
National Transportation Safety Board - Aircraft Accident/Incident Database

Accident Rpt# CEN18CA072 01/04/2018 2120 CST Regis# N214AM Norfolk, NE
Acft Mk/Mdl BELL HELICOPTER TEXTRON CANADA Acft SN 54485 Acft Dmg: Rpt Status: Prelim Prob Caus: Pending
Fatal 0 Ser Inj 0 Flt Conducted Under: FAR 091
Opr Name: AIR METHODS CORP Opr dba: Aircraft Fire:

National Transportation Safety Board - Aircraft Accident/Incident Database

Incident Rpt# ENG14IA005 12/23/2013 1615 CST Regis# N360SW St. Louis, MO Apt: St Louis Lambert Intl STL
Acft Mk/Mdl BOEING 737 3H4-3H4 Acft SN 26571 Acft Dmg: MINOR Rpt Status: Factual Prob Caus: Pending
Eng Mk/Mdl CFM INTL. CFM56 SERIES Fatal 0 Ser Inj 0 Flt Conducted Under: FAR 121
Opr Name: SOUTHWEST AIRLINES CO Opr dba: Aircraft Fire: NONE

Summary

On December 23, 2013, at approximately 1615 central standard time a Boeing 737-344, registration number N360SW, operated by SWA as flight 1091, and powered by two CFM56-3 turbofan engines, experienced a bird strike and ingestion on the No. 2 or right-hand engine (RHE) after takeoff from Lambert-St. Louis International Airport (STL), Missouri. As the airplane climbed through 1,700 feet, it impacted multiple birds causing damage to the RHE and wing. The pilot declared an emergency and returned to STL for an uneventful landing. There were no injuries reported to the 110 passengers, 2 flight crew and 3 flight attendants. The incident flight was a 14 CFR Part 121 domestic passenger flight from STL to Kansas City International Airport, Kansas City, Missouri (MCI). Day visual meteorological conditions prevailed at the time and an instrument flight rules flight plan was filed.

Examination of the airplane revealed no damage to the fuselage. Examination of the engine revealed no penetration or breaches of the cases; however, the fan case exhibited several bulges that corresponded to hard impacts and missing fan blade rub strip material exposing the parent material below.

Examination of the RHE revealed that all the fan blades were extensively damaged exhibiting hard-body impact damage with significant material loss along the length of the leading edge. Two adjacent fan blades were fractured transversely across the airfoil near the one-third span, and exhibited leading edge soft-body impact damage. The remains of the two birds were identified as one male and one female mallard duck. The average weight of the male mallard is 1246 grams or 2.75 pounds; the average weight of the female mallard is 1095 grams or 2.4 pounds.

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.

Cause Narrative

THE NATIONAL TRANSPORTATION SAFETY BOARD DETERMINED THAT THE CAUSE OF THIS OCCURRENCE WAS: The initial damage to the fan blades was caused by the ingestion of two mallard ducks that caused one or more fan blades to fracture, striking the fan shroud, as well as other passing fan blades, producing various sized blades fragments that created a cascading effect of collateral impact damage to the other fan blades, the fan case, and the inlet cowl. One large blade fragment was deflected out of the fan containment plane, which pierced and exited the inlet cowl in a benign direction.

The engine and airplane met the applicable bird and containment design standards since the engine did not catch on fire, no engine cases exhibited any penetrations, the engine was able to be shutdown normally, and the airplane damage did not impact the safe operation of the airplane or create a hazard to the persons on board.

