shows it as an IO-540 and not a TIO-540

Conclusion:
On the parts / accessories that could be inspected or bench tested, no mechanical or technical defects found that could of caused the engine to fail in flight.
Trust this suffices your requirements,
We remain,
Your's in aviation
....
A.

ITEM: **TURBOCHARGERS, LYCOMING IO-540-K1G5D ENGINE, PIPER PA-32R-300 LANCE, ZS-JZF**

1. INTRODUCTION

1.1. Both Rajay turbochargers (Refurbished by Kelly Aviation) from a Lycoming IO-540 engine fitted to the crashed Piper PA-32R-300 Lance, aircraft number ZS- JZF, were submitted to determine condition on impact.

Photo 1: Condition of wreck (digital)

1.2 Turbochargers, Basic Operation:

The turbocharger is bolted to the **exhaust manifold** of the engine. The exhaust from the cylinders spins the **turbine**, which works like a gas turbine engine. The turbine is connected by a shaft to the **compressor**, which is located between the air filter and the intake manifold. The compressor pressurizes the air going into the pistons.

The exhaust from the cylinders passes through the **turbine blades**, causing the turbine to spin. The more exhaust that goes through the blades, the faster they spin.

On the other end of the shaft that the turbine is attached to, the **compressor** pumps air into the cylinders. The compressor is a type of centrifugal pump -- it draws air in at the center of its blades and flings it outward as it spins.

In order to handle speeds of up to 150,000 rpm, the turbine shaft has to be supported very carefully. Most bearings would explode at speeds like this, so most turbochargers use a **fluid bearing**. This type of bearing supports the shaft on a thin layer of oil that is constantly pumped around the shaft. This serves two purposes: It cools the shaft and some of the other turbocharger parts, and it allows the shaft to spin without much friction.

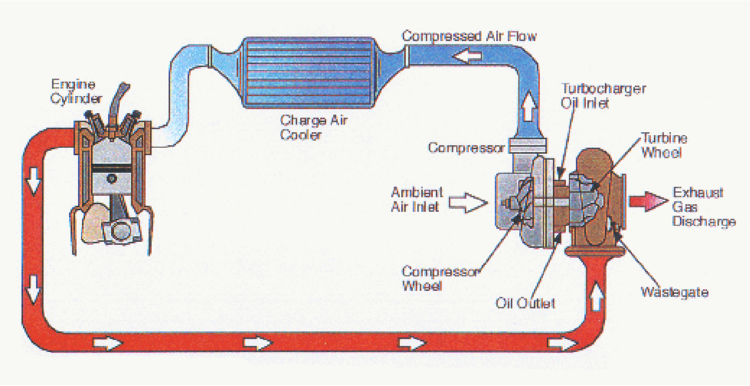


Diagram 1: Basic turbocharger cycles (courtesy Garret)

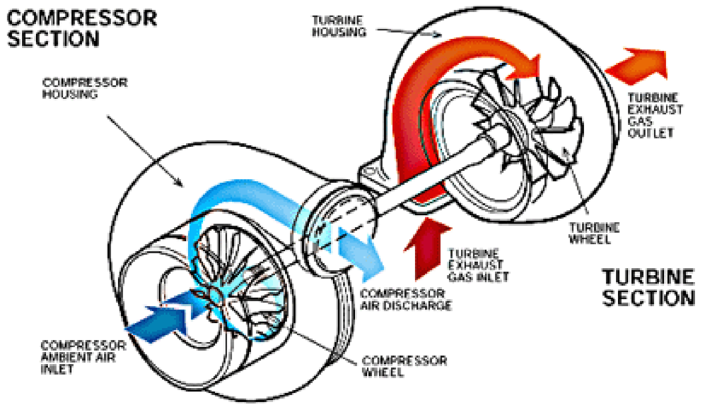


Diagram 2: basic turbocharger design (courtesy Garret)

1.3. This report is divided into the following sections:

(a) INTRODUCTION Par. 1
(b) APPLICABLE DOCUMENTS Par. 2
(c) DEFINITIONS Par. 3
(d) INVESTIGATOR Par. 4
(e) APPARATUS AND METHODOLOGY Par. 5
(f) INVESTIGATION Par. 6
(g) DISCUSSION AND CONCLUSIONS Par. 7
(h) RECOMMENDATIONS Par. 8
(i) DECLARATION Par. 9

2. APPLICABLE DOCUMENTS

(a) None.

