Aviation Investigation Final Report

Location:	Oklahoma City, Oklahoma	**Incident Number:**	FTW04IA078
Date & Time:	February 19, 2004, 14:15 Local	**Registration:**	N21
Aircraft:	Beech C90	**Aircraft Damage:**	Minor
Defining Event:		**Injuries:**	2 None
Flight Conducted Under:	Part 91: General aviation - Instructional		

Analysis

The crew reported the landing gear would not completely retract after take off, and only the right main came up while the gear motor continued to run. The left main and nose gear did not retract. The landing gear handle was cycled to the down position and the gear motor stopped running, but the right main landing gear failed to extend. The landing gear handle was cycled again, and the right main still would not extend. The crew used the emergency checklist, but the emergency gear extension handle was very hard to move, then it seemed to not catch anything at all. The crew made an emergency landing with the right main gear retracted. During the recovery process, a bolt, which attached the clutch shaft and nose gear drive sprocket, was found laying in the belly of the airplane. Examination of aircraft and maintenance records revealed the airplane underwent a phase inspection about a month prior to the event that included the replacement of the landing gear retraction gear box and clutch. The records indicated that this item was removed and an overhauled unit was reinstalled in accordance with the manufacturer's maintenance manual. According to the maintenance technician that performed the work, he used the manufacturer's maintenance manual as a step-by-step guide, and "all parts, nuts, bolts, cotter pin, etc, were intact when the final inspection was completed. New cotter pins were used to safety these items." After installation, the assembly and operational checks were inspected by his lead mechanic and an inspector. The gear was cycled approximately 12-15 times, and the "cavity" was vacuumed before the final inspection and the floor panels reinstalled. At the time of the incident, the airplane had flown a total of 21.9 hours, which included a total of 35 landings, after the phase inspection was completed. Nine days prior to the emergency landing, another flight crew reported that they were unable to retract all three landing gear while executing a go-around procedure. An examination revealed that a mechanic had removed the center and right floor boards and visually inspected the landing gear limit switches and engagement of the emergency extension disconnect assembly. Inspection of the limit switches consisted of visually inspecting the mount bracket and security of the switches and wiring. The mechanic also made a visual inspection of the wiring to the gear motor and engagement of the

emergency extension disconnect, and engaged and disengaged "J" hook several times and found it operated normally. The visible portion of the nose gear chain was also examined for general condition. The floorboard panels were reinstalled, and the gear were cycled three times in five minutes, followed by four more cycles. All functional tests were normal and the airplane was returned to service. At the time of this inspection, the airplane had flown 11 hours since the phase 4 inspection, which included 17 landings.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this incident to be: The failure of the right main landing gear to extend due to an improperly installed attachment bolt by other maintenance personnel.

Findings

Occurrence #1: AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation: TAKEOFF

Findings
1. (C) LANDING GEAR,NORMAL RETRACTION/EXTENSION ASSEMBLY - DISENGAGED
2. (C) MAINTENANCE,INSTALLATION - IMPROPER - OTHER MAINTENANCE PERSONNEL

Occurrence #2: WHEELS UP LANDING
Phase of Operation: EMERGENCY LANDING

Factual Information

On February 19, 2004, at 1415 central standard time, a Beech C90 twin-engine turboprop airplane, N21, sustained minor damage during an emergency landing with only two landing gear extended at the Will Rogers World Airport (OKC), near Oklahoma City, Oklahoma. The two airline transport pilots were not injured. The airplane was owned and operated by the Federal Aviation Administration (FAA) National Flight Program Oversight Office, Oklahoma City, Oklahoma. No flight plan was filed for the flight that originated at Mid Continent Airport (ICT), near Wichita, Kansas, about 1250. Visual meteorological conditions prevailed for the instructional flight conducted under Title 14 Code of Federal Regulations Part 91.

The pilot reported the landing gear would not completely retract after take off. The left main and nose gear stayed in the down and locked position, and the right main gear remained in the up and locked position. The crew used the emergency checklist and the emergency gear extension handle, but it had no affect on extending the right main gear. The pilot contacted dispatch, the FAA's Fort Worth, Texas, Communications Center, and Raytheon Aircraft Company, who assisted in trouble-shooting the problem. After realizing that the right main landing gear would not extend, a decision was made to land at Will Rogers World Airport. Prior to landing, the pilot made a low pass over the runway to assess the wind condition. Upon landing, he held the right wing up as long as possible while the second pilot secured both engines.

