SOUTH AFRICAN CIVIL AVIATION AUTHORITY

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

AIRCRAFT ACCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:	CA18/2/3/9313		
Aircraft Registration	**ZS-LLD**	**Date of Accident**	22 April 2014		**Time of Accident**	0921Z	
Type of Aircraft	Piper PA-46-310P (Malibu)		**Type of Operation**		Private (Part 91)		
Pilot-in-command Licence Type		Commercial	**Age**	35	**Licence Valid**	Yes	
Pilot-in-command Flying Experience		Total Flying Hours	1569.4		Hours on Type	163.2	
Last point of departure	Cape Town International Airport (FACT), Western Cape						
Next point of intended landing	Swartwater, in the Limpopo Province						
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)							
Farm Rooisand in the Niekerkshoop area, Northern Cape (GPS S29°26.103 E022°43.722)							
Meteorological Information	Temperature: 25 ºC; Dew Point: 06 °C; Wind 300º/167 kt; Visibility: 10 000 m; QNH: 1 016 hPa						
Number of people on board	1 + 1	**No. of people injured**	0	**No. of people killed**	2		

Synopsis

On 22 April 2014 at approximately 0716Z the Commercial pilot accompanied by a passenger departed Cape Town International Airport (FACT) on an IFR flight to Swartwater in the Limpopo Province. Approximately 16 minutes after take-off with the aircraft climbing through an altitude of 13500 feet to 17000 feet, the Air Traffic Controller advised the pilot that the aircraft's Mode C transponder started transmitting erroneous altitude data and indicating that the aircraft was descending whereas the pilot thought he was ascending. The pilot notified the ATC that the aircraft was not descending and attempted to rectify the problem by recycling the Mode C transponder that however didn't resolve the problem. As the transponder information was intermittent during the IFR flight to Swartwater, the ATC requested the pilot to descent to the VFR flight level FL 135. The pilot then requested Area West for approval to ascent to flight level (FL 195) which was approved.

It appears that the pilot was unaware that the pitot static tube system that supplies both pitot and static air pressure for the airspeed indicator, altimeter and triple indicator was most probably blocked by dust or sand. The aircraft exceeded the Maximum Structural Air Speed (VNO) of the aircraft and the VNE air speed of 1 hour 44 minutes and 9 minutes respectively. The VNO of 173 airspeed and VNE of 203 airspeed exceedance resulted in the catastrophic inflight breakup of the aircraft. The wreckage was found scattered in a 1.58km path in mountainous terrain. Both occupants on board the aircraft sustained fatal injuries.

Probable Cause

The aircraft exceeded the Maximum Structural Cruising Speed (VNO) and Calibrated Never Exceed Speed VNE airspeed due to the fact that erroneous airspeed and altitude data information indicated on the cockpit instruments as a result of blockage of the pitot tube by dust and sand.

Contributory Factor/s

He switched off the transponder.

SRP date	31 January 2017	Release date	05 April 2017

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AIRCRAFT ACCIDENT REPORT

Name of Owner	:	L. Botha
Name of Operator	:	Private
Manufacturer	:	Piper Aircraft Corporation
Model	:	PA-46-310P (Malibu)
Nationality	:	South African
Registration Marks	:	ZS-LLD
Place	:	Farm Rooisand, Niekerkshoop, Northern Cape
Date	:	22 April 2014
Time	:	0921Z

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

Purpose of the Investigation:

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

Disclaimer:

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 On 20 April 2014, the pilot landed with the Piper PA 46-310 P Malibu aircraft ZS-LLD at Cape Town International Airport (FACT) after a flight from Thabazimbi Aerodrome. The aircraft was then parked at an Aviation Handling Company at the airport.

1.2 On 22 April 2014, the pilot accompanied by a female passenger arrived at Cape Town International Airport where after the Aviation Handling Company assisted the pilot with the flight plan (FP) and refuelling of the aircraft registration ZS-LLD. According to the refuelling company, 349 litres of avgas was uplifted into the aircraft fuel tanks. According to the IFR flight plan, the aircraft endurance was 8.00 hours with the actual time of departure at 0717Z and the estimated time of arrival at Swartwater in the Limpopo Province at 1157Z.

1.3 The pilot accompanied by the passenger departed from FACT at approximately

0716Z enroute to Swartwater in the Limpopo Province. Approximately 15 minutes after the aircraft departed from Cape Town International Airport with the aircraft climbing through an altitude of 13500ft AMSL to 17000ft AMSL, the Air Traffic Control advised the pilot of ZS-LLD that the Mode C transponder of the aircraft was transmitting erroneous data. The Mode C transponder indicated that ZS-LLD was descending whilst the aircraft was actually climbing. The pilot then attempted to rectify the problem by recycling the Mode C transponder but the transponder continued sending erroneous data. As the Mode C transponder of the aircraft was intermittent and was transmitting erroneous data, the pilot of ZS-LLD was then requested by the ATC to descend to VFR flight level one three five (FL135). The pilot then requested flight level one nine five (FL 195) from Area West which was approved with the instruction to report when overhead Lichtenburg. Enroute to Swartwater, the aircraft exceeded the Maximum Structural airspeed (VNO) Catastrophic inflight breakup of the aircraft and the VNE airspeed for 1 hour 44 minutes and 9 minutes respectively. The VNO of 173 airspeed and VNE of 203 airspeed exceedance resulted in the failure of the flight control surfaces which initiated a catastrophic inflight breakup of the aircraft. According to the aircraft GPS data logged, at approximately 0921Z, it also indicated that the aircraft experienced the catastrophic breakup during flight. The aircraft wreckage was found scattered in a 1.58km path in mountainous terrain on the farm Rooisand in the Niekerkshoop area, near Prieska in the Northern Cape. The accident occurred during daylight conditions and the main wreckage was found at a GPS position S29°26.103 E022°43.722. Both occupants on board the aircraft sustained fatal injuries.

1.4 It can only be assumed that during the flight that the pitot tube and head heating element was serviceable but it is uncertain whether the pilot selected the pitot heat switch to on. However, If the pitot tube inlet was restricted by any foreign object like sand, the heating element could not have solved the problem . According to the pilot's flight folio, the accident aircraft took off and landed several times on gravel runways at Swartwater and Khami. An obstruction of dust and sand in the pitot head assembly will cause erroneous airspeed and altitude indications to the cockpit which can be disastrous should the pilot be unaware of the actual problem.

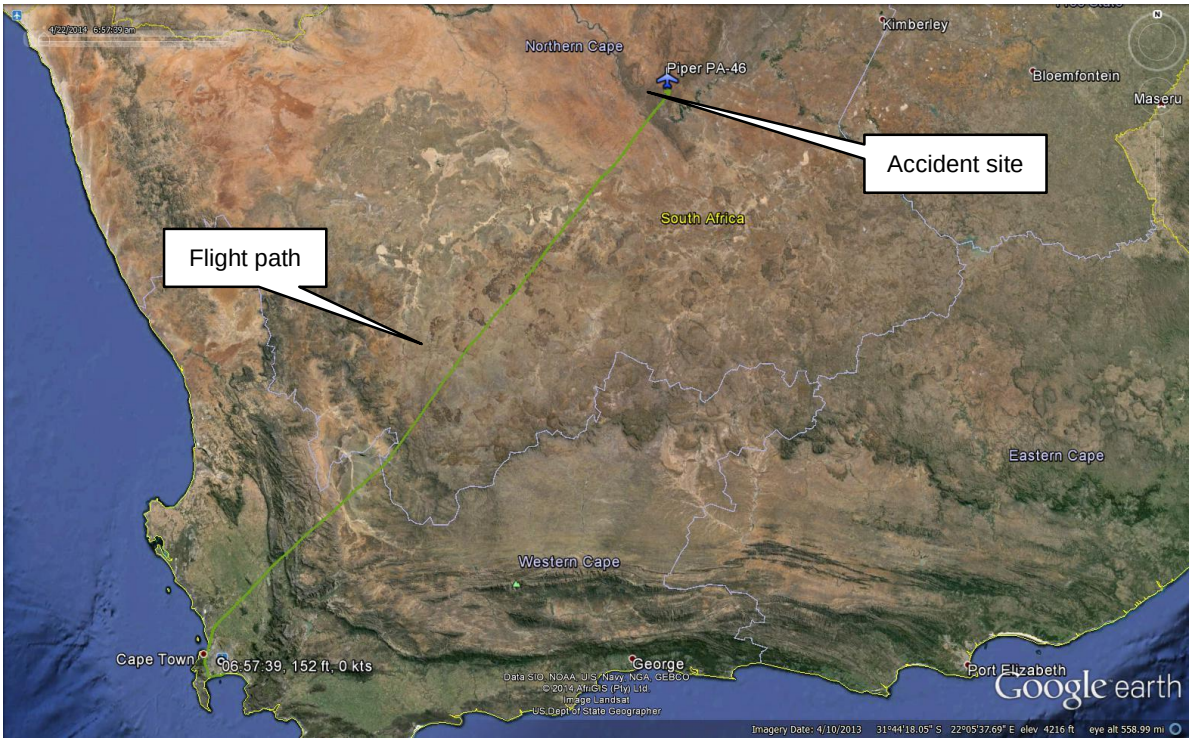

Figure 1: Google Earth view of the area and flight path

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 experienced a catastrophic in flight failure and was also destroyed during the impact sequence.

