SOUTH AFRICAN CIVIL AVIATION AUTHORITY

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

AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:	CA18/2/3/9209		
Aircraft Registration	**ZS-NOF**	**Date of Accident**	2 August 2013		**Time of Accident**	1310Z	
Type of Aircraft	PA-36-285 (Aeroplane)		**Type of Operation**		Agricultural crop spraying		
Pilot-in-command Licence Type		Private Pilot	**Age**	58	**Licence Valid**	Yes	
Pilot-in-command Flying Experience		Total Flying Hours	2259		Hours on Type	1764	
Last point of departure	Jakkalskloof Farm, West of Porterville (Western Cape Province)						
Next point of intended landing	Jakkalskloof Farm, West of Porterville (Western Cape Province)						
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)							
Jakkalskloof Farm (GPS position: 33°01'47" South 18°54'40" East, elevation 276 ft. AMSL)							
Meteorological Information	Temperature: 24°C, Wind direction: 10° Wind speed: 3kts, Visibility: CAVOK						
Number of people on board	1 + 0	**No. of people injured**	1		**No. of people killed**	0	

Synopsis

The pilot departed in his aircraft with the intention to complete a crop spraying detail on his farm in Porterville. The aircraft climbed to 300ft above mean sea level (AMSL) after take-off when the pilot noticed the surface wind had increased substantially.

The pilot struggled to maintain control of the aircraft and shortly after the aircraft began to descend. The pilot reduced the aircraft's flap setting in an attempt to get maximum lift and increased the aircraft's engine manifold and power settings.

The pilot was able to regain control of the aircraft and maintain altitude temporarily. The pilot then opted to turn to the right towards the lee side of the hill and away from trees in front of the aircraft's flight path, in an attempt to fly towards stable air conditions. The aircraft then experienced wind shear which the pilot was unable to recover from. The aircraft descended and impacted the ground.

The pilot was seriously injured and the aircraft was substantially damaged during the impact sequence.

Probable Cause

The pilot lost control of the aircraft due to wind shear.

IARC Date		Release Date	

AIRCRAFT ACCIDENT REPORT

Name of Owner	**:**	Mr. W.J. Visagie
Name of Operator	**:**	Visagie Air CC
Manufacturer	**:**	Piper Aircraft Company
Model	**:**	PA-36-285
Nationality	**:**	South Africa
Registration Marks	**:**	ZS-NOF
Place	**:**	West of Porterville in the Western Cape
Date	**:**	2 August 2013
Time	**:**	1310Z

All times given in this report is 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 the morning of the accident the wind was strong and variable. The pilot waited for the wind to reduce before embarking on the crop spraying detail at approximately 1300Z. The aircraft departed from the gravel runway and gained height quickly due to the strong headwind.

1.1.2 The pilot noticed that the wind speed had increased significantly and the aircraft required a lot of coordination to control. The aircraft began to descend so the pilot reduced the flap setting and increased the engine manifold and power to 29 inches and 2600RPM respectively. The pilot was able to regain control of the aircraft temporarily and opted to manoeuvre the aircraft to the right, away from the hill and trees in its flight path.

1.1.3 The aircraft was on the lee side of the hill when it experienced wind shear. The pilot attempted to recover by releasing the fertilizer that was intended for the crop spraying exercise in order to reduce his weight and increase the aircraft's lift. He was unsuccessful in regaining control of the aircraft. The aircraft descended and impacted the ground.

1.1.4 The pilot sustained severe injuries and was transported by an ambulance to the nearest hospital for medical attention. The aircraft was substantially damaged during the impact sequence.

