



NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Washington, D.C. 20594

January 4, 2022

AIRWORTHINESS GROUP CHAIRMAN'S FACTUAL REPORT

NTSB No: ERA21FA130

A. ACCIDENT

Operator: Caribbean Buzz
Aircraft: Bell 206B-III, registration N13AT
Location: Saint Thomas, United States Virgin Islands
Date: February 15, 2021
Time: 15:14 Atlantic standard time

B. GROUP

Group Chairman:	Chihoon Shin National Transportation Safety Board Washington, District of Columbia
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LIST OF ACRONYMS

ATT	aircraft total time
CSL	Commercial Service Letter
CSN	cycles since new
CTSN	component time since new
CTSO	component time since overhaul
ETT	engine total time
FAA	Federal Aviation Administration
FOD	foreign object debris
NTSB	National Transportation Safety Board
S/N	serial number
TSN	time since new
TSO	time since overhaul
USVI	United States Virgin Islands

C. SUMMARY

On February 15, 2021, about 1514 Atlantic standard time, a Bell 206B-III, N13AT, was destroyed when it was involved in an accident on Saint Thomas, United States Virgin Islands (USVI). 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, who was also a pilot for the operator, 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 the helicopter started to make a 180° turn back toward him. At that time, the witness pulled out his mobile phone and started recording a video of the helicopter flying toward him. The local terrain had steep slopes and he was located at the peak of a steep hill. Review of the video revealed that the terrain was ascending as the helicopter flew closer to the witness. About 6 seconds after the start of the video, a puff of dark-colored smoke emanated from the vicinity of the engine compartment, which dissipated in the helicopter's rotor wash. The helicopter then abruptly yawed nose-left, after which the nose yawed right and the helicopter descended in a right turn toward the wooded terrain downhill from the witness.

Examination of the engine found two of the stage 3 compressor blades from the stage 2-3 compressor wheel had fractured with signatures of fatigue observed on the fracture surface. The fatigue progressed from an impact-damaged area of the fracture surface. No geometric or material anomalies were observed on the intact trailing edge locations that exhibited fatigue. All remaining stage 3 compressor blades exhibited impact damage on their trailing edges. Generalized surface corrosion was observed along the gas path surfaces, but there was no evidence of pitting corrosion on the stage 3 compressor blades. All compressor blades from stages 4, 5, and 6 were fractured and separated from their respective compressor wheels.

D. DETAILS OF THE INVESTIGATION

1.0 HELICOPTER INFORMATION

1.1 HELICOPTER DESCRIPTION

The Bell 206B-III is type certificated under Federal Aviation Administration (FAA) type certificate data sheet No. H2SW. The 206B-III has a two-bladed semi-rigid (teetering) main rotor system that provides helicopter lift and thrust. A two-bladed teetering tail rotor system provides thrust for helicopter directional control. The accident helicopter was equipped with a Rolls-Royce 250-C20B turboshaft engine.

1.2 HELICOPTER HISTORY

The accident helicopter, serial number (S/N) 3267, was manufactured in 1981. Engine S/N CAE-833459 was installed at the time of the accident. According to aircraft records, the accident helicopter and its engine had each accumulated an aircraft total time (ATT) of about 11,519.3 hours and an engine total time (ETT) of about 11,519.3 hours, respectively, at the start of the day of the accident.

2.0 ON SCENE EXAMINATION¹

On February 18-19, 2021, National Transportation Safety Board (NTSB) investigators examined the wreckage at the accident site. The helicopter came to rest upright on a heading of about 200° magnetic. The wreckage location was 18°21'18" North by 65°1'40" West and an elevation of about 376 feet above mean sea level. The majority of the wreckage exhibited thermal damage due to exposure from the postcrash fire (**Figure 1**).



Figure 1. The accident site.

¹ The terms “left”, “right”, “up” and “down” are used when in the aft-looking-forward frame of reference. All locations, directions, and clock positions will be viewed from aft-looking-forward unless otherwise specified.

2.1 STRUCTURES

The majority of the main fuselage, including the cockpit and cabin, was consumed by the postcrash fire. The forward section of the tail boom, where the intercostal mounts are located, was on the ground adjacent to the main wreckage. The aft section of the tail boom assembly, including the horizontal stabilizers, was in a tree (a few feet above the ground) adjacent to the forward section of the tail boom. The aft end of the tail boom, with the vertical fin and tail rotor still attached, was found about 15 feet away from the tail boom section in the tree. The skid landing gear was found at the main wreckage site. Both left and right skid tubes were fragmented into multiple large pieces. The forward crosstube had fractured into multiple pieces and the aft crosstube was mostly whole but deformed by impact. The upper wire strike protection system's cutter, mounted on the roof near the top of the windscreen, was found next to a fractured main rotor blade.

