Aviation Investigation Final Report

Location:	Denver, Colorado	**Incident Number:**	CEN15IA014
Date & Time:	October 15, 2014, 15:22 Local	**Registration:**	N694ES
Aircraft:	RAYTHEON AIRCRAFT COMPANY HAWKER	**Aircraft Damage:**	Minor
Defining Event:	Sys/Comp malf/fail (non-power)	**Injuries:**	3 None
Flight Conducted Under:	Part 91: General aviation		

Analysis

The commercial pilot and the airline transport pilot were operating a business flight. According to the operator, the pilots reported that, during the takeoff roll, they felt and heard a vibration emanating from the airframe. They continued the takeoff and retracted the landing gear. Air traffic control tower personnel radioed the pilots and informed them that they had momentarily observed white smoke coming from the airplane. Shortly after, the hydraulic low pressure lights illuminated. The pilots returned to the airport but were unable to extend the landing gear normally. They subsequently attempted to extend the landing gear using the alternate gear extension procedures without success. Due to the hydraulic system malfunction, the pilots diverted to an airport with a longer runway and landed the airplane with the flaps and gear retracted.

An examination of the airplane revealed that the No. 2 (inboard) tire on the left main landing gear assembly had ruptured, which resulted in the servo block separating from its actuator. The separation of the servo block resulted in the loss of both the normal and emergency hydraulic system pressures.

There were no obvious signatures of cuts or foreign object damage to the tire's external layer, and no manufacturing anomalies of the tire were noted. An examination of the tire fragments revealed wrinkles on the inner liner of the tire shoulder area consistent with overdeflection. The tire could have become overdeflected if it was operated below the recommended pressure and/or if it was overloaded. According to the operator, tire pressures were checked before flight, but the pressures were not recorded; therefore, it could not be determined whether the incident tire was consistently operated at the recommended pressure. The operator was not aware of any overloaded condition of the airplane.

Due to similar incidents, the airplane manufacturer had previously issued a service bulletin (SB), which recommended the installation of a landing gear jack that had improved servo block mounting hardware that would prevent separation of the servo block in the event of a tire failure. The SB recommended installing the landing gear jack with the improved hardware at the next landing gear jack replacement or

overhaul; however, the airplane had not required a landing gear jack overhaul or replacement and, therefore, it did not have the improved servo block mounting hardware installed. No similar failures involving the improved mounting hardware have been reported.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this incident to be:

The failure of the main landing gear tire, which resulted in separation of the servo block and subsequent total loss of all hydraulic system pressure and prevented the landing gear from extending before landing.

Findings

Aircraft	Tire casing - Failure
Aircraft	Gear extension and retract sys - Damaged/degraded
Aircraft	Hydraulic, main system - Failure

Factual Information

History of Flight

Takeoff	Sys/Comp malf/fail (non-power) (Defining event)
Landing	Landing gear not configured
Landing	Abnormal runway contact

On October 15, 2014, about 1522 mountain daylight time, a Raytheon Aircraft Company Hawker 800XP airplane, N694ES, experienced a hydraulic malfunction and landed gear up at the Denver International Airport (DEN), Denver, Colorado. The two pilots and one crew member were not injured and the airplane received minor damage. The airplane was registered to GLO LLC and operated by Eaton Metals under the provisions of 14 Code of Federal Regulations Part 91 as a business flight. Visual meteorological conditions prevailed for the flight, which operated on an instrument flight rules flight plan. The flight originated from Centennial Airport (APA), Englewood, Colorado, and was en route to Arnold Palmer Regional Airport (LBE), Latrobe, Pennsylvania.

According to information provided by the operator, during the takeoff roll, the pilot felt and heard a vibration from the airframe. They continued the takeoff and retracted the landing gear. Personnel in the APA tower, radioed the pilot that they momentarily observed white smoke come from the airplane. A short time later, the airplane's hydraulic low pressure lights illuminated. The pilot returned to APA but was unable to lower the landing gear. The pilots attempted to extend the landing gear through the alternate gear extension procedures with no success. Due to the hydraulic system malfunction, the crew elected to divert to Denver International Airport (DEN) which had longer runways. The airplane was landed with the flaps and gear retracted on runway 34L (16,000 ft by 200 ft) at DEN. An examination of the takeoff runway at APA after the event did not find any evidence of foreign object debris (FOD).

A postaccident examination of the airplane revealed that the No. 2 (inboard) tire on the left main landing gear assembly had ruptured and the servo block appeared to have separated due to impact forces. The servo block is a hydraulic shuttle valve mounted on the landing gear extend/retract actuator that allows either normal or emergency hydraulic pressure to extend/retract the landing gear actuator. The servo block and mounting bolts were sent to the NTSB laboratory in Washington, D.C. An examination of the servo block and mounting bolts found that both mounting bolts exhibited signatures consistent with mechanical overstress. The fragments of the No. 2 tire were collected and sent to Goodyear for examination under supervision of the NTSB investigator-in-charge. A visual inspection of the fragments found wrinkles on the inner liner in the tire shoulder area consistent with over-deflection. There were localized areas of melted nylon on some of the tire's inner most layers. There were no visible signatures of cuts or FOD damage to the external layer of the tire. A microscopic examination of the tire fragments also did not reveal any cut or FOD damage that could have contributed to the tire failure. No manufacturing anomalies were detected with the tire.

A tire could be over-deflected if the tire was operated below the recommended pressure and/or if the tire was overloaded. According to the operator, tire pressures are checked prior to flight, but the pressures are not recorded, so it could not be determined if this tire was consistently under the recommended tire

pressure. The operator was not aware of any overloaded condition the tire would have experienced previously.