The second pilot reported that after take off when the landing gear were retracted, only the right main came up and the gear motor continued to run. The left main and nose gear did not retract. The pilot cycled the landing gear handle to the down position and the gear motor stopped running, but the right main landing gear failed to extend. The landing gear handle was cycled again, and the right main still would not extend. The crew used the emergency checklist, but the emergency gear extension handle was very hard to move, then it seemed to not be "grabbing" anything at all. An emergency landing was made at Will Rogers Airport. After touchdown, the airplane veered to the right, departed the runway into the grass, and came to rest approximately 180 degrees from the direction of landing.

The airplane was recovered by FAA personnel and moved to an FAA maintenance hangar located on the airport. During the recovery process, when FAA personnel attempted to lower the right main gear so it could be towed to the hangar, the right-hand floorboard located inside the cabin was removed to allow access to the landing gear drive shaft and motor. According to an FAA employee, who assisted in the recovery, he reported that a bolt [which was later identified as an AN4-16 bolt that would have been installed to attach the clutch shaft and nose gear drive sprocket], a washer, a nut, and cotter key were found laying in the belly of the airplane.

The airplane was examined on February 21, 2004, under the supervision of the Safety Board and FAA. The examination revealed minor damage to the right wing flap, aileron, wing tip, and right engine propeller blades.

The airplane was placed on jacks and the center and right floorboards were removed to expose the landing gear motor, right main gear drive shaft, clutch, and nose gear drive sprocket. At that time, it was confirmed that the bolt that would have attached the clutch shaft and nose gear drive sprocket was not installed.

The right main landing gear failure sequence was recreated with the bolt not installed. When the gear handle was placed in the up position, the left main and nose gear remained down and locked, and the right main gear retracted to the up and locked position. In this configuration, the down limit switch was still closed on the main drive torque shaft. With the gear handle in the down position, the system was locked due to the down limit switch being closed. The right main landing gear would not extend due to the incorrect switch position. In addition, the emergency gear extension handle was not effective in extending the right main landing gear due to the attaching bolt not being installed, even though it was still linked to the left main and nose gear. The handle would not move due to the gears already being in the down and locked position.

Examination of aircraft and maintenance records revealed the airplane underwent a Phase 4 inspection in accordance with the FAA Flight Standards Division Southwest Region C90 Approved Aircraft Inspection Program (AAIP), and returned to service on January 23, 2004. Included in the inspection was the replacement of the landing gear retraction gear box and clutch inspection. The records indicated that the gear box and clutch were removed and an overhauled unit was reinstalled in accordance with the Raytheon Aircraft Beech King Air 90 series maintenance manual, reference 32-30-00 Landing Gear Motor and Gearbox Removal and Installation, by an FAA maintenance technician. According to the manual, "All steps must be accomplished to remove the gearbox and overload clutch." The steps to remove the landing gear motor and gearbox were listed alphabetically from a to q. Step l stated, "Mark the nose gear drive sprocket, chain and shaft for proper relocation upon reassembly, then remove the bolt securing the sprocket to the shaft. Move the sprocket to the left just far enough to clear the clutch shaft."

The steps to install the gear motor and gearbox were listed from a to k; of which, item e stated, "Align the holes in the clutch shaft and the nose gear drive sprocket, then install the attaching bolt."

According to the FAA maintenance technician, who removed and installed the landing gear motor and gearbox, he copied and used the Raytheon Aircraft Beech King Air 90 series maintenance manual, reference 32-30-00 Landing Gear Motor and Gearbox Removal and Installation, as a step-by-step guide, and each step was checked off as completed. He said, "All parts, nuts, bolts, cotter pin, etc, were intact when the final inspection was completed. New cotter pins were used to safety these items." After installation, the assembly and operational

checks were inspected by his supervisor and Team Leader. The landing gear was cycled approximately 12-15 times, and the "cavity" was vacuumed before the final inspection and the floor panels reinstalled.

