Aviation Investigation Final Report

Location:	OAK SHORES, California	**Accident Number:**	LAX02FA148
Date & Time:	April 27, 2002, 17:45 Local	**Registration:**	N9180S
Aircraft:	Beech C23	**Aircraft Damage:**	Destroyed
Defining Event:		**Injuries:**	3 Fatal, 1 Serious
Flight Conducted Under:	Part 91: General aviation - Instructional		

Analysis

The airplane collided with trees following a loss of engine power. A passenger heard a "roar" through the four-way intercom. The certified flight instructor (CFI) and the student pilot checked the oil pressure and fuel pressure; both were "good." The CFI pointed to the left and directed the student toward a private strip. During or immediately following the left turn, the CFI said, "I've got it." The student looked back at the two passengers, and motioned with his right hand that they were going to land at the strip. The last thing that the passenger remembered was contact with the trees and coming to rest. The airplane cleared a ridge top, but collided with trees about 1/4 mile from the landing strip. The spark plug for cylinder no. 1 sustained mechanical damage and contained metallic debris. The head of the cylinder no. 1 exhaust valve was missing, and the top of the piston exhibited mechanical damage across its entire surface. Metallurgists examined the valve and cylinder. The valve stem was broken and remained in the valve guide. The stem fractured and there were numerous secondary cracks below the fracture surface. The areas around the valve seats were severely damaged. The fracture surface condition was such that the fracture mechanism could not be determined. The secondary cracks were only in a local area where the material was severely battered and deformed. Many of the cracks were slightly curved and/or did not appear to be perpendicular to the outer or inner surface. These types of cracks are most likely to occur where surfaces have overlapped, or are the result of the excessive local strains in the area. There were no material or dimensional abnormalities that would suggest fatigue. The manufacturer issued maintenance instructions describing methods for determining exhaust valve and guide condition. This maintenance function was optional for the operator, and maintenance records indicated that this had not been done. Although the diameter of the exhaust valve stem was slightly below the specified diameter, this would have a small affect on overall stresses. However, a small change in diameter of the valve stem significantly changes the amount of clearance between the exhaust valve stem and the exhaust valve guide. Excessive clearance can lead to exhaust valve sticking, which can lead to overstress fracture. The engine total time was 2,079 hours, and it had not been overhauled since it was new in 1975. The manufacturer

recommended overhaul at 2,000 hours or after 12 years of service life. Given the high hours on this engine and the number of years since overhaul, it was likely that the failure was due to exhaust valve sticking.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: the number 1 cylinder exhaust valve fractured and separated resulting in a loss of engine power and an off airport forced landing. A finding in the accident was the owner's failure to maintain the engine in accordance with the manufacturer's recommendations.

Findings

Occurrence #1: LOSS OF ENGINE POWER(PARTIAL) - MECH FAILURE/MALF
Phase of Operation: CRUISE

Findings
1. (C) ENGINE ASSEMBLY,VALVE,EXHAUST - FRACTURED
2. (C) ENGINE ASSEMBLY,VALVE,EXHAUST - SEPARATION
3. MAINTENANCE,SERVICE BULLETIN/LETTER - NOT COMPLIED WITH - OWNER/BUILDER

Occurrence #2: FORCED LANDING
Phase of Operation: EMERGENCY DESCENT/LANDING

Occurrence #3: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: MANEUVERING - TURN TO LANDING AREA (EMERGENCY)

Findings
4. OBJECT - TREE(S)
5. TERRAIN CONDITION - MOUNTAINOUS/HILLY

Factual Information

HISTORY OF FLIGHT

On April 27, 2002, about 1745 Pacific daylight time, a Beech C23, N9180S, collided with trees following a loss of engine power near Oak Shores, California. The owner was operating the airplane under the provisions of 14 CFR Part 91. The certified flight instructor (CFI) pilot, the student pilot, and one passenger sustained fatal injuries; one passenger sustained serious injuries. The airplane was destroyed. The personal cross-country flight departed Oceano Airport, San Luis Obispo, California, about 1630 en route to Harris Ranch (3O8), California. Visual meteorological conditions prevailed, and no flight plan had been filed. The primary wreckage was at 35 degrees 47.449 minutes north latitude and 120 degrees 59.615 minutes west longitude.

