Aviation Investigation Final Report

Location:	Roanoke, Virginia	**Accident Number:**	ERA13LA065
Date & Time:	November 20, 2012, 10:30 Local	**Registration:**	N702DK
Aircraft:	Beech C90A	**Aircraft Damage:**	Substantial
Defining Event:	Sys/Comp malf/fail (non-power)	**Injuries:**	4 None
Flight Conducted Under:	Part 135: Air taxi & commuter - Non-scheduled		

Analysis

During the downwind leg of the traffic pattern at the destination airport, the pilots lowered the landing gear. The pilot then noticed that the right main landing gear (MLG) was not down and locked in position for landing. The flight crew made multiple attempts to get a down-and-locked indication without success, so the pilot decided to abort the landing and divert to another airport with longer runways. After executing the manual gear extension checklist, the flight crew made a low pass at the diversion airport, and the air traffic controller in the control tower advised that the landing gear appeared to be in the down position. During the landing, the touchdown was normal, and the airplane slowed normally; however, as the airplane exited the runway, the right MLG collapsed. Examination of the wreckage revealed that the right wing, right nacelle, and right wheel well had received substantial damage and that the right MLG, after collapsing, had punctured the right nacelle fuel tank.

The right MLG bearing actuator support bracket was made of aluminum. Examination of the right MLG revealed that the right MLG bearing actuator support bracket was broken and had separated from its mounting position. Multiple cracks in the bracket were visible, and, at the microscopic level, the cracks had shiny surfaces indicative of abrasion, and overload regions with a cloudy appearance. Essentially, with each cycle, whether it was with extension of the landing gear, retraction of the landing gear, or landing itself, the cracks were subjected to loading which caused them to continue to propagate until the entire assembly reached a point at which structural integrity was no longer present to hold the landing gear actuator.

In December 2003, the airplane manufacturer issued a mandatory service bulletin to replace the right and left aluminum MLG bearing actuator support brackets with steel brackets and specified that the replacement of the brackets be accomplished "as soon as possible," but "no later than the next scheduled inspection, the next 200 flight hours or 24 months." The airplane manufacturer also requested that the Federal Aviation Administration (FAA) issue an Airworthiness Directive (AD) based on the service bulletin. However, the FAA did not find an "unsafe condition" and did not issue an AD, which would have made compliance with the service bulleting mandatory.

Review of the airplane's maintenance records confirmed that the airplane owner and the operator had not had the new steel brackets installed. Further, the FAA has not issued an AD for the MLG bearing actuator support brackets.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The failure of the right main landing gear bearing actuator support brackets. Contributing to the accident was the owner's and operator's failure to comply with the airplane manufacturer's mandatory service bulletin and the Federal Aviation Administration's failure to issue an airworthiness directive.

Findings

Organizational issues	Policy/procedure development - FAA/Regulator
Personnel issues	Lack of action - Owner/builder
Personnel issues	Replacement - Maintenance personnel
Aircraft	Main landing gear attach sec - Not installed/available
Aircraft	Main landing gear attach sec - Failure

Factual Information

History of Flight

Prior to flight	Aircraft maintenance event
Approach	Aircraft structural failure
Approach	Sys/Comp malf/fail (non-power) (Defining event)
Landing-landing roll	Landing gear collapse

On November 20, 2013, at 1030 eastern standard time, a Beech C90A, N702DK, operated by Dominion Aviation Services Incorporated, was substantially damaged during a landing gear collapse, after a precautionary landing, at Roanoke Regional Airport (ROA), Roanoke, Virginia. The pilot, copilot, and the two passengers were uninjured. Visual meteorological conditions prevailed, and an IFR flight plan was filed for the air taxi flight conducted under Title 14 Code of Federal Regulations (CFR) Part 135 which departed Chesterfield County Airport (FCI), Richmond, Virginia, originally destined for Montgomery Executive Airport (BCB), Blacksburg, Virginia.

According to the pilot, after departing FCI for BCB, the flight was uneventful until the landing gear was lowered while on the downwind leg of the traffic pattern for runway 12 at BCB, when the pilot realized that the right main landing gear was not down and locked in position for landing. The landing gear annunciator panel indicated that both the nose landing gear and left main landing gear were in the proper position but, the right main landing gear "green light" was not illuminated.

