



AVIATION



HIGHWAY



MARINE



RAILROAD



PIPELINE

Aviation Investigation Final Report

Location:	The Woodlands, Texas	Accident Number:	CEN15LA104
Date & Time:	January 16, 2015, 12:30 Local	Registration:	N416JB
Aircraft:	BAKER BOBBY J SAFARI	Aircraft Damage:	Substantial
Defining Event:	Aircraft structural failure	Injuries:	1 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The commercial pilot was conducting a personal flight in the experimental, amateur-built helicopter. Several witnesses reported seeing the helicopter flying overhead. They reported that it appeared to be flying normally but that it then turned sideways, banked left, and descended to the ground. One witness reported hearing a breaking sound and then seeing the "back rotor" hanging from the helicopter.

The horizontal stabilizer was found separated from the tailboom. Postaccident examination revealed that the horizontal stabilizer spar tube had fractured at the weld area just outboard of the mounting flange. Examinations of the fracture surfaces revealed features consistent with fatigue cracking that had initiated at multiple origins along the weld toe. Although no weld defects or corrosion were noted at the fatigue origins, large areas of both fracture faces were covered by red and brown corrosion products, indicating that the cracks were present and exposed for a considerable amount of time (at least many days but more likely many weeks).

The fatigue origins were located on the aft surface of the spar and propagated generally forward. The origin location and direction of propagation were indicative of cyclic bending loads in the spar as if the tip of the stabilizer repetitively moved forward relative to the mount. The source of the cyclic bending loads was not clear but could have been the result of many different helicopter factors. These factors could have been unique to the accident helicopter or could be present on all similar helicopters. It is likely that the horizontal stabilizer separated in flight due to undetected fatigue cracking in the stabilizer spar, which resulted in the uncontrolled descent.

As assembled, the fracture location and weld were partially hidden by the horizontal stabilizer's airfoil skin and not directly visible, which would have made any cracking difficult to see. Following the accident, the kit manufacturer issued a mandatory inspection and modification bulletin for the horizontal stabilizer, which detailed inspection criteria and spar replacement guidance if cracking was found.

Probable Cause and Findings

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

An in-flight separation of the helicopter's horizontal stabilizer due to undetected fatigue cracking of the stabilizer spar, which resulted in a loss of control.

Findings	
Aircraft	(general) - Failure
Aircraft	(general) - Fatigue/wear/corrosion

Factual Information

History of Flight

Enroute	Aircraft structural failure (Defining event)
Enroute	Loss of control in flight

On January 16, 2015, about 1230 central standard time, an experimental, amateur-built Safari 400 helicopter, N416JB, impacted terrain following a loss of control in The Woodlands, Texas. The commercial pilot was fatally injured, and the helicopter was destroyed. The helicopter was registered to and operated by the pilot under the provisions of 14 *Code of Federal Regulations* Part 91 as a personal flight. Visual meteorological conditions prevailed for the flight, and no flight plan was filed.

Witnesses reported that the helicopter was flying in a south-west direction over the property of Woodland Church. The helicopter appeared normal as it neared the church, then the helicopter "turned sideways," banked to the left, and descended to the ground. One witness stated that he heard a breaking sound and saw the "back rotor" hanging.

Pilot Information

Certificate:	Commercial	Age:	51
Airplane Rating(s):	Single-engine land	Seat Occupied:	Left
Other Aircraft Rating(s):	None	Restraint Used:	
Instrument Rating(s):	Airplane	Second Pilot Present:	No
Instructor Rating(s):	None	Toxicology Performed:	No
Medical Certification:	Class 2 With waivers/limitations	Last FAA Medical Exam:	April 23, 2014
Occupational Pilot:	No	Last Flight Review or Equivalent:	
Flight Time:	25.7 hours (Total, this make and model)		

The pilot, age 51, held a commercial pilot certificate with airplane single-engine land and instrument ratings. He held a second-class airman medical certificate that was issued on April 23, 2014, with the limitation that he must wear corrective lenses. On the application for this medical certification, the pilot reported that he had accumulated 2,300 total flight hours of which 150 hours were in the previous 6 months.