The National Transportation Safety Board investigator-in-charge (IIC) interviewed one of the student pilot's sons. The son flew the airplane with the CFI from 0700 to 0900 at the airplane's home base in Oakdale, California. They completed two takeoffs and two landings, and then refueled the airplane. They took off again, and flew about 30 to 45 minutes of practice instrument work. The son reported that he experienced no difficulties with the airplane.

The student pilot and the CFI departed Oakdale about 0910, and flew to Modesto to pickup two passengers. They departed Modesto about 0950, and flew to Hanford to visit one passenger's son. At Hanford, the CFI contacted the Rancho Murrieta Automated Flight Service Station (AFSS) to obtain a weather briefing for the San Luis Obispo area.

The surviving passenger said that they flew to the Oceano Airport, and went to Pismo Beach for a snack. They planned to stop at Harris Ranch for dinner on the way back to Modesto. After their snack, they departed and flew up the coast. About 1715, they made two circles around Hearst Castle and headed inland.

All occupants in the airplane were on a four-way intercom. As they neared Oak Shores the engine sounds changed. The surviving passenger heard a roar, and the CFI asked the student about the oil pressure. It was "good" and both men stated that the fuel pressure was good. The CFI pointed to the left and directed the student to a private strip. During or immediately following the left turn, the CFI said, "I've got it." The student looked back at the two women, and motioned with his right hand that they were going to land at the strip. The last thing that the survivor remembered was contacting trees and coming to rest.

The airplane cleared a ridge top, but collided with trees about 1/4 mile from the landing strip.

When the airplane did not return at its scheduled time, family members verified that the

individual's respective automobiles where still at the originating airports. They notified the Rancho Murrieta AFSS, which issued an alert notice (alnot).

The Air Force Rescue Coordination Center (AFRCC) in Langley, Virginia, detected a signal from an emergency locator transmitter (ELT) about 1920. They received two more signals, and with the alnot in effect, they initiated a search mission for the Civil Air Patrol (CAP). The CAP began a ground search about 0200 on April 28, and located the wreckage about 0600. The survivor was sitting next to the wreckage.

PERSONNEL INFORMATION

A review of Federal Aviation Administration (FAA) airman records revealed that the instructor pilot held a commercial certificate with ratings for airplane singe engine land, multiengine land, and instrument airplane. He also held a certified flight instructor certificate with ratings for airplane single engine land, multiengine land, and instrument airplane.

The instructor pilot held a second-class medical certificate issued on March 3, 2001. It had the limitations that the pilot must wear corrective lenses. The medical application indicated that the pilot had accumulated about 3,500 hours at the time of the application with 274 hours in the previous 6 months. The pilot's logbooks were not recovered.

The student pilot did not hold a medical certificate; however, he had petitioned the FAA for a medical certificate. All of his flight time was dual. The IIC reviewed his logbook and estimated his total flight time at 230 hours (all single engine time) with 200 in this make and model.

AIRCRAFT INFORMATION

The airplane was a Beech C23, serial number M-1801. The airplane and engine did not have the original logbooks. A mechanic created new logbooks in 1993, and noted that the total time on the airframe and engine was 1,445 hours. A review of the airplane's logbooks revealed a total airframe time of 2,097 hours. The logbooks contained an entry for an annual inspection dated April 6, 2001, at a total time of 1,976 hours.

The engine was a Textron Lycoming O-360-A4K engine, serial number L-20956-36A. Total time on the engine at the annual inspection was 1,976 hours. The tachometer read 2,097.5 at the accident scene.

METEOROLOGICAL INFORMATION

The nearest reporting weather station was Paso Robles, California. An aviation routine weather report (METAR) for Paso Robles was issued at 1753. It stated: skies clear; visibility 10 miles; winds 220 degrees at 11 knots; temperature 54 degrees Fahrenheit; dew point 41 degrees Fahrenheit; altimeter 30.01 inHg.

