

THE REPUBLIC OF KENYA
MINISTRY OF TRANSPORT, INFRASTRUCTURE, HOUSING,
URBAN DEVELOPMENT AND PUBLIC WORKS

STATE DEPARTMENT FOR TRANSPORT

AIRCRAFT ACCIDENT INVESTIGATION

LOSS OF CONTROL INTO TERRAIN
INVOLVING
SKYWARD INTERNATIONAL AVIATION LTD
FOKKER B. V. F27 MARK 050,
KENYAN 5Y-CET
UTAWALA, NAIROBI, KENYA
02 JULY, 2014

AIRCRAFT ACCIDENT INVESTIGATION DEPARTMENT

PRELIMINARY REPORT

OPERATOR:	Skyward International Aviation Ltd
AIRCRAFT TYPE/ MANUFACTURER: B.V.	Fokker B. V F27 Mark 050/ Fokker Aircraft
YEAR OF MANUFACTURE:	1992
AIRCRAFT REGISTRATION:	5Y-CET
AIRCRAFT SERIAL NUMBER:	20262
DATE OF REGISTRATION:	29 April 2014
TYPE OF ENGINE:	Two Pratt & Whitney PW 125B
DATE OF OCCURRENCE:	02 July 2014
TIME OF OCCURRENCE:	0117
LOCATION OF OCCURRENCE:	Nairobi, Utawala area 01° 17'16"S, 36° 57'5"E
TYPE OF FLIGHT:	Commercial (Cargo)
NUMBER OF PERSONS ON BOARD:	Crew - 2; Passengers - 2
INJURIES:	4 fatal
NATURE OF DAMAGE:	Destroyed
CATEGORY OF OCCURRENCE:	Accident
PIC'S FLYING EXPERIENCE:	Over 14,453 hrs TT; over 5,842 hrs on type

*All times given in this report are Coordinated Universal Time (UTC)
East African Local Time is UTC plus 3 hours.*

OBJECTIVE

This report contains factual information which has been determined up to the time of publication. The information in this report is published to inform the aviation industry and the public of the general circumstances of the accident.

This investigation has been carried out in accordance with *The Kenya Civil Aviation (Aircraft Accident and Incident Investigation) Regulations, 2018 and Annex 13 to the International Civil Aviation Organization Convention on International Civil Aviation*.

The sole objective of the investigation of an accident or incident under these Regulations shall be the prevention of accidents and incidents. It shall not be the purpose of such an investigation to apportion blame or liability.

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Figure 2: Accident site location on Google maps indicated by the yellow pin

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Table 1: Injury chart

ABBREVIATIONS

AAID	-	Aircraft Accident Investigation Department
AGL	-	Above Ground Level
AMEL	-	Aeronautical Maintenance Engineers License
AMO	-	Aeronautical Maintenance Organization
AMSL	-	Above Mean Sea Level
AOC	-	Air Operators Certificate
ATC	-	Air Traffic Services
ATPL	-	Airline Transport Pilot License
ATS	-	Air Traffic Services
COA	-	Certificate of Airworthiness
COR	-	Certificate of Registration
CPL	-	Commercial Pilot License
CVR	-	Cockpit Voice Recorder
DME	-	Distance Measuring Equipment
ELT	-	Emergency Locator Transmitter
FDR	-	Flight Data Recorder
FIR	-	Flight Information Region
FMS	-	Flight Management System
GPS	-	Global Position System
HF	-	High Frequency
HKJK	-	Jomo Kenyatta International Airport
HKKT	-	Kitale Airport
HKNW	-	Wilson Airport
ICAO	-	International Civil Aviation Organization
IFR	-	Instrument Flight Rules
IMC	-	Instrument Meteorological Conditions
JKIA	-	Jomo Kenyatta International Airport
KAA	-	Kenya Airports Authority
KCAA	-	Kenya Civil Aviation Authority
METAR	-	Meteorological Terminal Air Report
MHZ	-	Megahertz
MSL	-	Mean Sea Level
NM	-	Nautical Mile
NTSB	-	National Transportation Safety Board
PAPI	-	Precision Approach Path Indicator
QNH	-	Altimeter setting related to sea level
SAR	-	Search and Rescue
TCAS	-	Traffic Collision Avoidance System
TSB	-	Transportation Safety Board
TSO	-	Technical Standard Order
USA	-	United States of America
UTC	-	Coordinated Universal Time
VFR	-	Visual Flight Rules
VHF	-	Very High Frequency
VOR	-	High Frequency Omnidirectional Range

SYNOPSIS

On July 2, 2014, at about 0114 UTC, Skyward International Aviation Limited Fokker B.V. F27 Mark 050 airplane, registration 5Y-CET impacted a building in Utawala, moments after taking off from runway 06 Jomo Kenyatta International Airport (JKIA), Nairobi, Kenya (JKIA). Instrument Meteorological Conditions prevailed at the time and the airplane was on an instrument flight plan to Aden Adee International Airport, Mogadishu, Somalia. The four crewmembers were fatally injured. The airplane was destroyed on impact and the conflagration that ensued.

The Aircraft Accident Investigation Department (AAID) received information from the JKIA control tower, when the accident occurred and AAID investigators were immediately deployed to the site.

AAID notified the Transportation Safety Board (TSB) of the Netherlands the State of manufacture of the Fokker 27 aircraft, the Air Accident Investigation Branch of the United Kingdom the State of manufacturer of the propellers, the Transportation Safety Board (TSB) of Canada, the State of manufacturer of the power plant, and the International Civil Aviation Organization.

The downloaded and analysis of the Flight Recorders were performed in the National Transportation Safety Board laboratory in the United States of America in the presence of investigators from AAID of Kenya.

The investigation determines the probable cause(s) of this accident to be the flight crew's decision to conduct the flight with a known mechanical problem and their failure to abort or reject the takeoff after receiving twenty-seven cautions.

1. FACTUAL INFORMATION

1.1 History of the flight

On 2 July 2014, about 01.14 UTC, 5Y-CET, a Fokker F50, an international cargo flight, operated by Skyward International, crashed shortly after takeoff from Jomo Kenyatta International Airport (JKIA), Nairobi, Kenya (JKIA). Instrument Meteorological Conditions prevailed at the time and the airplane was on an instrument flight plan. The four crewmembers were fatally injured. The airplane was destroyed and consumed by post-crash fire. The destination of the flight was Aden Adeo International Airport, Mogadishu, Somalia.

The airplane was repositioned from its home base at Wilson Airport in Nairobi, the day before. The accident captain (CAPT) and another first officer conducted the repositioning flight. (see Aircraft Information). At JKIA, the airplane was loaded with cargo in preparation for the accident flight. The accident crew consisted of the Capt and FO in addition to a maintenance engineer and loadmaster. According to air traffic control (ATC), the flight plan was filed for duration of 2.5 hours at an altitude of 19,000 feet along with 5 hours of fuel aboard. Based on flight recorder data, the Capt was the pilot-flying and the FO was the pilot-monitoring.

The accident flight was reconstructed using data from air traffic control and flight recorder information. According to FDR data, engine start occurred at 01.50.20. At about 01.10.59 the flight made initial contact with JKIA air traffic control tower and after routine communication, including the confirmation of the number of person and fuel endurance, the flight was cleared for takeoff at 0112.30.

At 01.11.58, both engines accelerated to a high power setting with engine no. 1 stabilizing at 78% torque, 100% propeller speed and engine 2 stabilizing at 80% torque, 99% propeller speed. About six seconds later, the Capt indicates “power is set”. About 2 seconds afterwards the Capt indicated “the auto-feather is off, left” and then 5 seconds later, the FO calls out “seven eighty” (?).

About 16 seconds after initial engine acceleration was applied, the first of a series of three chimes audio alerts occurred, and continued at 1 second interval throughout the CVR recording. Immediately after the initial chimes, the Capt said “you see” and “how much is that?”. The FO responded “okay niner”. The Capt then asked “it has gotten to?” The FO replied “thirty four thirty ninety two” and shortly afterward “the left one is thirty”

About 24 seconds after initial engine acceleration, engine 1 torque climbs over a period of 2 seconds to a recorded value of 119.9%, the maximum value the recorder is capable of recording. Simultaneously Engine 1 propeller speed falls from 100% to 57%. Other engine shaft speeds remain at approximately their original high power values. Airspeed at the point this change occurs was less than 30 knots. During this period, the FO called out “one twenty two now [pause] torque”. The Capt responded “it is rising eh? The FO then noted “torque one twenty six now”. About 31 seconds after initial engine acceleration, the FO called out “okay speed alive sixty”. About a second later the Capt asked “do we reduce or”? The FO responded “we can just cut”. The Capt inquired “do we abort or continue?” The FO responded, “okay one one twelve and nine four point three” and then “okay one sixteen [pause] ninety four.” The Capt acknowledged “yeah okay”

About 47 seconds after initial engine acceleration, the Capt said twice “did I reduce it?” and the FO responded sequentially “yeah” and “okay”]

About 52 seconds after initial engine acceleration, the Capt asked “how is it now?” and the FO replied “yeah one oh two [pause] ninety four”. About 7 seconds later the FO called out “okay, one sixteen ninety four”.