According to the pilot's logbook, he had accumulated a total of 48.5 hours total helicopter time at the time of the accident. The pilot began his helicopter training in a Schweizer 269C on September 28, 2014. He accumulated a total of 24.0 hours (including 2.5 hours of solo time) in the Schweizer before transitioning to the accident helicopter on December 18, 2014. He had accumulated 25.7 hours total time (including 11 hours of solo time) in the Safari at the time of the accident.

Aircraft and Owner/Operator Information

Aircraft Make:	BAKER BOBBY J	Registration:	N416JB
Model/Series:	SAFARI NO SERIES	Aircraft Category:	Helicopter
Year of Manufacture:	2010	Amateur Built:	Yes
Airworthiness Certificate:	Experimental (Special)	Serial Number:	CH2181
Landing Gear Type:	Skid	Seats:	2
Date/Type of Last Inspection:		Certified Max Gross Wt.:	
Time Since Last Inspection:		Engines:	1 Reciprocating
Airframe Total Time:		Engine Manufacturer:	AEROSPORT
ELT:		Engine Model/Series:	O-360
Registered Owner:	On file	Rated Power:	180 Horsepower
Operator:	On file	Operating Certificate(s) Held:	None

The helicopter was constructed from a kit produced by Safari Helicopter. It was a two-seat, skid-equipped helicopter with two composite main rotor blades that rotated clockwise and a tail rotor for anti-torque control. The helicopter was equipped with an Aero Sport O-360 engine. Components such as the main rotor head and the tail rotor would typically be delivered to the customer fully assembled.

The accident helicopter, serial number CH2181, was built by the owner of Safari Helicopters on March 1, 2010. A special airworthiness certificate for the helicopter was issued by the FAA on March 6, 2010. The helicopter was sold about 5 days later to a private individual who owned the helicopter until the accident pilot purchased it on November 6, 2014.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	Condition of Light:	Day
Observation Facility, Elevation:	KCXO, 245 ft msl	Distance from Accident Site:	10 Nautical Miles
Observation Time:	11:53 Local	Direction from Accident Site:	19°
Lowest Cloud Condition:	Clear	Visibility	10 miles
Lowest Ceiling:	None	Visibility (RVR):	
Wind Speed/Gusts:	/	Turbulence Type Forecast/Actual:	/
Wind Direction:		Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	30.35 inches Hg	Temperature/Dew Point:	12°C / 1°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Conroe, TX	Type of Flight Plan Filed:	None
Destination:	Conroe, TX	Type of Clearance:	None
Departure Time:		Type of Airspace:	Class G

At 1153, the George Bush Intercontinental Airport (KIAH) automated surface reporting system, located 17 miles southeast of the accident site, reported the following weather conditions: calm winds, 10 miles visibility, ceiling broken at 2,500 ft, temperature 8°C, dew point 3°C, and altimeter 30.93 inches of mercury.

Wreckage and Impact Information

Crew Injuries:	1 Fatal	Aircraft Damage:	Substantial
Passenger Injuries:		Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	1 Fatal	Latitude, Longitude:	30.199722,-95.476387(est)

The NTSB investigator-in-charge (IIC) did not travel to the accident scene. According to photographs taken by the FAA on-site, the main wreckage consisting of the fuselage, main rotor, tail and tail rotor came to rest at the fenceline of a treed area. The horizontal stabilizer had separated from the tail boom and was found about 65 feet northeast of the fuselage. The right door frame was found about 85 feet northeast of the fuselage.

The helicopter wreckage was examined at the facilities of Air Salvage of Dallas on February 24-25, 2015, under the supervision of the NTSB IIC. The examination revealed that the horizontal stabilizer's spar (a steel tube) had separated at the weld area just outboard of a round steel plate (the stabilizer

mounting flange) that was welded to the spar. The fracture exhibited signatures of corrosion and fatigue at the weld line. The inboard portion of the spar remained bolted to the tail boom at the mounting flange. Paint transfers were observed on one tail rotor blade. These transfers were located on the side of the blade where the horizontal stabilizer would be mounted. Additionally, both tail rotor blades exhibited impact damage on the leading and trailing edges of the blades.

Flight control continuity was established from the cockpit flight controls through the tail rotor system. The control pedal cable leading from the tail rotor assembly to the right control pedal was found in the full right control pedal position. (In this helicopter, the right pedal is used to counter the torque of the main rotor.) The stationary swash plate (controlling right/left, fore, and aft cyclic) was fractured and separated at all three push-pull tubes. The right door upper and lower hinges were intact, and the upper and lower latching points appeared normal.