Events

1. Takeoff - Birdstrike

Findings - Cause/Factor

1. Environmental issues-Physical environment-Object/animal/substance-Animal(s)/bird(s)-Effect on equipment - C

Narrative

HISTORY OF FLIGHT

On December 23, 2013, at approximately 1615 central standard time a Boeing 737-344, registration number N360SW, operated by SWA as flight 1091, and powered by two CFM56-3 turbofan engines, experienced a bird strike and ingestion on the No. 2 or right-hand engine (RHE) after takeoff from Lambert-St. Louis International Airport (STL), Missouri. As the airplane climbed through 1,700 feet, it impacted multiple birds causing damage to the RHE and wing. The pilot declared an emergency and returned to STL for an uneventful landing. There were no injuries reported to the 110 passengers, 2 flight crew and 3 flight attendants. The incident flight was a 14 CFR Part 121 domestic passenger flight from STL to Kansas City International Airport, Kansas City, Missouri (MCI). Day visual meteorological conditions prevailed at the time and an instrument flight rules flight plan was filed.

ENGINE AND NACELLE DAMAGE EXAMINATION

National Transportation Safety Board - Aircraft Accident/Incident Database

On site examination of the airplane revealed a hole in the leading edge of the wing with its immediate surroundings splattered with red colored organic debris. The inner barrel of the RHE inlet cowl exhibited multiple impacts, gouges, and through-holes. There was no evidence of fuel or oil leaks from the engine. The engine and nacelle were removed from the airplane and sent to the Southwest Airlines Maintenance Training Building in Dallas, Texas for detailed examination.

Examination of the nacelle revealed that the inlet nose cowl had a dent at 5:30 o'clock location on the outer surface of the inlet lip, approximately 8 inches x 4 inches x 0.5 inches deep. The inlet inner barrel had multiple small punctures on the inner skin (airflow) side and two large thru-holes; the one at 2:30 o'clock location was approximately 3 inches x 2 inches in size and the other at 3:00 o'clock was approximately 5 inches x 4 inches in size. One fan blade fragment penetrated the outer skin of the inlet at the 3 o'clock location, creating a 7-inch long tear, in the shape of a fan blade chord, consistent with a piece of fan blade passing thru edgewise. The exiting direction of the uncontained fan blade particle was outboard, causing no damage to the fuselage.

Examination of the RHE revealed that all the fan blades were extensively damaged with two adjacent engine fan blades fractured transversely across the airfoil below the mid span shrouds. 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 exposing the parent material below.

TESTS AND RESEARCH

A United States Department of Agriculture Wildlife Biologist collected tissue and feathers from the leading edge of the wing and sent them to the Smithsonian Institution National Museum of Natural History Division of Birds - Feather Identification Laboratory in Washington, D.C. for analysis. The analysis of the remains identified it as both male and female mallard ducks. The average weight of the male mallard is 1246 grams or 2.75 pounds; the average weight of the female mallard is 1095 grams or 2.4 pounds. No damage to the fuselage was reported.

ADDITIONAL INFORMATION

Bird Ingestion Requirements

The CFM56-3 was certified under Part 33, effective February 1, 1965, with Amendments 33-1 through 33-6. 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

National Transportation Safety Board - Aircraft Accident/Incident Database

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.

National Transportation Safety Board - Aircraft Accident/Incident Database

Accident Rpt# CEN18LA062	12/27/2017 650 CST	Regis# N525KT	Michigan City, IN	Apt: Michigan City Municipal Airpor MGC
Acft Mk/Mdl CESSNA 525A		Acft SN 525A-0058	Acft Dmg: SUBSTANTIAL	Rpt Status: Prelim Prob Caus: Pending
			Fatal 0 Ser Inj 0	Flt Conducted Under: FAR 091
Opr Name: INTEGRATED FLIGHT RESOURCES INC	Opr dba:			Aircraft Fire: NONE
				AW Cert: STN

Events

3. Landing - Collision during takeoff/land

Narrative

On December 27, 2017, at 0650 central standard time, a Cessna 525A, N525KT, impacted an airport fence, highway barrier, and terrain during a landing overrun on runway 20 (4,100 feet by 75 feet, asphalt/dry snow) following an RNAV runway 20 approach at Michigan City Municipal Airport-Phillips Field (MGC), Michigan City, Indiana. The airplane came to rest in a corn field about 300 yards from the departure end of the runway 20. The airplane sustained substantial damage, which included separation of the left wing near the wing root and impact damage to the vertical stabilizer. The pilot and copilot received minor injuries. The airplane was registered to Van E Aviation LLC and operated by Integrated Flight Resources Inc under 14 Code of Federal Regulations Part 91 as a positioning flight and was operating on an instrument flight rules flight plan. The flight originated from DuPage Airport (DPA), West Chicago, Illinois, at 0622 and was destined to MGC for a Part 135 on-demand passenger flight.

