



# National Transportation Safety Board Aviation Accident Final Report

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<b>Location:</b>	Troy, AL	<b>Accident Number:</b>	ATL01FA021
<b>Date &amp; Time:</b>	01/14/2001, 1345 CST	<b>Registration:</b>	N1DC
<b>Aircraft:</b>	Learjet LJ-60	<b>Aircraft Damage:</b>	Destroyed
<b>Defining Event:</b>		<b>Injuries:</b>	2 Serious
<b>Flight Conducted Under:</b>	Part 91: General Aviation - Executive/Corporate		

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## Analysis

According to witnesses, the airplane collided with two deer shortly after touchdown. Following the collision, the airplane continued down the runway with the tires smoking, veered off the right side of the runway near the end, crossed a taxiway, impacted into a ditch and burst into flames. After the accident, the captain and first officer both reported that the thrust reversers failed to operate after they were deployed during the landing.

Examination of the landing gear found all three gear collapsed. The right and left main tires had areas of rubber that were worn completely through. The flaps were found extended, and both thrust reversers were found in the stowed position. Examination of the cockpit found the throttles in the idle position, and the thrust reverser levers in the stowed position.

Aircraft performance calculations indicate that the airplane traveled 1,500 feet down the runway after touchdown, in 4.2 seconds, before striking the deer. The calculations also indicate that the airplane landed with a ground speed of 124 knots. At 124 knots and maximum braking applied, the airplane should have come to a complete stop in about 850 feet. However, investigation of the accident site and surrounding area revealed heavy black skid marks beginning at the first taxiway turnoff about 1,500 feet down the 5,010 foot runway. The skid marks continued for about 2,500 feet, departed the right side of the runway and proceeded an additional 500 feet over grass and dirt.

The investigation revealed that deer fur was found lodged in the squat switch on the left main landing gear, likely rendering the squat switch inoperative after the impact with the deer, and prior to the airplane's loss of control on the runway. Since a valid signal from the squat switch is required for thrust reverser deployment, the loss of this signal forced the thrust reversers to stow. At this point, the electronic engine control (EEC) likely switched to the forward thrust schedule and engine power increased to near takeoff power, which led to the airplane to continue down the runway, and off of it.

Following the accident, the manufacturer issued an Airplane Flight Manual revision that

changed the name of the “Inadvertent Stow of Thrust Reverser During Landing Rollout” abnormal procedure to “Inadvertent Stow of Thrust Reverser After a Crew-Commanded Deployment” and moved it into the emergency procedures section.

[ This Brief of Accident was modified on April 5, 2010, based on information obtained during NTSB Case No. DCA08MA098. ]

## Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: On ground collision with deer during landing roll, and the inadvertent thrust reverser stowage caused by the damage to the landing gear squat switch by the collision, and subsequent application of forward thrust during rollout.

### Findings

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Occurrence #1: ON GROUND/WATER COLLISION WITH OBJECT  
Phase of Operation: LANDING - ROLL

#### Findings

1. (C) OBJECT - ANIMAL(S)

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Occurrence #2: ON GROUND/WATER ENCOUNTER WITH TERRAIN/WATER  
Phase of Operation: LANDING - ROLL

#### Findings

2. TERRAIN CONDITION - DITCH

## Factual Information

[ This factual report was modified on April 5, 2010, based on information obtained during NTSB Case No. DCA08MA098. ]

### HISTORY OF FLIGHT

On January 14, 2001, at 1345 central standard time (cst), a Learjet LJ-60, N1DC, collided with two deer during landing and ran off the end of runway 7 at the Troy Municipal Airport, Troy, Alabama. The airplane was registered to and operated by Ark-Air Flight Inc. The business flight was operated under the provisions of Title 14 CFR Part 91. Visual meteorological conditions prevailed, and an instrument flight rules (IFR) flight plan was filed. The airline transport pilot (ATP) and the ATP-rated first officer received serious injuries. The airplane was destroyed and there was a post-impact fire. The flight originated from Love Field in Dallas, Texas, at 1030 cst on the day of the accident..