3. DEFINITIONS

(a) OEM Original Equipment Manufacturer
(b) CAA Civil Aviation Authority
(c) SEM Scanning Electron Microscope

(d) EDS X-ray Energy Dispersive Analytical System

4. PERSONNEL

(a) The investigative member and compiler of this report is Mr C.J.C. Snyman, ID number 6406105057080. Mr Snyman is a qualified Physical Metallurgist (H.N.Dip Metallurgical Engineering, Tech. PTA), Radiation Protection Officer (RPO) registered with the National Nuclear Regulator (NNR) and Aircraft Accident Investigator (SCSI).

5. APPARATUS AND METHODOLOGY

(a) The apparatus employed for this investigation are Stereo- and Scanning Electron Microscopes and Digital Camera.

(b) The methodology included a visual investigation of supplied parts and tear-down followed by a microscopic investigation.

6. INVESTIGATION

6.1. Visual, Stereo- and SE microscope Investigation. The visual inspection revealed severe impact and post-impact fire damages (Photo's 1, 2 and 3).

The left hand (pilots view) turbocharger marked B revealed impact marks resulting in a tear in the exhaust outlet duct (Photo's 2 and 3, blue arrows). No clear evidence of pre-impact damages to the exhaust inlet and air outlet ducts could be detected.

The right hand (pilots view) turbocharger marked A revealed a fracture in the exhaust outlet duct (Photo's 4 and 5, blue arrows). Decolourisation in the adjacent areas to the fracture (Photo 5, green arrow) indicates exposure over a period of time to the high temperature exhaust gases. Taking into account that the exhaust inlet duct was fractured on impact, it can be assumed that the exposure of the exhaust outlet duct to exhaust gasses was prior to final impact. Also compare to Turbocharger B (Photo 3). On tear down of Turbocharger A foreign matter was detected entrapped in the hot cycle turbine (Photo 6, green arrow). The foreign matter was most probably ingested after impact indicating that the engine was operating on impact. The cold cycle turbine (Photo 7) appeared to be in good condition. The bearing proved to be sticky but this can be attributed to post-impact ingested matter as well as lubrication break down during the post-impact fire. The inner area of the exhaust outlet duct (Photo 8, blue arrow) revealed severe wear due to high temperature exhaust gas exposure during operation.

The SEM investigation revealed signs of flaking (Photo 9) adjacent to the original fracture. EDS results (attached) showed that these areas exposed by the flaking, as well as the majority of the investigated area adjacent to the original fracture, covered by exhaust residue with a high lead (Pb) content. This to prove that these flaked areas was exposed to leaking exhaust gasses over a period of time. Also compare the EDS results from the inner exhaust outlet duct areas (Photo 10) adjacent to the original fracture (attached). The fracture surface from the original fracture (Photo 11) shows some residue build-up as well as geometry comparable with a slow propagating fracture (Photo 12). Compare to a laboratory induced overload type fracture surface (Photo 13) from the same material.

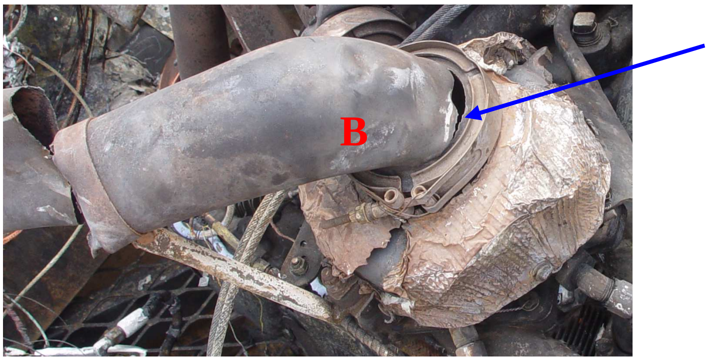


Photo 2: Left hand turbocharger B (digital)

