



# National Transportation Safety Board Aviation Accident Final Report

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<b>Location:</b>	Telluride, CO	<b>Accident Number:</b>	DCA13FA148
<b>Date &amp; Time:</b>	09/01/2013, 1310 MDT	<b>Registration:</b>	N169GL
<b>Aircraft:</b>	BEECH 1900D	<b>Aircraft Damage:</b>	Substantial
<b>Defining Event:</b>	Landing gear collapse	<b>Injuries:</b>	12 None
<b>Flight Conducted Under:</b>	Part 121: Air Carrier - Scheduled		

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## Analysis

During approach to landing the crew selected landing gear down and observed a problem with the left main landing gear (MLG). The landing gear hydraulic motor pump automatically shut down when the landing gear was not locked down after 16 seconds and an internal mechanical lock intended to hold the landing gear actuator in the selected position, did not engage.

The crew carried out the abnormal procedures checklist and attempted to extend the left MLG using the manual landing gear extension procedures, but was unsuccessful. The crew then prepared for landing in accordance with the procedures contained in the quick reference handbook for landing with main gear up or unsafe.

As the airplane slowed through about 80 knots on the landing roll, the left main landing gear collapsed.

Post-accident inspection indicated hydraulic fluid had leaked from a hole, which was normally plugged with a Lee plug, on the left main actuator between the primary and secondary extend ports. The Lee plug was missing and was not found. Examination of the actuator and of the hydraulic fluid quantity remaining indicated the Lee plug was in place during the in-flight attempts to extend the landing gear.

The airplane landed with the gear not locked down and as the landing gear collapsed, the piston in the actuator forced hydraulic fluid back through the system increasing the landing gear actuator internal hydraulic pressure sufficiently to force the Lee plug out of position. The remaining fluid in the actuator leaked out of the hole until system pressure decreased to ambient pressure.

## Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: Failure of the left main landing gear actuator internal lock to engage in the locked position for undetermined reasons.

## Findings

Aircraft	Landing gear actuator - Malfunction (Cause)
Not determined	Not determined - Unknown/Not determined (Cause)

## Factual Information

### HISTORY OF FLIGHT

On September 1, 2013, at about 1310 mountain daylight time (MDT), Great Lakes Airlines flight 7125, a Beechcraft 1900D, N169GL, suffered a left main landing gear collapse during landing on runway 27 at Telluride Regional Airport (TEX), Telluride, Colorado. The two flight crew members and 10 passengers were not injured and the airplane sustained substantial damage. The scheduled passenger flight was operating under 14 Code of Federal Regulation Part 121 and originated from Denver International Airport (DEN), Denver, Colorado.

The first officer was the pilot flying and the captain was the pilot monitoring. Takeoff, climb, and cruise were normal.

At 1231, the crew selected landing gear down and observed a problem with the left main landing gear. The captain began the "Failure of Landing Gear to Extend Normally" checklist and noted that both green left landing gear down and locked lights were not illuminated and the landing gear circuit breaker had tripped.

At 1240, the captain began the "Landing Gear Manual Extension" checklist and advised maintenance control via radio through Telluride operations that there was no green left gear down and locked indication, the red in transit light was illuminated, and the circuit breaker had tripped. Telluride operations relayed a message from company dispatch asking if the crew could consider diverting to Farmington, NM (FMN) for landing. After discussing fuel burn, safety concerns, and the Airport Rescue and Fire Fighting (ARFF) capabilities at Telluride, the crew decided landing at Telluride was the best option and advised operations accordingly.

At 1247, the captain attempted to pump the landing gear down in accordance with the checklist and reported to the first officer that the landing gear extension handle would not move.

At 1250, the captain began the "Gear Up Landing" checklist and then proceeded with the "Planned Emergency Preparation" checklist. He contacted Telluride Unicom to request ARFF services and briefed passengers regarding the situation.

At 1259, the captain began the "Landing with One Main Up or Unsafe" checklist and after preparing for landing, the crew conducted the approach and landing on runway 27. During the landing roll, as the airplane slowed through about 80 knots, the left main landing gear collapsed. The airplane stopped on runway 27 at 1309 and the crew initiated an evacuation.

### INJURIES TO PERSONS

There were no injuries to the 10 passengers or 2 crewmembers on board.

### DAMAGE TO AIRCRAFT

The airplane received substantial damage, coming to rest on the nose landing gear, the right main landing gear, and the left wingtip. The left wingtip lower skin suffered abrasion damage, the left inboard flap was deformed and wrinkled and the trailing edge and aft nacelle were abraded where they contacted the ground. The left outboard flap was deformed and wrinkled and the trailing edge was abraded. The left aileron had abrasion damage to the outboard 2 feet

of trailing edge and lower trailing edge skin. The left ventral strake was damaged along its lower edge where it contacted the ground. The left engine inboard machined mount fitting was fractured and portions were separated. The firewall was deformed and bent. The left engine and propeller were also damaged.

