



National Transportation Safety Board Aviation Incident Final Report

Location:	Denver, CO	Incident Number:	ENG111A051
Date & Time:	09/26/2011, 1637 MDT	Registration:	N526UA
Aircraft:	BOEING 757-222	Aircraft Damage:	Minor
Defining Event:	Birdstrike	Injuries:	185 None
Flight Conducted Under:	Part 121: Air Carrier - Scheduled		

Analysis

On September 26, 2011, 1637 mountain daylight time, a Boeing B-757-222, registration number N526UA, operated by United Airlines (UAL) as flight 909, and powered by two Pratt & Whitney PW2037M turbofan engines, experienced a left engine (No. 1) bird strike^F following touchdown on runway 35R at the Denver International Airport (DEN), Denver, Colorado. According to the flightcrew, after initial touchdown and the application of full reverse thrust, two hawks were observed on the centerline of runway 35R and shortly thereafter impacts were felt on the fuselage. The airplane was towed to the gate using a tug where the passengers deplaned normally. The incident flight was a 14 CFR Part 121 domestic passenger flight from Chicago O'Hare Airport (ORD) to DEN.

Examination of the airplane revealed only minor gouging of the fuselage while the No. 1 engine inlet cowl exhibited multiple impacts, gouges, and through-holes. Examination of the No. 1 engine revealed that all the fan blades were extensively damaged, three fractured transversely across the airfoil at or near the mid-span shroud, but no penetration or breaches were observed in any of the engine cases. The bird remains recovered within the No. 1 engine were identified as coming from a female Red-Tailed Hawk. An intact bird that struck the side of the No. 1 inlet was also identified as a Red-Tailed Hawk but was not sexed.

Comparing the airplane and engine damage to the requirements for bird ingestion and engine debris containment at the time the engine and airplane were both certificated revealed that the engine complied with the bird ingestion and containment requirements set forth in Parts 33.77 and 33.19 and the airplane complied with the containment requirements set forth in Parts 25.903.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this incident to be:
This probable cause was modified on 4/5/2012. Please see the public docket for this accident to view the original probable cause.

The initial damage to the fan blades was caused by the ingestion of a Red-Tailed Hawk that caused one or more fan blades to fracture, striking the fan case and causing it to bulge. The initial fan blade fragment release impacted and damaged other passing fan blades generating various sized blades fragments. Some of these blade fragments were propelled forward of the fan case by passing fan blades and were reingested, creating a cascading effect of collateral impact damage to the other fan blades, the fan case, and the inlet cowl.

Findings

Aircraft	Engine cowling system - Damaged/degraded Engine cowling system - Capability exceeded Compressor section - Damaged/degraded Compressor section - Capability exceeded
Environmental issues	Animal(s)/bird(s) - Effect on equipment (Cause)

Factual Information

HISTORY OF FLIGHT

On September 26, 2011, 1637 mountain daylight time, a Boeing B-757-222, registration number N526UA, operated by United Airlines (UAL) as flight 909, and powered by two Pratt & Whitney PW2037M turbofan engines, experienced a left engine (No. 1) bird strike following touchdown on runway 35R at the Denver International Airport (DEN), Denver, Colorado. According to the flightcrew, after initial touchdown and the application of full reverse thrust, two hawks were observed on the centerline of runway 35R and shortly thereafter impacts were felt on the fuselage followed by a 'hot' odor in the cockpit. After the airplane cleared the runway, a No. 1 engine oil pressure light illuminated accompanied by low oil pressure indication. The No. 1 engine was reported to have spooled down on its own while the airplane continued to taxi using the No. 2 engine to taxiway 'EE'. A flight attendant observed smoke coming from the rear of the No. 1 engine and the flightcrew requested that Airport Rescue and Firefighting (ARFF) come to the airplane. The No. 1 engine was shutdown using the Engine Fire or Engine Severe Damage or Separation procedure in the UAL 757 Quick Reference Handbook (QRH) Non-Normals. ARFF inspected the airplane and no signs of fire were observed. The airplane was towed to the gate using a tug where the passengers deplaned normally. Of the 179 passengers and 6 crewmembers on board the flight, no injuries were reported. The incident flight was a 14 CFR Part 121 domestic passenger flight from Chicago O'Hare Airport (ORD) to DEN. Day visual meteorological conditions prevailed at the time and an instrument flight rules flight plan was filed.

AIRCRAFT AND ENGINE DAMAGE

Examination of the airplane revealed minor gouging of the fuselage and under the left wing, with no through holes, a passenger window was nicked, and the left-hand main landing gear forward right tire was slashed but not deflated. The inner barrel of the No. 1 engine inlet cowl exhibited multiple impacts, gouges, and through-holes that penetrated through the outer skin of the inlet at two locations.

Examination of the No. 1 engine revealed that all the fan blades were extensively damaged with three blades fractured transversely across the airfoil at or near the mid-span shroud. The three fractured fan blades were all located within a consecutive group of 5 blades. No penetration or breaches were observed in any of the engine cases but the fan case exhibited several bulges that corresponded to hard impacts and missing fan blade rub strip material (parent material exposed). Examination of the No. 2 engine revealed that several of the fan blades exhibited minor leading edge impact damage primarily located outboard of the mid-span shroud.