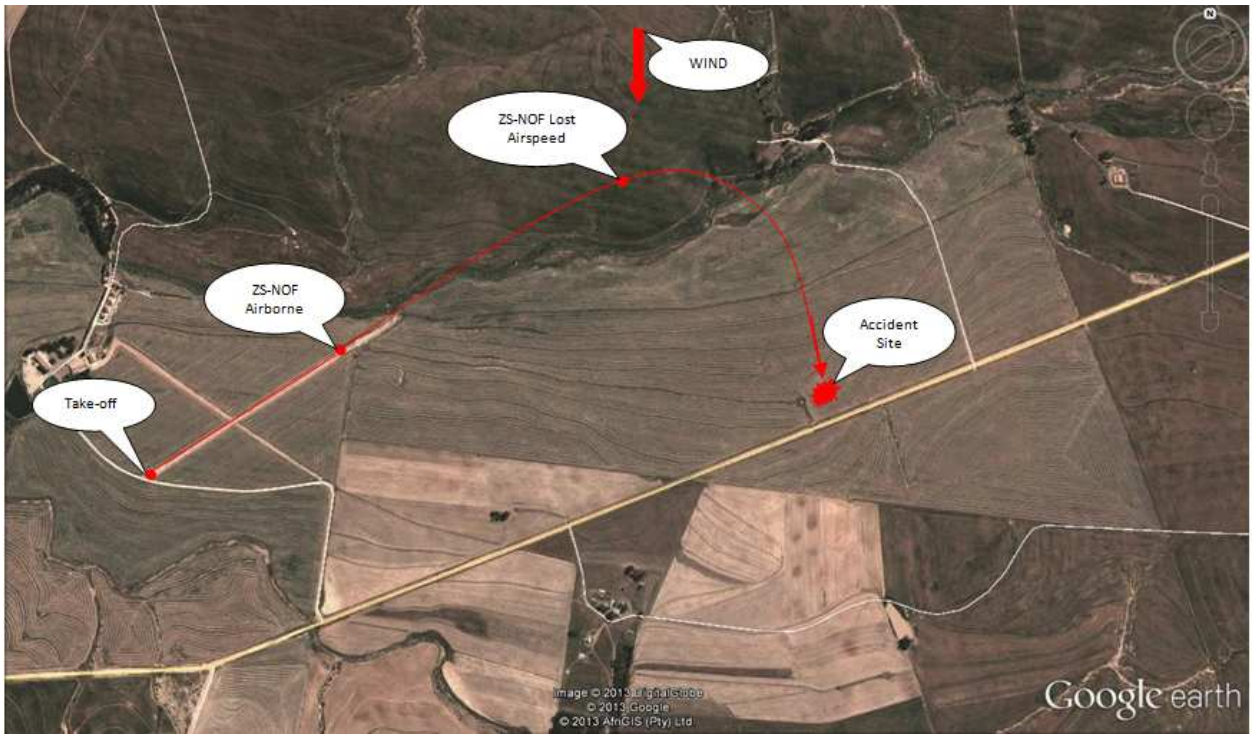


Figure 1: Depicts flight path of the aircraft

1.2 Injuries to Persons

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

1.3 Damage to Aircraft

1.3.1 The aircraft was substantially damaged during the accident sequence.

1.4 Other Damage

1.4.1 Damage was limited to vegetation

1.5 Personnel Information

Nationality	South African	Gender	Male	Age	58
Licence Number	0270275217	Licence Type	PPL		
Licence valid	Yes	Type Endorsed	Yes		
Ratings	Agricultural Pilot Rating & Night Rating				
Medical Expiry Date	31 January 2014				
Restrictions	Corrective lenses and Hearing Aids				
Previous Accidents	None				

Flying Experience:

Total Hours	2259
Total Past 90 Days	155
Total on Type Past 90 Days	155
Total on Type	1764

1.6 Aircraft Information

Airframe:

Type	PA-36-285	
Serial Number	36-7660093	
Manufacturer	Piper	
Date of Manufacture	1976	
Total Airframe Hours (At time of Accident)	4882 hours	
Last MPI (Date & Hours)	18 April 2013	4798 hours
Hours since Last MPI	84 hours	
C of A (Issue Date)	29 July 2004	
C of A (Expiry Date)	28 July 2014	
C of R (Issue Date) (Present owner)	23 April 2010	
Maximum take-off weight	1996kg	
Operating Categories	Part 137	
Recommended fuel used	Avgas	

Engine:

Type	Lycoming
Serial Number	L-1226-54A
Hours since New	3274
Hours since Overhaul	837

Propeller:

Type	Hartzell
Serial Number	DY5522B
Hours since New	642
Hours since Overhaul	98

Weight and Balance

Basic Empty Weight	1223kg
Pilot	115kg
Fuel on board	50kg
Fertiliser	600kg
Maximum Take-off weight	1996kg

Note: The maximum take-off weight for this aircraft is 1996kg. The aircraft was within the take-off weight limitation.