Figure 2: View of the main wreckage (fuselage)

Figure 3: View of the main wreckage

1.4 Other Damage

1.4.1 No other damage was caused.

1.5 Personnel Information

Nationality	South African	Gender	Male	Age	35
Licence Number	0271021099	Licence Type	Commercial		
Licence valid	Yes	Type Endorsed	Yes		
Ratings	Instructor; Instrument; Night; Multi Engine Piston				
Medical Expiry Date	31 May 2014				
Restrictions	None				
Previous Accidents	None				

Flying Experience:

Total Hours	1569.4
Total Past 90 Days	13.6
Total on Type Past 90 Days	7.1
Total on Type	163.2

Note: 1. The pilot's logbook was updated until 09 April 2014.
2. The pilot's last annual flight renewal test was done on 09 April 2014.

1.6 Aircraft Information

1.6.1 Description

The PA-46-310P Malibu is a single engine, all metal, retractable landing gear, low wing, turbocharged airplane. It has a pressurized cabin with seating for six occupants and it has two separate luggage compartments.

The Airframe

The primary airframe is constructed of aluminum alloy, with a steel combination engine mount and nose gear support structure. The nose cowl and rear section of the dorsal fairing are fiberglass. The fuselage is an all metal, semi-monocoque structure with flush riveted skin. There are three basic fuselage sections: the forward baggage section, the pressurized cabin section, and the tail cone section. The cabin section is sealed to maintain pressurization.

Engine

The Malibu is powered by a Teledyne Continental TSIO-520-BE engine. The propeller is a Hartzell,BHC-C2YF-1BF.

Figure 4: Prior photo of the ZS-LLD

1.6.2 Airframe:

Type	Piper PA46-310P	
Serial Number	46-8408063	
Manufacturer	Piper Aircraft Corporation	
Date of Manufacture	1984	
Total Airframe Hours (At time of Accident)	2029.8	
Last MPI (Date & Hours)	1983.0	30 May 2013
Hours since Last MPI	46.8	
C of A (Issue Date)	04 October 2013	
C of R (Issue Date) (Present owner)	31 May 2013	
Operating Categories	Standard Part 135	

1.6.3 Engine:

Type	Continental TSIO-520BE1
Serial Number	528067
Hours since New	1958.1
Hours since Overhaul	T.B.O.

1.6.4 Propeller:

Type	Hartzell BHC-C2YF-1BF
Serial Number	AM3059
Hours since New	1672.4
Hours since Overhaul	263.4

1.6.5 The Piper PA 46-31OP Malibu aircraft is equipped with two integral main fuel wing tanks, located outboard of the mid-wing splice. The total fuel quantity in both wing tanks is 120 U.S gallons of which 1.0 U.S gallon in each wing tank is unusable fuel. The minimum fuel grade is 100 or 100LL aviation grade.

The aircraft was refuelled with 349 litres of Avgas 100LL before the flight. According to the flight plan, the aircraft had 8.0 hours fuel endurance which computes to full tanks. The flight plan indicated the estimated flight time of 4.0 hours and 40 minutes for the planned flight.

Both the left and right outboard wings which incorporate the fuel tanks failed in flight at the mid-wing splice during the catastrophic inflight breakup as result of the VNO and VNE airspeed exceeded during flight.

1.6.6 Weight and Balance

Basic Empty Mass		2730 lbs
Pilot and Front Passenger		353 lbs
Passengers	(Centre Seats)	-
Passengers	(Rear Seats)	-
Fuel	(120 Gallon Maximum Usable)	719 lbs
Baggage	(Forward - 100 Lb. Limit)	66 lbs
Baggage	(Aft - 100 Lb. Limit)	
Ramp Weight		3868 lbs
Fuel Allowance for Engine Start, Taxi & Runup		-18 lbs
Take-off Weight		**3849 lbs**
Maximum Take-off Weight		4100 lbs
Below Maximum Take-off Weight		**251 lbs**
Maximum Landing Weight		3900 lbs

The total weight of the aircraft was within limits for the flight and was determined to be 251 lbs below the maximum take-off weight limit of the aircraft.

1.7 Meteorological Information

1.7.1 The South African Weather Service (SAWS) concluded the following weather information:

The Upper Wind Charts taken from Figure 5 indicated the temperature at Cape Town at 13000 AMSL was -4°C.

AMSL in feet	Temperature	
	Cape Town	At accident site
5000	7	n/a
7000	5	14
10000	2	6
13000	- 4	0
15000	- 8	- 4
17000	- 15	- 10
21000	- 21	- 16
24000	- 27	- 22

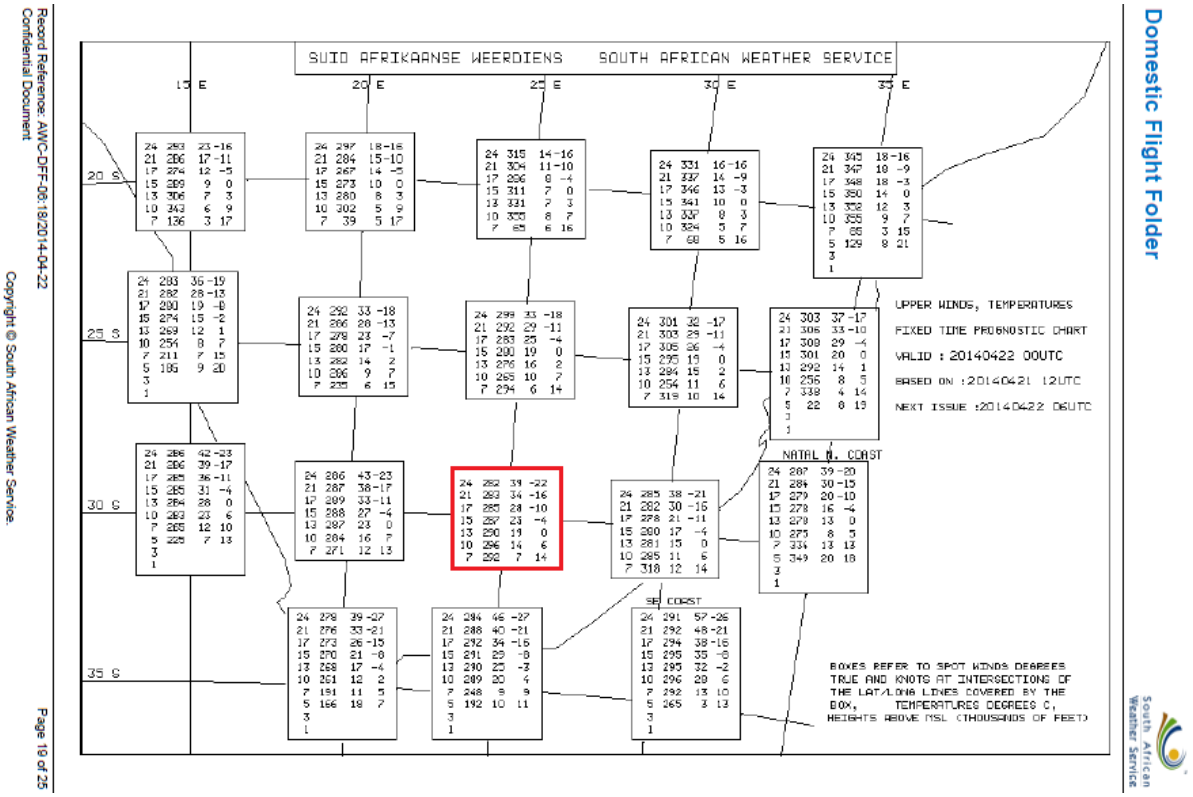

Figure 5: Upper winds chart

The Low Level Significant Weather Chart in Figure 6 below shows that in Cape Town between 0600Z and 0900Z, the freezing level started at 9500 feet AMSL and In the vicinity of the accident site the freezing level started at 12000 feet AMSL.