TESTS AND RESEARCH

A United States Department of Agriculture Wildlife Biologist collected a whole and intact bird and what appeared to be the remains of second bird from runway 35R. The Wildlife Biologist identified the intact bird as a juvenile Red-Tailed Hawk. The remains of the second bird, along with remains collected by the Powerplant group from the No. 1 engine, were sent to the Smithsonian Institution National Museum of Natural History Division of Birds - Feather Identification Laboratory in Washington DC for analysis. The remains of the second bird were identified as coming from a female Red-Tailed Hawk. The Red-Tailed Hawk ranges in weight from about 24.3 to 51.50 ounces (1.52 to 3.22 pounds) with the female larger in size.

ADDITIONAL INFORMATION

Bird Ingestion Requirements

The PW2037 was certified under Part 33, Amendment 6 and the bird ingestion requirement at that time in Part 33.77 Foreign Object Ingestion was for a 4-pound bird. Under Part 33.77, the ingestion of a 4-pound bird that may not cause the engine to:

- i. Catch Fire;
- ii. Burst (penetrate its case);
- iii. Generate loads greater than those specified in Part 33.23; or
- iv. Loss of capability of being shut down.

Examination of the engine revealed that the engine did not catch fire, there were no engine case penetrations, the pilot was able to shutdown the engine normally, and the calculated imbalance loads based on the loss of fan blade material were less than those the engine was certified.

Engine and Airplane Containment Requirements

The engine containment standards are found in Part 33.19 Durability and require engine manufacturers to design compressor and turbine rotor cases that must provide for the containment of damage from rotor blade failure. Examination of the engine revealed that the fan case sustained some bulging but no exit holes, penetrations, or uncontainments were noted.

No containment requirements exist that call for airplane manufacturers to design inlets or nacelles to contain engine debris. Therefore, the requirement for containment of fan blades stops are the interface between the engine structure and the airplane inlet structure. Although the airplane manufacturers are not required to design structure to contain engine debris, they are responsible for the overall safety of the airplane and do have some engine debris uncontainment responsibility. Engine debris containment requirements for transport category airplanes are addressed in Part 25.903 Engines subsection (d)(1) and require airplane manufacturers to incorporate design precautions to minimize the hazards to the airplane in the event of an engine rotor failure or of a fire originating inside the engine which burns through the engine case. FAA Advisory Circular (AC) 20-128A, "Design Considerations for Minimizing Hazards Caused by Uncontained Turbine Engine and Auxiliary Power Unit Rotor Failure" describes how to best mitigate the threat of the debris causing a potential hazardous or catastrophic condition to the airplane or harm to the occupants on board by requiring design precautions based on service experience and tests. Examination of the airplane revealed minor superficial gouging of the fuselage, the left-hand wing, and one passenger window, none of which posed a hazard to the airplane or passengers.

History of Flight

Landing-landing roll

Birdstrike (Defining event)

Aircraft and Owner/Operator Information

Aircraft Manufacturer:	BOEING	Registration:	N526UA
Model/Series:	757-222	Aircraft Category:	Airplane
Year of Manufacture:		Amateur Built:	No
Airworthiness Certificate:	Transport	Serial Number:	24994
Landing Gear Type:	Tricycle	Seats:	178
Date/Type of Last Inspection:		Certified Max Gross Wt.:	
Time Since Last Inspection:		Engines:	2 Turbo Fan
Airframe Total Time:		Engine Manufacturer:	P & W
ELT:		Engine Model/Series:	PW2037M
Registered Owner:	WELLS FARGO BANK NORTHWEST NA TRUSTEE	Rated Power:	37530 lbs
Operator:	UNITED AIRLINES INC	Operating Certificate(s) Held:	Flag carrier (121)
Operator Does Business As:		Operator Designator Code:	UALA

Meteorological Information and Flight Plan

Conditions at Accident Site:		Condition of Light:	
Observation Facility, Elevation:		Observation Time:	
Distance from Accident Site:		Direction from Accident Site:	
Lowest Cloud Condition:		Temperature/Dew Point:	
Lowest Ceiling:		Visibility	
Wind Speed/Gusts, Direction:		Visibility (RVR):	
Altimeter Setting:		Visibility (RVV):	
Precipitation and Obscuration:			
Departure Point:	Chicago, IL (ORD)	Type of Flight Plan Filed:	VFR
Destination:	Denver, CO (DEN)	Type of Clearance:	Unknown
Departure Time:		Type of Airspace:	

Airport Information

Airport:	Denver International (DEN)	Runway Surface Type:	
Airport Elevation:		Runway Surface Condition:	Dry
Runway Used:	35R	IFR Approach:	Unknown
Runway Length/Width:		VFR Approach/Landing:	Unknown

Wreckage and Impact Information

Crew Injuries:	6 None	Aircraft Damage:	Minor
Passenger Injuries:	179 None	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	185 None	Latitude, Longitude:	

Administrative Information

Investigator In Charge (IIC):	Jean-Pierre M Scarfo	Adopted Date:	03/12/2012
Additional Participating Persons:			
Publish Date:	10/19/2015		
Investigation Docket:	http://dms.nts.gov/pubdms/search/dockList.cfm?mKey=81900		

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