The governor friction clutch was found loose. The friction clutch was found to rotate freely and was characterized by a Safari Helicopter representative as slightly loose. According to the Safari Helicopter representative, an excessively loose friction clutch could prevent effective throttle manipulation by the governor, and an overly tight friction clutch could prevent the pilot from over-riding the governor. An instructor pilot for Safari who had recently flown with the accident pilot in the accident helicopter stated that the governor appeared to operate properly.

Engine continuity was confirmed by turning the crankshaft to establish compression at all four cylinders. The four top and four bottom spark plugs were removed from the engine. All eight spark plugs appeared unremarkable. The magneto was turned by hand and sparked at all four connection wires.

The carburetor was in the full throttle position. Blue colored fuel (consistent in appearance with 100 low-lead aviation fuel) was found in the carburetor. The gascolator and carburetor fuel filter screens were void of contaminants. The air filter was examined and appeared unremarkable.

Main Rotor System

The main transmission pinion, tail rotor output shaft, and clutch assembly were separated from the main transmission and free of their mountings. The bottom of the clutch assembly showed evidence of a rotational impact of the clutch drive plate on one of the six clutch drum mount bolts consistent with rotation at the time of impact.

Both composite main rotor blades were deformed upward. One main rotor blade was broken through the laminate and spar about 2 feet outboard of the grip; however, the brass rod along the leading edge was intact but severely deformed. Both main rotor blades exhibited impact marks along the outboard 3 to 4 feet of the leading edges. The main rotor blades rotated normally about the feathering axis when rotated by hand at the grips.

The shear line from the transmission to the main rotor shaft was intact consistent with movement of the gears of the main shaft. The drive gear was still coupled to the shaft.

Tail Section

Impact marks on the tail structure and tail rotor drive shaft were observed. The damage was consistent with a right to left main rotor strike, when looking forward.

The tail rotor drive shaft was impacted at 14.5 inches aft of the forward edge of the fifth bearing frame. The fractured end of the tail was near the forward end of the tail boom. The sixth bearing, along with the tail rotor input coupling and the aft end of the drive shaft (about 24 inches) were missing.

The tail rotor output from the main transmission spun freely; however, the bearings did not rotate smoothly. The tail rotor pitch arms were fastened in their grips. The tail rotor pitch links were deformed and still attached.

Flight Deck Observations

The ignition switch was found in the right ("R") position. A test of the magneto switch and the ignition module pin (#1) indicted the electronic ignition was open, and the magneto was grounded. Only the electronic ignition would have been operating at this switch setting.

The helicopter had warning indicator bulbs for the main rotor, tail rotor, governor, fuel low, and low oil pressure; examination of all five bulbs revealed that none exhibited the typical filament stretching found when a bulb is lit at impact.

Medical and Pathological Information

An autopsy of the pilot was conducted under the authority of Montgomery County Forensic Services, Conroe, Texas. The cause of death for the pilot was attributed to "multiple blunt injuries."

The FAA Bioaeronautical Sciences Research Laboratory, Oklahoma City, Oklahoma, performed toxicology testing for the pilot. The pilot's toxicology results were negative for carbon monoxide and alcohol. The medications colchicine, doxazosin, and valsartan were detected.

The pilot reported use of doxasozin and valsartan on his most recent FAA medical examination. Both of these prescription medications are used to treat high blood pressure and are not considered to pose a hazard to flight safety. The prescription medication colchicine, which is used to prevent and/or relieve the pain from gout attacks in adults, was not reported previously to the FAA. Some possible side effects of colchicine include nausea, diarrhea, stomach cramps, and weakness.

Tests and Research

Horizontal Stabilizer

The horizontal stabilizer and the tail rotor cross and sleeve assembly were sent to the NTSB Materials

Laboratory in Washington, DC, for further examination. The phenolic sleeve on the tail rotor cross was fractured at the end flange. Examination of the flange fracture revealed a brittle overstress separation with no indications of discontinuities.

The spar tube of the horizontal stabilizer was fractured just outboard of the mounting flange and adjacent to the inboard edge of the airfoil section. The forward side of the end plate was bent slightly outboard but no impact damage was apparent on either the end plate or the airfoil skin of the stabilizer.