1.6.1 The fuel quantity was sufficient for the flight.

1.7 Meteorological Information

1.7.1 An official weather report was obtained from the South African Weather Services.

Wind direction	010˚	Wind speed	3 knots	Visibility	CAVOK
Temperature	24˚C	Cloud cover	-	Cloud base	-
Dew point	-				

1.7.2 Fine weather with light surface wind was observed over Porterville at the time of the accident. Pronounced vertical wind shear was forecasted between 3000ft and 5000ft above ground level (AGL) with stronger wind above 5000ft.

1.7.3 The density altitude at the time of the accident was 1226ft.

1.8 Aids to Navigation

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

1.9 Communications

1.9.1 The aircraft was equipped with one VHF (Very High Frequency) radio approved by the Regulator. There were no recorded defects regarding the communication equipment prior to flight.

1.10 Aerodrome Information

1.10.1 The accident did not occur on or near an aerodrome. The accident occurred on a farm at the GPS co-ordinates determined as: (S33˚01’47” E18˚54’40”).

Figure 2: Jakkalskloof Farm

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 impacted the ground in a nose down attitude and came to rest in a westerly direction in an open field surrounded by vegetation.

1.12.2 The aircraft sustained substantial damage to the forward engine section of the fuselage, propeller, wings, tail plane and undercarriage.

1.12.3 Witness marks on the propeller indicate the engine was producing power prior to impact.

1.12.4 The aircraft had a 15 degree flap configuration following post-crash inspection.

Figure 3: Side view of the aircraft

Figure 4: View from the back

Figure 5: The destroyed forward section of the aircraft

1.13 Medical and Pathological Information

1.13.1 The pilot's medical certificate was valid at the time of an accident.

1.13.2 The pilot sustained serious injuries to his chest and facial area during the impact sequence.

1.13.3 The pilot was removed by his son and workers on the farm for medical attention.

1.14 Fire

1.14.1 There was no evidence of a pre or post impact fire.

1.15 Survival Aspects

1.5.1 The accident was considered survivable due to the low kinetic energy associated with the impact.

1.5.2 The pilot was properly restrained by the aircraft equipped safety harness.

1.16 Tests and Research

1.16.1 None.

1.17 Organizational and Management Information

1.17.1 The pilot was the owner of the aircraft and the farm that he intended completing the crop spraying detail over.

1.17.2 The Aircraft Maintenance Organisation (AMO) was in possession of a valid approval certificate.

1.18 Additional Information

1.18.1 Mountain wave and associated turbulence (information obtained from the Australian Transport Safety Bureau

Mountain waves are commonly experienced over and to the lee of mountain ranges in the They often appear in the strong westerly wind flows on the east coast in late winter and early spring.

Mountain waves are a different phenomenon to the mechanical turbulence found in the lee of mountain ranges, and can exist as a smooth undulating airflow or may contain clear air turbulence in the form of breaking waves and 'rotors'. Mountain waves are defined as 'severe' when the associated downdrafts exceed 600 ft. /min and/or severe turbulence is observed or forecast.

'Breaking waves' and 'rotors' associated with mountain waves are among the more hazardous phenomenon that pilots can experience. Understanding the dynamics of the wind is important in improving aviation safety.

Glider pilots learn to use these mountain waves to their advantage; typically to gain altitude. However, some aircraft have come to grief in those conditions. Encounters have been described as similar to hitting a wall. In 1966, clear air turbulence associated with a mountain wave ripped apart a BOAC Boeing 707 while it flew near Mt. Fuji in Japan. In 1968, a Fairchild F-27B lost parts of its wings and empennage, and in 1992 a Douglas DC-8 lost an engine and wingtip in mountain wave encounters.