According to the FAA Flight Standards Division Southwest Region C-90 AAIP, this maintenance item was required to have a dual inspection before the airplane could be returned to service. In a written statement, the maintenance technician's supervisor stated, "After [the maintenance technician] installed the gearbox and clutch assy. I went behind him and looked at the installation. All bolts and cotter pins were installed. Several days later we ops checked the gear. He also vacuumed after he finished and again before closing panels."

In addition, the maintenance technician asked his Team Leader to inspect his work. In a written statement, the Team Leader said, "After [maintenance technician] installed gear motor and clutch he ask[ed] me to look it over. I looked it over and everything looked good. I was outside the aircraft when the gear was ran. Inspected the gear operation from outside checking outside clearances for the gear in the up position. The gear operation was good."

At the time of the incident, the airplane had flown a total of 21.9 hours since the Phase 4 inspection, which included a total of 35 landings.

On February 10, 2004, another flight crew reported that they were unable to retract all three landing gear while executing a go-around procedure at the Kansas City Downtown Airport (MKC), Kansas City, Missouri. The airplane was taken to Beechcraft Executive, located at the airport, to be inspected. Examination of aircraft records and a written statement from the mechanic who conducted the inspection, revealed that he had removed the center and right floor boards and visually inspected the landing gear limit switches and engagement of the emergency extension disconnect assembly. Inspection of the limit switches consisted of visually inspecting the mount bracket and security of the switches and wiring. The mechanic also made a visual inspection of the wiring to the gear motor and engagement of the emergency extension disconnect, and engaged and disengaged "J" hook several times and found it operated normally. The visible portion of the nose gear chain was also examined for general condition. The floorboard panels were reinstalled, and the gear were cycled three times in five minutes, followed by four more cycles. All functional tests were normal and the airplane was returned to service.

At the time of this inspection, the airplane had flown 11 hours since the phase 4 inspection, which included 17 landings.

Pilot Information

Certificate:	Airline transport; Flight instructor	**Age:**	46,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
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 2 Valid Medical--w/ waivers/lim	**Last FAA Medical Exam:**	April 11, 2003
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	December 15, 2003
Flight Time:	7650 hours (Total, all aircraft)		

Co-pilot Information

Certificate:	Airline transport; Commercial	**Age:**	29,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):		**Toxicology Performed:**	No
Medical Certification:	Class 1 Valid Medical--w/ waivers/lim	**Last FAA Medical Exam:**	March 7, 2003
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	January 27, 2004
Flight Time:	5008 hours (Total, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Beech	**Registration:**	N21
Model/Series:	C90	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	LJ-902
Landing Gear Type:	Retractable - Tricycle	**Seats:**	7
Date/Type of Last Inspection:	January 23, 2004 Continuous airworthiness	**Certified Max Gross Wt.:**	
Time Since Last Inspection:	21.9 Hrs	**Engines:**	2 Turbo prop
Airframe Total Time:	11420.5 Hrs at time of accident	**Engine Manufacturer:**	Pratt & Whitney Canada
ELT:	Installed, not activated	**Engine Model/Series:**	PT6A Series
Registered Owner:	FAA -National Flight Program Oversight Office	**Rated Power:**	
Operator:	National Flight Oversight Office/FAA	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	OKC,1295 ft msl	**Distance from Accident Site:**	
Observation Time:	14:52 Local	**Direction from Accident Site:**	
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	Broken / 25000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	23 knots / 28 knots	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	170°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.48 inches Hg	**Temperature/Dew Point:**	22°C / 7°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Wichita, KS (ICT)	**Type of Flight Plan Filed:**	Company VFR
Destination:	Oklahoma City, OK (OKC)	**Type of Clearance:**	VFR
Departure Time:	12:50 Local	**Type of Airspace:**	Class B

Airport Information

Airport:	Will Rogers World Airport OKC	**Runway Surface Type:**	Asphalt
Airport Elevation:	1295 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	17R	**IFR Approach:**	None
Runway Length/Width:	9800 ft / 150 ft	**VFR Approach/Landing:**	Precautionary landing;Straight-in

Wreckage and Impact Information

Crew Injuries:	2 None	**Aircraft Damage:**	Minor
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 None	**Latitude, Longitude:**	35.393054,-97.600555

Administrative Information

Investigator In Charge (IIC):	Yeager, Leah
Additional Participating Persons:	Gail G Sober; FAA/FSDO; Oklahoma City, OK
Original Publish Date:	September 1, 2004
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=58782