National Transportation Safety Board - Aircraft Accident/Incident Database

Accident Rpt# WPR15LA178	05/31/2015 1126 PDT	Regis# N462CC	Cove, OR	Apt: N/a
Acft Mk/Mdl GARLICK HELICOPTERS INC UH 1H-NO	Acft SN 6509666	Acft Dmg: SUBSTANTIAL	Rpt Status: Factual	Prob Caus: Pending
Eng Mk/Mdl LYCOMING T53-L-703	Acft TT 7599	Fatal 0 Ser Inj 0	Flt Conducted Under: FAR 133	
Opr Name: ELKHORN AVIATION INC DBA	Opr dba: BAKER AIRCRAFT	Aircraft Fire: NONE		

Events

1. Maneuvering-low-alt flying - Powerplant sys/comp malf/fail
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Narrative

On May 31, 2015, about 1126 Pacific daylight time, a Garlick Helicopters Inc. UH-1H, N462CC, sustained substantial damage during an emergency landing, about 10 miles east of Cove, Oregon. The commercial pilot, sole occupant of the helicopter, was not injured. The helicopter was registered to and operated by Elkhorn Aviation Inc., under the provisions of 14 Code of Federal Regulations Part 133, as an external load flight. Visual meteorological conditions prevailed and a company visual flight rules (VFR) flight plan was filed for the local flight that departed from a field near Cove, Oregon about 1100, with a planned destination of Minam Lodge Airport, Cove, Oregon.

The pilot reported that while maneuvering at low altitude, during logging operations, with an external load of about 24 logs, he felt a vibration and heard a "howling sound" coming from the transmission area of the helicopter. He immediately dropped the logs and initiated a precautionary landing to an open grass field. The pilot further reported that the helicopter's controls became stiff during the descent and he heard the rotor RPM decreasing. About 5 ft above the ground, he pulled up on the collective as hard as he could to cushion the landing, but the helicopter experienced a hard landing. Upon landing, the pilot noticed that the rotor RPM had decreased and was continuing to drop, while the engine rpm remained constant, at a high setting.

Postaccident examination of the helicopter revealed flight control continuity. The main rotor transmission, that is mounted forward of the engine, was observed to be tilted slightly forward, and the transmission input quill turned freely within the transmission, when rotated manually.

The engine-to-transmission drive shaft assembly, manufactured by Kamatics, (a division of Kaman), transmits engine output power to the main rotor transmission and was installed between the engine and the transmission. The drive shaft assembly is composed of the engine-to-transmission drive shaft, two flexible Kaflex couplings, a transmission shaft flange, and an engine shaft flange. The Kaflex coupling utilizes metal flexure elements to accommodate for misalignment in the engine-to-transmission drive shaft assembly during operation (i.e. relative movement between the engine and main rotor transmission). On the forward end of the drive shaft assembly, a Kaflex coupling is installed between the forward flange of the drive shaft to the transmission shaft flange. On the aft end of the drive shaft assembly, a second Kaflex coupling is installed between the flange of the drive shaft to the engine shaft flange.

The flex coupling metal flexure elements at each end of the drive shaft were fractured into multiple pieces. The remnant flex coupling remained installed on the engine shaft flange via attaching hardware (nuts and bolts). No remnants of the Kaflex coupling was found to be attached to the transmission shaft flange; the fractured attaching hardware was recovered. The engine-to-transmission drive shaft, the Kaflex coupling and their fragments, and an electronic RPM detector were sent to the NTSB Materials laboratory for further examination.