About 1 minute after initial engine acceleration, the Capt inquired “Is it really going?” The FO replied “one oh one, ninety five”. The Capt acknowledged and shortly afterward he queried “is it going really, is the aircraft really moving”. The FO responded “okay, one oh one, ninety five”.

About 4 seconds later, the Capt indicated “it is not giving power”

About 1 minute 9 seconds after the initial engine acceleration the FO called out “okay speed has now reached about hundred”. The Capt responded “oh yeah” and immediately afterward the FO called out “okay one eleven, ninety five”.

About 1 minute 18 seconds after the initial engine acceleration, the FO indicated “hundred now”. The Capt acknowledged.

About 1 minute 26 seconds after the initial engine acceleration, the FO called out “V one V R rotate”

About 1 minute 33 seconds after the initial engine acceleration a transition of the airplane from ground to air mode is recorded and the pressure altitude begins to climb along with the Capt immediately afterward expressing two exclamations.

Following the transition to air mode there were 51 seconds of flight recorder data before the recording ended. During this time and over a period of about 3 seconds, the FO calls out

“positive rate of climb” and the Capt responded “gear up”. About 3 second later, the Capt expressed “it doesn’t have power [pause] it’s on one side.” About 6 seconds afterward, the FO said “we can also turn back” .

About 3 seconds later the first of seven “don’t sink” (GPWS aural warning alerts) begins over a period of 23 seconds. After the second GPWS alert the Capt queried “ok, we’re ok?” After the third GPWS alert, the FO said “we can turn back” and the Capt immediately responded “let’s just go”. The FO replied “okay”.

After the fifth GPWS alert, the Capt indicated “and this one is showing one fourteen” and then queried? “we can turn back?”. About 2 seconds later, the FO called out “okay speed is one hundred” and the Capt responded “but this one has nothing” About 1 second later and about the time of the sixth GPW alert, JKIA control tower radioed “five yankee charlie echo tango contact radar one two three decimal three. Good morning.”

After the seventh GPWS alert the recording ended about 13 seconds later. During this time, the controller called the aircraft again. The Capt expressed “tell him [pause] tell him we have no power”. The last CVR data indicates the FO radioed, “ah tower charlie echo” and the transmission abruptly ended along with simultaneous sounds of distress.

According to FDR data, about 15 seconds after the airplane transitioned from ground to air mode the recorded altitude peaked about 5060 feet and accompanied by a maximum airspeed of 100 knots. Along with a variation of airspeed between 90 knots and 100 knots for the remainder of the recording, during the following 20 seconds the altitude decreased to about 5000 feet and then increased to 5050 feet over the next 10 seconds where it remained until the recording ended at 1.14.27.

Witness Accounts (Air Traffic Controller Civilians).

The aircraft crashed during the hours of darkness at geographical coordinates of 01° 17’16”S, 36° 57’5”E.



Figure1: The 5Y-CET wreckage at the accident site



Figure 2: Accident site location on Google maps indicated by the yellow pin

1.1.1 Previous flight

The previous day, 5Y-CET performed a positioning flight from Wilson Airport to JKIA.

1.2 Injuries to Persons

Injuries	Crew	Passenger	Total in the aircraft	Others
Fatal	2	2	4	0
Serious	0	0	0	0
Minor/none	0	0	0	Not applicable
Total	2	2	4	0

Table 1: Injury chart

1.3 Damage to Aircraft

The aircraft was destroyed by impact forces and the ensuing fire

1.4 Other Damage

A single storey commercial building was substantially damaged by the impact forces and the inferno.

1.5 Personnel information

1.5.1 Pilot in Command

The captain was a 54 year old male and held a valid airline transport pilot license (ATPL) number YK-3621-AL. He had about 14,531 total hours, including 13,397 hours as pilot-in-command (PIC). He had about 6821 hours accrued as PIC on the Fokker 50. The captain had flown the accident airplane about 77 hours during the previous 60 days.

At the time of the accident, his ATPL license was valid till 10th November 2014. He held a class one medical certificate, which had been done on 6th May 2014. The Medical was due to expire at the same time as the ATPL.

He also had a valid certificate for a flight radio telephony operator license.

He had a rating in Landplanes class, with type ratings of LET 410A, LET 410 UVP-E9 and LET 410 UVP-E20. He was also rated on Fokker 27-50 and Dash 8 in his license. His English LPR level 5 was due to expire on 9th March 2015.

1.5.2 The Copilot

The first officer held a commercial pilot license. He had about 823 total hours, which included 513 hours second-in-command time accrued in Fokker 50. He had flown in the accident airplane about 18 hours during the previous 60 days.

1.6 Aircraft Information

1.6.1 General

The Fokker B.B F27 Mark 050 is a twin engines turbo propeller aircraft with a max takeoff mass of 20,820 kg. It is equipped with two Pratt and Whitney PW 125B engines each fitted with a 6 bladed Dowty propeller.

The aircraft had certificate of airworthiness issued on 09 May 2014 and valid from 09 May 2014 till 08 May 2015.

The last scheduled inspection was a C-check completed on 21 May 2013.

Type of fuel used was Jet A1.

The accident airplane had about 27,243 and 26,358 total hours and total cycles since new respectively. The No. 1 and No. 2 engines had 19,343 and 32,145 hours since new respectively. The No. 1 propeller had about 33,208 and 7,064 hours, since new and since overhaul respectively. The airplane was acquired in April 2014 from an operator in The Netherland and ferried to Kenya in early May 2014 where it was subsequently operated for 92 hours at the time of the accident.

1.6.2 Aircraft Systems:

1.6.2.1 Takeoff Configuration Warning

Description

With the aircraft on the ground and either power lever in TO position, the TO CONF light at the CAP illuminates when one of the follow conditions is met:

- Elevator trim not in TO position
- Rudder trim not in TO position
- Flaps not in TO position
- Parking brake not released
- Neither TO nor FLX nor GA selected at the engine rating panel. SE OM Part B section POWER PLANT
- Propeller autofeather not armed. See OM Part B section POWERPLANT.

NOTE: The alerts cannot be cancelled by depressing MWL.

With the aircraft on the ground and either power lever not in TO position, the take-off configuration can be tested by depressing the TO CONFIG button at the test panel for at least 2 seconds. The TO CONF light at the CA remains out when the take-off configuration is complete.

NOTE: The test can be performed with the parking brake on.

1.6.2.2 Propeller Feathering

According to the Fokker Flight Operations Manual:

The propeller can be feathered automatically or manually. The propeller is feathered manually when the FUEL lever is set to SHUT or START. During shutdown on the ground combined action of the counterweights or oil pressure is sufficient to feather the propeller. In flight, additional oil pressure from an electrically driven feather pump, which operates during 30 seconds, is used to obtain automatic or manual feathering. Pump operation is indicated by a FEATHER PUMP light. The feathering pump uses reserve engine oil.

The autofeathering system, which has automatic power reserve (APR) facility, can be inactive, standby, or armed. Each condition will be presented by the autofeather light at the center main instrument panel.

The autofeather system is on standby (STBY) when TO, GA, or FLX is selected at the ERP, or when the landing gear is down, provided neither propeller is feathered. When, in addition, both POWER levers are set to TO and the actual torque values reach 50 per cent, the system will be ARMED.

A propeller will autofeather when:

- The autofeather system is ARMED, and
- The actual engine torque drops below 25 per cent

Auto-feathering results in an uptrim command (APR) to the ENG EC of the live engine. Automatic ignition of the engine of which the propeller is feathered is inhibited. The pilots are informed by an engine failure alert and the autofeather system will be disarmed. Two AUTO FEATHER TEST buttons are located at the test panel to check the system.

1.6.2.3 Integrated Alert Unit (IAU)

General

According to the Fokker Aircraft information, failure conditions are processed by an IAC for visual and aural presentations to the pilots.

Note: Pre-stall warning and ground proximity warning are not integrated.