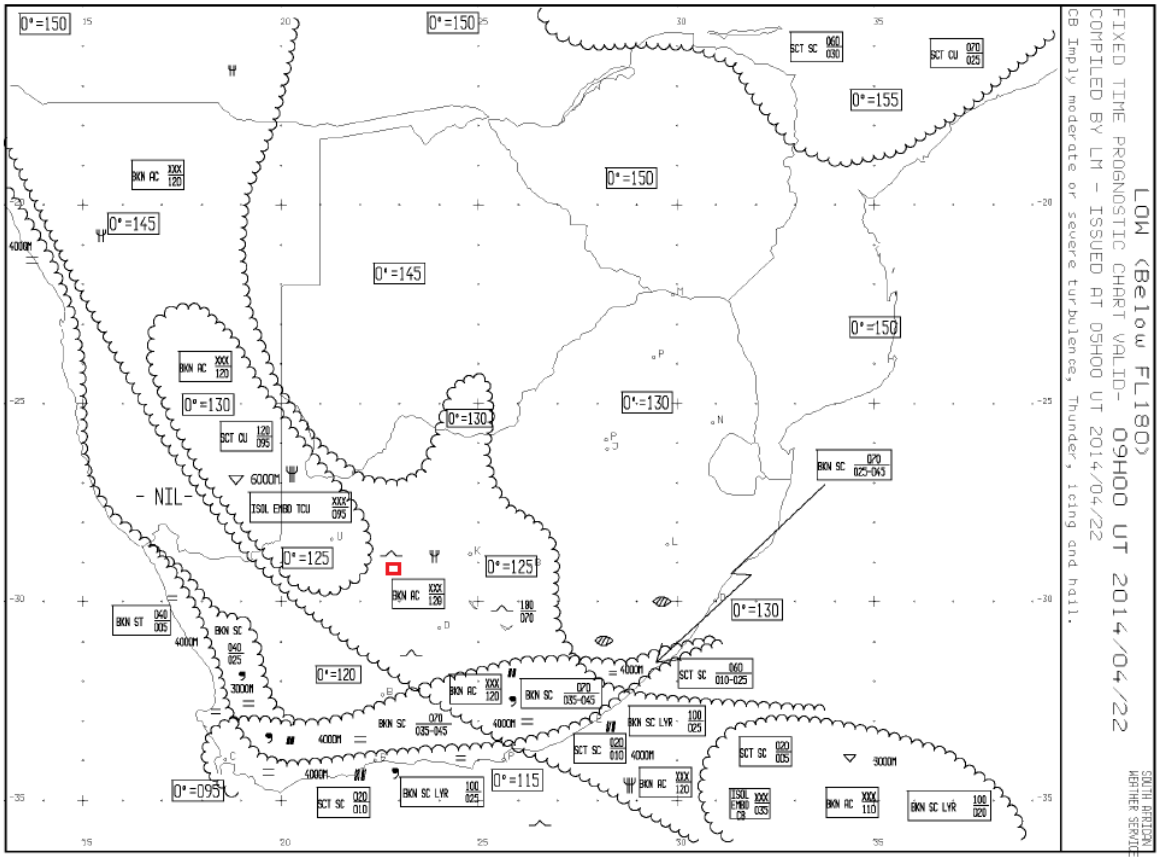

Figure 6: Low Level Significant Weather Chart valid from 0600Z to 0900Z

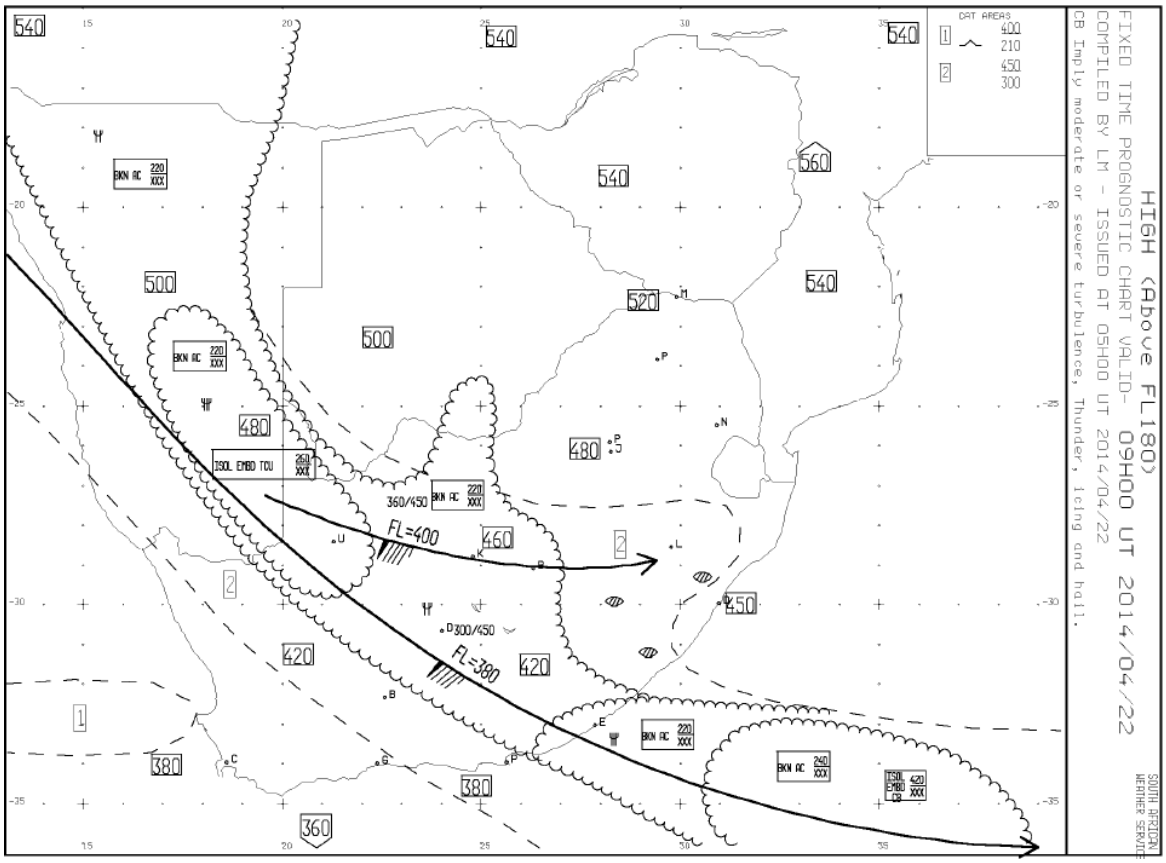

Figure 7: High Level Significant Weather Chart valid from 0600Z to 0900Z

1.7.2 Weather at the accident site

Surface Data

There is no automatic weather station at Prieska but FAKM is the closest reporting weather station to the accident area. The 0900Z METAR closest to the time of accident contains the following weather variables:

Wind direction	300°	Wind speed	16kt	Visibility	CAVOK
Temperature	25°C	Cloud cover		Cloud base	
Dew point	06°C	QNH	1016hPa		

The 0900Z Significant Weather Chart shows that altocumulus clouds at 12000ft above mean sea level were forecasted over the accident area with moderate turbulence between FL070 and FL180, see Figure 7.

Satellite Image

The satellite image in Figure 8 shows cloudy conditions over the accident area. FAKM is the closest reporting weather station to the accident area and CAVOK condition was reported at 0900Z which were about 20 minutes before the accident occurred. At 1000Z a few towering cumulus at 4000ft AGL were reported.

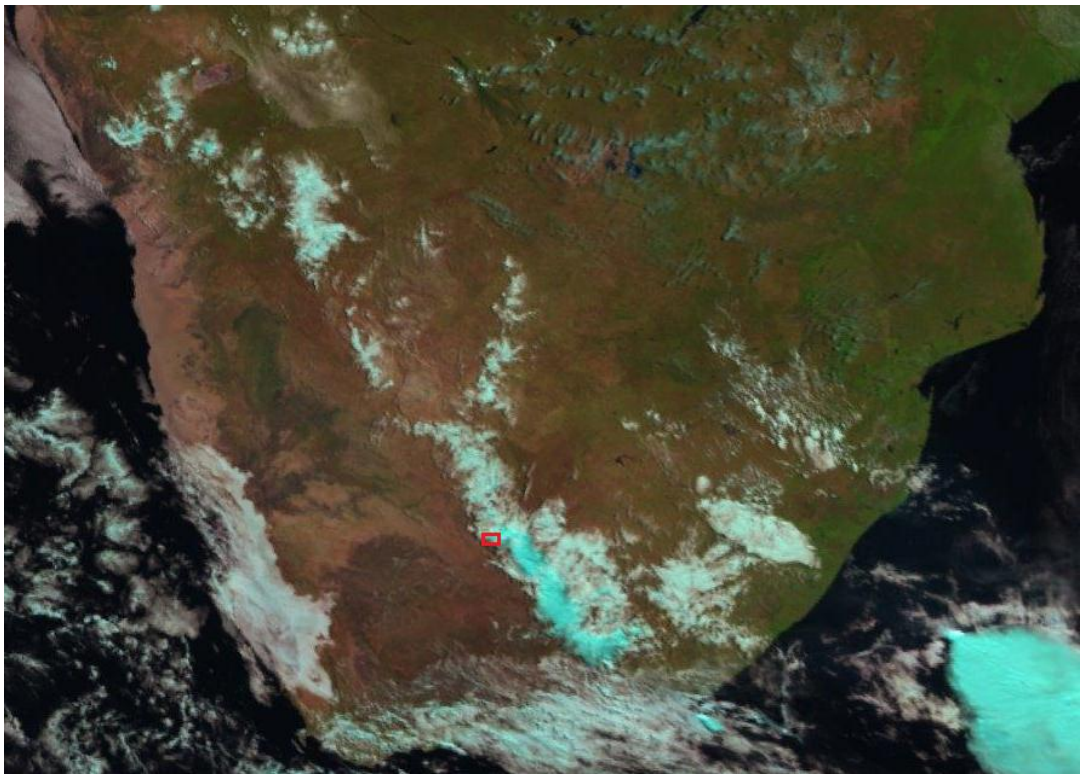

Figure 8: Satellite image for 22 April 2014

Note: The weather information image above was included in the official report by the South African Weather Services (SAWS).

