# Aviation Investigation Final Report

| | | | |
|---|---|---|---|
| **Location:** | Valencia, California | **Accident Number:** | WPR09LA340 |
| **Date & Time:** | July 7, 2009, 12:30 Local | **Registration:** | N926JB |
| **Aircraft:** | Bender Kitfox | **Aircraft Damage:** | Substantial |
| **Defining Event:** | Part(s) separation from AC | **Injuries:** | 2 None |
| **Flight Conducted Under:** | Part 91: General aviation - Instructional | | |

## Analysis

The pilot reported that he was flying back to the airport when the experimental airplane began to shake violently, which was accompanied by a loud noise. The propeller blades departed the airplane and the engine subsequently experienced an overspeed, followed by a loss of power. During a forced landing, the airplane encountered a ditch and spun 90 degrees. Metallurgical examinations of the blades could not determine the method of failure. Tests and calculations indicate that the engine could not rotate fast enough to liberate the blades unless their strength had been degraded in some way. Several possible sources of such degradation were observed, but none of them could be conclusively identified as the cause of the event. The strength of the blades was provided by the wood of the propeller, and the fractures in the wood of the three blades appeared similar, making no obvious difference to identify the initial separation. The blades were found very close to one another, suggesting that they were liberated at nearly the same point of rotation during a single revolution of the propeller. Assuming one blade had accumulated enough damage to initiate the event, the resulting unbalanced vibration was sufficient to eject the other two blades, in the process creating fractures similar to those on the damaged blade. The measured gap between hub halves was less than the expected gap for new, correctly installed blades. Such over-clamping of the hub is one problem that has apparently occurred in the past due to improper torquing. It is possible that the hub had previously been over-clamped to a greater degree, with subsequent adjustment leading to an under-clamped condition. Looseness in this area can lead to fatigue cracking, because it allows for the variations in stresses from repetitive loads to be maximized on the components being connected. Bird impact was ruled out, but the blade might have been struck by debris picked up during takeoff. Although there was no staining or other signs of degradation in the wood, one blade had an area that was susceptible to moisture due to a manufacturing defect, which could have allowed the decrease in the stiffness and strength of wood structures and may have played a role in liberating the blades.

## Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The failure and separation of a propeller blade for undetermined reasons.

### Findings

| | |
|---|---|
| **Aircraft** | Propeller blade section - Failure |
| **Not determined** | (general) - Unknown/Not determined |

# Factual Information

## History of Flight

| | |
|---|---|
| **Enroute-cruise** | Part(s) separation from AC (Defining event) |
| **Enroute-cruise** | Loss of engine power (total) |

On July 7, 2009, about 1230 Pacific daylight time, a Bender Kitfox experimental airplane, N926JB, experienced a loss of engine power during a forced landing near Valencia, California. The student pilot, who was additionally the owner, was operating the airplane under the provisions of 14 Code of Federal Regulations Part 91. The airplane was substantially damaged. The certificated flight instructor (CFI) and student pilot were not injured. The local instructional flight originated from Whiteman Airport, Los Angeles, California, about 1135. Visual meteorological conditions prevailed, and a flight plan had not been filed.

In a written report, the CFI stated that the purpose of the flight was for the student to practice maneuvers. While en route back to the airport, the airplane began to shake violently, which was accompanied by a loud noise. The engine subsequently experienced a loss of power and the CFI observed the propeller to be missing. The CFI performed a forced landing in a remote field. During touchdown, the airplane encountered a ditch and spun 90 degrees.

The Federal Aviation Administration (FAA) inspector, who responded to the accident, reported that while on-scene he located all three propeller blades, which were about 30 feet apart from one another.

AIRCRAFT INFORMATION

The airplane was a homebuilt Kitfox Speedster, serial number KBS 079, which was built in 1994.

According to the pilot, the airframe had accumulated a total time in service of 278 hours. The most recent conditional inspection was completed on September 15, 2008, 49 hours prior to the accident.

The engine on the airplane was identified as a Rotax 912UL, serial number 4005365, with 80 horsepower. The maximum permitted rate of rotation for that model engine is 5,800 rpm (with a
5-minute limit), and that the transmission between the engine and the propeller includes a reduction gear with a ratio of 2.27 to 1. The maximum permitted rotation rate of the propeller equates to 2,555 rpm. Typical cruise operation for this engine and propeller combination was reported to be 5,000 rpm for the engine, corresponding to 2,203 rpm for the propeller. A Rotax representative reported that the engine could be physically capable of rotating up to 7,000 rpm

before mechanical damage would occur.