The IAU classified the alerts in three levels according to urgency and/or priority of the required action:

Level 3

This alert requires immediate corrective or compensatory action by the crew. The presentation comprises a repetitive triple chime, two flashing red Master Warning Lights (MWL), and the relevant red light at the Central Annunciator Panel (CAP). Any engine related level 3 alert is

accompanied by an IAU produced white light in the relevant FUJE lever. Engine fire is additional annunciated at the ENGINE FIRE panel

Visual Alerts

Master Warning and Master Caution Lights

Neither MWL's nor MCL's can be dimmed. MWL's and MCL's are cancelled when the fault is corrected or when the relevant master light is depressed by either pilot.

Two Level 3 annunciations cannot be cancelled by depressing MWL:

- The landing gear not down with landing flap position alert
- The take-off configuration warning

Aural Alerts

Identification

All aural alerts are integrated in the aircraft audio system. Aural alerts for level 3, 2, and 1 are attention getting chimes; they identify the level of urgency. The repetitive triple chimes, which annunciates a level 3 alert, is cancelled when the fault is corrected or when either MWL is depressed. The repetitive chime due to landing gear not down with landing flap position, or due to an unsafe take-off configuration cannot be canceled by depressing either MWL.

In addition to the chimes the IAU provides the following dedicated aural alerts:

Priority

Aural alerts are presented in the following order of descending priority:

Aural alerts are presented in the following order of descending priority:

Calvary charge

Clacker

Repetitive triple chime (+MWL)

'C'-chord

Double chime (+MCL)

Buzzer

Interrupted buzzer (only for selcal equipped aircraft)

Single chime.

1.6.3 Weight and Balance:

The investigation reviewed the preflight weight and balance sheet that was prepared for the accident flight, determined the post-accident actual weight of the cargo recovered from the aircraft wreckage and thereof conducted a post-accident calculation of the aircraft load.

1.6.3.1 Weight and Balance Sheet

Tables 1-4 were the entries listed in the noted section of the weight and balanced (WB) sheet used for the dispatch of the accident flight. Table 5 is the actual graph from the WB sheet that shows the determination of the aircraft weight and balance. According to the WB sheet, The Total Takeoff Weight (TOW) was 20,167 of which adjacently listed is the Maximum Takeoff Weight (TMO) as 20820.

A review of the Weigh and Balance sheet (Table 3) revealed the entry on the “basic mass and crew” section of the sheet included the basic mass only, but did not include the crew weight. The standard weight for crew members used for calculation purposes in the weight and balance section of the Fokker Aircraft Manual is 75 kgs (165 lbs).

FWD Compartment	1000
AFT Compartment	0400
Stowage in Cabin FWD	1300
Stowage in Cabin AFT	2300
Total Cargo	5000

Table 1

Total Pax	
Total Cargo	5000
Ballast	
Traffic Load	5000

Table 2

Basic Mass + Crew	12817		
Pantry			
Miscellaneous			
DOM			
Traffic Load	5000		
ZFM	17817	MAXIMUM ZFM	18600
Blockfuel	02400		
TM	20217	MAXIMUM TM	20865
Taxifuel	00050		
TOM	20167	MAXIMUM TOM	20820
Tripfuel	01430		
LM	18737	MAXIMUM LM	19730

Table 3

	FWD		AFT	
Pax	26		59	Pax
Cargo	42		26	Cargo
			55	+DOI
Total FWD	68		140	Total AFT
			68	
Loaded Index			72	

Table 4

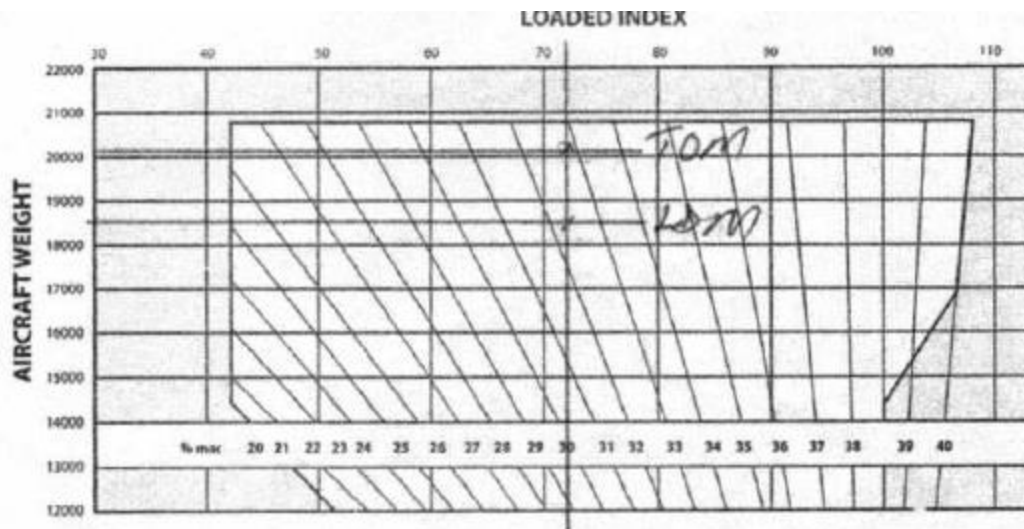


Table 5

1.6.3. 2 Post-Accident Cargo Weight

The cargo recovered from the wreckage was loaded onto a truck, which was weighed as denoted in table 6. The resulting weight for the recovered cargo was 5520 kg¹.

Description	Weight (kg)
Truck Gross Weight	10280
Tare	4760
Net load ²	5520

Table 6

1.6.3. 3 Post-Accident Weight and Balance Calculation

The post-accident calculation to determine the weight and balance included revisions to (1) the basic mass and crew entry to include the crew weight, (2) traffic load to reflect the actual weights of cargo recovered from the aircraft wreckage. Based on the revised weights, the post-accident

¹ Due to the limited capacity of the truck, not all of the cargo was transported for the determination of the actual weight. Additionally, the investigation determined that unauthorized removal of some cargo occurred at the accident site.

²Fuel load for truck not included, though it was minimal.

WB calculation for TOM was 22,517, which was 267 kg above the MTOM of 20,820 (see Table 7).

Basic Mass + Crew	13,117		
Pantry			
Miscellaneous			
DOM			
Traffic Load	5,520		
ZFM	18,637	MAXIMUM ZFM	18600
Blockfuel	02,400		
TM	21,037	MAXIMUM TM	20865
Taxifuel	00050		
TOM	21087	MAXIMUM TOM	20820
Trip fuel	01430		
LM	22517	MAXIMUM LM	19730

Table 7

1.6.4 Aircraft Operating Manual

Rejected Takeoff

According to the Fokker Aircraft Operating Manual, Chapt.07.01, Flight Techniques, Abnormal Operations:

A take-off should be rejected upon any alert from the Integrated Alerting System. During take-off, above 80 kt, until 40 seconds after lift-off, all alerts except engine failure, engine fire and low oil pressure are inhibited. The pilot who detects an alert or a conflicting situation outside the aircraft calls “Stop”. The work “Stop” announced by the F/O is an advice to the captain. Upon receiving any alert, or after the announcement “Stop”, the captain will decide to abort the take-off. It should be realized that rejecting a take-off at high speed can be hazardous, particularly on a short or contaminated runway.

Pilot Flying	Pilot Monitoring
Alert or conflicting situation: <ul style="list-style-type: none"> Decide to abort (captain) Announce: “Stop” 	Alert or conflicting situation: <ul style="list-style-type: none"> Announce: “Stop”
<ul style="list-style-type: none"> Pull power levers to ground-idle and apply full brakes 	<ul style="list-style-type: none"> Hold control column
<ul style="list-style-type: none"> Stop aircraft and evaluate the situation 	<ul style="list-style-type: none"> Inform ATC

An Engine failure with autofeather will cause a large yawing moment. Retard both power levers and maintain directional control with rudder and nose-wheel steering. After coming to a stop, depending on circumstances, application of the ON GROUND EMERGENCY procedure may be required.

Note: Section of ground idle will disarm the autofeather circuit, which may result in a windmilling propeller on the failed engine.

1.7 Meteorological Information

The weather at the airfield was reported as CAVOK with calm winds. The flight was being carried out sometime during night-time.

1.8 Aids to Navigation

JKIA was equipped with Radio navigation and landing aids, which were serviceable and available, are as follows: VOR/DME, DVOR, TVOR, ILS, GP/DME, NDB and visual ground aids (signage and markings). However, the navigation aids were not considered to have had an effect on the occurrence.

1.9 Communication

The crew was in communication with air traffic services. Immediately prior to the crash, the aircraft attempted to transmit to tower but the transmission was unintelligible and incomplete.