According to witnesses, the airplane collided with the deer shortly after touchdown. After the collision, the airplane was observed to continue down the runway with the tires smoking, veered off the right side of the runway near the end, crossed a taxiway, impacted into a ditch and burst into flames. Local rescuers were able to extricate the crew before the fire engulfed the cockpit.

According to the two pilots on board, the thrust reversers failed to operate when engaged.

### PILOT INFORMATION

The captain held an ATP certificate with privileges for airplane multiengine land, with type ratings in the Learjet LJ-60. He also held commercial pilot privileges for airplane single engine land, and was a certified flight instructor (CFI) for airplane single and multiengine instrument airplanes. The pilot reported 20,750 total civilian hours on his most recent second class medical certificate, dated June 5, 2000, with no waivers or limitations. The pilot's most recent biennial flight review was in May of 2000, in the Learjet LJ-35.

The first officer held an ATP certificate with privileges for airplane multiengine land. He also held commercial pilot privileges for airplane single engine land, and was a CFI for airplane single and multiengine instrument airplanes. The first officer reported 3,500 hours total flight time in all aircraft, including 750 hours in the LJ-60. The first officer's most recent first class medical certificate was dated February 7, 2000, with no waivers or limitations. The first officer's most recent biennial flight review was dated May of 2000, in the LJ-60.

### AIRCRAFT INFORMATION

The accident airplane, a Learjet model 60, serial number was manufactured in 1994 by Learjet. FAA records show the airplane was registered to Ark-Air Inc., on June 12, 1997. The maintenance records revealed the airplane was on a manufacturer's inspection program and was last inspected on August 8, 2000. The airplane had accumulated a total time of 2,088 hours at the time of the accident, including 241 hours since its last inspection.

## METEOROLOGICAL INFORMATION

Visual flight rule (VFR) conditions prevailed at the time of the accident, with visibility at 10 statute miles, ceiling at 8,000 feet above ground level, temperature 16 degrees Celsius, dew point 8 degrees Celsius, wind 170 degrees at 8 knots and altimeter 30.19 inches of mercury.

## WRECKAGE EXAMINATION

Investigation of the accident site and surrounding area revealed heavy black skid marks beginning at the first taxiway turnoff about 1,500 feet down the 5,010 foot runway. Two fragmented deer carcasses were found several hundred feet beyond the initial impact.. The skid marks continued for about 2,500 feet and departed the right side of the runway near the Instrument Landing System (ILS) shack at the end of the runway and proceeded an additional 500 feet over grass and dirt.

The airplane was found resting on its left side down an embankment. The cockpit section of the fuselage was crushed upward into the crew seats. The fuselage aft of the cockpit was consumed by the post crash-fire.

Examination of the landing gear found all three gear collapsed, and deer fur was found lodged in the squat switch on the left main landing gear.

The right and left main tires had areas of rubber that were worn completely through. The flaps were found extended, and both thrust reversers were found in the stowed position.

Examination of the cockpit found the throttles in idle, and the thrust reverser levers in the stowed position.

## MEDICAL AND PATHOLOGICAL INFORMATION

Both pilots were hospitalized with serious injuries. There was no toxicology testing conducted.

## ADDITIONAL INFORMATION

### Aircraft Performance Calculations

Specialists from Bombardier Aerospace Learjet performed basic aircraft performance calculations for the accident landing. The calculations took into consideration the following assumptions: Empty weight of 15,800 pounds; estimated fuel load of 1,100 pounds; and the aforementioned reported weather conditions at Troy.

The calculations indicated that the airplane traveled 1,500 feet down the runway after touchdown, in 4.2 seconds, before striking the deer. The calculations also indicated that the airplane landed with a ground speed of 124 knots. At 124 knots and maximum braking applied, the airplane should have come to a complete stop in about 850 feet.