The propeller hub and blades were a Tech 3 LE series, manufactured by GSC Systems. The numbers on the blades indicated that the propeller was manufactured around June 2006. The blades' construction was a laminate of three pieces of hard rock maple, reportedly dried to a moisture level of 6 to 7 percent prior to assembly and machining. The root ends of the blades were encapsulated in a layer of black urethane elastomer, while the rest of the blade was coated with clear polyurethane.

The root end of each blade was cylindrical, allowing the blade to rotate and enabling the pitch of the propeller to be adjusted on the ground. The aluminum hub consisted of two pieces (fore and aft) and the pitch of the propeller was held fixed during flight by the root ends of the propeller blades being clamped between the two hub halves. The root end of each blade also had a groove, which mated to a flange machined into each hub piece; this was to provide the centripetal force necessary to overcome the inertia of the blade when the propeller is rotating.

The hub was bolted to the propeller shaft with six bolts and there were six additional bolts clamping the hub halves together at the end of each hub arm, adjacent to the leading and trailing edges of each blade. The propeller manufacturer instructs that the bolts should be torqued to a maximum of 100 inch-pounds, and states that the correct torque applied to a newly installed propeller would leave a gap between the hub halves of 0.030 inch. A Service Bulletin, dated May 17, 1999, was issued by GSC Systems reiterating the maximum torque of 100 inch-pounds to be applied to the bolts, and indicating that a correct installation will have a visible gap between hub halves. The nuts for the bolts clamping the hub halves together have a locking polymeric insert.

## TESTS AND RESEARCH

The propeller blades and hub were sent to the NTSB Materials Laboratory for examination. The complete examination report is contained in the public docket for this accident.

Fractures located primarily along the wood grain separated all three blades from the encapsulated root ends, which remained in the hub. The fractures were similar in all three blades, exhibiting varying amounts of smooth and fibrous fracture surfaces (possibly related to the varying angle of the fracture surfaces with respect to the growth patterns in the three laminates making up each blade). No one blade or area on any fracture surface was obviously identifiable as the initial point of failure. There was no significant staining or other signs of degradation on any of the fracture surfaces.

The FAA inspector reported that the nuts for the bolts clamping the hub halves together were not loosened when the hub was removed from the airplane. Before disassembly in the NTSB Materials laboratory, the gap between the hub halves was measured adjacent to the leading and trailing edges of each blade using feeler gauges, with the results falling between 0.010 inch and 0.020 inch (below the prescribed 0.030 inches). The dimensions of the hub pieces

matched the drawings provided by GSC Systems; there was no indication that there had been any modifications to the hub.

All three blades showed similar patterns of fretting wear and material transfer from both the forward and aft hub pieces at the leading edge, but predominantly from the aft hub at the trailing edge. On one of the blades, near the leading edge, there was brown staining on the corner of the flange adjacent to an area where the encapsulant was fractured, as a result of a manufacturing anomaly where the encapsulant layer was thinner than typical or expected. There was a similar stain on the aft hub piece, but smaller and fainter.

On the leading edge of a blade there were two scrape marks consistent with impact. These two scrape marks were approximately 0.6 to 0.7 inches long and were centered at about 0.9 inch, and at about 2.8 inches in from the tip of the blade. The other two blades did not show any similar impact marks. The blade was taken to the Smithsonian Natural History Museum Feather Identification Laboratory to be examined for bird remains. None of the samples taken were consistent with bird remains.

The Safety Board investigated one previous case involving the same make and model of engine and propeller, which occurred on June 15, 2005, in Redford, Michigan (CHI05LA143). Only two of the three blades were recovered in that investigation. The fractures in the wood were similar to the fractures observed in this accident, but the fractures in the encapsulant were somewhat different in location and appearance.

According to a representative from Kitfox, they have no means of tracking propellers used on all the kits they sell. They have been made aware of some instances in which propeller blades have departed from hubs while in flight. Usually it is caused by over torque of the hub or not doing careful inspections or proper re-torques. The representative added that it is important to continually monitor and inspect the propeller as wood can expand and contract.