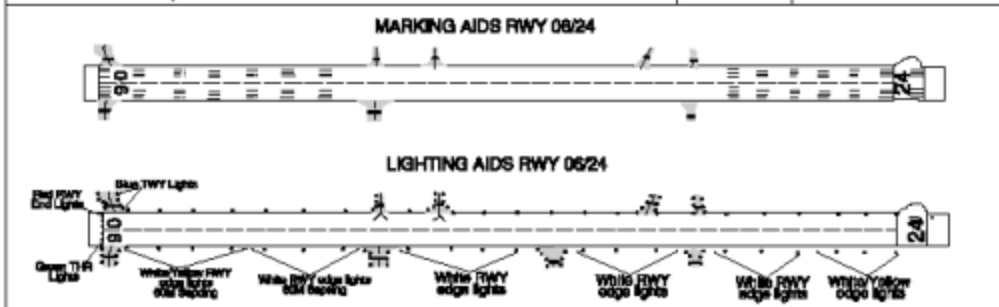
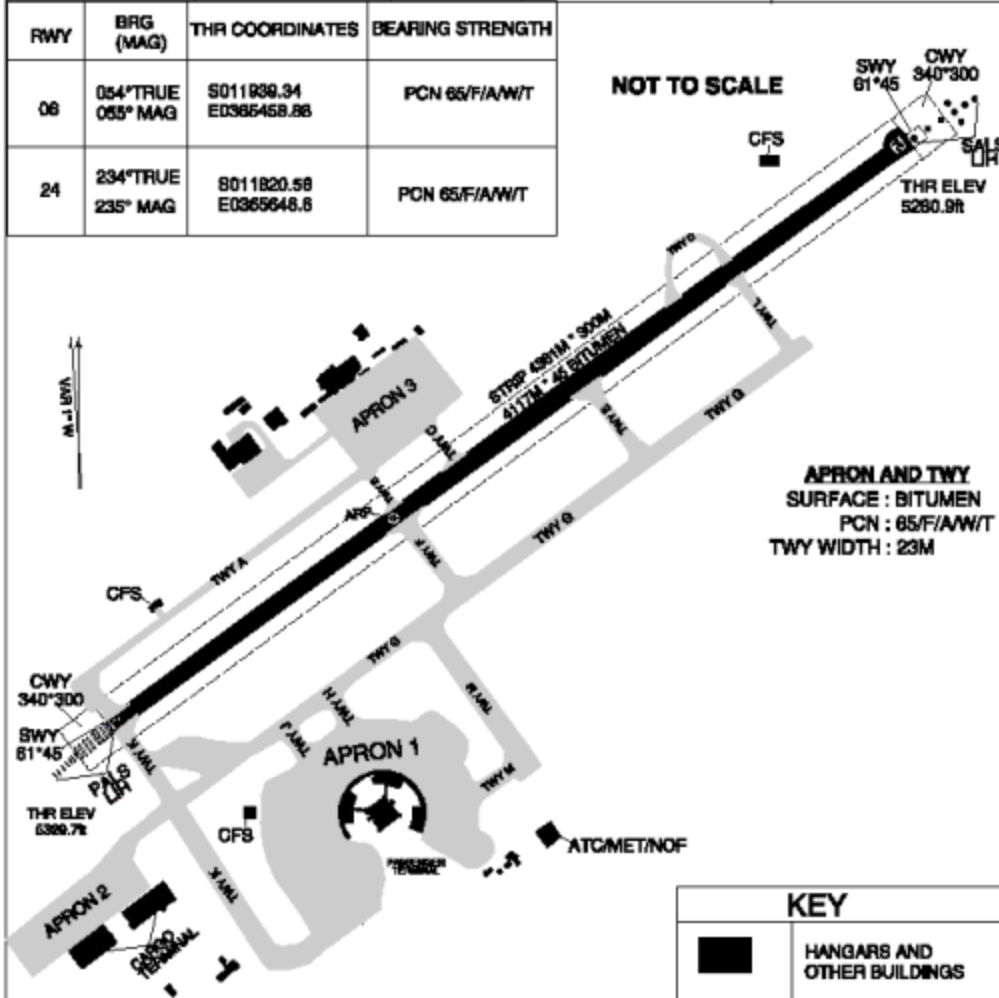
The following ATS communication facilities were also available: Approach; Tower; Approach Radar; Area Control Centre; Arrival, Departure and General ATIS.

1.10 Aerodrome Information

The Jomo Kenyatta International Airport, with ICAO designation HKJK) is located eighteen kilometers from Nairobi. It has a bitumen runway surface length 4117m and width 45m located at WGS coordinates S 01°19'09.2'' E 036°55'39.9'' with an elevation of 5330ft agl. It has PAPI lights on both runway 06 and 24. Runway 06 has Precision Approach Landing Systems (PALS) and runway 24 has Simple Approach Landing Light Systems (SALS).

AERODROME CHART	ARP S011909.267 E0385539.992	AD ELEV 5330	TWR 118.7MHZ APRON 121.6MHZ	NAIROBI / JKIA
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RWY	BRG (MAG)	THR COORDINATES	BEARING STRENGTH
06	054°TRUE 055° MAG	S011939.34 E0385458.88	PCN 65/F/A/W/T
24	234°TRUE 235° MAG	S011820.58 E0385648.8	PCN 65/F/A/W/T



1.11. Flight Recorders

A voice data recorder (CVR) serial number 59652 and a flight data recorder (FDR) serial number 04844 were fitted at the time of the accident.

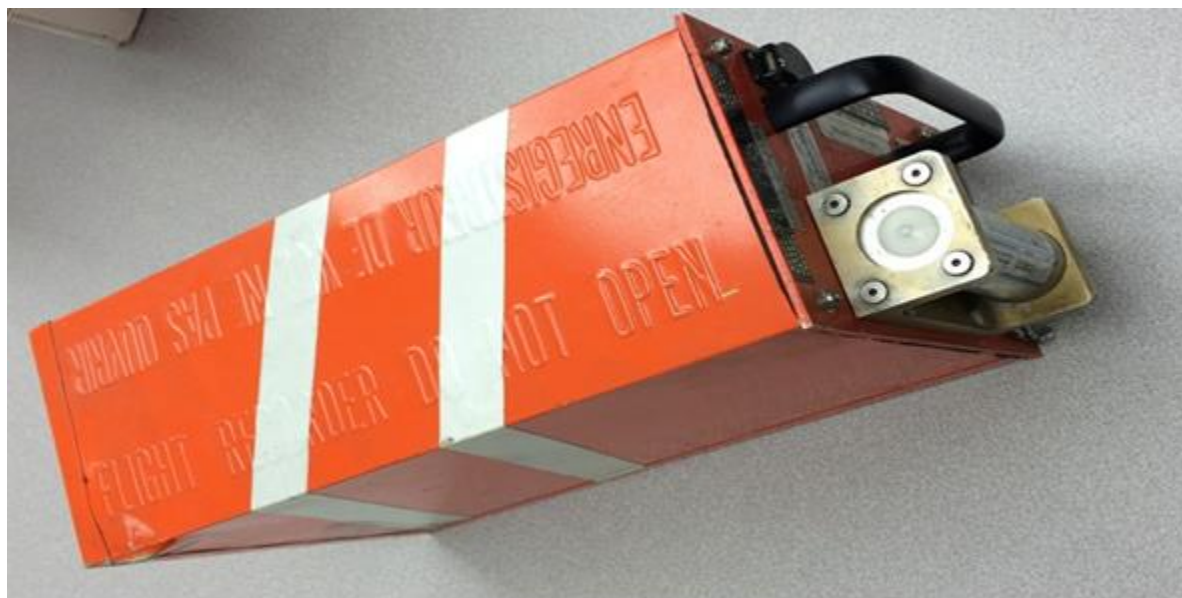
1.11.1 Cockpit Voice Recorder (CVR)

Recorder

Manufacturer/Model: Fairchild

A-100A

Recorder Serial Number: 59652



The CVR was located in the upper tail section of the aircraft, in the vicinity of the stabilizer attachment point. This section was not damaged by the post-crash fire and did not have much structural damage. The recorders were retrieved from the wreckage on the day of the occurrence without much difficulty.

The CVR had sustained minimal structural damage and the audio information was extracted from the recorder normally, without difficulty.

Analogue audio lasting 30 minutes was retrieved from the recorder. This represented a previous positioning flight from Wilson airport, Nairobi, to Jomo Kenyatta International Airport, Nairobi and the fateful flight up until the time of impact.

