National Transportation Safety Board
Aviation Accident Final Report

Location:	Philadelphia, PA	**Accident Number:**	NYC06LA081
Date & Time:	03/22/2006, 0155 EST	**Registration:**	N58EM
Aircraft:	Gates Learjet 35	**Aircraft Damage:**	Substantial
Defining Event:		**Injuries:**	2 None
Flight Conducted Under:	Part 135: Air Taxi & Commuter - Non-scheduled		

Analysis

During the takeoff roll, after the pilot disengaged the nose gear steering, the airplane began to turn to the right. The copilot noticed fluctuations with the engine indications, and called for an abort. Power was reduced to idle, and the pilot corrected to the left using left rudder pedal and braking. The airplane turned to the right again, and the pilot corrected to the left. The airplane continued to turn left, and departed the left side of the runway, tail first, and was substantially damaged. The airplane had accrued 18,040.3 total hours of operation. It was powered by two turbofan engines, each equipped with an electronic fuel computer. Examination of the left engine's wiring harness revealed that the outer shielding on the fuel computer harness assembly was loose, deteriorated, and an approximate 3-inch section was missing. Multiple areas of the outer shielding were also chaffed, the ground wire for the shielding was worn through, and the wiring was exposed. Testing of the wiring to the fuel computer connector, revealed an intermittent connection. After disassembly of the connector, it was discovered that the connector pin's wire was broken off at its crimp location. Examination under a microscope of the interior of the pin, revealed broken wire fragments that displayed evidence of corrosion. Simulation of an intermittent electrical connection resulted in N1 spool fluctuations of 2,000 rpm during engine test cell runs. According to the airplane's wiring maintenance manual, a visual inspection of all electrical wiring in the nacelle to check for security, clamping, routing, clearance, and general condition was to be conducted every 300 hours or 12 calendar months. Additionally, all wire harness shield overbraids and shield terminations were required to be inspected for security and general condition every 300 hours or 12 calendar months, and at every 600 hours or 24 calendar months. According to company maintenance records, the wiring had been inspected 6 days prior to the accident.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The operator's inadequate maintenance of the fuel computer harness which resulted in engine surging and a subsequent loss of control by the flight crew during the takeoff roll.

Findings

Occurrence #1: LOSS OF CONTROL - ON GROUND/WATER
Phase of Operation: TAKEOFF - ROLL/RUN

Findings
1. (C) POWERPLANT - SURGE
2. (C) MAINTENANCE - INADEQUATE - COMPANY MAINTENANCE PERSONNEL
3. ELECTRICAL SYSTEM,ELECTRIC WIRING - DETERIORATED

Occurrence #2: ON GROUND/WATER ENCOUNTER WITH TERRAIN/WATER
Phase of Operation: TAKEOFF - ABORTED

Findings
4. TERRAIN CONDITION - GROUND

Factual Information

HISTORY OF FLIGHT

On March 22, 2006, about 0155 eastern standard time, a Gates Learjet 35, N58EM, operated by Bankair as flight 123, was substantially damaged during an aborted takeoff at Philadelphia International Airport (PHL), Philadelphia, Pennsylvania. The certificated airline transport pilot and certificated commercial copilot were not injured. Night visual meteorological conditions prevailed for the planned flight to Charlotte Douglas International Airport (CLT), Charlotte, North Carolina. An instrument flight rules flight plan was filed for the non-scheduled air cargo flight conducted under 14 CFR Part 135.

The flight crew was departing runway 27L. They initiated a "standing start" takeoff, with the pilot holding the brakes until the engines indicated a power setting of 70% N2. The pilot then released the brakes and increased power to 91.5% N1. At 50 to 60 knots, the copilot called out "speed alive," and the pilot then disengaged the nose gear steering. At 80 knots the copilot called out "cross check," and at approximately 95 knots, the airplane began to turn right. The copilot noticed fluctuations with the engine indications and called for an abort. The pilot reduced the power to "idle," and corrected back to the left using left rudder pedal and "light" braking. The airplane then turned to the right again, and the pilot corrected once again to the left. The airplane continued to turn left and departed the left side of the runway, tail first at a 45-degree angle. The right main landing gear assembly then collapsed, the right tip tank impacted the ground, and the airplane came to rest.

PERSONNEL INFORMATION

The pilot held an airline transport pilot certificate with multiple ratings including airplane multi-engine land, and a Learjet type rating. According to records provided by Bankair, the pilot had a total flight experience of 2,900 hours, with 1,300 hours in the accident airplane make and model. His most recent FAA first-class medical certificate was issued on October 10, 2005.

The copilot held a commercial pilot certificate with ratings for airplane single and multi-engine land. According to records provided by Bankair, he had a total flight experience of 1,600 hours, with 700 hours in the accident airplane make and model. His most recent FAA first-class medical certificate was issued on July 13, 2005.