1.8 Aids to Navigation

1.8.1 The aircraft was equipped with approved navigational aids. No defects to the navigational equipment were reported or recorded prior to the accident flight.

1.8.2 The aircraft were equipped with a King KT79 Transponder, King KNS80 NAV/RNAV/DME/GLS, King KR87 ADF and Tracor TA 7880VLF NAV System.

1.8.3 The aircraft Mode C transponder transmitted erroneous information to the ATC radar at Cape Town International Airport. According to the aircraft GPS that was downloaded by the NTSB in the United State of America, the initial erroneous data received by the ATC was when the aircraft was climbing through an altitude of 13500ft AMSL to an altitude of 17000ft AMSL at the coordinates of S33°43'40.37", E18°32'0.54".

Figure 9: Google Earth view of the area and the first erroneous data received

1.9 Communications

1.9.1 The aircraft was equipped with the approved communications equipment. No defects to the communication equipment were reported or recorded prior to the accident flight.

1.9.2 The aircraft were equipped with a King KY 196 COMM and a Flightcom 403M Intercom.

1.9.3 During the flight the aircraft transponder transmitted erroneous information to ATC radar. The following transmissions were communicated on the 22 April 2014 on the frequency Cape Town frequencies. This transcript is from different stations in the tower as indicated.

Note:

- The time was calculated and recorded from the start of the recording in minutes and seconds as the exact UTC time was not available. From Area Central and Area West on the transcript the times are expressed in **UTC daylight** time as taken from the radar screen.
- The relevant communication is included where necessary.

- The audio quality was fair where the majority of the conversation was intelligible and there was a lot of double transmission.
- TWR…….. Tower Controller
  * ……..... Unintelligible word
  ZS-LLD……. The accident aircraft
  NMB 724…….. Aircraft on frequency trying to communicate with the ZS-LLD

Source	Time	Content
TWR	13:23	LLD good morning climb to flight level one nine zero (FL 190)
ZS-LLD	13:27	Climb to one nine zero (190) LLD
TWR	13:57	LLD route direct OKLOK
ZS-LLD	15:40	Direct OKLOK LLD
ZS-LLD	16:50	Cape Town can you please give me a heading for OKLOK
TWR	16:56	Confirm that's LLD
ZS-LLD	17:00	Yes its LLD
TWR	17:03	LLD track required to OKLOK is zero six two degree (062°)
ZS-LLD	17:07	* LLD
TWR	17:41	LLD just to advise Mode Charlie (C) not indicating confirm you * and just recycle your squawk
ZS-LLD	17:49	*one four zero(140) recycling squawk
UNKNOWN	18:19	I don't need this shit
TWR	18:31	LLD Mode Charlie indicating your descending flight level one two eight (FL128)
UNKNOWN	18:36	What is he doing
ZS-LLD	18:39	Er copy that em we are definitely climbing to level one four eight (L148) at ONH 1013 on my * LLD
UNKNOWN	18:49	Yesses he says he is climbing but this thing is indicating that he is descending
TWR	18:59	Ok LD Mode C indicating that one two four (124) on the descent, recycle your squawk to three seven zero one (3701)
ZS-LLD	19:04	Recycling squawk 3701 LLD.
UNKNOWN	19:40	No no there is something wrong with this transponder.
TWR	19:56	Ok sir there is definitely something wrong with your transponder its now indicating descending flight level one five five (FL 155) on the descent.
ZS-LLD	20:00	Err copy that level one six zero (L160) and climbing * you want me to switch off the Mode C?
TWR	20:09	No I need your altitude indication
UNKNOWN	20:10	I don't know what he mean switch off the Mode C
ZS-LLD	20:15	Ok let me * flight level one six zero (FL160) at the stage climbing* (double transmission)
UNKNOWN	20:19	I can't afford him to switch if off I need it
TWR	20:27	LLD as such you have to actually descend and remain outside of controlled airspace if your Mode C is not indicating the correct altitude.
TWR	21:09	LLD as such contact approach now one two zero decimal five zero (120.50) for further instructions
ZS-LLD	21:15	Contact approach on one two zero decimal five zero (120.50) LLD
ZS-LLD	21:39	*good morning from LLD
TWR		LLD I will change your flight plan descend to *
TWR	22:01	Confirm you have fix it
ZS-LLD	22:09	I have recycled and it indicate correctly on your screen at this stage its fixed LLD
TWR	22:16	Copied standby maintain one six five (165) just want to speak to Area.* (double transmission)
ZS-LLD	22:20	One six five (165) LLD
TWR	22:49	LLD disappeared now just confirm your recycling again
ZS-LLD	22:53	Er negative * (Double transmission)
TWR	23:14	LLD it seems that your transponder is intermittent, the best we can do now is flight level one three five (FL135) you will * to information airspace.
TWR	24:32	LLD descent to VFR flight level one three five (FL135) *
TWR	24:51	LLD you can maintain your current heading VFR got other traffic to the South inbound to Cape Town as well
ZS-LLD	24:59	Copied traffic will maintain current heading descend to level one three five (135) LLD
UNKNOWN	26:13	What is he doing now descending to one three five (135)
TWR	26:18	LLD report level passing, Mode C on radar indicating flight level one six two (FL162)
ZS-LLD	26:26	Heading for level one five zero (FL150) at the stage LLD
UNKNOWN	26:44	Yes like, you know you can't have that kind of thing flying around
ZS-LLD	28:59	LLD flight level one three five(FL 135)
TWR	29:02	LLD thank you contact information on * bye bye.
ZS-LLD	29:46	Good morning from LLD
TWR	30:12	LLD get information *
ZS-LLD	30:32	LLD request level one nine five (FL 195) if you can accommodate
TWR	30:38	Standby

Area Central (Station)		
TWR	09:14:10 UTC	LLD contact Area Central correction Area West on one one eight decimal five five (118.55).
ZS-LLD	09:14:20	*decimal five five (.55) LLD
Area West (Station)		
ZS-LLD	09:14:46	Johannesburg good morning from LLD.
TWR	09:14:49	LLD Johannesburg good day no reported traffic flight level one nine five (FL 195) report overhead Lichtenburg.
ZS-LLD	09:14:59	No reported traffic level one nine five (L 195) report overhead Lichtenburg.
TWR	09:41:42	LLD radio check
TWR	09:41:55	LLD radio check
TWR	10:33:04	LLD Johannesburg
TWR	10:37:20	LLD Johannesburg go head
NMB724	10:40:15	And aircraft LLD from Namibia seven two four (NMB724)
NMB724	10:40:32	LLD Namibia seven two four (NMB724) your on frequency one one eight decimal five five (118.55)

1.10 Aerodrome Information

1.10.1 The aircraft accident occurred in mountainous terrain on the private farm Rooisand in the Niekerkshoop area, Northern Cape. The GPS coordinates of the accident site position are S29°26.103 E022°43.722.

1.11 Flight Recorders

1.11.1 The aircraft was not fitted with a cockpit voice recorder (CVR) or a flight data recorder (FDR), nor was it required by regulations.

1.11.2 The aircraft was fitted with a Garmin GPS296 which was recovered from the accident site. As an approved service center in Johannesburg was unable to download the GPS that was damaged during the impact sequence, the GPS was sent to the NTSB in the United States of America where it was successfully downloaded.

1.11.3 The downloaded GPS data in Figure 10 and Figure 11 was overlaid on the radar data obtained from ATC. This indicates the actual flight with erroneous radar data information ATC received and from the GPS. The aircraft GPS data graph also shows the erroneous data captured at altitude of 13500 ft before the aircraft reached an altitude of 17000 ft and during the flight.

1.11.4 The abovementioned figures illustrate the actual flight path prior and at the point where the aircraft experienced inflight breakup, at figure 10, is evident that the aircraft ascended to an altitude of 17000 ft, the graph indicate that there was definitely a problem with a transponder and the aircraft descended to an altitude of approximately 13500 ft. in figure 11 indicate the aircraft ascending to altitude of 21 000 ft and flew for approximately 52 min before diving and experience inflight breakup of altitude of 17000 ft.

