Aviation Investigation Final Report

Location:	SALISBURY, Maryland	**Accident Number:**	IAD99FA070
Date & Time:	September 28, 1999, 06:50 Local	**Registration:**	N69945
Aircraft:	Cessna 310Q	**Aircraft Damage:**	Substantial
Defining Event:		**Injuries:**	4 Serious
Flight Conducted Under:	Part 135: Air taxi & commuter - Non-scheduled		

Analysis

After takeoff, the right engine 'started surging' and the pilot turned back toward the departure airport. He configured the airplane for landing, and then attempted to secure the right engine. The engine seized, and the propeller stopped. The airplane was unable to maintain altitude sufficient to clear trees at the approach end of the landing runway, and the pilot performed a forced landing to a field approximately 1 mile short of the airport. The #2 cylinder of the right engine was replaced 160 aircraft hours prior to the accident. Examination of the right engine revealed the crankshaft was broken between the #2 main bearing journal and the #3 connecting rod journal. The mating surfaces of both crankcase halves, in the area of the #2 and #3 main bearing saddles, displayed fretting across the entire face surface. Examination of the fracture surfaces revealed that the damage was consistent with bearing shifting and rubbing. A warning published in the manufacturer's cylinder installation instructions stated: 'Failure to torque through bolt nuts on both sides of the engine can result in a loss of main bearing crush, main bearing shift and engine failure.' According to the FAA Airplane Flying Handbook, Engine Inoperative Approach And Landing: '...neither full flaps nor the landing gear should be extended until the landing is assured.'

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The improper installation of the #2 cylinder that resulted in a fractured crankshaft and a total loss of engine power. Factors in the accident were the premature deployment of the landing gear and flaps by the pilot.

Findings

Occurrence #1: LOSS OF ENGINE POWER(TOTAL) - MECH FAILURE/MALF
Phase of Operation: APPROACH - VFR PATTERN - FINAL APPROACH

Findings
1. 1 ENGINE
2. (C) MAINTENANCE,INSTALLATION - IMPROPER - COMPANY MAINTENANCE PERSONNEL
3. (C) ENGINE ASSEMBLY,CRANKSHAFT - SUDDEN STOPPAGE

Occurrence #2: FORCED LANDING
Phase of Operation: APPROACH - VFR PATTERN - FINAL APPROACH

Occurrence #3: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: EMERGENCY DESCENT/LANDING

Findings
4. (F) LANDING GEAR - PREMATURE - PILOT IN COMMAND
5. (F) FLAPS - PREMATURE - PILOT IN COMMAND
6. AIRCRAFT WEIGHT AND BALANCE - EXCEEDED - PILOT IN COMMAND

Factual Information

HISTORY OF FLIGHT

On September 28, 1999, at 0650 Eastern Daylight Time, a Cessna 310Q, N69945, was substantially damaged during a forced landing and collision with terrain, while on approach to the Salisbury-Ocean City Wicomico Regional Airport (SBY), Salisbury, Maryland. The certificated commercial pilot and three passengers received serious injuries. Visual meteorological conditions prevailed for the flight that originated at SBY at 0643, destined for the Wilkes-Barre/Scranton International Airport (AVP), Wilkes-Barre, Pennsylvania. An instrument flight rules flight plan was filed for the flight operated by Bayland Aviation Incorporated, and conducted under 14 CFR Part 135.

In a telephone interview, one back-seat passenger said the purpose of the flight was to fly to Scranton, Pennsylvania, on business. He said that he and one other person in the party were to travel earlier in the month, but the trip was postponed to September 28th due to hurricane Floyd. The passenger said the third person was added to the group shortly before departure. He said:

"We took off and a few minutes into the flight the right engine sputtered. A few minutes later, it did it again. It was too loud to hear but [the pilot] was talking; he reached over and tapped one of the engine gauges. He had no more than banked it when the engine quit. The propeller stopped dead as a doornail. It was straight up and down. I said something to [the other backseat passenger] like it's a good thing we have that other engine, but then I realized that the other engine wasn't keeping us up in the air. After that it was a fast descent."