### Cockpit Voice Recorder Sound Spectrum Analysis

A sound spectrum study was conducted using the Cockpit Voice Recorder (CVR) as the source of the sound. The study was conducted by the National Transportation Safety Board's Vehicle Recorders Division in Washington, DC.

The study revealed that the engines' fan speed increased from 8,727.5 (82.3 percent) rpm to 9,590 (90.4 percent) rpm between 11 seconds after touchdown and 18.2 seconds after touchdown. This increase in fan speed does not achieve the calculated takeoff N1, however, this engine speed is higher than achievable on a reverse thrust schedule.

According to the engine manufacturer (Pratt and Whitney of Canada), N1 is governed during reverse operations. The governing limit varies, and is based on ambient conditions and the airspeed. At 100 knots or greater, the maximum governing limit for N1 should be about 85.2 percent (according to Bombardier Aerospace) instead of the 90 percent found on the engines 20.4 seconds after landing.

#### Thrust Reverser Operation

Normal operating procedures call for deploying the thrust reversers within 4 to 6 seconds after landing. Pilots are to deploy the thrust reversers by raising piggyback levers located in the cockpit with the throttles.

With the loss of the squat switch on the left main landing gear, the thrust reverser relay box would deenergize the deploy solenoid, and the thrust reverser would move to the stowed position. As the thrust reversers complete the stow cycle, the EEC's switch to the forward thrust schedule, and if the piggybacks remain at the max reverse position, the engines rpm begins to increase to near takeoff power.

#### Post-Accident Actions

Following the accident, Learjet manufacturer issued an Airplane Flight Manual revision that changed the name of the "Inadvertent Stow of Thrust Reverser During Landing Rollout" abnormal procedure to "Inadvertent Stow of Thrust Reverser After a Crew-Commanded Deployment" and moved it into the emergency procedures section.

#### Wreckage Release

The airplane was released to the owner's representative USAIG, 2635 Century Parkway Suite 120, Atlanta, Georgia.

## Pilot Information

<b>Certificate:</b>	Airline Transport; Flight Instructor; Commercial	<b>Age:</b>	56, Male
<b>Airplane Rating(s):</b>	Multi-engine Land; Single-engine Land	<b>Seat Occupied:</b>	Left
<b>Other Aircraft Rating(s):</b>		<b>Restraint Used:</b>	Seatbelt, Shoulder harness
<b>Instrument Rating(s):</b>	Airplane	<b>Second Pilot Present:</b>	Yes
<b>Instructor Rating(s):</b>	Airplane Multi-engine; Airplane Single-engine; Instrument Airplane	<b>Toxicology Performed:</b>	No
<b>Medical Certification:</b>	Class 2 Valid Medical--no waivers/lim.	<b>Last FAA Medical Exam:</b>	06/05/2000
<b>Occupational Pilot:</b>	Yes	<b>Last Flight Review or Equivalent:</b>	05/01/2000
<b>Flight Time:</b>	20750 hours (Total, all aircraft), 800 hours (Total, this make and model), 17000 hours (Pilot In Command, all aircraft), 120 hours (Last 90 days, all aircraft), 40 hours (Last 30 days, all aircraft), 3 hours (Last 24 hours, all aircraft)		

## Co-Pilot Information

<b>Certificate:</b>	Airline Transport; Flight Instructor; Commercial	<b>Age:</b>	31, Male
<b>Airplane Rating(s):</b>	Multi-engine Land	<b>Seat Occupied:</b>	Right
<b>Other Aircraft Rating(s):</b>	None	<b>Restraint Used:</b>	Seatbelt, Shoulder harness
<b>Instrument Rating(s):</b>	Airplane	<b>Second Pilot Present:</b>	Yes
<b>Instructor Rating(s):</b>	Airplane Multi-engine; Airplane Single-engine; Instrument Airplane	<b>Toxicology Performed:</b>	No
<b>Medical Certification:</b>	Class 1 Valid Medical--no waivers/lim.	<b>Last FAA Medical Exam:</b>	02/07/2000
<b>Occupational Pilot:</b>	Yes	<b>Last Flight Review or Equivalent:</b>	08/01/1999
<b>Flight Time:</b>	3500 hours (Total, all aircraft), 750 hours (Total, this make and model), 3000 hours (Pilot In Command, all aircraft), 135 hours (Last 90 days, all aircraft), 45 hours (Last 30 days, all aircraft), 3 hours (Last 24 hours, all aircraft)		