In the recording, it is evident that the crew had a malfunction; this is both from their conversation and aural warning sounds heard in the cockpit, specifically a “three chime alert”. This particular aural warning sounded on both the previous positioning flight and on the fateful flight the next day. Transcript of the audio recording is presented in Appendix 3

1.11.2 Flight Data Recorder

Recorder Manufacturer/Model: Loral/Fairchild F800

Recorder Serial Number: 04844

The FDR was also located in the upper tail section of the aircraft, adjacent to the CVR. As earlier indicated, this section was not damaged by the post-crash fire and did not have structural damage. The recorder was retrieved from the wreckage on the day of the occurrence without much difficulty.



The recorder was in good condition. The FDR was opened so that the FDR tape could be removed for download and the data were extracted normally using relevant readout equipment.

The FDR data was scanned and only the event flight was downloaded for analysis. The event flight from the time the FDR started recording to the end of the FDR recording was approximately 9 minutes and 7 seconds in duration. Data dropouts (e.g., gaps in data) occurred due to the nature of the tape-based readout equipment.

Data was converted into graphical form, with the various parameters presented as plots (see appendix 4).

Here are a few highlights from the data:

(Time format hh:mm:ss)

01:12:15 torque and RPM increase to 75% and 100% respectively.

01:12:23 torque increases from 75% to 93% on Engine 2, with propeller RPM remaining constant at 100% but Engine 1 increases to 120% and the propeller speed reduces to 55% RPM. At the same time the FDR begins to capture airspeed value, with the first computed data showing an airspeed of 20 knots. This value will increase for the next 67 seconds, reaching 102 kts and thereafter fluctuating between 90 – 100 kts for the next 47 seconds until the end of the recording.

01:12:53 Engine 1 torque starts to reduce from 120% to 105% over 15 seconds and then increases to 110% for the next 10 seconds then to 120% for the next 47 seconds until the end of the recording. Engine 1 propeller RPM reduces from 55% to 45% for about 40 seconds then climbs back to 55% for the next 47 seconds until the end of the recording.

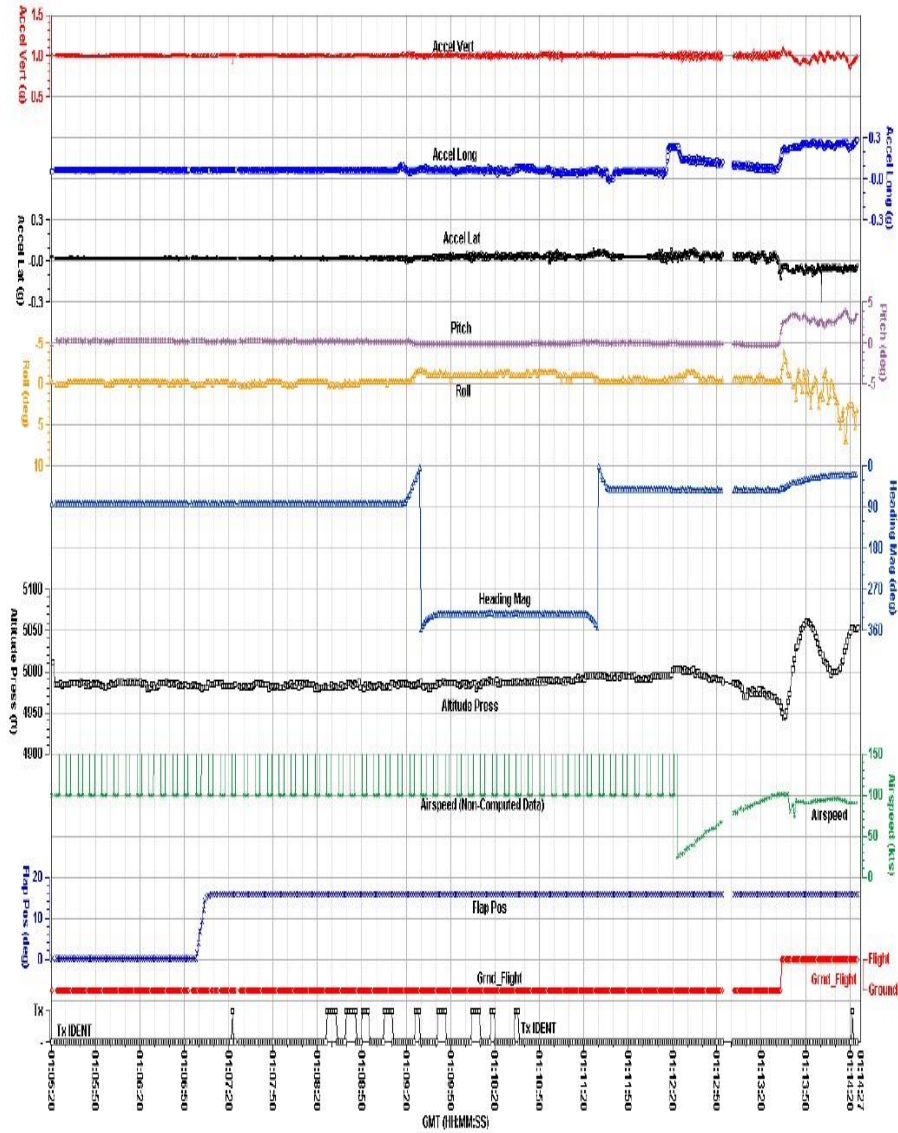
01:13:33 the aircraft takes off at approximately 100 knots IAS. The pressure altitude at the point of lift off is 4940 feet. It climbs steadily to 5060 for the next 15 seconds before dropping to 5000 ft in the next 20 seconds then climbing to 5050 ft for the next 10 seconds and staying there until the end of the recording 7 seconds later.

5 seconds after liftoff Engine 1 torque increases to 120% while its propeller RPM increases slightly to 55%. Both parameters remain at those values until the end of the recording 47 seconds later.

Skyward International, Fokker F-50, 5Y-CET, Basic Parameters (Beginning of Event Data to End of FDR Recording)

Location, Date: Nairobi, Kenya, 07/02/14

NTSB No. DCA14WA138

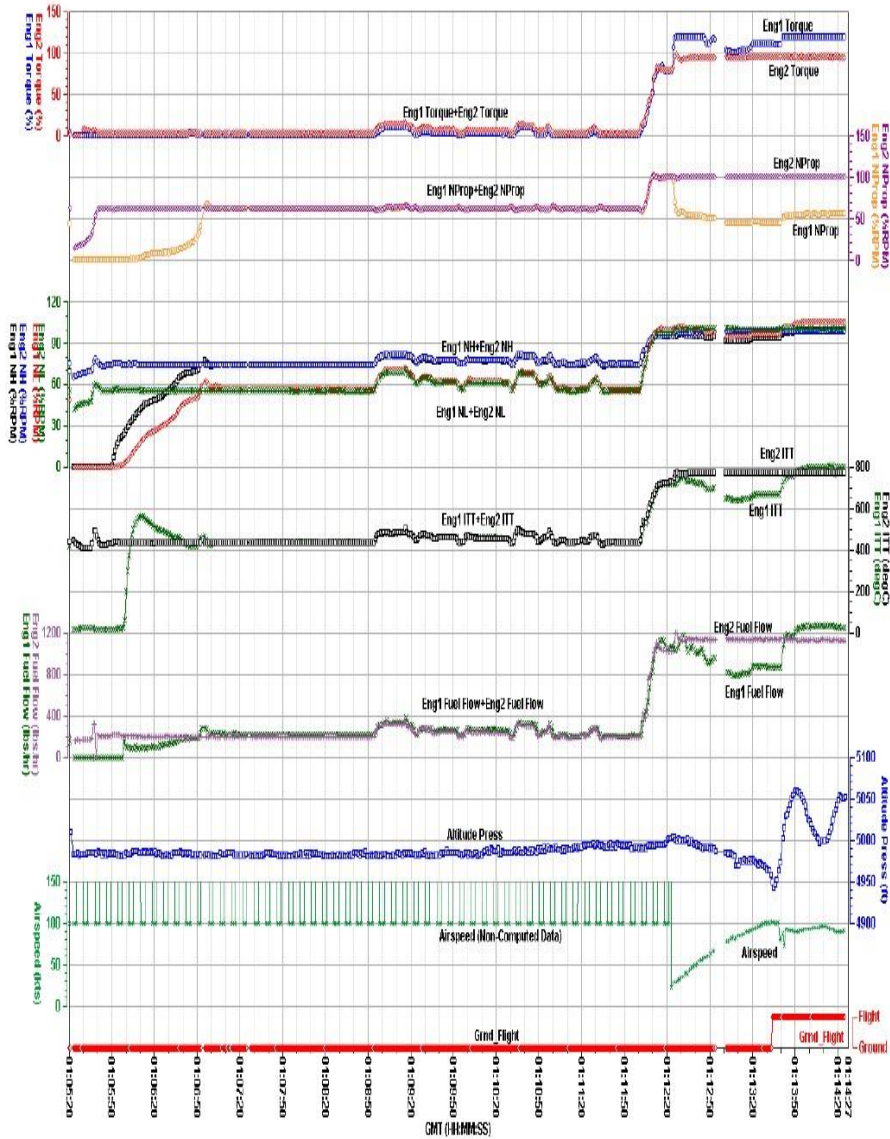


Revised: 20 August 2014

Basic Parameters (Beginning of Event Data to End of FDR Recording)