2.2 MAIN ROTOR SYSTEM

2.2.1 MAIN ROTOR

Both main rotor blades remained attached to their respective grips, and both main rotor blade grips remained attached to the main rotor hub (**Figure 2**). One main rotor blade span was continuous from root to tip. The second main rotor blade was fractured about 41 inches outboard of its [inboard] blade attachment bolt. A 100-inch section of the second main rotor blade was found on the ground adjacent to the main rotor hub and the tip weight for this blade was found within the fuselage wreckage. The main rotor hub remained attached to the main rotor mast. The mast nut and adjacent installation hardware remained installed.



Figure 2. The main rotor, main rotor mast, and a portion of the main rotor gearbox found as an assembly at the accident site.

2.2.2 MAIN ROTOR DRIVE

The main rotor gearbox was found within the main wreckage. The gearbox housing was consumed by the postcrash fire, revealing the internal gears. The mast, planetary gearset, and main bevel gear remained as an assembly. The input quill (pinion gear) was found in the main wreckage near the engine deck and had the forward portion of the Kaflex coupling still attached to its flange. The left pylon support link remained attached to the remnants of the gearbox. The right pylon support link was separated and found in the main wreckage near the engine deck.

The Kaflex drive shaft remained attached to the freewheeling unit. The aft Kaflex coupling was whole and the remainder of the forward Kaflex coupling remained attached to the forward end of the Kaflex drive shaft. The freewheeling unit remained attached to the power output gear but had resolidified metal covering it. The rotor brake disk remained attached to the drive shaft assembly.

2.3 TAIL ROTOR SYSTEM

2.3.1 TAIL ROTOR

The tail rotor assembly remained attached to the tail rotor gearbox output shaft (**Figure 3**). The crosshead, pitch links, pitch horns, and yoke assembly did not exhibit evidence of preimpact fractures or separation. The two tail rotor blades remained attached to the yoke and were whole with no significant damage to its leading edge and afterbody. Manual manipulation of tail rotor blade pitch revealed no evidence of restriction or anomalous damage to the pitch change mechanism.



Figure 3. The tail rotor, tail rotor gearbox, and vertical stabilizer at the accident site.

2.3.2 TAIL ROTOR DRIVE SYSTEM

The steel tail rotor driveshaft was located adjacent to the engine and was continuous to the spline adapter. The splines of the spline adapter exhibited no anomalous wear. The blower shaft and blower were found adjacent to the engine and its drive splines showed no anomalous wear. The tail rotor drive system was continuous within the tail boom section located in the tree.

The tail rotor gearbox remained installed on the aft-most section of the tail boom (containing the vertical fin). Tail rotor drive continuity was confirmed through the tail rotor gearbox with no evidence of restriction when manually rotated. Oil was present in the tail rotor gearbox. The tail rotor gearbox chip detector showed no evidence of magnetic chips.

2.4 FLIGHT CONTROL SYSTEM

2.4.1 ROTOR CONTROLS

The link assembly (the rotating scissors) remained installed on the outer ring (the rotating swashplate). Both pitch links remained installed to their respective blade pitch horn and the outer ring, but the tubes of both pitch links were fractured. The inner ring (stationary swashplate) input link ends remained attached to the collective lever and the input link was present. However, the control tubes were melted from the input link.

2.4.2 COCKPIT CONTROLS

Both left and right collective controls were present in the wreckage. The right collective control twist grip throttle position was in the 'flight' position. For the right seat pedals, the left pedal and a portion of the right pedal was found within the wreckage. For the left seat pedals, the pedal mounts were found in the wreckage but neither pedal was present. The left and right cyclic controls were not found.

2.5 POWERPLANT

2.5.1 ACCIDENT SITE OBSERVATIONS

The engine was present on the engine deck, but the accessory gearbox housing was consumed by the postcrash fire (**Figure 4**). The engine case showed no evidence of uncontained failure. The compressor discharge tubes were separated from the compressor module but remained attached to the combustor. All first stage compressor blades were present with no evidence of foreign object debris (FOD) ingestion (**Figure 5**). The compressor section data plate showed it was S/N CAC-36783.

The fuel spray nozzle and igniter plug remained attached to the combustor and the lines running to them were continuous up to the area of the accessory gearbox. There was no visible separation between the combustor and turbine sections. Both exhaust outlets were attached but the right outlet was dented on its outer edge. Visual examination through the exhaust showed no evidence of FOD damage or operational failure of the fourth stage power turbine and turbine vanes.

Within the accessory gearbox, the power turbine pinion gear was present and resting on top of the spur adapter gearshaft. The torquemeter gear was resting on the engine wreckage. The power output gear remained attached to the freewheeling unit.



Figure 4. The engine assembly at the accident site.