Piper PA-46, ZS-

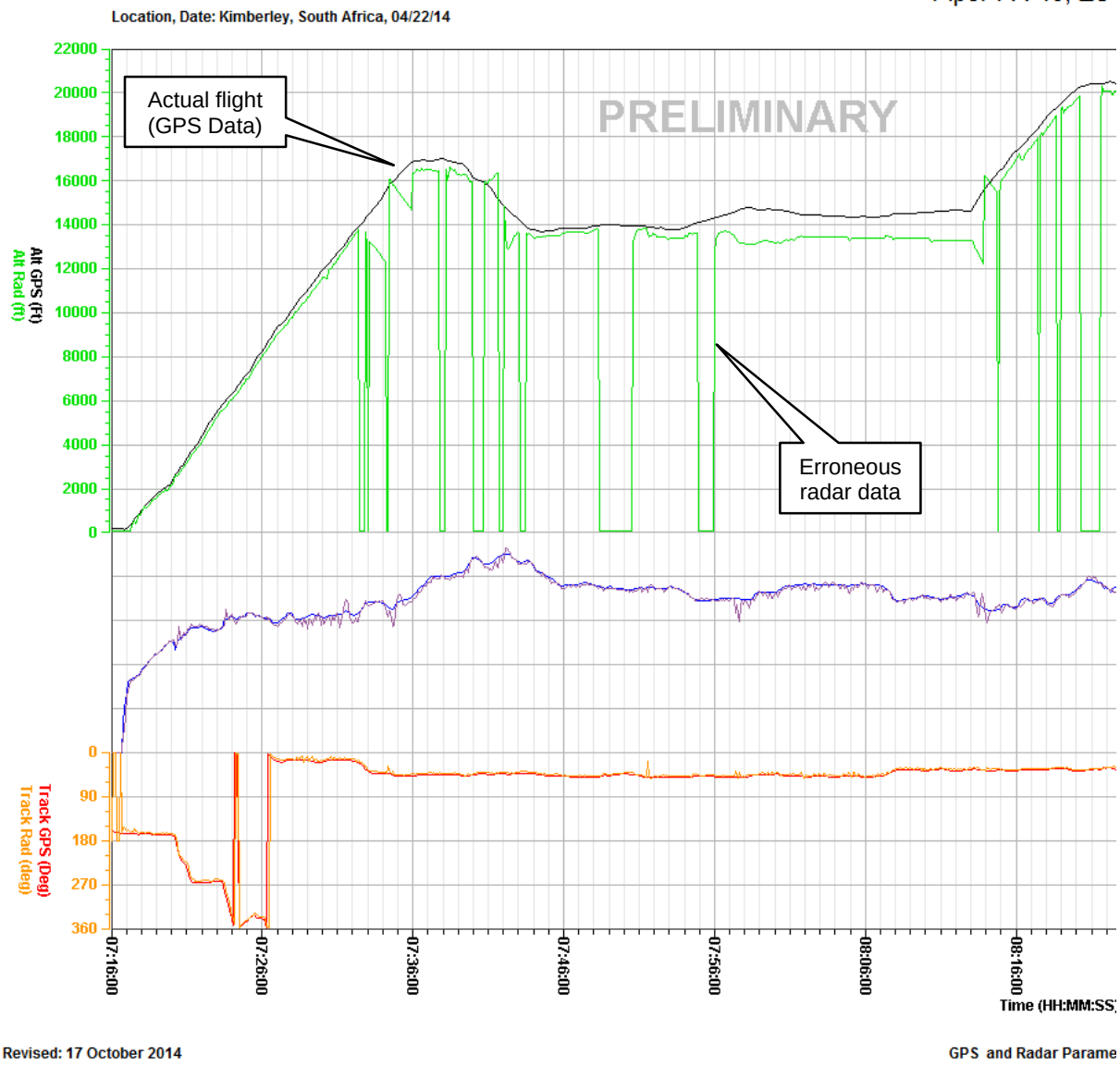

Figure 10: The GPS download and Radar Data overlay as supplied by the NTSB

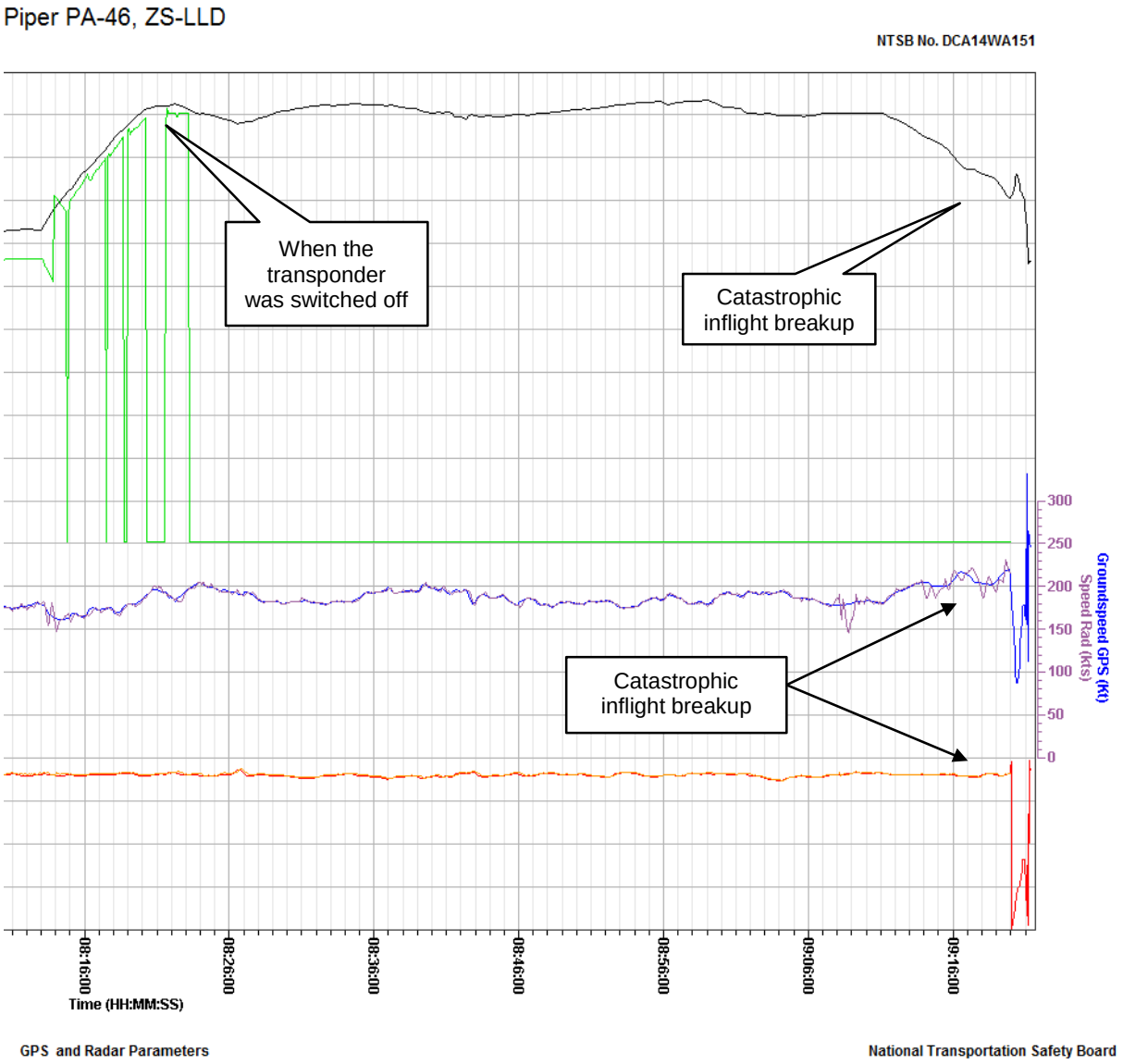

Figure 11: The GPS download and Radar Data overlay as supplied by the NTSB

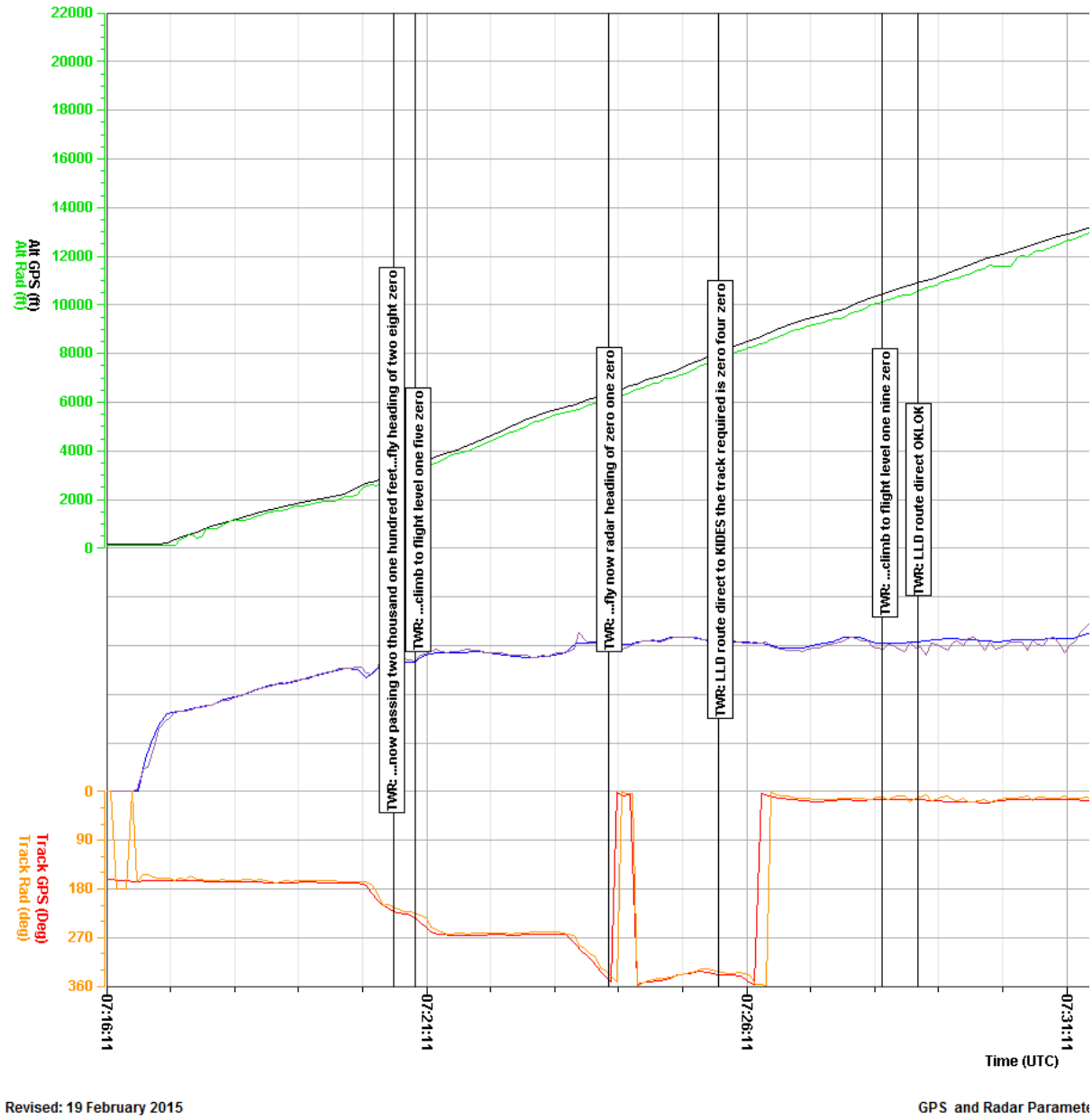

Figure 12: The GPS download and Radar Data overlay with the communication between ATC and the pilot as supplied by the NTSB

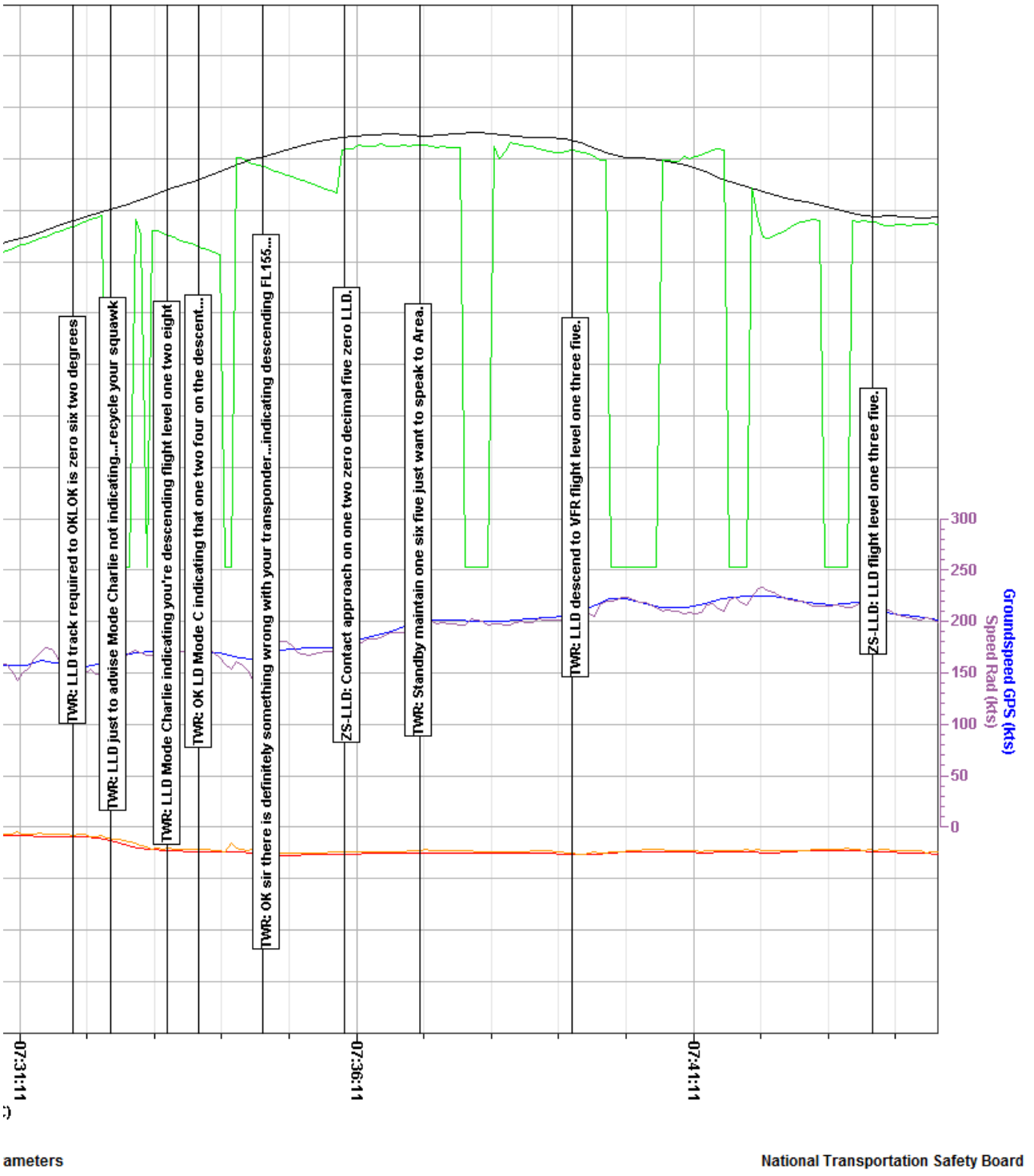

Figure 13: The GPS download and Radar Data overlay with the communication between ATC and the pilot as supplied by the NTSB

1.12 Wreckage and Impact Information

1.12.1 According to the aircraft GPS that was downloaded and radar information the aircraft exceeded the VNO of 