When questioned about the left engine's performance, the witness said:

"I didn't hear any off sound, it sounded strong. But I was expecting to hear that engine speed up. I mean, you lose one you expect the other to be at 120 percent."

In a telephone interview, the front seat passenger, a certificated pilot, said:

"The aircraft was fueled and ready to go. There were four of us; a pilot and three passengers. We took off and it was a normal climb. It was clear. We were at 2,000 to 2,500 feet over the Perdue Feed Mill when all of a sudden, 'spurt, spurt, spurt,' and we got a vibration out of the right engine. About 2 to 3 minutes later, the engine stopped and it wasn't feathered. That prop just stopped. It stuck straight out like a poker and the left engine wasn't producing enough power to keep us flying. I had every expectation, when that engine locked up, that we were going to make the airport."

In a telephone interview, the pilot stated:

"After we departed Salisbury, I transitioned to a cruise climb; 130 knots, 24 inches of manifold pressure, and 2,450 RPM. I cleaned the airplane up and contacted Washington Center. After I contacted Center the right engine started surging. I was getting fluctuating oil pressure and surging RPM. It was going up and down a couple of hundred RPM."

The pilot said he informed the Washington Center controller that he was returning to Salisbury. He said he was approximately 5 miles north of SBY at 2,500 feet when he turned back for the airport.

The pilot further stated:

"I called when I was over the stadium and Salisbury said cleared to land. Then I get the yaw, as in the power failure. The right engine loses power and I'm getting a lot of excessive yaw.

"I should be able to make it back to Salisbury. As I start turning final, I'm trying to clean up that right engine. When I bring the power [lever] back, it just locked right up. I knew I was never going to make it over the trees. I had the flaps and the gear down before I lost power.

"When the engine started to surge, I turned around. I started back to Salisbury and then got the flaps and the gear down. Then the engine quit and I couldn't get the propeller to feather. It struck me as weird that the prop would just seize like that."

A transcript of conversation between the pilot and the local controller (LC) was prepared from Air Traffic Control (ATC) records. The transcript revealed the following:

0642:36 - N69945 cleared for takeoff Rwy 14 with IFR clearance to AVP.

0647:44 - N69945 "Salisbury Tower 945 we have to come back in we have right engine failure."

0647:52 - LC " Your position now?" N69945 - "Over Perdue"

LC - "Do you need equipment out?" N69945 - "No, just a sputter not a failure."

0648:09 - LC "Not in sight, cleared to land"

A controller's note to the transcript stated that at 0648:09, "N69945 was approximately 3-4 mile left base for Rwy 14 at this time."

0649:43 - N69945 "[Salisbury] you better launch the equipment."

A controller's note to the transcript stated that at 0649:43 N69945, "...was approximately 1 1/2 - 2 mile final for Rwy 14 and in sight by LC at tree top level before going down."

The accident occurred during the hours of daylight approximately 38 degrees, 21 minutes north latitude, and 75 degrees, 32 minutes west longitude.

PERSONNEL INFORMATION

The pilot held a commercial pilot's certificate with ratings for airplane single and multi-engine land, and rotorcraft-helicopter. He held ratings for instrument airplane and helicopter. The pilot also held flight instructor ratings for airplane single-engine land, multi-engine land and instrument airplane.

The pilot's most recent Federal Aviation Administration (FAA) second class medical certificate was issued on August 16, 1999.

The pilot reported approximately 3,353 hours of flight experience, 292 hours of which were in multi-engine airplanes, and 179 hours of which were in the Cessna 310.

The pilot reported 141 hours of flight experience in the 90 days prior to the accident. His most recent biennial flight review was January 1, 1999, in the Cessna 310.

AIRCRAFT INFORMATION

The airplane was a 1974 Cessna 310Q with 3,595 hours of total time. The airplane was on a manufacturer's inspection program and its most recent 100 hour inspection was completed just prior to the accident flight. The most recent annual inspection was performed July 23, 1999, at 3547.9 aircraft hours.

Examination of the maintenance records revealed that the engines were overhauled and installed in the airplane on December 1, 1987. The engines accrued 953.8 hours since overhaul.