WRECKAGE AND IMPACT INFORMATION

Investigators from the Safety Board, the FAA, Raytheon Beech, and Textron Lycoming inspected the wreckage at the accident scene. The accident area was in hilly terrain with a mixture of cultivated land, open grassland, and clusters of oak trees.

The first identified point of contact (FIPC) was just over the crest of a ridge. Oak tree limbs with shiny debarked surfaces lay strewn along the ground. One limb that was about 1 inch in diameter exhibited a smooth fracture surface along about 12 inches of its length. The debris path was along a magnetic heading of 330 degrees. The debris path went downhill and through trees from the FIPC to the main wreckage.

Looking along the debris path, about 42 feet left of the FIPC lay the right aileron. The aileron bent down, and the fracture surfaces were irregular and on an angular plane. Along the debris path centerline and 150 feet from the FIPC lay the portion of the right wing that was outboard of the right main landing gear. It separated along a jagged angular fracture surface.

About 230 feet from the FIPC was a splintered oak tree stump that was about 12 inches in diameter. The main wreckage was intertwined with oak tree limbs just beyond this stump. The airplane was inverted, and the nose of the airplane was on a magnetic heading of 180 degrees.

The main wreckage was about 270 feet from the FIPC. The fuselage fractured around 270 degrees of its circumference at the aft part of the cabin. The tail section rotated 180 degrees around that fracture surface so that the empennage was lying inboard of the right main landing gear, parallel to the fuselage, and on top of the inverted right wing stub. The vertical stabilizer and rudder folded over so that their tops were pointing toward the right wing tip. The right horizontal stabilizer and right elevator pointed toward the ground, and sustained the most mechanical damage. The left horizontal stabilizer and elevator pointed toward the nose of the airplane.

All of the major components of the airplane remained attached together except the previously mentioned right aileron and outboard right wing. The propeller and engine remained attached to the airframe.

Rescue personnel reported that all of the victims had their seat belts fastened, and the front seat occupants utilized their shoulder harness restraints. The survivor released herself, but stayed in the airplane overnight for warmth.

MEDICAL AND PATHOLOGICAL INFORMATION

The San Luis Obispo County Coroner completed autopsies of both pilots.

The FAA Toxicology and Accident Research Laboratory, Oklahoma City, Oklahoma, performed

toxicological testing of specimens of the pilots. The results of analysis of the specimens for the pilot were negative for carbon monoxide, cyanide, volatiles, and tested drugs.

The results of analysis of the specimens for the student pilot were negative for ethanol. The FAA did not test for carbon monoxide or cyanide. They detected diphenhydramine in blood and 1.24 (ug/ml, ug/g) in the liver; diphenhydramine was present in urine. They detected 10.6 (ug/ml, ug/g) acetaminophen in urine.

TESTS AND RESEARCH

Investigators examined the wreckage on scene. The control cable for the right aileron fractured and separated at the bellcrank attach fitting. The fracture surface was rough and had a matte appearance. Investigators established control continuity from all remaining control surfaces to their cockpit attach points. The left control column fractured and separated along an angular plane at the base of the column. Movement of the respective control cables followed movement of the right control yoke.

The fuel selector valve was in the left main position. Investigators observed approximately 1 gallon of a clear blue fluid that smelled like avgas pooled in the wreckage of the right wing. The left wing tank had been punctured, but the recovery agent reported that several gallons of fuel spilled from the wing as he righted the wreckage. The fuel sump contained a clear blue fluid that smelled like avgas. It was free of contamination, and the screen was clean. The carburetor contained about a tablespoon of a clear blue fluid that smelled like avgas. The fuel pump had a section of the housing missing; however, when manually operated, the IIC heard a sucking sound.

The Beech representative determined that the position of the flap actuator corresponded to the full up position. The elevator trim measured 2.3 inches. The representative determined that this equated to 2 degrees tab up. The carburetor heat handle was out about 1 inch.

