Aviation Investigation Final Report

Location:	St Thomas, Caribbean Sea	**Accident Number:**	ERA21FA130
Date & Time:	February 15, 2021, 15:14 Local	**Registration:**	N13AT
Aircraft:	Bell 206	**Aircraft Damage:**	Destroyed
Defining Event:	Loss of engine power (total)	**Injuries:**	4 Fatal
Flight Conducted Under:	Part 91: General aviation - Aerial observation		

Analysis

During a short sightseeing flight around an island, the helicopter lost total engine power and descended into heavily wooded, steep terrain. The majority of the helicopter was consumed by a postcrash fire. The helicopter's proximity to the rising terrain at the time of the power loss likely precluded the pilot from performing a successful autorotation.

Examination of the engine found evidence of fatigue fractures on two of the stage 3 compressor blades and fatigue fractures on the majority of the stage 6 compressor blades. Analysis of the remainder of the stages 3 and 6 compressor wheels showed that they met material requirements. Thermal damage to the compressor case halves precluded determining whether the stages 3 and 6 blades were rubbing against the case and its plastic coating, which could have initiated the fatigue fractures. While pitting corrosion could also result in fatigue fractures, no evidence of pitting corrosion was found and only surface corrosion was present. The liberation of the two stage 3 compressor blades led to their ingestion within the remaining compressor stages, resulting in the total loss of engine power in flight.

The engine maintenance manual contained provisions for more frequent inspections when the engine is operating in an erosive and/or corrosive environment, such as where the accident operator was located. A caution within the 300-hour inspection table stated that the inspection must not exceed 300 hours or 12 months for coated compressor wheels, including the accident engine's stage 2-3 compressor wheel. The engine logbook showed that a 300-hour engine inspection was completed about 3 years and 800 flight hours before the accident. Paperwork associated with the two most recent inspections, conducted by the accident operator about 11 months and 1 month before the accident, respectively, did not indicate that the 300-hour inspection had been performed. Had maintenance personnel completed the 300-hour inspection of the compressor case halves, blades, and vanes within the recommended

12-month interval, the presence of corrosion or damage to the plastic coating could have been detected and addressed.

Probable Cause and Findings

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

A total loss of engine power due to fatigue failure of two of the stage 3 compressor blades. Contributing to the failure of the compressor blades was the failure of maintenance personnel to inspect the compressor at the recommended interval for operation in corrosive environments.

Findings

Aircraft	Compressor section - Fatigue/wear/corrosion
Personnel issues	Scheduled/routine inspection - Maintenance personnel

Factual Information

History of Flight

Maneuvering-low-alt flying	Loss of engine power (total) (Defining event)
Uncontrolled descent	Collision with terr/obj (non-CFIT)

HISTORY OF FLIGHT

On February 15, 2021, about 1514 Atlantic standard time, a Bell 206B-III, N13AT, was destroyed when it was involved in an accident near St. Thomas, U.S. Virgin Islands. The pilot and three passengers were fatally injured. The helicopter was operated as a Title 14 *Code of Federal Regulations* Part 91 sightseeing flight.

According to the Director of Operations, the accident flight was a planned 17-minute sightseeing flight around the island.

A witness standing in his front yard saw the helicopter fly over his house and out over the ocean. He stated that the helicopter began to make a 180° turn back toward him, at which time he began recording a video of the helicopter. About 6 seconds after the start of the video, a puff of dark-colored smoke emanated from the vicinity of the engine compartment and dissipated in the helicopter's rotor wash. The helicopter then abruptly yawed nose-left, then yawed nose-right, and descended in a right turn over wooded terrain downhill from the witness.

WRECKAGE AND IMPACT INFORMATION

The accident site was located in heavily wooded, steep terrain and the wreckage came to rest upright oriented on a heading of about 200° magnetic. The landing skids, main rotor system, main rotor drive system, engine, hydraulic system, and the forward portion of the tail rotor drive system were thermally damaged by a postimpact fire. The majority of the cockpit, cabin, and flight controls were consumed by fire. A portion of the tailboom, with the horizontal stabilizers attached, was embedded upright in a tree adjacent to the main wreckage. The aft portion of the tailboom, with the vertical fin and tail rotor, was found about 15 feet from the tailboom section.