## PERSONNEL INFORMATION

The flight crew consisted of two pilots and the accident occurred on their first flight of the day.

The captain, age 32, reported 5,800 hours total flight time, including 4,700 hours as pilot in command and 3,000 hours in the BE-1900 at the time of the accident. The captain held a valid Federal Aviation Administration (FAA) Airline Transport Pilot (ATP) certificate with type ratings for EMB-120 and BE-1900, and a current FAA first-class medical certificate with a limitation requiring that he must wear corrective lenses.

The first officer, age 30, reported 2,576 hours total flight time, including 1,350 hours pilot-in-command, and 1,350 hours in the BE-1900 at the time of the accident. He held a valid FAA ATP certificate with a type rating for the BE-1900 and a current FAA first-class medical certificate with no limitations or waivers.

## AIRCRAFT INFORMATION

N169GL, manufacturer serial number UE-169, was a Beech 1900D equipped with two Pratt and Whitney PT6A-65B turbo-prop engines. The company reported that the airplane had logged 35,184 hours total time on the airframe at the time of the accident. Recorded data and airline records indicated no open maintenance items with the airplane.

### Landing Gear System

The airplane is equipped with a retractable tricycle landing gear system. Extension and retraction of the nose landing gear (NLG) and the two main landing gear (MLG) is accomplished by the action of individual hydraulic actuators installed on each landing gear assembly. The MLG actuators retract for gear extension and extend for gear retraction while the NLG actuator extends for gear extension and retracts for gear retraction. Hydraulic pressure for the system is supplied by a hydraulic power pack located in the left wing leading edge inboard of the engine nacelle.

The hydraulic system has a nominal operating pressure of 3,000 psi and includes a system relief valve that will open automatically to prevent over pressurization and damage.

### Landing Gear Controls and Indications

The landing gear control selector handle was located on the captain's side of the cockpit on the lower right subpanel and included two positions: UP and DOWN. The control handle must be pulled out of a detent before it can be selected either UP or DOWN. When the handle is placed in either the UP or DOWN position, a hydraulic pump motor is activated and a solenoid allows hydraulic fluid to flow to the appropriate side of the actuators. When the landing gear are fully extended, an internal mechanical lock in each actuator holds the landing gear in the down position, and activates a switch that removes power from the hydraulic pump.

Landing gear position indication is provided by six green lights; two for each of the nose and

the left and right main gear, on the subpanel adjacent to the landing gear control selector handle. The two green lights for the left main landing gear are labeled "L" and "H". Two red in transit lights are provided on the landing gear control selector handle which illuminate when the landing gear control has been selected and any of the landing gear are not either fully extended or fully retracted.

A landing gear relay circuit breaker is located on the pilot's right sub panel to protect the system from electrical overload. The relay circuit breaker will trip open if the landing gear does not reach the down and locked position after the hydraulic pump motor has run continuously for about 16 seconds.

#### Manual Landing Gear Extension

An alternate landing gear extension handle is located on the floor on the pilot's side of the flight deck. To engage the manual extension system, the landing gear control lever must be in the down position, the landing gear relay circuit must be pulled and the handle is then pumped until the green gear down annunciators are illuminated.

#### Maintenance History

Review of maintenance records indicated the left main landing gear actuator was purchased by Great Lakes Airlines and sent for overhaul in August 2011. At that time, a component upgrade included replacement of the end cap and Lee plug in addition to the standard overhaul parts. The actuator was received from the overhaul facility in September 2011 and installed on the accident airplane in March 2012.

Since the installation of the left main gear actuator, landing gear problems were noted in the airplane logbook in June 2012, September 2012, and July 2013. The most recent maintenance issues documented in July 2013 included three separate instances in which the landing gear would not retract when commanded. These discrepancies were corrected by performing maintenance on the landing gear safety switches.

#### Flight Crew Procedures

The Quick Reference Handbook (QRH) includes the following abnormal procedures; Failure Of The Landing Gear To Extend Normally, Landing Gear Manual Extension, Landing With One Main Up Or Unsafe and, Planned Emergency Preparation. These procedures include guidance to pull the landing gear relay circuit breaker, the landing gear warning horn circuit breaker, and the TAWS (Terrain Awareness Warning System) circuit breaker. The Landing With One Main Up Or Unsafe procedure includes a step directing the landing gear alternate extension handle should be pumped "...until maximum resistance is felt. Do not stow".

#### METEOROLOGICAL INFORMATION

Day visual meteorological conditions prevailed at the time of the accident. The Telluride Airport surface observation at 1255 MDT, the most recent observation at the time of landing, reported wind from 260 degrees at 9 knots gusting to 16 knots, visibility 10 statute miles, 6,500 feet broken, 11,000 feet overcast, temperature 20 degrees Celsius, dew point temperature 8 degrees Celsius, and altimeter 30.43 inches mercury.