The spinner was crushed flat and contained wood debris. The starter and ring gear teeth pinched part of the compressed spinner. The propeller exhibited a few faint chordwise scratches on the blade face. Both propeller blades bent aft slightly, and exhibited some wavy bending.

The Lycoming representative removed the bottom spark plugs. The spark plug for cylinder no. 1 sustained mechanical damage and contained metallic debris. The electrodes for cylinders no. 2 and 3 were sooty.

Investigators examined cylinder no. 1 with a lighted borescope. The head of the exhaust valve was missing, and the top of the piston exhibited mechanical damage across its entire surface.

The recovery agent separated the engine from the wreckage, and slung it from a hoist. Investigators removed cylinder no. 1 for metallurgical examination.

Investigators examined the engine. The oil sump screen was clean. Investigators manually rotated the crankshaft. All remaining valves moved in sequence, and the left magneto produced spark at the ignition leads for all cylinders. Investigators removed the right magneto and manually rotated it. The magneto produced spark at the ignition leads for all cylinders.

All of the cylinder heads were wet under the rocker covers. Oil was on the oil pressure gauge and in the filter. The IIC retained the filter for further examination.

SEAL Laboratories in El Segundo, California, performed two examinations. The first exam (SEAL Job No. 9035) consisted of various components of cylinder no. 1, the no. 1 exhaust valve, and the oil filter. The second exam (SEAL Job No. 9069) consisted of cylinders no. 2, 3, and 4. The full reports are attached.

The first report was dated July 10, 2002. The lab examined components of cylinder no. 1.

The valve stem, made of a martensitic stainless steel, was broken and remained in the valve guide. The stem fractured and there were numerous secondary cracks below the fracture surface. Technicians removed the valves. The areas around the valve seats were severely damaged. The inside surface diameter of the valve guide was 0.503 inch. The diameter of the valve stem was 0.493 inch. The valve stem had a small amount of deposit below the fracture surface. The average hardness of the valve stem was 37 HRC. EDX spectrum tests revealed the presence of iron, chromium, silicon, and nickel, which are materials consistent with stainless steel.

The lab examined the oil filter. Metal particles contained in the filter consisted of particles from an aluminum-silicon casting alloy, the material that made up the cylinder.

The second report was dated October 8, 2002. The lab examined the exhaust valves for cylinders no. 2, 3, and 4. The examiner observed no cracking or excessive deformation on the exhaust valves. The exhaust valve from the no. 3 cylinder revealed coarsening of chromium carbide particles below the deposit near the valve head. The diameter of the valve stem was 0.493 inch and 0.490 inch at the areas with and without deposits.

Based upon the SEAL Laboratory reports, the Safety Board materials laboratory issued a factual addendum. Upon review of the first report, the Senior Metallurgist stated that the secondary cracks shown in the report were only in a local area where the material was severely battered and deformed. Many of the cracks appeared to be slightly curved and/or did not appear to be perpendicular to the outer or inner surface. The locations and shapes of these cracks were consistent with compression shear cracks created during the deformation process.

The average hardness of the valve stem was 37 HRC, which was slightly lower than the specified hardness range of 70 to 76 HRA (39 to 52.5 HRC) for the new part.

As noted in the SEAL Laboratory reports, the diameters of the no. 1 and no. 3 exhaust valve stems measured 0.493 inch in an area with exhaust deposits. The diameter of the no. 3 exhaust valve stem measured 0.490 inch in an area outside of the exhaust deposits. According to engineering drawings, the specified diameter for a new exhaust valve stem is 0.4938 inch to 0.4945 inch. According to the manufacturer, the service minimum diameter permitted is 0.4915 inch.

As documented in the first SEAL Laboratory report, the inside diameter of the exhaust valve guide measured 0.503 inch. The diameter specified in the drawings for a new guide is 0.4985 inch to 0.4995 inch. The manufacturer expects the exhaust valve guide to wear under normal service conditions, leading to an increase in the inside diameter. According to engineering drawings, the inside diameter may increase up to 0.5140 inch at the time of overhaul.