The pilot and copilot then tested the light to ensure that it was operating properly and it illuminated when pressed. The landing gear "handle" was then moved to the up position with no change in the landing gear position indication. It was then was placed back into the "down" position with no change in indication. At this point the pilot decided to abort the landing.

Further attempts to extend the right main landing gear were unsuccessful and the pilot made a decision to divert to ROA since the runways were longer than the ones at FCI or BCB. After executing the manual gear extension checklist the flight crew made a low pass down runway 24 at ROA and the air traffic controller who was in the control tower advised that from his vantage point it appeared the landing gear appeared to be in the down position. The pilot then made a decision to land without flaps and to shutdown the right engine and feather the propeller to minimize damage should the right main landing collapse.

During the landing, the touchdown was normal and no "abnormal feelings" were observed. After applying the brakes and adding reverse thrust on the operating engine the airplane slowed normally, however as the airplane exited the runway, the right main landing gear collapsed.

Pilot Information

Certificate:	Airline transport; Commercial; Flight instructor	**Age:**	26
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	None	**Restraint Used:**	4-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane single-engine	**Toxicology Performed:**	No
Medical Certification:	Class 1 Without waivers/limitations	**Last FAA Medical Exam:**	January 16, 2012
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	July 27, 2012
Flight Time:	2520 hours (Total, all aircraft), 210 hours (Total, this make and model), 1700 hours (Pilot In Command, all aircraft), 75 hours (Last 90 days, all aircraft), 35 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft)		

Co-pilot Information

Certificate:	Airline transport; Commercial; Flight instructor	**Age:**	40
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	4-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane single-engine; Instrument airplane	**Toxicology Performed:**	No
Medical Certification:	Class 1 With waivers/limitations	**Last FAA Medical Exam:**	August 20, 2012
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	October 1, 2012
Flight Time:	4783 hours (Total, all aircraft), 2664 hours (Total, this make and model), 4655 hours (Pilot In Command, all aircraft), 49 hours (Last 90 days, all aircraft), 17 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft)		

According to Federal Aviation Administration (FAA) and pilot records, the pilot held an airline transport pilot certificate with a rating for airplane multi-engine land, commercial privileges for airplane single-engine land, and type ratings for the CA-212, and DHC-6. He also held a flight instructor rating for airplane single engine, and instrument airplane. His most recent FAA first-class medical certificate was issued on January 16, 2012. He reported that he had accrued 2,520 total hours of flight experience, 210 of which, was in the accident airplane make and model.

According to FAA and pilot records, the copilot held an airline transport pilot certificate with a rating for airplane multi-engine land, commercial privileges for airplane single-engine land, and a type rating for the RA-390S. He also held a flight instructor rating for airplane single engine, and instrument airplane. His most recent FAA first-class medical certificate was issued on August 20, 2012. He reported that he had accrued 4,783 total hours of flight experience, 2,664 of which, was in the accident airplane make and model.

Aircraft and Owner/Operator Information

Aircraft Make:	Beech	**Registration:**	N702DK
Model/Series:	C90A	**Aircraft Category:**	Airplane
Year of Manufacture:	1990	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	LJ-1259
Landing Gear Type:	Retractable - Tricycle	**Seats:**	6
Date/Type of Last Inspection:	March 29, 2012 AAIP	**Certified Max Gross Wt.:**	12000 lbs
Time Since Last Inspection:		**Engines:**	2 Turbo prop
Airframe Total Time:	5086 Hrs at time of accident	**Engine Manufacturer:**	P&W CANADA
ELT:	C91A installed, not activated	**Engine Model/Series:**	PT6-21
Registered Owner:	CHEYENNE VENTURES LLC	**Rated Power:**	550 Horsepower
Operator:	DOMINION AVIATION SERVICES INC	**Operating Certificate(s) Held:**	On-demand air taxi (135)
Operator Does Business As:		**Operator Designator Code:**	ODAA

The accident airplane was a 6-seat, low wing, pressurized, twin engine airplane of conventional metal construction. It was equipped with retractable landing gear and was powered by two Pratt & Whitney PT6-21 reverse flow turboprop engines each capable of producing 550 shaft horsepower. It could fly 1,277 nautical miles with reserve fuel, at cruise speeds up to 247 knots true airspeed, and climb to altitudes in excess of 32,000 feet.

According to FAA records, the airplane was manufactured in 1990.