Examination of the engine logs revealed that the #2 cylinder of the right engine was replaced on September 27, 1997, at 3,435.6 aircraft hours.

METEOROLOGICAL INFORMATION

Weather reported at SBY at the time of the accident was broken clouds at 8,000 feet with winds from 120 degrees at 5 knots. The temperature was 66 degrees and the dewpoint was 66 degrees.

AERODROME INFORMATION

The Salisbury-Ocean City Wicomico Regional Airport (SBY), Salisbury, Maryland, had two intersecting runways. One runway oriented 140 and 320 degrees, was 5,500 feet long and 150

feet wide. It was bisected by a runway oriented 050 and 230 degrees that was 5,000 feet long and 150 feet wide. The airport tower and several hangers were on the east side of the airport. The airport was at 52 feet mean sea level.

WRECKAGE AND IMPACT INFORMATION

The airplane was examined at the site on September 28, 1999. All major components were accounted for at the scene. The airplane came to rest in a soybean field with the crop still in the field. The soybean plants were approximately 24 inches tall. The area of flattened soybean plants defined the wreckage path and all separated components were found within this area.

The wreckage path was oriented approximately 180 degrees in the vicinity of the final approach course for Runway 14 at SBY. The path was approximately 115 feet from the initial ground scar to the main wreckage. The airplane came to rest upright on its belly. The nose and main landing gear were separated from their mounts, and the wing flaps and the flap handle were at the 15-degree position.

Both three-bladed propellers came to rest with the blades at approximately the four, eight, and twelve o'clock positions. Each propeller had blades at the twelve o'clock position intact and undamaged. The remaining propeller blades rested on the ground, were bent aft approximately 90 degrees, and displayed span-wise scratches.

The cockpit and cabin areas were intact and uncompromised. The main cabin door and the cargo door were both operational. Control continuity was established from the flight controls to all flight control surfaces. The main fuel (tip) tanks were compromised and there was a strong odor of fuel at the scene.

The wreckage was moved to a hanger at SBY for examination on the day of the accident. A cursory examination of the right engine revealed that the crankshaft could be rotated no more than 50 degrees.

The wreckage was moved to Hagerstown, Maryland, for further examination.

TESTS AND RESEARCH

The airplane's right engine was examined at Hagerstown, Maryland, on October 22, 1999.

Removal of the engine oil sump revealed large pieces of metal and metal shavings in the sump and trapped in the oil sump suction screen. The connecting rod bolt on the #3 rod was stretched and separated. The rod bearing appeared intact.

The #3 connecting rod lower bolt was broken and the upper bolt was bent, but still attached. The #3 piston was staked in the cylinder.

The crankshaft was fractured forward of the #2 main bearing journal which was located between the #2 and #3 connecting rod journals.

The aft face of the #3 main bearing journal was cracked, and bent at the point of the crack.

The #2 bearing saddle in both case halves was smeared and streaked. The inner diameter was expanded and both saddles were cracked perpendicular to the direction of rotation. The #2 main bearing was extruded forward, perpendicular to the direction of rotation.

The mating surfaces of both crankcase halves, in the area of the #2 and #3 main bearing saddles, displayed fretting across the entire surface face.

The engine crankshaft (2 pieces), the lower portion of the #3 connecting rod, and several main bearing fragments were examined at the National Transportation Safety Board Materials Laboratory, Washington, D.C., on November 10, 1999. The Materials Laboratory Factual Report stated the fracture surfaces on the crankshaft suffered post-fracture deformation, but a portion remained undamaged. According to the report:

"The undamaged portion of the fracture surface had smooth features with a curving boundary, typical of fatigue...Circumferential wear and ladder cracks were observed in both the forward and aft radial sections between [the main bearing] journal and the cheeks, damage consistent with bearing shifting and rubbing."

ADDITIONAL INFORMATION

A review of the FLIGHT DISPATCH/LOAD MANIFEST signed by the pilot revealed that the pilot listed only two passengers on the manifest. The combined weights of one pilot, two passengers, and the fuel weight reflected a takeoff weight of 5,255 pounds.

The maximum allowable gross weight of the airplane was 5,300 pounds.