Figure 1: Photograph of fractured spar tube from horizontal stabilizer

As manufactured, the mounting flange of the spar is welded (on the outboard side) to the spar tube and positioned immediately adjacent to the inboard edge of the airfoil skin. As assembled, the fracture location and weld are partially hidden by the airfoil skin and not directly visible.

Most of the fracture followed the outboard edge of the mounting flange weld. As initially received, large areas of both fracture faces were obscured by red and brown corrosion products. These surfaces were cleaned for a more detailed examination. Magnified optical examinations of the fracture surfaces identified features consistent with fatigue cracking. Three fatigue origins were found on the outer surface of the spar tube at the outboard toe (edge) of the assembly weld. The fatigue propagated generally radially through the wall thickness with some circumferential spreading. The fatigue cracking progressed through about half of the total spar cross section. The fatigue origins and propagation were

all on the aft portion of the spar. No corrosion or other obvious damage was apparent at any of the origins.

Examinations also uncovered a rust-covered crack slightly inboard of and undercutting the main fracture plain. The undercutting crack intersected the outboard fatigue and formed part of the overall fracture. Magnified examinations of the crack faces without opening revealed fatigue features with at least one fatigue origin on the outer surface of the spar. The crack morphology was consistent with additional fatigue origins in the unopened portion of the crack.

The remaining fracture surface displayed separation features and deformation patterns consistent with overstress separation. The deformation pattern was consistent with forces associated with the stabilizer tip moving forward and outboard.

Visually, the weld exhibited good workmanship with no apparent undercutting, weld cracking, or surface discontinuities. A small pore and a single area of lack of fusion were uncovered by the weld fracturing in the overstress regions.

The inboard fracture face was viewed using a scanning electron microscope (SEM) after it was cleaned and the corrosion removed. The fracture area near one fatigue origin point displayed a corrosion-damaged surface, while fracture two other surfaces were much less damaged by corrosion and displayed features consistent with fatigue cracking in alloy steels.

Energy dispersive x-ray spectra of the spar material acquired during SEM examinations were typical of an AISI2 4100 series alloy steel as indicated on the stabilizer engineering drawing.

Ignition System

Examinations of the LSE Plasma III CD Ignition Module (S/N: 43546), the Hall Effect Module (S/N: 1440), and the ignition coils (P/N: 356120) were conducted on March 31, 2015, at the facilities of Light Speed Engineering in Santa Paula, California, with NTSB oversight. No evidence of preimpact mechanical malfunction was noted during the examinations.

Handheld GPS Device

A Garmin GPSMAP 296 hand-held GPS device was retrieved from the accident site and sent to the NTSB Recorders Laboratory for examination. No tracklog information was present on the device after download using the manufacturer procedures.

Additional Information

As a result of the fatigue cracking of the horizontal stabilizer spar found during this investigation, Safari Helicopter issued a mandatory inspection and modification bulletin titled, "Horizontal Stabilizer

Mandatory Inspection and Modification," on April 6, 2015. The bulletin specified a liquid penetrant inspection (LPI) of the horizontal stabilizer as follows:

"On helicopters in operation less than 24 months, this inspection should be accomplished at the next annual condition or 100-hour inspection. On helicopters older than 24 months, the inspection should be accomplished before next flight. This inspection should be added to the annual condition inspection for your particular aircraft."

The bulletin stated that, if cracking was found on the horizontal stabilizer spar, it must be replaced with a new spar. If no cracking was found during LPI inspection, Safari indicated that a steel tube insert must be installed into the end of the stabilizer to extend the "full length of the tail boom mount."

The bulletin also noted that the loss of the horizontal stabilizer "would change the attitude of the helicopter." Given that the stabilizer provides a downward-acting force on the tail section of the helicopter, this attitude change would be experienced by the pilot as an abrupt, uncommanded nose-down pitch.

Administrative Information

Investigator In Charge (IIC):	Liedler, Courtney
Additional Participating Persons:	Peter Brandon; FAA FSDO; Houston, TX Delane Baker; Safari Helicopter; Marianna, FL Sean McGann; Safari Helicopter; Marianna, FL
Original Publish Date:	October 2, 2017
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.nts.gov/Docket?ProjectID=90610

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