Figure 5. A view of the first stage compressor blades through the engine inlet.

2.5.2 POST-RECOVERY EXAMINATION

The wreckage was recovered to a hangar at Cyril E. King Airport in Charlotte Amalie, Saint Thomas for further examination on February 20, 2021. The compressor section was separated from the remainder of the engine. Subsequently, the compressor case halves were separated. All blades on compressor stages 1 and 2 were present and did not exhibit anomalous damage. Two of the stage 3 blades were fractured and separated from the wheel (**Figure 6**). The remainder of the stage 3 blades were present and the majority of them had impact damage on their trailing edges. All blades from compressor stages 4, 5, and 6 were fractured and separated from their wheels (**Figure 7**). Remnant pieces of axial compressor blades were found within the axial compressor section as well as the impeller inducer. The impeller inducer exhibited damage consistent with hard body FOD ingestion.² The impeller exducer did not exhibit evidence of FOD ingestion. Remnant pieces of [axial] compressor blades were found within the impeller vane assembly. The inner surfaces of the impeller shroud exhibited circular scoring marks. The part numbers and S/Ns for the compressor wheels are listed in **Table 1**.



Figure 6. Two fractured stage 3 compressor blades.

Table 1. The part and serial numbers of the wheels from compressor section S/N CAC-36783.

Nomenclature	Part Number	Serial Number
Stage 1 wheel	23057111	KR115419
Stage 2-3 wheel	23057112	KR112489
Stage 4 wheel	23057114	KR72700
Stage 5 wheel	23060406	KR52387
Impeller	23079638	KR117988

² Hard body FOD ingestion damage is characterized by a serrated appearance and deep cuts or tears to a blade's leading and trailing edges. Such damage can result from ingestion of metal parts, concrete, asphalt, or rocks.



Figure 7. The axial compressor after removal of a case half.

All [axial] compressor stators were present between the stages 1 and 2 wheel as well as the stages 2 and 3 wheels, though several vanes on the latter exhibited damage on their downstream edges (**Figure 8**). All but 11 stator vanes were fractured and separated between the stages 3 and 4 wheels. The 11 remaining stator vanes exhibited deformation and were bent in the direction of normal axial compressor rotation. All stator vanes between stages 4 and 5; 5 and 6; and 6 and impeller stages were fractured and separated. The plastic coating within the compressor case halves exhibited thermal degradation from exposure to the postcrash fire.



Figure 8. The two compressor case halves showing the damaged liner.

The power turbine shaft and compressor turbine shaft were both removed and their splines showed no evidence of anomalous damage. These shafts were used to attempt manual rotation of the compressor and power turbine, but neither could be manually rotated.

The compressor section, power turbine shaft, and compressor turbine shaft were shipped to Rolls-Royce in Indianapolis, Indiana for metallurgical examination.

3.0 ENGINE COMPRESSOR SECTION LAB EXAMINATION

From February to May 2021, the compressor section, power turbine shaft, and compressor turbine shaft were examined by the Materials Engineering Department at Rolls-Royce in Indianapolis, Indiana.

The compressor vanes between stages 1-2 and stages 2-3 were present. A portion of the compressor vanes between stages 3-4 were missing, while the ones present were bent in the direction of normal compressor rotation. None of the remaining downstream compressor vanes 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 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.

For the additional details of the metallurgical examination of the compressor section, [Attachment 1](#) contains the Rolls-Royce Materials Evaluation Report No. 21FAE-025-PR in the docket for this investigation.

4.0 MAINTENANCE

According to aircraft and engine records, the accident engine, S/N CAE-833459, was installed new onto the accident airframe, S/N 3267, on February 6, 1981 during the helicopter's manufacture at Bell. The accident helicopter had previously operated in Alaska and Texas with other operators prior its arrival to Saint Thomas, USVI on November 26, 2019 for operation at Caribbean Buzz Helicopters.³

4.1 COMPRESSOR COMPONENT TIMES

According to the engine logbook, between December 2008 to January 2009, at an 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 the impeller were installed; the original stage 4 and stage 5 compressor wheels remained installed. At the conclusion of the 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. **Table 2** shows the CTSN and CSN of the compressor wheels at the conclusion of the overhaul in January 2009.

Table 2. The compressor wheel times and cycles at the conclusion of the January 2009 overhaul.

Nomenclature	Serial Number	CTSN (hours)	CSN (cycles)
Stage 1 wheel	KR115419	0	0
Stage 2-3 wheel	KR112489	0	0
Stage 4 wheel	KR72700	4,876.4	4,659
Stage 5 wheel	KR52387	4,876.4	4,659
Impeller	KR117988	0	0

The most recent engine maintenance occurred on February 12, 2021 at an ATT of 11,516.9 hours and an ETT of 11,516.9 hours in which the power turbine governor was replaced with an overhauled governor.⁴ At the start of the day of the accident, when 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. **Table 3** shows the calculated CTSN and CSN of the compressor wheels at the start of the day of the accident.