## AERODROME INFORMATION

The Telluride Regional Airport (TEX) is located about 5 miles west of the city of Telluride, CO. The airport has 2 runways for commercial and general aviation. Runway 27 is asphalt, 7,111 feet long, 100 feet wide with a touchdown zone elevation of 9,070 feet above mean sea level. The runway is served by a precision approach path indicator system (PAPI) with a 4 degree glide path on the left side of the runway.

## FLIGHT RECORDERS

The cockpit voice recorder (CVR), an L-3/Fairchild model FA2100-1020, serial number 000694648, was removed from the airplane and downloaded at the NTSB Vehicle Recorder Laboratory. The cockpit voice recorder contained 2 hours, 4 minutes of recording on 4 audio channels. The audio quality of the channels containing information from the captain's and first officer's audio panels, and public address system were each characterized as excellent, and the audio quality of the channel containing information from the cockpit area microphone was characterized as fair. The recording included events from the entire flight beginning with ground operations prior to departure from DEN. Timing on the transcript was established by adjusting CVR elapsed time to align with the reported time the aircraft came to a stop on the runway.

The FDR, a Loral/Fairchild F1000, S703-1000-00 64 wps, serial number 01318, was removed from the airplane and downloaded at the NTSB Vehicle Recorder Laboratory. The recorder was in good condition and contained approximately 98 hours of data which was extracted normally. The pitch parameter evaluated during this investigation was out of calibration and not in accordance with FDR carriage requirements. Correlation of the FDR data to event local time, Mountain Daylight Time, was established by aligning common events observed on the CVR.

## TESTS AND RESEARCH

The airplane was lifted, the left main landing gear was pulled to the extended position, and the airplane was towed to a hangar for examination. Initial inspection of the flight deck indicated the LANDING GEAR RELAY, the LANDING GEAR WARNING HORN, the TAWS, the CKPT VOICE RCDR, and the 26VAC FLT DATA RCDR circuit breakers were popped out. The landing gear selector lever was in the DOWN position and the alternate landing gear extension handle was not stowed.

Initial inspection of the left main landing gear indicated hydraulic fluid was present on the actuator and strut. The hydraulic reservoir quantity was between the cold and warm fill levels on the dipstick. The hydraulic system was pressurized and fluid was found to be exiting a hole on the left main actuator between the primary and secondary extend ports.

According to the manufacturer, the hole between the extend ports was a design feature that facilitated the manufacturing of the end cap and was supposed to be plugged with a Lee plug during the manufacturing process. There was damage to the outboard section of the hole. The Lee plug was missing and was not found.

The actuator end cap was removed for inspection and disassembled. There was no damage

found to the end cap or actuator. A new end cap was built and installed for functional testing of the actuator. No anomalies were noted during functional testing.

Disassembly and inspection of the actuator indicated signs of normal wear on internal components. Dimensional analysis of the actuator's internal components indicated some measurements were outside of manufacturer drawing specifications. The actuator lock spring length, the slide length, the piston length, the outside diameter of the piston, and the inside diameter of the end cap and cup were found to exceed drawing requirement tolerances.

Analysis of the hydraulic fluid indicated the fluid was rated at NAS Class 12 due to a high particle count in the 5-15 micron size range. Beech has not set an in-service limit for hydraulic fluid cleanliness on the 1900 series airplanes.

## ORGANIZATIONAL INFO

Great Lakes Airlines is certificated as a 14 CFR Part 121 air carrier and operates as an independent carrier and as a code share partner under agreements with multiple airlines. As of September 30, 2013, the company had 651 full-time and 328 part-time employees and operated a fleet of 6 Embraer EMB-120 aircraft and 28 Beechcraft 1900D aircraft out of four hubs located at Denver, CO, Los Angeles, CA, Minneapolis, MN, and Phoenix, AZ, serving 45 airports in 13 states.

The accident airplane was owned by Great Lakes Aviation Ltd., and operated by Great Lakes Airlines for common carrier passenger operations.