173 airspeed and VNE airspeed of 203 airspeed causing a catastrophic inflight failure and destruction of the aircraft during the flight and impact sequence with terrain.

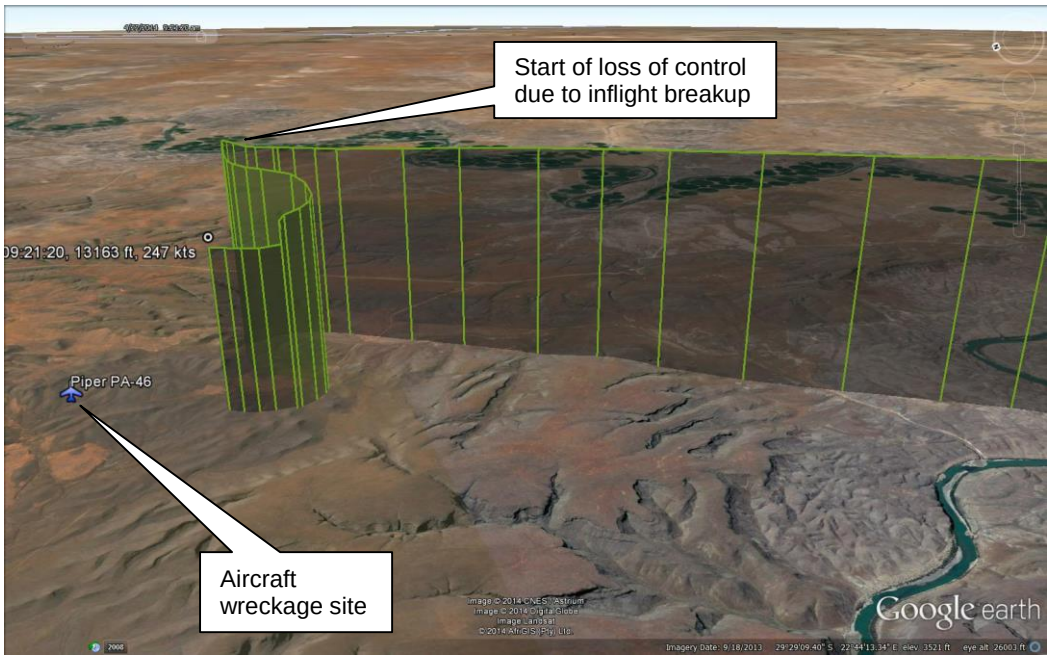

Figure 14: The final three minutes of the flight as recorded by the aircraft on-board GPS

1.12.2 The right hand flap and right hand aileron was located some distance away from the main wreckage that strongly suggested that it was one of the first flight control surfaces that failed during the inflight breakup. However sections of the horizontal stabilizer, elevator, the left aileron and a piece of the right aileron were not located at all. It is thus not possible to determine exactly which control surface failed first.