The engine case showed no evidence of uncontained failure. The 1st and 2nd stage compressor blades displayed no evidence of foreign object debris ingestion. Two blades from the third stage compressor wheel had fractured near their respective root ends and were not present. The remainder of the 3rd stage compressor blades were present, but exhibited damage, primarily on their trailing edges. The 4th, 5th, and 6th stage compressor wheel blades

were all fractured near their root ends and were not present. The impeller inducer exhibited evidence of hard body debris ingestion.

The compressor section, power turbine shaft, and compressor turbine shaft were examined by the materials engineering department at the engine manufacturer's facility. The compressor vanes between stages 1 and 2 and stages 2 and 3 were present. A portion of the compressor vanes between stages 3 and 4 were missing, while the ones present were bent in the direction of normal compressor rotation. None of the remaining compressor vanes downstream of stage 4 were present. The stage 1 compressor wheel did not exhibit anomalous damage and its blades did not exhibit leading edge damage. Material analysis of the stage 1 compressor wheel showed that it met the required material type per the component drawing.

Both fractured stage 3 compressor blades exhibited signatures consistent with fatigue. Both fractures originated near the pressure side of their trailing edge, but the area of fatigue origins were impact damaged, precluding further analysis of the fatigue origins. There was no evidence of pitting corrosion on the remaining blades. On one blade, the fatigue progressed about 0.31 inches toward the leading edge, with the remainder of the fracture surface exhibiting signatures of overload. On the second blade, the fatigue fracture progressed about 0.023 inches toward the leading edge with the remainder of the fracture surface exhibiting signatures of overload. Analysis of a cross-section of the stage 2-3 compressor wheel found it met material requirements, including chemistry for material type as well as hardness.

Generalized corrosion was present on the inner and outer diameters of the compressor wheels for stages 4 and 5, but no pitting corrosion was present on the remnant airfoils and rim. On the stages 4 and 5 compressor wheels, the majority of the fracture surfaces were smeared, but the portions that were not smeared exhibited signatures consistent with overload. Material analysis of the stages 4 and 5 compressor wheels showed they met the required material type per the component drawing.

The stage 6 compressor inner and outer diameter surfaces exhibited generalized corrosion. On every stage 6 compressor blade, except for one, all fracture surfaces exhibited signatures of fatigue with multiple origins near the suction-side crown root. For the one blade, a crack was present on the surface that, when opened by the lab, revealed evidence of fatigue progression from multiple origins. Material analysis of the stage 6 compressor wheel showed it met material requirements, including chemistry for material type as well as hardness.

AIRCRAFT INFORMATION

According to the engine logbook, the accident engine, serial number (S/N) CAE-833459, was installed new onto the accident airframe, S/N 3267, on February 6, 1981, at the time of manufacture. The accident helicopter had previously operated in Alaska and Texas with other operators before its arrival to Saint Thomas on November 26, 2019, for operation at Caribbean Buzz Helicopters. Between December 2008 to January 2009, at an engine total time (ETT) of 8,487.6 hours, compressor section S/N CAC-36783 was removed from the engine for overhaul and inspection. During this overhaul, a new stage 1 compressor wheel, stage 2-3 compressor

wheel, and impeller were installed; the original stage 4 and stage 5 compressor wheels remained installed. At the conclusion of this overhaul, compressor section S/N CAC-36783 had a component time since new (CTSN) of 8,398.1 hours, a component time since overhaul (CTSO) of 0 hours, and a component cycles since new (CSN) of 8,892 cycles.

The most recent engine maintenance occurred on February 12, 2021, at an airframe total time (ATT) of 11,516.9 hours and an ETT of 11,516.9 hours, during which the power turbine governor was replaced with an overhauled governor. At the start of the day of the accident, the helicopter had an ATT of 11,519.3 hours and an ETT of 11,519.3 hours; compressor section S/N CAC-36783 had a CTSN of 11,429.8 hours, a CTSO of 3,031.7 hours, and a CSN of 12,607 cycles.

During the helicopter's time at Caribbean Buzz Helicopters, two annual/100-hour inspections were completed on the airframe and engine. The first annual inspection occurred on March 1, 2020, at an ATT of 11,406.2 hours and an ETT of 11,406.2 hours. The second and most recent annual inspection was performed on January 25, 2021, at an ATT of 11,504.2 hours and an ETT of 11,504.2 hours. The 100-hour engine inspection included a visual inspection for the compressor inlet guide vanes and visible blades and vanes for foreign object damage.