A review of the airplane's weight and balance data along with the combined weight of the four occupants revealed the approximate takeoff weight of the accident airplane was 5,585 pounds.

According to the Cessna Model 310 Owner's Manual, the first steps of the checklist for SINGLE-ENGINE APPROACH AND LANDING were as follows:

(1) Mixture - FULL RICH (2) Propeller - FULL FORWARD (3) Approach at 94 Knots with excessive altitude. (4) Landing Gear - DOWN within glide distance of field. (5) Wing Flaps - DOWN when landing is assured.

According to the FAA Airplane Flying Handbook, Engine Inoperative Approach And Landing:

"...neither full flaps nor the landing gear should be extended until the landing is assured."

According to Teledyne Continental Aircraft Engine Service Bulletin (SB96-7B) on the subject of TORQUE VALUES:

"Proper cylinder installation requires a multiple step torquing process."

The WARNING associated with cylinder installation states:

"Failure to torque through bolt nuts on both sides of the engine can result in a loss of main bearing crush, main bearing shift and engine failure."

The airplane wreckage was released on November 10, 1999, to a representative of the owners insurance company.

Pilot Information

Certificate:	Commercial; Flight instructor	**Age:**	39,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	
Instrument Rating(s):	Airplane; Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine; Instrument airplane	**Toxicology Performed:**	No
Medical Certification:	Class 2 Valid Medical--no waivers/lim.	**Last FAA Medical Exam:**	August 16, 1999
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	3353 hours (Total, all aircraft), 179 hours (Total, this make and model), 2755 hours (Pilot In Command, all aircraft), 141 hours (Last 90 days, all aircraft), 86 hours (Last 30 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Cessna	**Registration:**	N69945
Model/Series:	310Q 310Q	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	310Q1036
Landing Gear Type:	Retractable - Tricycle	**Seats:**	4
Date/Type of Last Inspection:	July 23, 1999 100 hour	**Certified Max Gross Wt.:**	5300 lbs
Time Since Last Inspection:	1 Hrs	**Engines:**	2 Reciprocating
Airframe Total Time:	3595 Hrs	**Engine Manufacturer:**	Continental
ELT:	Installed, activated, did not aid in locating accident	**Engine Model/Series:**	IO-470-V-O
Registered Owner:	BAY LAND AVIATION, INC	**Rated Power:**	260 Horsepower
Operator:		**Operating Certificate(s) Held:**	On-demand air taxi (135)
Operator Does Business As:		**Operator Designator Code:**	

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Dawn
Observation Facility, Elevation:	SBY ,52 ft msl	**Distance from Accident Site:**	320 Nautical Miles
Observation Time:	06:50 Local	**Direction from Accident Site:**	1°
Lowest Cloud Condition:	Unknown	**Visibility**	4 miles
Lowest Ceiling:	Broken / 8000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	5 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	120°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30 inches Hg	**Temperature/Dew Point:**	19°C / 19°C
Precipitation and Obscuration:	N/A - None - Fog		
Departure Point:	(SBY)	**Type of Flight Plan Filed:**	IFR
Destination:	WILKES-BARRE , PA (AVP)	**Type of Clearance:**	IFR
Departure Time:	06:43 Local	**Type of Airspace:**	Class D

Airport Information

Airport:	SALISBURY/WICOMICO REGION SBY	**Runway Surface Type:**	Asphalt
Airport Elevation:	52 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	14	**IFR Approach:**	None
Runway Length/Width:	5500 ft / 150 ft	**VFR Approach/Landing:**	Forced landing;Traffic pattern

Wreckage and Impact Information

Crew Injuries:	1 Serious	**Aircraft Damage:**	Substantial
Passenger Injuries:	3 Serious	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	4 Serious	**Latitude, Longitude:**	38.370018,-75.579444(est)

Administrative Information

Investigator In Charge (IIC):	Rayner, Brian
Additional Participating Persons:	RICHARD J THOMAS; BALTIMORE , MD GEORGE HOLLINGSWORTH; RESTON , VA LEAH YEAGER; WICHITA , KS
Original Publish Date:	May 17, 2001
Last Revision Date:	
Investigation Class:	Class
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=47573