## History of Flight

Landing-landing roll	Landing gear collapse (Defining event)
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## Pilot Information

<b>Certificate:</b>	Airline Transport	<b>Age:</b>	32
<b>Airplane Rating(s):</b>	Multi-engine Land; Single-engine Land	<b>Seat Occupied:</b>	Left
<b>Other Aircraft Rating(s):</b>	None	<b>Restraint Used:</b>	
<b>Instrument Rating(s):</b>	Airplane	<b>Second Pilot Present:</b>	Yes
<b>Instructor Rating(s):</b>	None	<b>Toxicology Performed:</b>	No
<b>Medical Certification:</b>	Class 1 With Waivers/Limitations	<b>Last Medical Exam:</b>	07/01/2013
<b>Occupational Pilot:</b>	Yes	<b>Last Flight Review or Equivalent:</b>	07/15/2013
<b>Flight Time:</b>	5800 hours (Total, all aircraft), 3000 hours (Total, this make and model), 4700 hours (Pilot In Command, all aircraft)		

## Co-Pilot Information

<b>Certificate:</b>	Airline Transport; Flight Instructor	<b>Age:</b>	30
<b>Airplane Rating(s):</b>	Multi-engine Land; Single-engine Land	<b>Seat Occupied:</b>	Right
<b>Other Aircraft Rating(s):</b>		<b>Restraint Used:</b>	
<b>Instrument Rating(s):</b>	Airplane	<b>Second Pilot Present:</b>	Yes
<b>Instructor Rating(s):</b>	Airplane Single-engine	<b>Toxicology Performed:</b>	No
<b>Medical Certification:</b>	Class 1 Without Waivers/Limitations	<b>Last Medical Exam:</b>	02/05/2013
<b>Occupational Pilot:</b>	Yes	<b>Last Flight Review or Equivalent:</b>	08/23/2013
<b>Flight Time:</b>	2576 hours (Total, all aircraft), 1350 hours (Total, this make and model), 1011 hours (Pilot In Command, all aircraft), 261 hours (Last 90 days, all aircraft), 99 hours (Last 30 days, all aircraft), 5 hours (Last 24 hours, all aircraft)		

## Aircraft and Owner/Operator Information

<b>Aircraft Manufacturer:</b>	BEECH	<b>Registration:</b>	N169GL
<b>Model/Series:</b>	1900D	<b>Aircraft Category:</b>	Airplane
<b>Year of Manufacture:</b>		<b>Amateur Built:</b>	No
<b>Airworthiness Certificate:</b>	Transport	<b>Serial Number:</b>	UE-169
<b>Landing Gear Type:</b>	Retractable - Tricycle	<b>Seats:</b>	19
<b>Date/Type of Last Inspection:</b>	09/01/2013, Continuous Airworthiness	<b>Certified Max Gross Wt.:</b>	17120 lbs
<b>Time Since Last Inspection:</b>		<b>Engines:</b>	2 Turbo Prop
<b>Airframe Total Time:</b>	35184 Hours	<b>Engine Manufacturer:</b>	P&W
<b>ELT:</b>	Installed, not activated	<b>Engine Model/Series:</b>	PT6A SER
<b>Registered Owner:</b>	GREAT LAKES AVIATION LTD	<b>Rated Power:</b>	750 hp
<b>Operator:</b>	GREAT LAKES AVIATION LTD	<b>Air Carrier Operating Certificate:</b>	Flag carrier (121)
<b>Operator Does Business As:</b>		<b>Operator Designator Code:</b>	GLBA

## Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	Condition of Light:	Day
Observation Facility, Elevation:	KTEX, 9078 ft msl	Observation Time:	1315 MDT
Distance from Accident Site:	0 Nautical Miles	Direction from Accident Site:	125°
Lowest Cloud Condition:	Scattered / 7500 ft agl	Temperature/Dew Point:	19° C / 9° C
Lowest Ceiling:	Broken / 10000 ft agl	Visibility	10 Miles
Wind Speed/Gusts, Direction:	12 knots, 90°	Visibility (RVR):	
Altimeter Setting:	30.43 inches Hg	Visibility (RVV):	
Precipitation and Obscuration:			
Departure Point:	DENVER, CO (DEN)	Type of Flight Plan Filed:	IFR
Destination:	Telluride, CO (TEX)	Type of Clearance:	IFR
Departure Time:	1140 MDT	Type of Airspace:	

## Airport Information

Airport:	TELLURIDE RGNL (TEX)	Runway Surface Type:	Asphalt
Airport Elevation:	9070 ft	Runway Surface Condition:	Dry
Runway Used:	27	IFR Approach:	None
Runway Length/Width:	7111 ft / 100 ft	VFR Approach/Landing:	Traffic Pattern

## Wreckage and Impact Information

Crew Injuries:	2 None	Aircraft Damage:	Substantial
Passenger Injuries:	10 None	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	12 None	Latitude, Longitude:	37.953056, -107.905556

## Administrative Information

Investigator In Charge (IIC):	David Helson	Adopted Date:	09/02/2015
Additional Participating Persons:	Robert Hendrickson; Federal Aviation Administration Mike Gibbons; Hawker Beechcraft Scott Lewis; Great Lakes Airlines		
Publish Date:	09/02/2015		
Investigation Docket:	<a href="http://dms.nts.gov/pubdms/search/dockList.cfm?mKey=87932">http://dms.nts.gov/pubdms/search/dockList.cfm?mKey=87932</a>		

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