## Aircraft and Owner/Operator Information

Aircraft Make:	Learjet	Registration:	N1DC
Model/Series:	LJ-60	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	No
Airworthiness Certificate:	Normal	Serial Number:	60-035
Landing Gear Type:	Retractable - Tricycle	Seats:	8
Date/Type of Last Inspection:	08/08/2000, AAIP	Certified Max Gross Wt.:	23500 lbs
Time Since Last Inspection:	241 Hours	Engines:	2 Turbo Jet
Airframe Total Time:	2325 Hours at time of accident	Engine Manufacturer:	Pratt & Whitney
ELT:	Installed, not activated	Engine Model/Series:	PCE-305191
Registered Owner:	Ark-Air Flight Inc.	Rated Power:	4300 lbs
Operator:	Ark-Air Flight Inc.	Operating Certificate(s) Held:	None

## Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	Condition of Light:	Day
Observation Facility, Elevation:	TOI, 397 ft msl	Distance from Accident Site:	0 Nautical Miles
Observation Time:	1253 EST	Direction from Accident Site:	0°
Lowest Cloud Condition:	Scattered / 8000 ft agl	Visibility	10 Miles
Lowest Ceiling:	None	Visibility (RVR):	
Wind Speed/Gusts:	8 knots /	Turbulence Type Forecast/Actual:	/
Wind Direction:	170°	Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	30.19 inches Hg	Temperature/Dew Point:	16° C / 8° C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Dallas, TX (DAL)	Type of Flight Plan Filed:	IFR
Destination:	Troy, AL (TOI)	Type of Clearance:	IFR
Departure Time:	1030 CDT	Type of Airspace:	Class E

## Airport Information

Airport:	Troy Municipal (TOI)	Runway Surface Type:	Asphalt
Airport Elevation:	397 ft	Runway Surface Condition:	Dry
Runway Used:	07	IFR Approach:	None
Runway Length/Width:	5010 ft / 100 ft	VFR Approach/Landing:	Full Stop; Traffic Pattern

## Wreckage and Impact Information

Crew Injuries:	2 Serious	Aircraft Damage:	Destroyed
Passenger Injuries:	N/A	Aircraft Fire:	On-Ground
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	2 Serious	Latitude, Longitude:	31.866667, -86.016667

## Administrative Information

Investigator In Charge (IIC):	Ralph L Wilson	Report Date:	07/23/2003
Additional Participating Persons:	Michael H Morgan; Federal Aviation Administration; Vestavia Hills, AL Ralph Witzke; Learjet		
Publish Date:	04/05/2010		
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 <a href="mailto:pubinq@ntsb.gov">pubinq@ntsb.gov</a> , or at 800-877-6799. Dockets released after this date are available at <a href="http://dms.nts.gov/pubdms/">http://dms.nts.gov/pubdms/</a> .		

The National Transportation Safety Board (NTSB), established in 1967, is an independent federal agency mandated by Congress through the Independent Safety Board Act of 1974 to investigate transportation accidents, determine the probable causes of the accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation. The NTSB makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

The Independent Safety Board Act, as codified at 49 U.S.C. Section 1154(b), precludes the admission into evidence or use of any part of an NTSB report related to an incident or accident in a civil action for damages resulting from a matter mentioned in the report. A factual report that may be admissible under 49 U.S.C. § 1154(b) is available [here](#).