Further examination of the components revealed that the fracture surfaces of the Kaflex coupling metal flexure elements were consistent with overload and that no evidence of fatigue cracking was present. All the attachment bolts for the Kaflex coupling on both the transmission shaft flange and the engine shaft flange, had the appropriate markings for their specified bolt part number, for this application. The transmission shaft flange, that was separated from the transmission, contained two through holes for the attachment bolts. One of the attachment bolts was observed to be fractured, at the threaded portion of the bolt. Microscopic examination of the fractured bolt surfaces revealed arrest marks that were consistent with fatigue cracking, that emanated from the shank area. The area where the fracture surface originated, contained fretting and deformation damage. Progressive fatigue fracture features were present through about 80% of the bolt's cross thread section.

The attachment bolts were checked with an alloy analyzer and their content was consistent with the manufacturer specified composition. According to the bolt manufacture representative, the tensile strength of the attachment bolts is supposed to be a minimum of 160,000 pounds per square inch (psi). The fractured bolt was removed from the transmission shaft flange and a hardness test was accomplished. Testing revealed that the hardness value of the bolt was about 166,000 psi, which was greater than the minimum specified tensile strength.

The transmission shaft flange contained an inner tube portion that was located inside the engine-to-transmission drive shaft. The tube portion had deformation

damage all around the circumference. The sides of the tube portion were deformed inward. The transmission end of the engine-to-transmission drive shaft had severe deformation damage all around the hollow shaft. The hollow shaft showed evidence of outward deformation. The outward deformation was consistent with the transmission shaft flange breaking out and away from the drive shaft.

The engine shaft flange coupling assembly remained attached. The two attachment bolts and corresponding nuts were relatively intact. The shank portion of one of the bolts showed evidence of lateral deformation that was in the same location of the fatigue origin of the fractured bolt found in the transmission shaft flange. Further, the bolts showed evidence of deformation and material loss all around the threads. The bolts were also fractured and showed evidence of ductile fractures in the shear mode.

According to the helicopter operator's manual, a main drive shaft failure will result in a complete loss of power to the rotor and a possible engine overspeed.

An examination of the electronic RPM detector revealed no evidence of mechanical damage.

National Transportation Safety Board - Aircraft Accident/Incident Database

Accident Rpt# CEN17LA336	09/02/2017 1645 CDT	Regis# N50MP	Burnet, TX	Apt: N/a
Acft Mk/Mdl HUGHES 369A-NO SERIES		Acft SN 1180860	Acft Dmg: SUBSTANTIAL	Rpt Status: Factual Prob Caus: Pending
Eng Mk/Mdl ALLISON 250			Fatal 0 Ser Inj 1	Flt Conducted Under: FAR 091
Opr Name: LYFT LLC		Opr dba:		Aircraft Fire: NONE

Events

1. Maneuvering - Fuel exhaustion
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Narrative

On September 2, 2017, about 1645 central daylight time, a Hughes 369A helicopter, N50MP, conducted an autorotation near Burnet, Texas. The pilot was not injured, one passenger received minor injuries, and one passenger received serious injuries. The helicopter was substantially damaged during the landing. The helicopter was registered to and operated by Lyft, LLC, Missoula, Montana, under the provisions of 14 Code of Federal Regulations Part 91. Visual meteorological conditions prevailed at the time of the accident.

According to the responding Federal Aviation Administration (FAA) inspector, the pilot and two passengers were conducting aerial hog hunt operations. The helicopter was en route to the Burnet Municipal Airport-Kate Craddock Field Burnet Municipal airport (KBMQ), Burnet, Texas, when the engine lost power. The pilot conducted an autorotation to a road; however, the helicopter landed hard, resulting in substantial damage to the fuselage and tailboom.