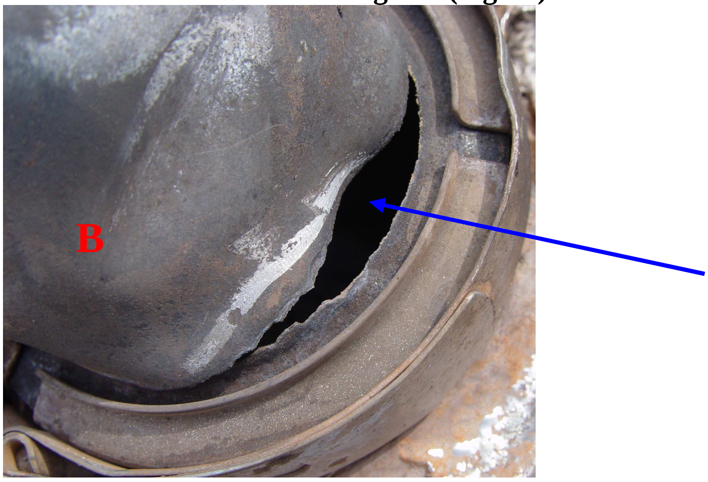


Photo 3: Turbocharger B, Exhaust outlet duct showing impact fracture (digital)

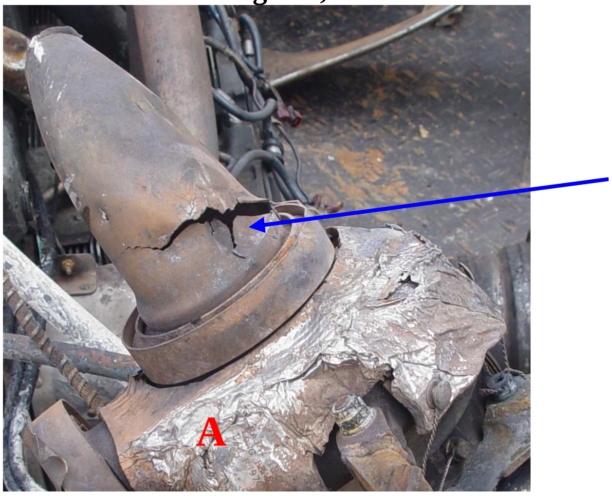


Photo 4: Right hand turbocharger A showing fracture, blue arrow (digital)

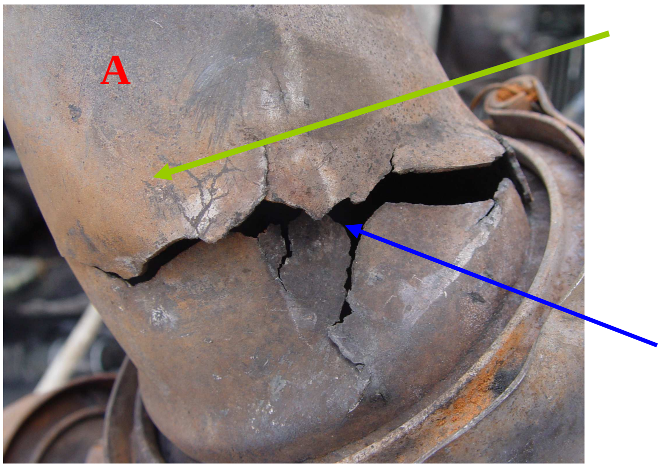


Photo 5: Turbocharger A, exhaust outlet duct showing pre-impact fracture (digital)