The 300-hour inspection checklist required inspection of the case, blades, and vanes when operating in an erosive and/or corrosive environment. The inspection recommended using 10X power magnification to inspect for corrosion pits. The 300-hour engine inspection included a caution that stated the following:

Rolls-Royce Commercial Service Letter (CSL) 1172 discusses compressor case inspection intervals that may change based on operating environments. CSL 1172 was originally issued on February 28, 1991, with Revision 4, the latest revision, dated December 21, 2007. CSL 1172 states that for non-coated compressor wheels, the case-half inspection interval shall not exceed 300 hours or 6 months, whichever occurs first. For coated compressor wheels and blisk compressor wheels, the inspection shall not exceed 300 hours or 12 months, whichever occurs first.

The engine logbook indicated that a 300-hour engine inspection was completed on February 16, 2017, at an ATT of 10,959.5 hours and an ETT of 10,959.5 hours. Another 300-hour inspection checklist was endorsed on January 11, 2018, at an ATT of 11,197.2 hours and an ETT of 11,197.2 hours, but a corresponding 300-hour inspection entry could not be found in either aircraft or engine logbooks. An undated engine inspection checklist from Caribbean Buzz Helicopters, endorsed on March 1, 2020, had no initials or markings in the 300-hour inspection section. During the last annual/100-hour inspection, endorsed on January 25, 2021, the engine inspection checklist's 300-hour inspection section was crossed out and marked "N/A." According to the operator's director of maintenance, the compressor case halves were not opened to facilitate visual inspection of the compressor section. Instead, only borescope was used to inspect the compressor.

Rolls-Royce CSL 1135, discusses engine contamination removal instructions using water, also known as a water rinse. CSL 1135 states that “engines subjected to saltwater contamination shall undergo water rinsing after shutdown following the last flight of the day” and provides instructions to spray water into the compressor inlet while the engine is being motored with the starter. A review of the aircraft logbook found multiple entries regarding an engine compressor rinse, with the most recent entry of an engine rinse occurring on January 13, 2021, at an ATT of 11,497.0 hours and an ETT of 11,497.0 hours.

Pilot Information

Certificate:	Commercial	**Age:**	56,Female
Airplane Rating(s):	None	**Seat Occupied:**	Right
Other Aircraft Rating(s):	None	**Restraint Used:**	Unknown
Instrument Rating(s):	Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	August 6, 2020
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	(Estimated) 9800 hours (Total, all aircraft), 9999 hours (Total, this make and model)		

Aircraft and Owner/Operator Information

Aircraft Make:	Bell	**Registration:**	N13AT
Model/Series:	206 B	**Aircraft Category:**	Helicopter
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	3267
Landing Gear Type:	Skid	**Seats:**	5
Date/Type of Last Inspection:	January 25, 2021 Annual	**Certified Max Gross Wt.:**	
Time Since Last Inspection:	15 Hrs	**Engines:**	1 Turbo shaft
Airframe Total Time:	11504.2 Hrs as of last inspection	**Engine Manufacturer:**	ALLISON
ELT:	Not installed	**Engine Model/Series:**	250-C20 SER
Registered Owner:	Caribbean Buzz Management LLC.	**Rated Power:**	420 Horsepower
Operator:	Caribbean Buzz Management LLC.	**Operating Certificate(s) Held:**	Commuter air carrier (135)

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	TIST,24 ft msl	**Distance from Accident Site:**	4 Nautical Miles
Observation Time:	14:53 Local	**Direction from Accident Site:**	90°
Lowest Cloud Condition:	Few / 5500 ft AGL	**Visibility**	8 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	12 knots /	**Turbulence Type Forecast/Actual:**	None / None
Wind Direction:	80°	**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	30.02 inches Hg	**Temperature/Dew Point:**	29.4°C / 17.2°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	St. Thomas, USVI, OF (STT)	**Type of Flight Plan Filed:**	None
Destination:	St. Thomas, USVI, OF (STT)	**Type of Clearance:**	None
Departure Time:	15:10 Local	**Type of Airspace:**	

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:	3 Fatal	**Aircraft Fire:**	On-ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	4 Fatal	**Latitude, Longitude:**	18.354444,-65.027778(est)

Administrative Information

Investigator In Charge (IIC):	Boggs, Daniel
Additional Participating Persons:	Raphael Gonzalez; FAA; San Juan, PR Jack Johnson; Rolls Royce; Inianapolis , IN Gary P. Howe; Bell Helicopter; Hurst, TX Beverley Harvey; TSB Canada; Gatineau, Quebec , OF
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Note:	
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