The FAA inspector used a dip stick to check the fuel tank; the fuel tank was empty. The inspector also looked at the pump/injector and check valve; however, no residual fuel was found. The inspector checked the last place the helicopter was refuel, noting that the station's filters were not contaminated and that other people had purchased fuel and no problems had been reported.

The pilot did not return a completed an NTSB 6120 form.

National Transportation Safety Board - Aircraft Accident/Incident Database

Accident Rpt# ERA18LA053	12/15/2017 650 EST	Regis# N911FK	Islamorada, FL	Apt: N/a
Acft Mk/Mdl SIKORSKY S76-A		Acft SN 760197	Acft Dmg: SUBSTANTIAL	Rpt Status: Prelim Prob Caus: Pending
Eng Mk/Mdl TURBOMECA ARRIEL 1S1		Acft TT 11406	Fatal 0 Ser Inj 0	Flt Conducted Under: FAR 135
Opr Name: GLOBAL SKY AIR CHARTER CORP.		Opr dba: TRAUMA SKY		Aircraft Fire: GRD
				AW Cert: STN

Events

1. Landing - Fire/smoke (non-impact)

Narrative

On December 15, 2017, about 0650 eastern standard time, a Sikorsky S76A, N911FK, operated by Global Sky Air Charter Corporation, was substantially damaged by an engine compartment fire after landing near Islamorada, Florida. The airline transport pilot was not injured. The flight was operated in accordance with Title 14 Code of Federal Regulations Part 135 as an on-demand air medical flight. Visual meteorological conditions prevailed, and a company visual flight rules flight plan was filed for the flight that departed The Florida Keys Marathon International Airport (MTH), Marathon, Florida at 0637.

The operator reported that the pilot was conducting an air medical trauma patient pickup and had landed at a pre-surveyed landing zone in Islamorada, Florida at 0650. After landing, the pilot positioned the engines controls to ground idle and applied the rotor brake before the onboard medical crew departed the helicopter. After the medical crew departed the helicopter and arrived at the parked ambulance, the flight nurse looked at the helicopter and noticed black smoke, followed by flames coming out of the main rotor gear box area.

The pilot reported that he noticed No. 1 engine temperature fluctuations and shut down the engine. The flight nurse waved her arms and shouted that the helicopter was on fire. The pilot did not observe any indications of a fire from the cockpit; however, he noticed flames when he partially exited the helicopter. He then shut down the No. 2 engine, discharged both fire bottles, and exited the helicopter. He stated the fire continued until the fire department extinguished it.

According to Federal Aviation Administration (FAA) records, the helicopter was manufactured in 1981. It was equipped with twin Safran turboshaft engines driving a four-blade main rotor system. At the time of the accident, the helicopter had 11,406 airframe total hours. It was issued a standard airworthiness certificate in the transport category on June 22, 1998.

According to the pilot and operator records, the pilot held an airline transport pilot certificate with ratings for airplane multi-engine land and helicopter. His reported total flight time was 5,850 total hours with 685 hours in make and model. In the last 90 days, he flew 43 hours.

Examination of the helicopter by an FAA inspector revealed that the engine compartment was damaged by fire and there was heat damage to the hydraulic lines, rotor shaft, swashplate and rotor blades. In addition, the rotor brake was damaged and fused by heat.

The helicopter was recovered from the accident site and retained for additional examination.

National Transportation Safety Board - Aircraft Accident/Incident Database

Accident Rpt# GAA18CA098 01/10/2018 1850 MST Regis# N561UP Rock Springs, WY Apt: Rock Springs-sweetwater County RKS
Acft Mk/Mdl SWEARINGEN SA227-AT Acft SN AT-561 Acft Dmg: SUBSTANTIAL Rpt Status: Prelim Prob Caus: Pending
Fatal 0 Ser Inj 0 Flt Conducted Under: FAR UNK
Opr Name: AMERIFLIGHT Opr dba: Aircraft Fire: NONE