National Transportation Safety Board

Skyward International, Fokker F-50, 5Y-CET, Engine Parameters (Beginning of Event Data to End of FDR Recording)
 Location: Nairobi, Kenya, 07/02/14 NTSB No. DCA14VA130



Revised: 20 August 2014

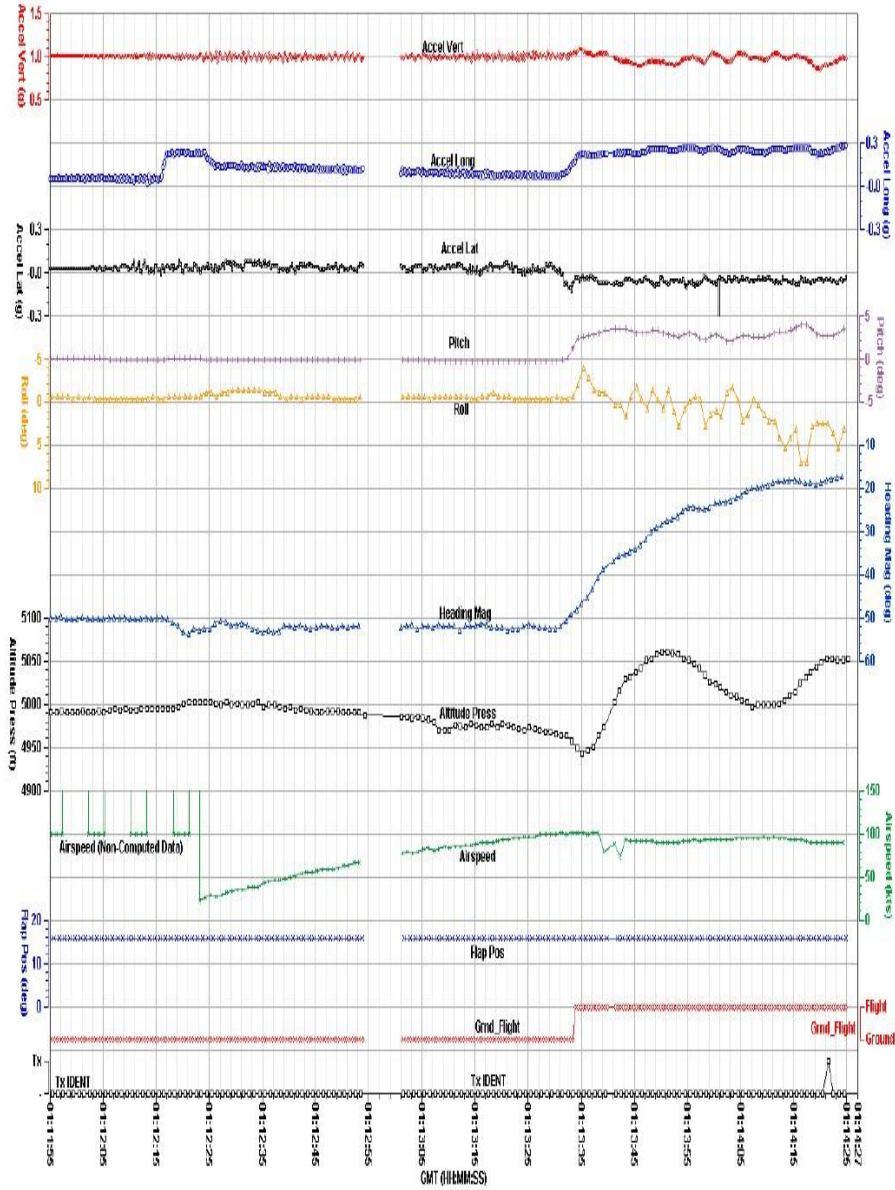
Engine Parameters (Beginning of Event Data to End of FDR Recording)

National Transportation Safety Board

Skyward International, Fokker F-50, 5Y-CET, Basic Parameters (From Engine Acceleration to End of FDR Recording)

Location: Nairobi, Kenya, 07/02/14

NTSB No. DCA14WA138



Revised: 20 August 2014

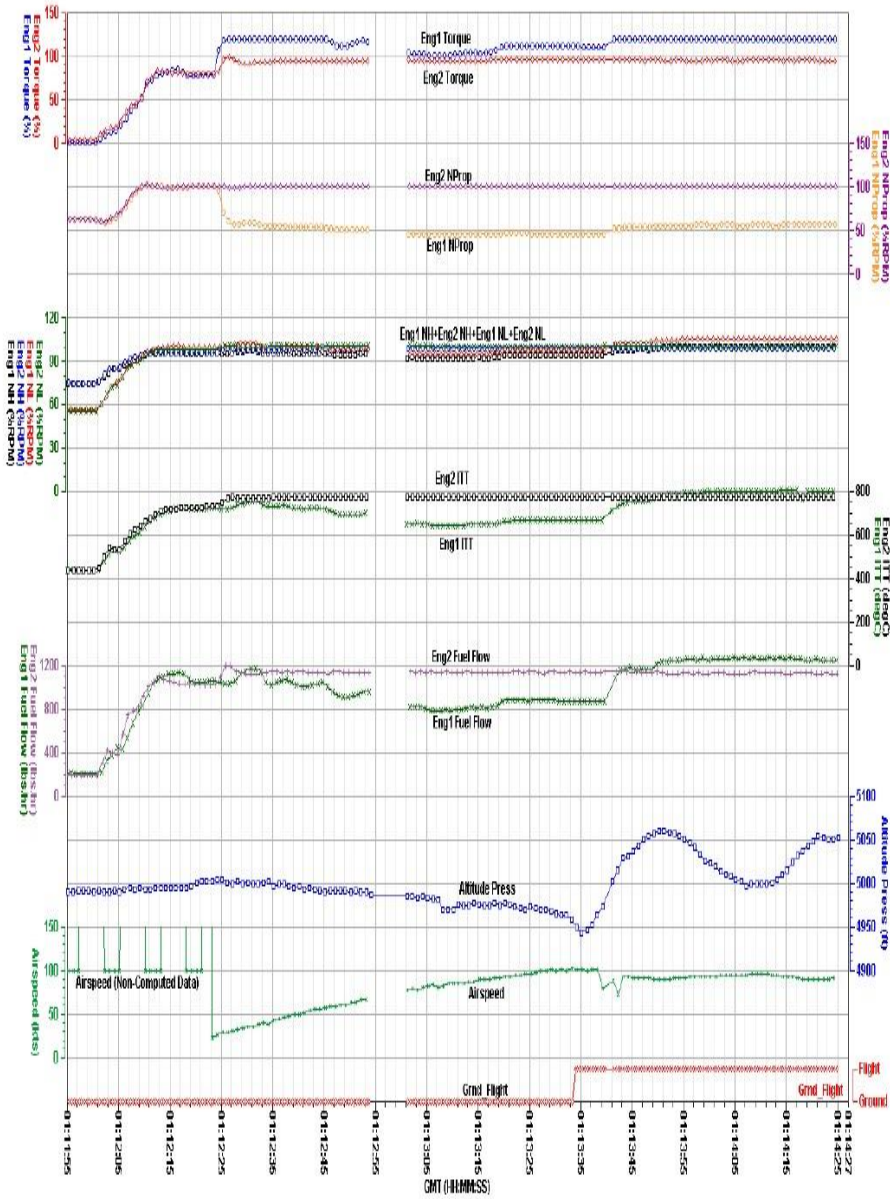
Basic Parameters (From Engine Acceleration to End of FDR Recording)

National Transportation Safety Board

Skyward International, Fokker F-50, 5Y-CET, Engine Parameters (From Engine Acceleration to End of FDR Recording)

Location: Nairobi, Kenya, 07/02/14

NTSB No. DCA14VA138



Revised: 20 August 2014

Engine Parameters (From Engine Acceleration to End of FDR Recording)

National Transportation Safety Board

1.12. Wreckage and Impact Information

The site of the accident was a commercial single storey building adjacent to a major road. The aircraft collided with the building at an angle in a “belly up” attitude. The front section of the aircraft remained mostly intact and come to rest upside down in one of the rooms of the building on the ground floor. Part of the cabin floor and cargo was found on the first floor of the building. The right (RH) wing and engine came to rest on the first floor. The wing was extensively damaged by fire. The left (LH) wing and engine were located on the ground adjacent to the building. The LH wing was extensively damaged from both impact and fire and was scattered across the debris trail. The LH engine had impacted the ground and imbedded therein.