Both the left and right outboard wings which incorporate the fuel tanks failed at the mid-wing splice during the inflight breakup and ruptured on impact with the ground. The failure of the wing tanks and fuel supply thus caused the engine to stop. The propeller was found still attached to the engine at the main wreckage with no indication of rotation at the time of impact which indicates that the engine stopped prior to impact with the terrain.

1.12.3 The accident debris path was approximately 45 m wide and 1.58 km long and was oriented on a 299 degree heading. The following wreckage pattern and damage were found:

Component	Distance from main wreckage	Condition when found
Main wreckage	n/a	Found inverted
Fuselage	At main wreckage	Extensively crumpled, consistent with the aircraft striking the ground in an inverted level attitude with a high vertical rate of descent.
Engine	At main wreckage	Remained partially attached to the firewall through wires and engine mounts
Propeller	At main wreckage	No indication of rotation at the time of impact.
Right outboard wing	325m SE to the main wreckage	Failed upwards
Rudder	392m SE to the main wreckage	Top part found

Left outboard wing	980m SE to the main wreckage	Failed downwards
Elevator	1179m SE to the main wreckage	Left side found
Rudder	1275m SE to the main wreckage	Part of rudder found
Vertical stabilizer	1380m SE to the main wreckage	Part of vertical stabilizer found
Horizontal stabilizer	1385m SE to the main wreckage	Part of horizontal stabilizer found
Right hand aileron	1506m SE to the main wreckage	Part of right hand aileron found
Right hand flap	1580m SE to the main wreckage	Part of right hand flap found

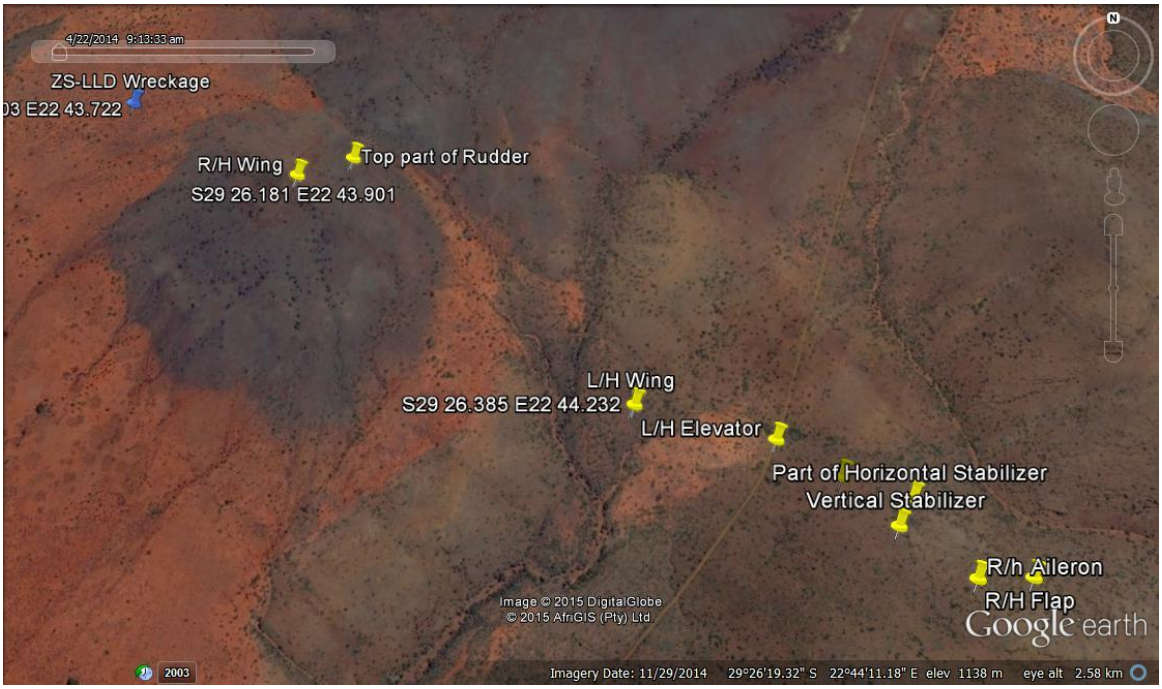

Figure 15: Wreckage layout of the accident site

1.13 Medical and Pathological Information

1.13.1 According to the post-mortem autopsy report, the cause of death of the pilot was determined to be multiple injuries. The results of the toxicology tests were not available at the time this report was compiled. Should any of the toxicology results indicate that medical aspects may have affected the performance of the pilot, this will be considered as new evidence and the investigation will be reopened.

1.14 Fire

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

1.15 Survival Aspects

1.15.1 The accident was not considered survivable due to the magnitude of the deceleration forces experienced when the aircraft impacted the ground surface.

1.15.2 Shoulder harnesses with inertia reels are standard equipment for all seats which secured both occupants without failure.

1.16 Tests and Research

1.16.1 Piper PA-46-310P and PA-46-350P Series Accident History

In the Transport Safety Board of Canada Aviation Investigation Report A08W0068 of 28 March 2008 it states that about 1016 PA-46-310P and PA-46-350P aircraft have been built, of which 165 have been involved in serious accidents (16 per cent). Of these accidents, 12 were involved in-flight breakups, of which 7 occurred in less than two years.

The United States National Transportation Safety Board (NTSB) initiated a special investigation in 1990 on the airworthiness of the PA-46 series. Its report, published in 1992, concluded that there were no deficiencies in the design and construction, citing a combination of pilot error and omissions in the aeroplane's operating manual regarding the use of pitot heat in icing conditions.

1.16.2 PITOT STATIC SYSTEM

Reference: The extract information below was obtained from the POH

Description

Pitot pressure for the airspeed indicator is sensed by a heated pitot head installed on the bottom of the left wing and is carried through lines within the wing and fuselage to the gauge on the instrument panel. Static pressure for the altimeter, vertical speed and airspeed indicators is sensed by two static source pads, one on each side of the rear fuselage forward of the elevator. They connect to a single line leading to the instruments. The dual pickups balance out differences in static pressure caused by slight side slips or skids.

If one or more of the pitot static instruments malfunction, the system should be checked for dirt, leaks or moisture. The static lines may be drained by a valve located on the side panel next to the pilot's seat. The pitot system drains through the pitot mast.

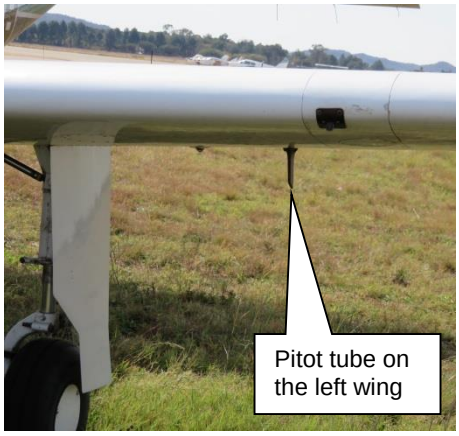

Figure 16: Pitot tube on a similar aircraft

WARNING: Do not attempt to drain static system during pressurized flight. The holes in the sensors for pitot and static pressure must be fully open and free from blockage. Blocked sensor holes will give erratic or zero readings on the instruments.

The heated pitot head, which alleviates problems with icing and heavy rain, is standard equipment and the switch for pitot heat is located on the lower centre instrument panel.

Figure 17 & Inset: Pitot heat switch in the cockpit on a similar aircraft

1.16.3 Pitot icing

Reference: Flight In Icing Conditions Summary Prepared by: Giuseppe Mingione (CIRA), Massimo Barocco (ANPAC) with the co-operation of: Eugenio Denti, Francesco Giuseppe Bindi (University of Pisa) On behalf of: French DGAC

Pitots are sensitive to icing because very light icing condition can cause ice obstruction of the pitot air entry hole. An obstruction of pitot entry can cause erroneous airspeed indications and can confuse pilots if they are not aware of the cause of the malfunctioning.

1.16.4 POH Normal Procedures regarding pitot heat

Reference: The extract below was taken from the POH

NOTE: If flight into icing conditions (in visible moisture below +5°C) is anticipated, conduct a preflight check of the icing systems per Supplement No. 10 - Ice Protection System.

Pitot heat .....AS REQUIRED

1.16.5 POH Emergency Procedures regarding pitot heat

Reference: The extract below was taken from the POH

INADVERTENT ICING ENCOUNTER OR FLIGHT IN SNOW

Pitot heat.....ON
Cabin heat .....full ON
Windshield defrost.....ON
Vent/Defog Fan.....ON
Change heading and/or altitude to exit icing conditions or snow.
Induction air.....monitor, ALTERNATE if required

1.16.6 The examination of the pitot tube of ZS-LLD

The pitot tube was removed from the left inboard wing on the main wreckage of ZS-LLD and the following was found:

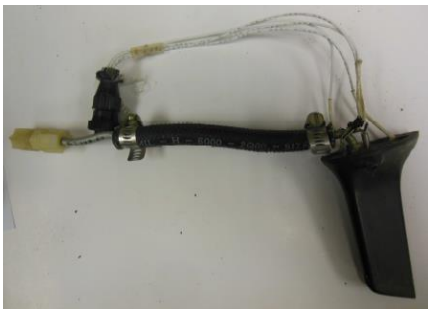

Figure 18: The recovered pitot tube

- Although the outboard wings separated during the inflight breakup from the inboard wing, the inboard was still attached to the fuselage. The pitot tube was found in a good condition.