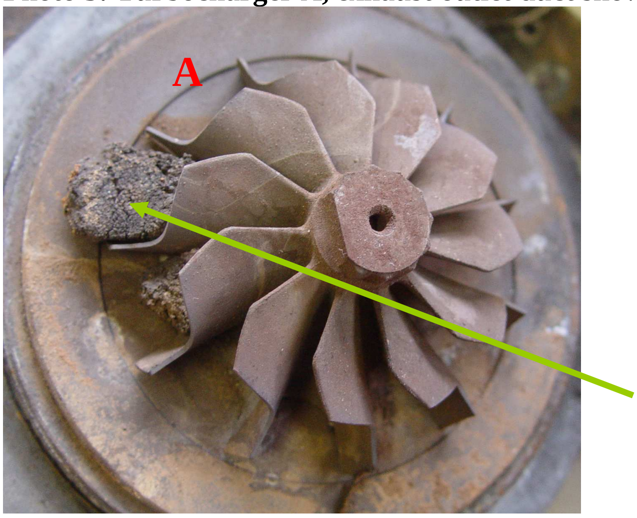


Photo 6: Turbocharger A, exhaust turbine showing ingested foreign matter (digital)

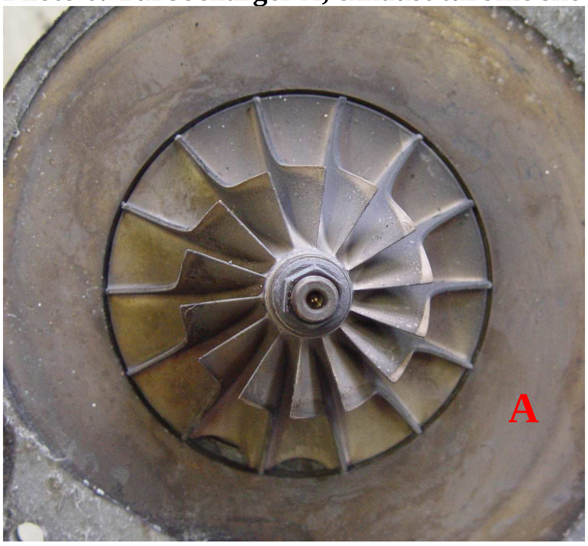


Photo 7: Turbocharger A, air turbine (digital)

Photo 8: Turbocharger A, exhaust outlet duct, inner area showing fractures (digital)

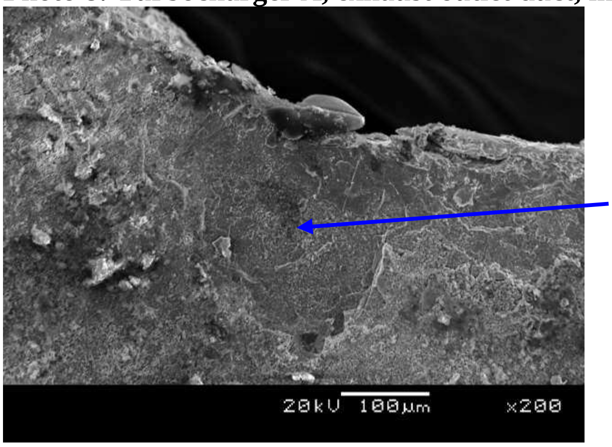


Photo 9: Flaking in area adjacent to original fracture (x200, SEM)

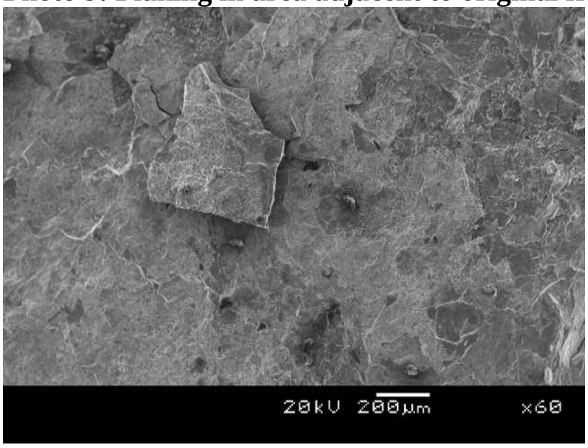


Photo 10: Exhaust residue build-up, inner area adjacent to original fracture (x60, SEM)