Mountain waves are the result of flowing air being forced to rise up the windward side of a mountain barrier, then as a result of certain atmospheric conditions, sinking down the leeward side. This perturbation develops into a series of standing waves downstream from the barrier, and may extend for hundreds of kilometers over clear areas of land and open water.

Mountain waves are likely to form when the following atmospheric conditions are present:

• the wind flow at around ridge height is nearly perpendicular to the ridge line and at least 25 kts

• the wind speed increases with height
• there is a stable layer at around ridge height.

If the wave amplitude is large enough, then the waves become unstable and break, similar to the breaking waves seen in the surf. Within these 'breaking waves', the atmospheric flow becomes turbulent.

The crests of the waves may be identified by the formation of lenticular clouds (lens-shaped), if the air is sufficiently moist. Mountain waves may extend into the stratosphere and become more pronounced as height increases. Some pilots have reported mountain waves at 60,000 feet. The vertical airflow component of a standing wave may exceed 8,000 ft. /min.

Rotors or eddies can also be found embedded in mountain waves. Formation of rotors can also occur as a result of down slope winds. Their formation usually occurs where wind speeds change in a wave or where friction slows the wind near to the ground. Often these rotors will be experienced as gusts or windshear. Clouds may also form on the up-flow side of a rotor and dissipate on the down-flow side if the air is sufficiently moist.

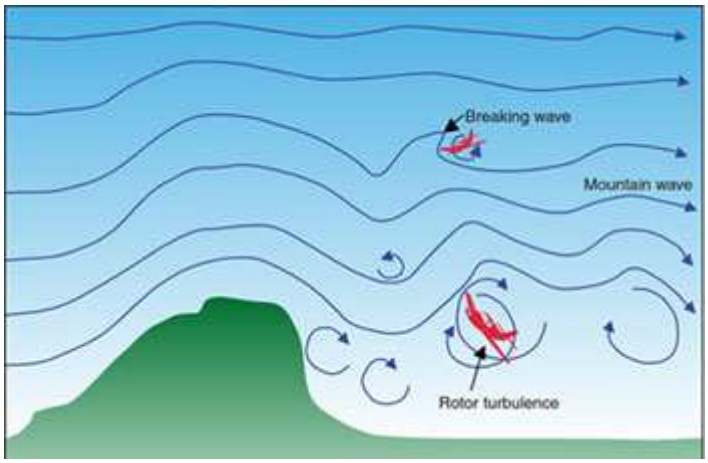
Many dangers lie in the effects of mountain waves and associated turbulence on aircraft performance and control. In addition to generating turbulence that has demonstrated sufficient ferocity to significantly damage aircraft or lead to loss of aircraft control, the more prevailing danger to aircraft in the lower levels in Australia seems to be the effect on the climb rate of an aircraft. General aviation aircraft rarely have performance capability sufficient to enable the pilot to overcome the effects of a severe downdraft generated by a mountain wave or the turbulence or windshear generated by a rotor. In 1996, three people were fatally injured when a Cessna 206 encountered lee (mountain) waves. The investigation report concluded, "It is probable that the maximum climb performance of the aircraft was not capable of overcoming the strong downdrafts in the area at the time".

Crossing a mountain barrier into wind also reduces the groundspeed of an aircraft and has the effect of keeping the aircraft in the area of downdraft for longer, while an aircraft flying downwind on the upwind side of a mountain range is likely to initially encounter updrafts as it approaches rising ground. Rotors and turbulence may also affect low level flying operations near hills or trees. In 1999, a Kawasaki KH-4 hit the surface of a lake during spraying operations at 30 feet. The lack of sufficient height to overcome the effects of wind eddies and turbulence was a factor in the accident.

Research into 'braking waves' and 'rotors' or eddies continues but there is no doubt that pilots need to be aware of the phenomenon and take appropriate precautions. Although mountain wave activity is usually forecast reasonably well by the Bureau of Meteorology, many local factors may affect the formation of 'breaking waves' and 'rotors'. When planning a flight a pilot should take note of the winds and the terrain to assess the likelihood of waves and rotors. There may be telltale signs in flight, including the disturbances on water or wheat fields and the formation of clouds, provided there is sufficient moisture for cloud to form.