According to the operator, the airplane was added to their 14 CFR Part 135 operating certificate on April 30, 2007.

According to airplane maintenance records, the airplane's most recent Approved Aircraft Inspection Program inspection was completed on March 29, 2012. At the time of the accident, the airplane had accrued approximately 5,086 total hours of operation, and the engines had accrued approximately 1,490 total hours of operation since major overhaul.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	ROA,1175 ft msl	**Distance from Accident Site:**	0 Nautical Miles
Observation Time:	10:54 Local	**Direction from Accident Site:**	
Lowest Cloud Condition:	Few / 11000 ft AGL	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	0 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	0°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.19 inches Hg	**Temperature/Dew Point:**	8°C / 3°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Richmond, VA (FCI)	**Type of Flight Plan Filed:**	IFR
Destination:	Blacksburg, VA (BCB)	**Type of Clearance:**	IFR
Departure Time:	09:23 Local	**Type of Airspace:**	Class C

The recorded weather at ROA at 1054 included: winds calm, 10 miles visibility, few clouds at 11,000 feet, temperature 8 degrees C, dew point 3 degrees C, and an altimeter setting of 30.17 inches of mercury.

Airport Information

Airport:	Roanoke Regional Airport ROA	**Runway Surface Type:**	Asphalt
Airport Elevation:	1175 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	34	**IFR Approach:**	Visual
Runway Length/Width:	5810 ft / 150 ft	**VFR Approach/Landing:**	Full stop

Roanoke Regional Airport was a tower controlled public use airport. It had two runways configured in a 16/34 and 06/24 configuration. Runway 24 was asphalt, grooved, and in good condition. The total length was 6,800 feet long and 150 feet wide. It was equipped with runway end identifier lights, and was marked with non-precision markings that were in good condition.

Wreckage and Impact Information

Crew Injuries:	2 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	2 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	4 None	**Latitude, Longitude:**	37.325553,-79.975555(est)

Examination of the wreckage revealed that the Right Main Landing Gear (MLG) after collapsing had punctured the right nacelle tank, and the right wing, right nacelle, and right wheel well had received substantial damage.

Examination of the Right MLG revealed that the Right MLG Bearing Actuator Support Bracket was broken, and had separated from its mounting position. Multiple cracks in the bracket were visible including a saw-tooth like crack along the fasteners. Discoloration also existed on the mounting surfaces around the fasteners on the outboard side of the bracket which attached it to the airplane's structure. Further examination of the Right MLG Bearing Actuator Support Bracket also revealed that it was made of aluminum, and examination of the cracks using an optical microscope and scanning electron microscope revealed shiny surfaces indicative of abrasion, and an overload region with a cloudy appearance.

Tests and Research

Mandatory Service Bulletin

According to FAA records, on September 18, 2003, while on approach to Piedmont triad International Airport (GSO), Greensboro, North Carolina, the pilot of a Beech C90A; N200TR lowered the landing gear for landing but could not get a right main landing gear down and locked indication. Several attempts were made by the pilot to get the landing gear down and locked indication, but they were unsuccessful. The pilot then performed a low pass for a visual inspection from the tower to help ascertain if the landing gear was in the down position. The pilot was advised by the tower and aircraft on the taxiway that it appeared to be so. The airplane landed without incident but, during the turnoff from the runway onto the taxiway, the right main landing gear collapsed. Examination of the airplane revealed that a MLG Bearing Actuator Support Bracket was found, "broken from its mounts."

Subsequent to this incident, the airplane manufacturer received reports of cracks in the MLG Bearing Actuator Support Brackets on two airplanes. Investigation of the cracks by the airplane manufacturer discovered that the cracks could cause the main landing gear to bind, preventing normal extension and retraction of the main landing gear which could lead to an inability to fully extend and lock the main landing gear.

As a result, in December of 2003, the airplane manufacturer issued Mandatory Service Bulletin (MSB)

32-3345 to replace the aluminum, MLG Bearing Actuator Support Brackets with steel brackets, for both the left and right main landing gears, to improve bracket support and service life of the assembly. This was distributed to authorized service centers, owners of record on the FAA Aircraft Registration Branch List, and individuals and organizations who had a publications subscription with the manufacturer. Furthermore, they specified in the MSB that the replacement of the brackets be accomplished "as soon as possible" but, "no later than the next scheduled inspection, the next 200 flight hours or 24 months" from the last day of the month that the service bulletin was issued, whichever occurred first.