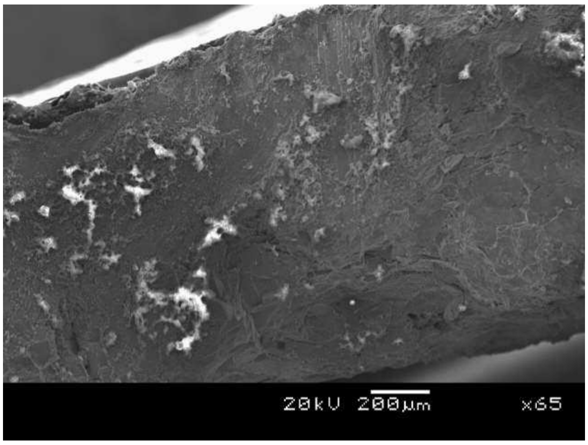


Photo 11: Fracture surface, original fracture (x65, SEM)

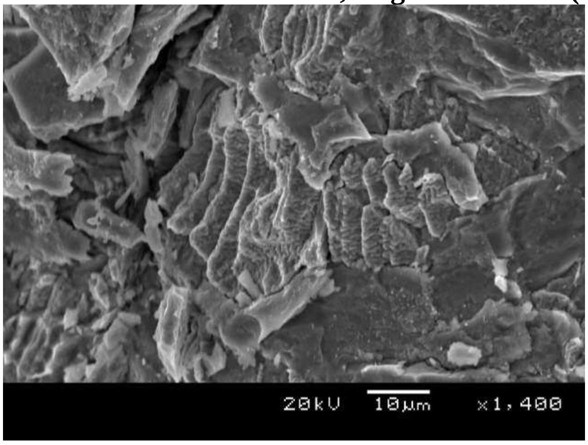


Photo 12: Fracture surface, original fracture (x1400, SEM)

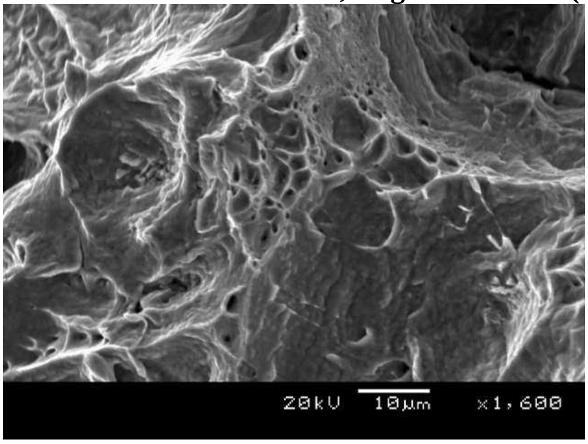


Photo 13: Fracture surface, laboratory induced overload fracture (x1600, SEM)

7. DISCUSSION AND CONCLUSIONS

Note: All deductions and conclusions are based on the investigation results obtained from the supplied parts only.

7.1 The investigation revealed that the fracture in the **exhaust outlet duct** (Photo's 4 and 5) was induced over a period of time prior to impact.

7.2. The total effect of a ruptured **turbocharger exhaust outlet duct** on the overall performance of the engine, except resulting in higher noise levels, should be minimal.

7.3. Cockpit indications as per the **Manifold Pressure/Boost Indicator** would also be difficult to note by the crew as it display the average performance of both turbochargers during operation.

7.4. Pre-flight inspections may have revealed staining of the inner engine cowling areas by the escaping high temperature exhaust gasses.

7.5. Furthermore, exhaust gas fumes as well as higher noise levels may have been present in the cockpit areas during operation.

8. RECOMMENDATIONS

8.1. A post-impact fire complicates an investigation immensely but it is still recommended that the engine and all its components to be scrutinized for any defects that may have contributed to this accident.

8.2. Tests recreating the same scenario may be performed to determine the overall effect, if any. The relevant engine and turbocharger OEM's may also shed some light on this aspect.

9. DECLARATION

9.1. All digital images has been acquired by the author and displayed in an un-tampered manner.