- Approximately 1.38 m from the pitot tube, the wiring insulation had a nick which was caused by a stringer in the wing which cut into it during the accident sequence when the wing warped. The wire touched the metal stringer but no burn marks were evident which indicated that the pitot heating had no current during the accident sequence. The pitot tube and wire loom were sent for further analysis.

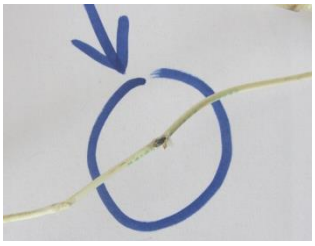

Figure 19: Nick on wiring loom

- The pitot heating was tested at an avionic facility and operated normal/heated up. The wiring loom also had continuity.

- A visual inspection of the pitot head revealed contamination at the inlet. This was sent for further analysis.

- The pitot heat illuminated rocker single pole switch in the cockpit was found completely destroyed. The circuit breaker panel was also destroyed.

The pitot tube and wire loom were sent for metallurgical examination in order to provide evidence whether electrical power was applied to the pitot heating element during the flight (whether it was switched on). The pitot tube was also tested to determine if the contamination found in the inlet had an effect on the indicated air speed performance.

The following conclusions were extracted from the report:

Pitot Tube Wiring Loom

The investigation results revealed no clear indications of shortcircuiting between the pitot wiring loom and the aircraft structure during flight and/or impact. Noted damages to the wiring loom strands suggest an exposed tensile overload, most probably at the moment of impact, causing the fractures to selected wiring strands at the attached/glued position.

Pitot Head Contamination

The investigation could not conclusively determine the origin of the contamination due to limited reference samples. Although the indicated air speed test results revealed no clear detrimental effect on the contaminated pitot head's performance, caution should be applied when considering this result as a possible contributing factor, or not, as the original in-flight contamination may have been dislodged during the accident.

Figure 20: Pitot head inlet contamination

1.17 Organizational and Management Information

1.17.1 This was a private flight.

1.17.2 The last mandatory periodic inspection (MPI) was carried out by an approved AMO no. 120 on 30 May 2013.

1.18 Additional Information

1.18.1 Aircraft Speeds as per the POH

V_{NE} – 203 KIAS (200 KCAS)
V_{NO} – 173 KIAS (170 KCAS)

Note: V_{NE} - Never Exceed Speed
V_{NO} - Maximum Structural Air Speed

Description
Reference:
Pilot's Handbook of Aeronautical Knowledge - 2003 FAA-H-8083-25

V_{NE} *– the calibrated airspeed which should NEVER be exceeded. If flight is attempted above this speed, structural damage or structural failure may result.*

V_{NO} *– the maximum calibrated airspeed for normal operation or the maximum structural cruising speed. This is the speed at which exceeding the limit load factor may cause permanent deformation of the airplane structure.*

According to the available evidence the V_{NE} speed of 203 KIAS (200 KCAS) was exceeded for **9 minutes** of the flight. The V_{NO} speed of 173 KIAS (170 KCAS) was also exceeded for **1 hour 44 minutes** of the flight.

1.19 Useful or Effective Investigation Techniques

1.19.1 None

2. ANALYSIS

2.1 On 22 April 2014 at approximately 0716Z the pilot accompanied by a passenger departed from FACT on an IFR flight enroute to Swartwater in the Limpopo Province. The aircraft had 331 lbs of fuel on board which equates to 8.0 hours fuel endurance. The total weight of the aircraft was well within limits for the flight.

2.2 Approximately 16 minutes after the aircraft departed from Cape Town International Airport, the aircraft's Mode C transponder started transmitting erroneous altitude data with the aircraft climbing thru 13500 feet AMSL to 17000ft AMSL. It however cannot be conclusively concluded that the erroneous altitude data was due to icing of the pitot tube at that stage. The weather report indicated that the freezing level was at 9500 feet AMSL. And the OAT temperature was -4°C. The aircraft's pitot tube was equipped with an electrical ice protection system and the aircraft's POH advises that in icing conditions the pitot heat must be switched on. Pitot heads are sensitive to icing and light icing condition can cause obstruction of the pitot air entry hole. An obstruction of the pitot tube can cause incorrect airspeed indication which canl confuse the pilot, especially if he is unaware of the cause of the malfunction.

2.3 The ATC at Cape Town International Airport advised the pilot that ZS-LLD's Mode C transponder indicated that the aircraft was descending. The pilot notified the ATC that the aircraft was climbing and not descending. The aircraft GPS that was downloaded by the NTSB in the USA showed that the aircraft was actually climbing. The pilot recycled the Mode C transponder In an attempt to rectify the defect but to no avail. The ATC eventually advised the pilot of ZS-LLD to descend to VFR FL135. The pilot then requested Area West for approval to climb to FL 195 at 0949Z which was approved with the instruction to report when overhead Lichtenburg.

2.4 At approximately 0921Z the aircraft experienced a catastrophic inflight failure as result of the V_{NO} speed of 173 airspeed (170 KCAS) with an endurance of 1.73 hours of the flight. The V_{NE} speed of 203 airspeed (200 KCAS) was also exceeded. The exceedance of the V_{NO} speeds causes permanent deformation of the airplane structure and the exceedance of the V_{NE} speeds may result in structural damage or structural failure of the aircraft. The exceedance of the V_{NO} and V_{NE} speeds most probably led to the failure of flight control surfaces of ZS-LLD which resulted in a catastrophic inflight break of the aircraft.

2.5 The pitot tube and wiring was examined by a metallurgic specialist in order to determine whether electrical power was applied to the pitot heating element during the flight. The investigation results revealed no clear indications of short-circuiting between the pitot wiring loom and the aircraft structure during flight or on impact that indicated that the pitot heat might not have been selected on, although it was in a serviceable condition. The pitot tube was also tested to determine the accuracy of the indicated air speed. Although contamination was found in the inlet of the pitot tube head it was determined that it had no effect on the indicated air speed performance unless some of the contamination came off during the impact sequence.

2.6 The wreckage was found scattered in a 1.58km path in mountainous terrain on Farm Rooisand in the Niekerkshoop area, Northern Cape. Both occupants on board the aircraft sustained fatal injuries.

3. CONCLUSION

3.1 Findings

3.1.1 The pilot was the holder of a valid commercial pilot licence and had the aircraft type endorsed on his licence. He accumulated a total of 1 569.4 flying hours which included 163.2 hours on type.

3.1.2 The pilot was the holder of a valid aviation medical certificate issued by an approved medical examiner.

3.1.3 The aircraft was in possession of a valid Certificate of Airworthiness.

3.1.4 There was sufficient fuel on board the aircraft at the time of the accident.

3.1.5 The weight and balance of the aircraft were below the maximum allowable limits for the aircraft.

3.1.6 Although not all control surfaces were accounted for, the damage to the aircraft was contributed to catastrophic inflight breakup when the aircraft exceeded the VNO and VNE airspeed during the flight.

3.1.7 Erroneous Mode C transponder data of the aircraft altitude was transmitted to the ATC at Cape Town International Airport after the aircraft was climbing past 13500ft AMSL. The erroneous altitude information was transmitted for about 1 hour 48 min until the accident occurred.

3.1.8 According to the South African Weather Services, the freezing level at Cape Town International Airport was at 9500ft AMSL. As the aircraft was climbing through 13500ft AMSL, the outside air temperature was recorded as -4°C when the erroneous altitude data was transmitted to the ATC at FACT.

3.1.9 The Piper PA-46 Malibu pitot tube head heating wire loom was found damaged during the impact sequence but revealed no clear short circuiting between the wiring loom and the aircraft structure. However the pitot head showed evidence of some contamination but the origin of the contamination could not be determined due to the limited reference samples.

3.1.10 The aircraft VNO speed was exceeded for 1 hour 44 minutes of the flight until the aircraft VNE airspeed was also exceeded.

3.1.11 The aircraft flight control surfaces failed during the catastrophic inflight breakup of the aircraft.

3.2 Probable Cause/s

3.2.1 The aircraft exceeded the Maximum Structural airspeed (VNO) and VNE airspeed due to the fact that erroneous altitude data information was indicated on the cockpit instruments as the result of blockage of the pitot tube by dust and sand.

3.3 Contributory Factor/s

3.3.1 The pilot was unaware that the cockpit instrument was reading incorrect Indicated airspeed due to the erroneous data transmitted from the Mode C Transponder.

4. SAFETY RECOMMENDATIONS

4.1 None

5. APPENDICES