The fuselage had separated from the nose section. Part of it was consumed by the post impact fire. The rest of it came to rest adjacent the building in an upside down attitude.

Debris field was contained approximately within a 10 metre radius. The aircraft severed power lines prior to crashing into a building. There was no evidence of pre-impact break-up of the aircraft.

1.13 Medical and pathological information

There was no evidence that physiological factors or incapacitation affected the performance of flight crew members.

1.14 Fire

Post-crash fuel fire ensued destroying part of the wreckage. At least one passenger is reported to have been exposed to the fire. The crew and one passenger located in the flight cabin appeared not to have suffered burn injuries. The flight cabin itself did not catch fire. Part of the building that the aircraft collided with showed signs of fire damage. No fuel samples were available for collection.

1.15 Survival aspects

Search and Rescue was initiated immediately after the crash with the sounding of the crash alarm from JKIA Control tower. Due to the proximity to JKIA the fire and rescue services are reported to have arrived on site within 10 minutes of the alarm sounding. The site was also in close proximity to a military installation and two police training institutions. The crash was not survivable.

1.16 TESTS AND RESEARCH

Most of the cargo, approximately 70% at the site was collected for weighing. The cargo, khat, is a mild stimulant and the possibility that some of it was burgled at the site cannot may not be ruled out. The cargo that was collected weighed in at 5.52 tonnes. The flight manifest had indicated the weight of the entire consignment as 5 tonnes.

1.17 Organizational and Management Information

1.17.1 Skyward International Aviation Ltd;

Skyward International Aviation Ltd is a company based at Wilson airport issued with an Air Operator Certificate number 233 with an expiry of 31 January, 2015 and operates a fleet of 3 Fokker B.V. F27 Mark 050 and one Fokker 100. The main business is charter flights between Kenya and Somalia. The management is comprised mainly of pilots who also conduct flight duties. The Director of Operations, for instance, doubles up as the Chief Pilot and regularly conducts flight duties like any other line pilot.

1.17.2 Maintenance organization; Five Forty Aviation

Maintenance for the aircraft operator was being handled by Five Forty Aviation KCAA-AMO Approval Certificate No.K/AMO/L/037 which is a sister company of the Aircraft Operator, EASAX. The two companies share the same Accountable Manager. The AMO is suitably staffed and equipped to effectively carry out the tasks it undertakes and utilizes the AMEL system as the basis for maintenance certification.

1.17.3 Kenya Civil Aviation Authority

Kenya Civil Aviation Authority (KCAA) is the charged with regulating civil aviation in Kenya. Air Traffic Control (ATC) and a training institution fall under KCAA's service provision arm, while the regulatory arm consists of the Safety Directorate among others. The Safety Directorate comprises of Airworthiness, Flight Operations and Licensing sections among others. Initial registration of aircraft onto the Kenyan registry is performed by the Licensing section. This section also issues licenses to pilots, dispatchers and cabin crew. Airworthiness issues and renews Certificates of Airworthiness (CofAs). It also licenses aircraft maintenance engineers and certifies Approved Maintenance Organizations. Flight Operations sections issues and renews Air Operator Certificates among other functions.

KCAA discharges its mandate through four directorates: Aviation Safety and Security Regulation, Air Navigation Services, East African School of Aviation and Corporate Services. The Aviation Safety and Security Regulation is responsible for oversight of the aviation industry; the Air Navigation Services and East African School of Aviation Directorates provide Air Navigational services and Aviation Training services respectively. The Corporate Services Directorate provides the shared services for the KCAA. The detailed mandate is provided for in the Civil Aviation Act No. 21 of 2013.

1.18 Additional information

Playback of ATC radar track showed that the aircraft did not gain significant altitude after takeoff.
Maintenance

Besides the C of A checks, there was no evidence to demonstrate that any maintenance work had been performed on the aircraft since Certificate of Airworthiness issue.

1.18.1 Human factors

From the CVR playback, it was established that a three-chime alert sounded repeatedly; it is not clear why the crew elected to proceed with the flight under those circumstances.

The three chime alert occurred before V1. The aircraft manufacturer's documentation requires the flight to be aborted in such circumstances.

CVR data indicated that the alerts had occurred previously but AAID was unable to get any evidence that the anomaly was recorded on the technical logbook neither that any maintenance actions had been performed in regard to the same.

During the positioning flight on the day prior to the accident date, the three chime alert occurred and the crew is noted to have spent considerable time trying to trouble shoot. The pilot monitoring during the positioning flight was interviewed and denied knowledge of any anomalies during the said flight.

1.18.2 Weight

There is evidence to suggest that the aircraft might have been operating outside weight limitations at the time of the accident:

- Review of the Operator's aircraft load sheets over a period of about a month showed that the maximum weight on board never exceeded 5 tonnes.
- AAID requested the Operator repeatedly for the load sheets of the other Skyward International Ltd. aircraft that departed on the day of the accident and the Operator failed to provide the same.
- The system used by the Operator for documenting the cargo and aircraft weights was via non-serialized load sheets
- The system used by the warehouse agent to indicate the cargo weight was not descriptive enough to allow investigators determine actual cargo weight loaded on each aircraft. It was unclear if an Air Way Bill (AWB) was issued for every flight since there was conflicting information from the warehouse agent and the Operator. Operator stated that one AWB was issued per load (this load could be later separated into different aircraft during loading) but warehouse agent stated that

an AWB was issued per flight. Only TWO airway bills were issued on the material day; one for 5.3 tonnes and the other for 7.9 tonnes. However according to the Operator and also from records obtained from JKIA ATC, the Operator had THREE flights that departed from JKIA on the material day as follows:

Table showing Skyward International Aviation Ltd departures for 02 July 2014

Date	A/c registration	Departure time*(hrs)	Weight indicated on Load manifest
02 July 2014	5Y-CET	0400	5,000 tonnes
02 July 2014	5Y-SIB	0315	Records not available
02 July 2014	5Y-MIS	0245	Records not available

*All times local

Table showing Skyward International Aviation Ltd cargo processed by a warehousing agent on and around 02 July 2014

Date	Standard Time of Departure(STD) /Destination	Air Cargo Manifest No.		Flight
No./Air waybill No.	No. of pieces	Weight(kg)		
01 July, 2014	0032/MGQ	7466	5YS001/NBO-02213169	201 7695
02 July, 2014	0032/HAD	7475	5YS001/NBO-02201371	140 5336
02 July, 2014	0500/MGQ	7476	5YS001/NBO-02201370	221 7954
03 July, 2014	0032/MGQ	7484	5YS001/NBO-02213172	167 5945

Table showing the cargo that was collected from the accident site and weighed.

Description Weight (in kilogrammes)

Gross Vehicle Weight 10280

Tare weight 4760

Net load weight** 5520

**Fuel load not factored, though it was presumed to be minimal. Not all the cargo was collected from site due to the limited capacity of the truck.

AAID investigations determined that the aircraft actual cargo weight could have been between approximately 0.5 tonnes in excess of the 5 tonnes that had been indicated on the cargo manifest. AAID was unable to determine whether the pilots had demonstrated ability to fly the aircraft with one engine inoperable during training or otherwise. Available training records indicate “In SIM only” against engine failure training. However, there is no evidence to show that the crew actually underwent any simulator training.

1.18.3 Chime alert

It was noted that a three chime alert occurred on a positioning flight conducted on the day prior to the date of the accident flight, and was not documented. The first officer on that positioning flight, who was not on the accident flight, denied existence of the discrepancies despite FDR/CVR data showing otherwise. Further, on the CVR playback of the positioning flight, a crew member indicated that a similar alert had occurred on at least two occasions previously.

The indecisiveness as to the required action following a three chime alert (crew debated whether to abort flight/turn back for a considerable length of time under the circumstances) possibly lost the crew precious second during the accident sequence.

1.18.4 Integrated Alerting Unit, IAU

General

Failure conditions are processed by an Integrated Alerting Unit (IAU) for visual and aural presentation to the pilots. Pre-stall warning and ground proximity warning are not integrated.