AIRCRAFT INFORMATION

The airplane was manufactured in 1976. The most recent inspection was completed on March 16, 2006. At the time of the inspection, the airplane had accrued 18,040.3 total hours of operation.

METEOROLOGICAL INFORMATION

A weather observation taken at the airport about 1 minute before the accident, included winds from 330 degrees at 9 knots, 10 miles visibility, overcast sky at 10,000 feet, temperature 35 degrees Fahrenheit, dew point 12 degrees Fahrenheit, and an altimeter setting of 29.77 inches of mercury.

AIRPORT INFORMATION

PHL had four runways, oriented in a 17/35, 08/26, and 09/27 configuration. Runway 27L was

asphalt, grooved, and in good condition. The total length of the runway was 10,506 feet, and its width was 200 feet.

WRECKAGE AND IMPACT INFORMATION

Examination of the runway revealed skidmarks, correlating to the accident airplane's main landing gear tire geometry that began 41 feet to the left of the runway centerline, and 974 feet from the threshold of the runway. At 1,130 feet the skidmarks began to return toward the runway centerline, and at 1,363 feet, once again diverged to the left, until leaving the left side of the runway at 1,736 feet. Ground scarring was evident and extended 1,898 feet from the point where the airplane left the paved surface of the runway, to where it came to rest.

Examination of the wreckage revealed that the right main landing gear leg had collapsed inboard, the left main landing gear leg had collapsed outboard, and the nose wheel landing gear assembly was sheared off. The left wing fuel tank was punctured and the right tip tank was broken in half.

TESTS AND RESEARCH

Nose Wheel Steering System

The variable authority nose wheel steering (NWS) system was examined for functionality. It was electronically controlled by the rudder pedals through a system of switches, relays, a computer-amplifier, position sensors, and a servo.

Several of the components were removed for examination. These components included the remaining portions of nose landing gear (NLG) upper assembly, containing the nose steering servo, gearbox and nose wheel position sensor. The rudder pedal position sensor, and P224 & P227 NWS computer harness connectors were also removed.

Examination revealed that, the case on the outside of the NWS servo was pulled loose from several screws. The drive shaft was sheared, and the motor rotated freely in both directions. A new gear & drive shaft was procured and installed to functionally test the unit. During the test, no malfunctions of the NWS servo were noted.

The NWS gearbox was loose on the NLG upper barrel. Internal examination revealed, that the castellated nut holding the drive gear to the strut shaft was not cotter keyed, and loose. The nut and drive gear were removed without the aid of any tools, and no thread locking compound was evident on the drive gear shaft, as required by the Airplane Maintenance Manual (AMM).

The three fasteners, which hold the gearbox case to the strut, were also loose. The forward fastener was bent. The two aft fasteners appeared serviceable. The torque of these fasteners was measured at 3 inch-pounds. According to the AMM, torque for these fasteners was required to be 50 to 70 inch-pounds.

No defects were found with the NWS servo position sensor, P224 & P227 connectors, or the rudder pedal position sensor.

Powerplants and Fuel Control Systems

The airplane was powered by two Garrett AiResearch TFE 731 turbofan engines, each equipped with an electronic fuel computer. The fuel computers responded to movements of the thrust levers to meter fuel to the engines. During normal operation, the fuel computer performed the functions of speed governing, and management of acceleration and deceleration by electrical

control inputs to the fuel control.

Examination of the right engine's wiring harness revealed that the PT2 sensor connector exhibited tool and crush marks consistent with the use of pliers. It was loose, not fully seated, and could be rotated by hand despite being safety wired. Further examination revealed that it would take approximately one full turn to fully tighten the connector. Testing of the wiring from the PT2 sensor to the P358 fuel computer connector did not reveal any open or intermittent connections.

Examination of the left engine's wiring harness revealed that the outer shielding on the fuel computer harness assembly was loose and deteriorated. An approximate 3-inch section was missing, and the edges of the shielding around the area of the missing section exhibited cut marks consistent with marks left by a cutting tool. Further examination also revealed that multiple areas of the outer shielding were chafed, the ground wire for the shielding was worn through, and the wiring was exposed. Testing of the wiring from the PT2 sensor to the P357 fuel computer connector, revealed an intermittent connection at the P357 connector's pin No. 11 which was one of the pins used for PT2 sensor input. After disassembly of the P357 connector, it was discovered that pin No. 11's wire was broken off at it's crimp location. Examination under a microscope of the interior of the pin, revealed broken wire fragments that displayed evidence of corrosion.

Examination of both engines revealed no preimpact mechanical discrepancies. During engine test cell runs, when a full open PT2 electrical condition was introduced, N1 speed decreased 600 rpm without oscillation or surge. Both engines exhibited controlled response to snap accelerations and decelerations and did not surge when the PT2 electrical connection was secure; however, simulation of an intermittent electrical connection to the PT2 sensor resulted in N1 spool fluctuations of 2,000 rpm.