Table 3. The calculated compressor wheel times and cycles at the start of February 15, 2021.

Nomenclature	Serial Number	CTSN (hours)	CSN (cycles)
Stage 1 wheel	KR115419	3,031.7	3,715
Stage 2-3 wheel	KR112489	3,031.7	3,715
Stage 4 wheel	KR72700	7,908.1	8,374
Stage 5 wheel	KR52387	7,908.1	8,374
Impeller	KR117988	3,031.7	3,715

³ According to the aircraft logbook, on November 26, 2019 the accident helicopter had an ATT of 11,371.3 hours. The ETT was calculated to be 11,371.3 hours.

⁴ According to the Director of Maintenance, the power turbine governor was replaced as it was coming due for overhaul but was also acting "sluggish" based on his recollection of pilot reports.

4.2 ANNUAL/100-HOUR AIRFRAME AND ENGINE INSPECTIONS

During the helicopter's time at Caribbean Buzz Helicopters, two annual/100-hour inspections were signed off for the airframe and engine. The first annual inspections 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. For the engine compressor section, the 100-hour engine inspection includes a visual inspection for the compressor inlet guide vanes and visible blades and vanes for foreign object damage.

Attachment 2 contains the last two annual/100-hour inspection sign offs for N13AT.

4.3 300-HOUR ENGINE INSPECTION

For the engine compressor section, the 300-hour inspection checklist requires inspection of the case, blades, and vanes when operating in an erosive and/or corrosive environment.⁵ The inspection recommends using 10X power magnification to inspect for corrosion pits. The 300-hour engine inspection includes a caution that states the following:

Caution: Inspection frequency must be based on the nature of the erosive and/or corrosive environment. The operating environment can dictate a more frequent inspection interval. When operating in a corrosive and/or erosive environment for non-coated compressor wheels, the inspection must not exceed 300 hours or 6 months. For coated compressor wheels, inspection must not exceed 300 hours or 12 months. For compressor blisks, inspection must not exceed 300 hours or 12 months. If any wheel exhibits corrosion and/or erosion, the inspection requirement must revert back to 300 hours or 6 months.⁶

Rolls-Royce Commercial Service Letter (CSL) 1172⁷ 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 showed a 300-hour engine inspection was signed off on February 16, 2017 at an ATT of 10,959.5 hours and an ETT of 10,959.5 hours. Additionally, a 300-hour inspection checklist was signed off 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, possibly from the annual/100-hour inspection signed off on March 1, 2020, had no initials or markings in the 300-hour inspection section. During the last annual/100-hour

⁵ Found in Table 602, "Scheduled Inspections", in Chapter 72-00-00 of the Rolls-Royce 250-C20 Series Operation and Maintenance Manual.

⁶ According to its Airworthiness Release Certificate (FAA Form 8130-3), the stage 1 and stage 2-3 compressor wheels, S/Ns KR115419 and KR112489, respectively, were coated.

⁷ This Rolls-Royce CSL applies to other variants of the Rolls-Royce 250 engine, each with their own CSL numbers.

inspection, signed off 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, a only borescope was used to inspect the compressor.

Attachment 3 contains the January 25, 2021 engine inspection checklists from Caribbean Buzz Helicopters. **Attachment 4** contains the undated engine inspection checklist from Caribbean Buzz Helicopters.

4.4 COMPRESSOR RINSE

Rolls-Royce CSL 1135⁸, discusses engine contamination removal instructions using water, also known as a water rinse. CSL 1135 states that "engines subjected to salt water 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. **Table 4** contains a list of engine compressor rinse entries found in the aircraft logbook for the last 100 hours.

Table 4. Engine compressor rinse entries from the last 100 hours, oldest entry first.

Date	ATT (hours)	ETT (hours)
July 20, 2020	11,423.7	11,423.7
July 31, 2020	11,424.9	11,424.9
August 5, 2020	11,426.6	11,426.6
August 18, 2020	11,435.7	11,435.7
August 20, 2020	11,435.7	11,435.7
October 19, 2020	11,443.3	11,443.3
November 21, 2020	11,457.0	11,457.0
December 4, 2020	11,464.2	11,464.2
December 6, 2020	11,465.8	11,465.8
December 10, 2020	11,468.6	11,468.6
December 26, 2020	11,477.0	11,477.0
December 30, 2020	11,482.9	11,482.9
January 13, 2021	11,497.0	11,497.0

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⁸ This Rolls-Royce CSL applies to other variants of the Rolls-Royce 250 engine, each with their own CSL numbers.