The IAU classifies the alerts in three levels according to urgency and/or priority of the required action:

Level 3

This alert level requires immediate corrective or compensatory action by the crew. The presentation comprises a repetitive triple chime, two flashing red Master Warning Lights (MWL), and the relevant red light at the Central Annunciator Panel (CAP). Any engine related level 3 alert

is accompanied by an IAU produced white light in the relevant FUEL lever. Engine fire is additionally annunciated at the ENGINE FIRE panel.

Level 2

This alert level requires immediate crew awareness and subsequent corrective or compensatory action. The presentation comprises a double chime, two flashing amber Master Caution Lights (MCL), and the relevant amber lights at the CAP and/or the relevant local panel.

Level 1

This alert level requires crew awareness and may require action. The presentation comprises a single chime and the relevant amber lights at the overhead panel. Level 1 alerts are not annunciated by MWL or MCL.

NOTE: Next to the levels described above, the IAU produces three dedicated alerts, which are presented aurally only.

Visual Alerts

Master Warning and Master Caution Lights

Neither MWL's nor MCL's can be dimmed. MWL's and MCL's are cancelled when the fault is corrected or when the relevant master light is depressed by either pilot.

Two level 3 annunciations cannot be cancelled by depressing MWL:

- The landing gear not down with landing flap position alert.
- The take-off configuration warning.

CAP and local lights

The nature and/or location of a failure is presented by lights at the CAP and/or local panel. The lights are cancelled when the fault is corrected. Corrective action to a fault which is presented by a light integrated with a pushbutton is accomplished by depressing that pushbutton. Local lights are located at the overhead panel, except the landing gear lights, which are located at the center main instrument panel. The CAP is also located at the center main instrument panel.

AURAL ALERTS

Identification

All aural alerts are integrated in the aircraft audio system. Aural alerts for level 3, 2 and 1 are attention getting chimes; they identify the level of urgency. The repetitive triple chime, which annunciates a level 3 alert, is cancelled when the fault is corrected or when either MWL is depressed. The repetitive chime due to landing gear not down with landing flap position, or due to an unsafe take-off configuration cannot be cancelled by depressing either MWL.

In addition to the chimes, the IAU provides the following dedicated aural alerts:

- Cavalry charge: Autopilot disengagement
- Clacker: Aircraft overspeed
- 'C' chord: Altitude entry
- Buzzer: Pilot call

For aircraft equipped with selcal

- Interrupted Buzzer Selcal

The dedicated aural alerts cannot be cancelled by depressing either master light.

Priority

Aural alerts are presented in the following order of descending priority:

1. Cavalry charge
2. Clacker
3. Repetitive triple chime (+MWL)
4. 'C'-chord
5. Double chime (+MCL)
6. Buzzer
7. Interrupted buzzer (only for selcal equipped aircraft)
8. Single chime

An aural alert in progress is interrupted when an alert of a higher priority is to be generated. When the overruling alert is cancelled, the interrupted alert is presented again.

NOTE: Local lights and CAP lights are not subject to priority.

Warning audio inhibition

All aural alerts can be inhibited by depressing the WARN AUDIO pushbutton at the general switching panel. The pushbutton, which should be operated only to prevent aural nuisance during emergency landings, is guarded.

INHIBIT MODES

General

Alerts that are not desired during take-off and in an engine-out condition are inhibited. The INHIB/CANC pushbutton at the CAP annunciates INHIBIT when the IAU is in either of these inhibit modes. The inhibit function can be cancelled by depressing this pushbutton.

NOTE: The system inhibits also consequential alerts, e.g. alerts following an intentional action such as engine shut down.

Take-off inhibit mode

During take-off, engine fire alerts, engine failure alerts and engine oil low pressure alerts are not inhibited. All other alerts are inhibited. The take-off inhibit mode is valid above 80 knots. The take-off inhibit mode ends approximately 40 seconds after lift-off, except for an attitude disagreement between LH and RH EFIS which can be presented immediately after lift-off.

NOTE: In case the take-off is rejected, the take-off inhibit mode is cancelled when the POWER levers are retarded.

Engine out inhibit mode

Engine related failure conditions, such as a low bleed-air pressure or generator failure, are not presented when the propeller speed of the engine is below ground idle. Engine fire and engine failure alerts are not inhibited.

NOTE: An engine failure alert is presented when the HP-spool speed or the torque is below a preset limit.

2.0. ANALYSIS

On 2 July 2014 at 0114 (0414 local time), a Fokker B.V. F27 Mark 50 aircraft registered as 5Y-CET, operated by Skyward International (SI) as a chartered cargo flight, crashed into a building shortly after takeoff from Jomo Kenyatta International Airport (JKIA), Nairobi, Kenya. Visual meteorological conditions prevailed and the airplane was on an Instrument Flight Rules (IFR) flight plan. The 4 persons on board were fatally injured. The airplane was destroyed and there was a post-crash fire. The flight was destined for Mogadishu, Somalia.

The investigation revealed that on ground roll for take-off, the aircraft seemed to take longer runway than anticipated before attaining the take-off speed. The airplane departed runway 06, barely climbing and attained not more than about 50 feet above ground level. The flight path continuously deviated left of the extended runway centerline at an airspeed of 100 knots, which was also the lift off airspeed. The airplane subsequently collided with the building, about 2.1 kilometers north-northeast of the runway departure end. The airplane impact attitude with the building was at about 120° left roll angle.

The cockpit voice recorder (CVR) data revealed aural warning alerts began about 8 seconds after the takeoff roll was initiated of which thereafter the flight crew also made reference to indications associated with visual warning alerts. However, despite the various alerts (about 27) the flight crew continued the takeoff. The flight data recorder data showed that no. 1 propeller rpm reduced from 100% to 50% where it stabilized at for the remainder of the flight. The decrease in propeller rpm corresponded with an increase of the no. 1 engine torque to about 110% along with the occurrence of the aural warning alerts. According to radar data, the lift-off occurred near the end of the runway.

The 'triple chime' is the highest level of alert to the crew and indicates fire/smoke warnings, aircraft configuration warnings or aircraft systems malfunction warnings. As for the engines, it may indicate an engine failure, engine fire, too high turbine inlet temperature (I.T.T.) or engine oil pressure drop. In this case, the I.T.T was operating normally and therefore it was not a factor. Triple chimes warnings require immediate action by the crew. As for the engines, as it was the case, it required to abort the take-off because the aircraft speed was below V1. If it occurs when airborne, it required the immediate shut down engine #1

The no. 2 engine operated normally throughout the entire flight.

The investigation revealed that the day before the accident, the airplane was repositioned from Nairobi-Wilson Airport to JKIA . The flight was commanded by the accident captain. During that flight, the CVR data disclosed warning alerts similar to those of the accident flight accompanied by the flight crew discussion on the interpretation and significance of the alerts. The investigation did not reveal any actions undertaken before the accident to address any irregularities that may have been associated with the warning alerts during the repositioning flight.

Calculations of the aircraft weight and balance that included the post-accident measured weights of most of the cargo determined that at takeoff the airplane weight was between 0.5 and 1.5 tonnes over the maximum certified gross weight. Of note is that AAID was unable to transport the entire consignment of cargo from the accident site. It is estimated that 0.5 – 1.5 tonnes was left on site and not weighed. It is further estimated that some of the cargo was pilfered at the site prior to the arrival of security personnel. That notwithstanding, the cargo that was actually weighed was 0.5 tonnes in excess of what was stated in the flight load sheet..

3.0 CONCLUSIONS

3.1 Findings

- A three chime alert occurred during the positioning flight from HKNW to HKJK
- Crew continued with the flight with a known fault
- No evidence that remedial maintenance action was taken after landing from that flight prior to the event flight
- No evidence of the anomaly being captured in the aircraft technical log
- At least one of the occupants during the event flight, possibly the PIC, had been present during the positioning flight and thus was aware of the three chime alert that had occurred then.
- Twenty seven sound of three chime alert event occurred during the take off roll on the accident flight
- The aforementioned alert occurred well before V1
- The left engine exhibited high torque values (in excess of 120%) while the left propeller speed was reduced to the range between 45% to 55% rpm for most of the flight.
- Crew continued with take of roll and subsequent rotation despite the twenty seven chime alert
- When airborne, crew contemplated turning back but eventually elected to continue with the flight
- Cargo weight exceeded what was indicated in the load sheet

- There was no evidence of any maintenance having been conducted on the aircraft since its Certificate of Airworthiness issue two months previously (9th May 2014)

3.2 Causes

3.2.1 Probable Cause

The probable cause of the accident was the decision by the crew to conduct the flight with a known mechanical problem and their failure to abort or reject the takeoff after receiving twenty seven cautions.

Martyn Lunani

CHIEF INVESTIGATOR OF ACCIDENTS

26 November 2019