Review of Maintenance Records

Review of maintenance records revealed that on the day before the accident, the right main landing gear actuator was removed as it was leaking. It was replaced with an overhauled unit. Rigging procedures were performed, an operational and leak check was performed, the hydraulic reservoir was serviced, and the landing gear system was "exercised" to purge air from the system. No leaks were detected by maintenance personnel, and the airplane was returned to service.

Postaccident testing and teardown of the overhauled actuator revealed, that it performed per the manufacturer's specifications. No evidence of any binding or of any preimpact failure or malfunction of the actuator was discovered. Further review of the maintenance records did reveal however, that the airplane had not received the new steel bracket installation as required under the MSB.

Organizational and Management Information

In 1983, Dominion Aviation was founded as Old Dominion Air Charter, initially providing aircraft management and charter.

In 1991, Dominion Aviation was awarded the contract to operate the fixed base operation (FBO) at the airport when Chesterfield County, Virginia privatized operations at FCI,

At the time of this report, in addition to charter, Dominion Aviation was providing a range of FBO services including refueling, maintenance, aircraft management, flight training, aircraft rental, and hangar leasing.

Additional Information

Request for Airworthiness directive

On December 3, 2003, the airplane manufacturer requested that the FAA issue an Airworthiness Directive (AD) based on the MSB. Review of FAA records revealed, that even though the FAA agreed with the issuance of the MSB by the airplane manufacturer, the FAA did not find an "unsafe condition as required by Title 14 of the CFR, Federal Aviation Regulations, Part 39" and did not issue an AD.

FAA Order 8620.2A

On November 5, 2007, the FAA issued Order 8620.2A which established a national policy for applicability and enforcement of manufacturer's data, and provided information and guidance to aviation safety inspectors (ASI) regarding the applicability and enforcement of Original Equipment Manufacturer (OEM) data listed on FAA type certificate data sheets (TCDS) and information and guidance regarding OEM maintenance manual material, Service Letters (SL), Service Bulletins (SB), and other maintenance or flight operations information including any material that has been identified or labeled by an OEM as "Mandatory."

According to the Order, 14 CFR Part 43.13(a) stated, in part, "Each person performing maintenance, alteration, or preventive maintenance on an aircraft, engine, propeller, or appliance shall use the methods, techniques, and practices prescribed in:

1) The current manufacturer's maintenance manual or;
2) Instructions for Continued Airworthiness prepared by its manufacturer, or;
3) Other methods, techniques, and practices acceptable to the Administrator."

According to the FAA, the language of section 43.13(a) clearly provides a person with three permissible options when performing maintenance, alterations, or preventive maintenance on a product. Section 43.13(a) does not provide an order of precedence for these three options. Further, although section 43.13(a) does not specifically address SB's or SL's, an OEM may legitimately incorporate an SB or SL into one of its maintenance manuals by reference. If it does so, the data specified, and the method, technique, or practice contained therein, may be acceptable to the Administrator. However, unless any method, technique, or practice prescribed by an OEM in any of its documents is specifically mandated by a regulatory document, such as Airworthiness Directive (AD), or specific regulatory language such as that in section 43.15(b); those methods, techniques, or practices are not mandatory.

Safety Actions

At the time of this report, of the 393 C90As that were affected by the MSB, 305 airplanes had the aluminum MLG actuator support brackets replaced with steel brackets, 48 had not. As a result, in order to improve safety, in July, 2014, Textron Aviation released Beechcraft King Air Series Communique 2014-01 to remind owners and operators of the importance of complying with the MSB to replace the Aluminum MLG actuator support brackets with ones made of steel.

On August 7, 2014, Dominion Aviation Services advised the NTSB that in order to improve safety they had reviewed all MSBs on all of their airplanes that were on their certificate after the accident, and aircraft that had been added to their certificate afterwards, had also been reviewed. They also advised though not required by the FAA, they would continue to review and analyze the pertinence of complying with MSBs and would include in their next revision of their Operations Manual this policy and procedure.

Administrative Information

Investigator In Charge (IIC):	Gunther, Todd
Additional Participating Persons:	Manuel Carvalho; FAA/FSDO; Richmond, VA Ernest C Hall; Hawker Beechcraft; Wichita, KS Anthony J Nunez; Dominion Aviation; Richmond, VA
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