Prudent flight planning may include allowing for the possibility of significant variations in the aircrafts altitude if updrafts and downdraughts are encountered. A margin of at least the height of the hill or mountain from the surface should be allowed, and consideration given to the need to adopt a manoeuvring airspeed

appropriate to the circumstances. Ultimately, it may be preferable for pilots to consider diverting or not flying, rather than risk flying near or over mountainous terrain in strong wind conditions conducive to mountain waves containing 'breaking waves' and 'rotors'.



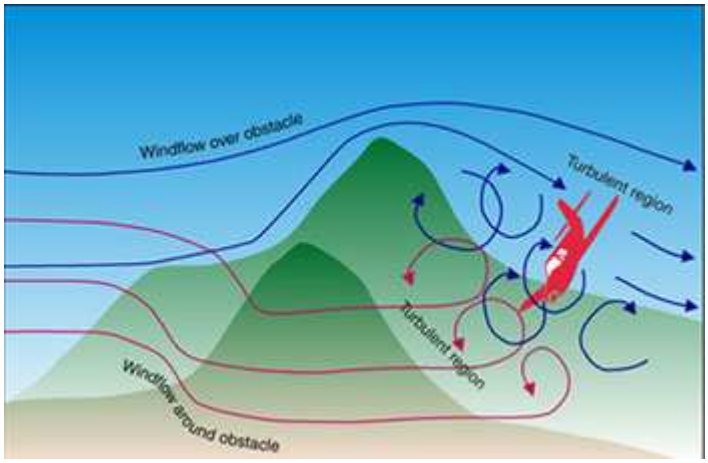


Figure 6 & 7: Illustration of mountain wave and associated turbulence

1.19 Useful or Effective Investigation Techniques

1.19.1 None.

2. ANALYSIS

2.1 Pilot (Man):

The pilot was appropriately licenced for the flight. The pilot assessed the surface wind conditions prior to departure and deemed it safe to continue with the flight. Following take-off the pilot indicated the surface wind speed increased substantially. The aircraft climbed to an altitude the pilot considered safe for the crop spraying detail. The pilot indicated that the aircraft's speed changed and the aircraft started to descend towards the ground. The pilot was able to regain control of the aircraft momentarily and opted to turn to the right towards the field for the crop spraying detail. At this point the aircraft became difficult to control because of external

conditions. Due to insufficient height the pilot was unable to recover the aircraft and impacted the ground.

2.2 Aircraft (Machine):

The aircraft had a valid Certificate of Airworthiness and had been maintained in compliance with the regulations. The aircraft was in a serviceable condition when the pilot departed for the crop spraying detail.

2.3 Environment:

The wind conditions on the day were variable and unpredictable throughout the day. During the take-off the wind increased substantially. The SAWS forecasted pronounced vertical wind shear between 3000ft and 5000ft above ground level (AGL) with stronger wind above 5000ft. Although the pilot operated the aircraft below 3000ft it was still possible to experience winds shear given the other surface conditions that were forecasted on the day.

3. CONCLUSION

3.1 Findings

3.1.1 The pilot held a valid pilot's license with the appropriate ratings.

3.1.2 The aircraft had a valid Certificate of Airworthiness and had been maintained in compliance with the regulations.

3.1.3 The aircraft was airworthy when dispatched for the flight.

3.1.4 The mass and the centre of gravity of the aircraft were within the prescribed limits.

3.1.5 All control surfaces were accounted for, and all damage to the aircraft was attributed to the impact forces.

3.1.6 The official weather report requested from the South African Weather Services indicated there was wind shear forecast on the day of the accident flight.

3.1.7 The pilot lost control of the aircraft when he entered an area of wind shear

3.2 Probable Cause/s

3.2.1 The pilot loss control of the aircraft due to wind shear.

4. SAFETY RECOMMENDATIONS

4.1 None

5. APPENDICES

5.1 None