## Flight instructor Information

| | | | |
|---|---|---|---|
| **Certificate:** | Airline transport; Commercial; Flight instructor | **Age:** | 58,Male |
| **Airplane Rating(s):** | Single-engine land; Single-engine sea; Multi-engine land; Multi-engine sea | **Seat Occupied:** | Right |
| **Other Aircraft Rating(s):** | None | **Restraint Used:** | |
| **Instrument Rating(s):** | Airplane | **Second Pilot Present:** | Yes |
| **Instructor Rating(s):** | Airplane multi-engine; Airplane single-engine; Instrument airplane | **Toxicology Performed:** | No |
| **Medical Certification:** | Class 2 With waivers/limitations | **Last FAA Medical Exam:** | September 11, 2008 |
| **Occupational Pilot:** | Yes | **Last Flight Review or Equivalent:** | May 29, 2008 |
| **Flight Time:** | (Estimated) 8433 hours (Total, all aircraft), 8 hours (Total, this make and model), 8300 hours (Pilot In Command, all aircraft), 21 hours (Last 90 days, all aircraft), 3 hours (Last 30 days, all aircraft), 2 hours (Last 24 hours, all aircraft) | | |

## Student pilot Information

| | | | |
|---|---|---|---|
| **Certificate:** | Student | **Age:** | 65,Male |
| **Airplane Rating(s):** | None | **Seat Occupied:** | Left |
| **Other Aircraft Rating(s):** | None | **Restraint Used:** | |
| **Instrument Rating(s):** | None | **Second Pilot Present:** | Yes |
| **Instructor Rating(s):** | None | **Toxicology Performed:** | No |
| **Medical Certification:** | Sport pilot With waivers/limitations | **Last FAA Medical Exam:** | |
| **Occupational Pilot:** | No | **Last Flight Review or Equivalent:** | |
| **Flight Time:** | 30 hours (Total, all aircraft), 28 hours (Total, this make and model), 2 hours (Last 90 days, all aircraft), 2 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft) | | |

## Aircraft and Owner/Operator Information

| | | | |
|---|---|---|---|
| **Aircraft Make:** | Bender | **Registration:** | N926JB |
| **Model/Series:** | Kitfox | **Aircraft Category:** | Airplane |
| **Year of Manufacture:** | | **Amateur Built:** | Yes |
| **Airworthiness Certificate:** | Experimental (Special) | **Serial Number:** | KBS 079 |
| **Landing Gear Type:** | Tailwheel | **Seats:** | 2 |
| **Date/Type of Last Inspection:** | September 15, 2008 Condition | **Certified Max Gross Wt.:** | 1200 lbs |
| **Time Since Last Inspection:** | 49 Hrs | **Engines:** | 1 Reciprocating |
| **Airframe Total Time:** | 278 Hrs at time of accident | **Engine Manufacturer:** | Rotax |
| **ELT:** | Installed, activated | **Engine Model/Series:** | 912UL |
| **Registered Owner:** | On file | **Rated Power:** | 80 Horsepower |
| **Operator:** | On file | **Operating Certificate(s) Held:** | None |

## Meteorological Information and Flight Plan

| | | | |
|---|---|---|---|
| **Conditions at Accident Site:** | Visual (VMC) | **Condition of Light:** | Day |
| **Observation Facility, Elevation:** | WHP,1003 ft msl | **Distance from Accident Site:** | 1 Nautical Miles |
| **Observation Time:** | 12:25 Local | **Direction from Accident Site:** | 100° |
| **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:** | 29.92 inches Hg | **Temperature/Dew Point:** | 27°C |
| **Precipitation and Obscuration:** | No Obscuration; No Precipitation | | |
| **Departure Point:** | Los Angeles, CA (WHP ) | **Type of Flight Plan Filed:** | Unknown |
| **Destination:** | Los Angeles, CA (WHP ) | **Type of Clearance:** | None |
| **Departure Time:** | 11:35 Local | **Type of Airspace:** | |

## Airport Information

| | | | |
|---|---|---|---|
| **Airport:** | Whiteman Airport WHP | **Runway Surface Type:** | |
| **Airport Elevation:** | 1003 ft msl | **Runway Surface Condition:** | |
| **Runway Used:** | | **IFR Approach:** | None |
| **Runway Length/Width:** | | **VFR Approach/Landing:** | Forced landing |

## Wreckage and Impact Information

| | | | |
|---|---|---|---|
| **Crew Injuries:** | 2 None | **Aircraft Damage:** | Substantial |
| **Passenger Injuries:** | | **Aircraft Fire:** | None |
| **Ground Injuries:** | N/A | **Aircraft Explosion:** | None |
| **Total Injuries:** | 2 None | **Latitude, Longitude:** | 34.398334,-118.552497(est) |

## Administrative Information

| | |
|---|---|
| **Investigator In Charge (IIC):** | Keliher, Zoe |
| **Additional Participating Persons:** | Jerry Badillo; Federal Aviation Administration; Van Nuys, CA |
| **Original Publish Date:** | July 22, 2010 |
| **Last Revision Date:** | |
| **Investigation Class:** | Class |
| **Note:** | |
| **Investigation Docket:** | https://data.ntsb.gov/Docket?ProjectID=74268 |