Damage to the servo block would result in depletion of both normal and emergency hydraulic system pressures. A similar accident involving a Hawker 600A occurred on August 17, 1999, that was investigated by the NTSB (see NTSB report LAX99FA272). As a result of that accident, Raytheon Aircraft Company recommended Service Bulletin SB 32-2777 was released to address two reports of tire disintegration during takeoff in which pieces of tire struck the main landing gear retraction actuator, resulting in separation of the servo block from the actuator. The service bulletin recommended the replacement of the main landing gear jack with a landing gear jack that has improved servo block mounting hardware for improved resistance to tire debris. It was recommended that the actuators be replaced at the next actuator overhaul (5,000 cycles) or any other time the actuator was replaced. An actuator overhaul or replacement had not been required on the accident airplane due to its 2,199 cycles and thus the incident airplane did not have the improved servo block mounting hardware. A review of the Federal Aviation Administration's Service Difficulty Report database and Textron Aviation (formly Raytheon Aircraft Company) service department records did not contain any reports of failures involving the improved mounting hardware.

In addition, as a result of this accident the FAA issued Special Airworthiness Information Bulletin NM-15-24 alerting owners, operators, and maintenance technicians of the potential for damage to the servo block mounted to the main landing gear retraction actuator due to debris from tire tread separation during takeoff on affected airframes. The FAA recommended that owners, operators, and maintenance personnel of the affected airplanes follow the procedures outlined in Raytheon Aircraft Company Bulletin 32-3777, dated October 2006, at the earliest opportunity.

Pilot Information

Certificate:	Airline transport; Commercial; Flight instructor	**Age:**	46
Airplane Rating(s):	Single-engine land; Single-engine sea; 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; Instrument airplane	**Toxicology Performed:**	No
Medical Certification:	Class 1 Without waivers/limitations	**Last FAA Medical Exam:**	September 25, 2014
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	June 21, 2014
Flight Time:	11102 hours (Total, all aircraft), 1981 hours (Total, this make and model), 110 hours (Last 90 days, all aircraft)		

Co-pilot Information

Certificate:	Airline transport	**Age:**	52,Male
Airplane Rating(s):	Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):		**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):		**Toxicology Performed:**	No
Medical Certification:		**Last FAA Medical Exam:**	
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	January 28, 2014
Flight Time:	5084 hours (Total, all aircraft), 895 hours (Total, this make and model), 133 hours (Last 90 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	RAYTHEON AIRCRAFT COMPANY	**Registration:**	N694ES
Model/Series:	HAWKER 800XP	**Aircraft Category:**	Airplane
Year of Manufacture:	2004	**Amateur Built:**	
Airworthiness Certificate:		**Serial Number:**	258694
Landing Gear Type:	Tricycle	**Seats:**	
Date/Type of Last Inspection:		**Certified Max Gross Wt.:**	
Time Since Last Inspection:		**Engines:**	2 Turbo fan
Airframe Total Time:		**Engine Manufacturer:**	HONEYWELL
ELT:		**Engine Model/Series:**	TFE731-5BR
Registered Owner:	GO LLC	**Rated Power:**	4660 Lbs thrust
Operator:	Eaton Metals	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KDEN,5431 ft msl	**Distance from Accident Site:**	1 Nautical Miles
Observation Time:	09:53 Local	**Direction from Accident Site:**	213°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	10 knots / None	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	230°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.04 inches Hg	**Temperature/Dew Point:**	8°C / -1°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	DENVER, CO (APA)	**Type of Flight Plan Filed:**	IFR
Destination:	LATROBE, PA (LBE)	**Type of Clearance:**	IFR
Departure Time:	11:00 Local	**Type of Airspace:**	

Airport Information

Airport:	DENVER INTL DEN	**Runway Surface Type:**	Concrete
Airport Elevation:	5433 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	34L	**IFR Approach:**	Unknown
Runway Length/Width:	16000 ft / 200 ft	**VFR Approach/Landing:**	Full stop

Wreckage and Impact Information

Crew Injuries:	3 None	**Aircraft Damage:**	Minor
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	3 None	**Latitude, Longitude:**	39.851665,-104.642219(est)

Administrative Information

Investigator In Charge (IIC):	Aguilera, Jason
Additional Participating Persons:	Robert Kanive; FAA; Denver, CO Peter Barry; Mayo Aviation; Englewood, CO Heather Halverson; Mayo Aviation; Englewood, CO Paul Yoos; Textron Aviation ; Wichita, KS
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Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=90261

The National Transportation Safety Board (NTSB) is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant events in other modes of transportation—railroad, transit, highway, marine, pipeline, and commercial space. We determine the probable causes of the accidents and events we investigate, and issue safety recommendations aimed at preventing future occurrences. In addition, we conduct transportation safety research studies and offer information and other assistance to family members and survivors for each accident or event we investigate. We also serve as the appellate authority for enforcement actions involving aviation and mariner certificates issued by the Federal Aviation Administration (FAA) and US Coast Guard, and we adjudicate appeals of civil penalty actions taken by the FAA.

The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, "accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties … and are not conducted for the purpose of determining the rights or liabilities of any person" (Title 49 *Code of Federal Regulations* section 831.4). Assignment of fault or legal liability is not relevant to the NTSB's statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report (Title 49 *United States Code* section 1154(b)). A factual report that may be admissible under 49 *United States Code* section 1154(b) is available here.