ADDITIONAL INFORMATION

According to the Wiring Maintenance Manual, a visual inspection of all electrical wiring in the nacelle to check for security, clamping, routing, clearance, and general condition was to be conducted every 300 hours or 12 calendar months. Additionally, all wire harness shield overbraids and shield terminations were required to be inspected for security and general condition every 300 hours or 12 calendar months and at every 600 hours or 24 calendar months.

According to company maintenance records, the wiring had been inspected 6 days prior to the accident.

Pilot Information

Certificate:	Airline Transport; Flight Instructor; Commercial	**Age:**	30, Male
Airplane Rating(s):	Multi-engine Land; Single-engine Land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Seatbelt, Shoulder harness
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane Multi-engine; Airplane Single-engine; Instrument Airplane	**Toxicology Performed:**	No
Medical Certification:	Class 1 Without Waivers/Limitations	**Last FAA Medical Exam:**	10/01/2005
Occupational Pilot:		**Last Flight Review or Equivalent:**	03/01/2006
Flight Time:	2900 hours (Total, all aircraft), 1300 hours (Total, this make and model), 236 hours (Last 90 days, all aircraft), 80 hours (Last 30 days, all aircraft), 4 hours (Last 24 hours, all aircraft)		

Co-Pilot Information

Certificate:	Commercial	**Age:**	27, Male
Airplane Rating(s):	Multi-engine Land; Single-engine Land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	None	**Restraint Used:**	Seatbelt, Shoulder harness
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 1 Without Waivers/Limitations	**Last FAA Medical Exam:**	07/01/2005
Occupational Pilot:		**Last Flight Review or Equivalent:**	06/01/2005
Flight Time:	1600 hours (Total, all aircraft), 700 hours (Total, this make and model), 238 hours (Last 90 days, all aircraft), 77 hours (Last 30 days, all aircraft), 4 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Gates Learjet	**Registration:**	N58EM
Model/Series:	35	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Normal	**Serial Number:**	046
Landing Gear Type:	Retractable - Tricycle	**Seats:**	3
Date/Type of Last Inspection:	03/01/2006, AAIP	**Certified Max Gross Wt.:**	18300 lbs
Time Since Last Inspection:	9.7 Hours	**Engines:**	2 Turbo Fan
Airframe Total Time:	18040.3 Hours as of last inspection	**Engine Manufacturer:**	Garrett
ELT:	Installed, not activated	**Engine Model/Series:**	TFE 731-2-2B
Registered Owner:	58EM LLC.	**Rated Power:**	3500 lbs
Operator:	Bankair Inc.	**Operating Certificate(s) Held:**	On-demand Air Taxi (135)
Operator Does Business As:		**Operator Designator Code:**	BKAA

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	**Condition of Light:**	Night
Observation Facility, Elevation:	PHL, 36 ft msl	**Distance from Accident Site:**	
Observation Time:	0154 EST	**Direction from Accident Site:**	
Lowest Cloud Condition:		**Visibility**	10 Miles
Lowest Ceiling:	Overcast / 10000 ft agl	**Visibility (RVR):**	
Wind Speed/Gusts:	9 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	330°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.77 inches Hg	**Temperature/Dew Point:**	2°C / -11°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Philadelphia, PA (PHL)	**Type of Flight Plan Filed:**	IFR
Destination:	Charlotte, NC (CLT)	**Type of Clearance:**	IFR
Departure Time:	0155 EST	**Type of Airspace:**	

Airport Information

Airport:	Philadelphia International (PHL)	**Runway Surface Type:**	Asphalt
Airport Elevation:	36 ft	**Runway Surface Condition:**	Dry
Runway Used:	27L	**IFR Approach:**	None
Runway Length/Width:	10506 ft / 200 ft	**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	2 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	N/A	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 None	**Latitude, Longitude:**	39.871944, -75.241111

Administrative Information

Investigator In Charge (IIC):	Todd G Gunther	**Report Date:**	05/29/2007
Additional Participating Persons:	Paul Basilotto; FAA/FSDO; Philadelphia, PA Marlin J Kruse; Honeywell Aerospace; Phoenix, AZ Ralph Witzke; Bombardier Learjet; Wichita, KS Jeanne Cook; Bank Air Inc.; West Columbia, SC		
Publish Date:			
Investigation Docket:	NTSB accident and incident dockets serve as permanent archival information for the NTSB's investigations. Dockets released prior to June 1, 2009 are publicly available from the NTSB's Record Management Division at pubinq@ntsb.gov, or at 800-877-6799. Dockets released after this date are available at http://dms.ntsb.gov/pubdms/.		