Textron Lycoming issued a Mandatory Service Bulletin (SB) 388B on May 13, 1992, describing two methods for determining exhaust valve and guide condition. It suggested inspections at a maximum interval of 400 hours time in service for airplane engines. In the first method, maintenance technicians measure the clearance between the exhaust valve stem and the exhaust valve guide. For this engine, the difference between the outer diameter of the exhaust valve stem and the inner diameter of the exhaust valve guide should be 0.003 inch to 0.009 inch. For the no. 1 cylinder in the accident engine, the difference was 0.01 inch. The logbooks contained no entries for compliance with this service bulletin, which was optional for the operator.

In 1983, the manufacturer changed the part number for the exhaust valve in this engine. They made the old part from a martensitic stainless steel and the new part from a nickel-base superalloy. Mandatory SB 240 suggests that technicians replace the old exhaust valves with the new part at the time of overhaul.

Textron Lycoming issued Service Instruction (SI) 1009 regarding recommended time between overhauls, and issued the latest revision (AQ) on January 12, 2001. This SI recommended an overhaul of this engine after 2,000 hours time in service (TIS). If the engine had not accumulated those hours within 12 years, the SI suggested an overhaul of this engine in the 12th year. The operator was not required to follow this recommendation

The owner had the oil periodically analyzed. Analysis occurred in November 1999; August and November 2000; and January, June, and September 2001. The analysis for all of the reports expressed the opinion that the results were normal. The reports for August 2000 and on included a note that said, "Some metal in filter-non ferrous," and that the engine may be making metal larger than the spectrometer could see. The August 2000 report also noted iron and aluminum. The October 2000 report noted iron.

ADDITIONAL INFORMATION

The Safety Board IIC released the wreckage to the owner's representative.

Flight instructor Information

Certificate:	Commercial; Flight instructor	**Age:**	52,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**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:**	Yes
Medical Certification:	Class 2 Valid Medical--w/ waivers/lim	**Last FAA Medical Exam:**	January 13, 2000
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	3542 hours (Total, all aircraft)		

Student pilot Information

Certificate:	None	**Age:**	64,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:**	Yes
Medical Certification:	None None	**Last FAA Medical Exam:**	
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:	225 hours (Total, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Beech	**Registration:**	N9180S
Model/Series:	C23	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	M-1801
Landing Gear Type:	Tricycle	**Seats:**	4
Date/Type of Last Inspection:	April 6, 2001 Annual	**Certified Max Gross Wt.:**	2450 lbs
Time Since Last Inspection:	118 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	2097 Hrs at time of accident	**Engine Manufacturer:**	Lycoming
ELT:	Installed, activated, aided in locating accident	**Engine Model/Series:**	O-360-A4K
Registered Owner:	Stephen W. Meester	**Rated Power:**	180 Horsepower
Operator:		**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	PRB,836 ft msl	**Distance from Accident Site:**	21 Nautical Miles
Observation Time:	17:53 Local	**Direction from Accident Site:**	95°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	4 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:		**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.01 inches Hg	**Temperature/Dew Point:**	12°C / 4°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	SAN LUIS OBISPO, CA (L52)	**Type of Flight Plan Filed:**	None
Destination:	HARRIS RANCH, CA (3O8)	**Type of Clearance:**	None
Departure Time:	16:30 Local	**Type of Airspace:**	Class G

Wreckage and Impact Information

Crew Injuries:	2 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:	1 Fatal, 1 Serious	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	3 Fatal, 1 Serious	**Latitude, Longitude:**	35.790832,-120.993614

Administrative Information

Investigator In Charge (IIC):	Plagens, H.
Additional Participating Persons:	Jeff Poschwatta; Textron Lycoming; Williamsport, PA Timothy Rainey; Beech Raytheon; Wichita, KS Dave Witt; Federal Aviation Administration; San Jose, CA
Original Publish Date:	September 29, 2004
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=54595