Aviation Investigation Final Report

Location:	Foley, Alabama	**Accident Number:**	ERA19FA164
Date & Time:	May 6, 2019, 12:47 Local	**Registration:**	N5542U
Aircraft:	Piper PA28	**Aircraft Damage:**	Destroyed
Defining Event:	Aerodynamic stall/spin	**Injuries:**	1 Fatal, 1 Serious
Flight Conducted Under:	Part 91: General aviation - Instructional		

Analysis

The flight instructor and student pilot were conducting simulated engine-out emergency procedures in the airport traffic pattern. About 300-400 ft above ground level after takeoff, witnesses reported that the flight instructor announced on the radio that the engine had quit. Witnesses reported that the airplane then entered a nose-high, steep left turn before pitching down and impacting the ground.

Postaccident examination of the airframe and flight controls revealed no mechanical anomalies that would have precluded normal operation. Examination of the engine revealed that the No. 4 cylinder exhaust valve was stuck in the valve guide due to excessive combustion deposits. It is likely that the stuck exhaust valve resulted in a partial loss of engine power.

A flight instructor who flew the accident airplane the day before the accident flight reported experiencing engine roughness when performing simulated engine-out procedures. Following that flight, a mechanic cleaned the sparkplugs, performed an engine run-up, and returned the airplane to service; however, maintenance records did not show that the engine valves were inspected for sticking at that time. Manufacturer service instructions suggested inspecting for valve sticking at regular intervals or sooner if sticking was suspected. If a valve inspection had been completed in accordance with engine manufacturer guidance the day before the accident following the report of engine roughness, it is likely that the heavy carbon deposits on the exhaust valve would have been detected.

Given that the flight instructor reportedly had students trim the airplane nose-up when landing, it is possible that the airplane was trimmed nose-high at the time of takeoff and the subsequent loss of engine power. Such a trim setting would have led to excessive pitch up, resulting in a rapid loss of airspeed, an exceedance of the airplane's critical angle of attack, and an aerodynamic stall at low altitude.

Probable Cause and Findings

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

A partial loss of engine power due to a stuck exhaust valve and the flight instructor's exceedance of the airplane's critical angle of attack following the loss of power, which resulted in an aerodynamic stall at low altitude.

Findings

Aircraft	Recip eng cyl section - Failure
Personnel issues	Aircraft control - Instructor/check pilot
Aircraft	Angle of attack - Not attained/maintained

Factual Information

History of Flight

Initial climb	Loss of engine power (partial)
Initial climb	Aerodynamic stall/spin (Defining event)
Uncontrolled descent	Collision with terr/obj (non-CFIT)

On May 6, 2019, at 1247 central daylight time, a Piper PA-28-140, N5542U, was destroyed when it impacted terrain shortly after takeoff from Foley Municipal Airport (5R4), Foley, Alabama. The flight instructor was seriously injured, and the student pilot was fatally injured. The airplane was owned and operated by Lightning Aviation as a Title 14 *Code of Federal Regulations* (*CFR*) Part 91 instructional flight. Visual meteorological conditions prevailed in the area, and no flight plan was filed for the local flight.

According to a witness, who was a flight paramedic on another instructional flight at 5R4, he saw the accident airplane take off from runway 36 after a touch-and-go landing. He then heard the flight instructor announce on the radio, "My engine just quit." He saw the accident airplane pitch up "like a power-on stall" then "lean to the left to start a spin" about 300-400 ft above ground level (agl). He added that it was only about 3 seconds from the time he saw the airplane in a nose-high pitch attitude to when it was descending toward the ground.

A flight instructor who was entering the traffic pattern at 5R4 reported that the airplane seemed to be making an aggressive left turn as if returning to the airport.

According to another flight instructor who flew the airplane the morning of the accident, the airplane "didn't seem to climb very well," which he attributed to high density altitude. He stated that, at the time of the accident, the accident flight instructor was conducting simulated engine-out emergency procedures in the pattern as touch-and-go landings. The instructor added that he had previously shared a flight student with the accident flight instructor. That student used a "two-swipe" pitch trim method during the landing flare that the accident flight instructor had taught him; just before flaring the airplane for landing, the student rolled the pitch trim wheel twice in a nose-up direction.

A different flight instructor who flew the accident airplane the day before the accident flight reported that he experienced engine roughness when performing simulated engine-out procedures with a student. He stated that on the last simulated engine-out procedure, when he added power at 600 ft agl, the engine started shaking. He leaned the mixture and the engine ran smoothly again. He wrote up a maintenance ticket when he landed and stated that the mechanic cleaned the sparkplugs, performed an engine run-up, and signed off the maintenance write-up. The instructor subsequently flew the airplane and noted no issues.

Flight instructor Information

Certificate:	Commercial; Flight instructor; Private	**Age:**	22,Female
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	None	**Restraint Used:**	Lap only
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane single-engine	**Toxicology Performed:**	Yes
Medical Certification:	Class 1 Without waivers/limitations	**Last FAA Medical Exam:**	February 14, 2019
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	February 27, 2019
Flight Time:	(Estimated) 977.5 hours (Total, all aircraft), 507.2 hours (Total, this make and model), 904.5 hours (Pilot In Command, all aircraft), 205.1 hours (Last 90 days, all aircraft), 90 hours (Last 30 days, all aircraft), 7 hours (Last 24 hours, all aircraft)		

Student pilot Information

Certificate:	Student	**Age:**	25,Male
Airplane Rating(s):	None	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Lap only
Instrument Rating(s):	None	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 3 Without waivers/limitations	**Last FAA Medical Exam:**	May 10, 2017
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:	(Estimated) 15.6 hours (Total, all aircraft), 15.6 hours (Total, this make and model), 0 hours (Last 90 days, all aircraft), 0 hours (Last 30 days, all aircraft), 0 hours (Last 24 hours, all aircraft)		

The flight instructor held a commercial pilot certificate with ratings for airplane single- and multi-engine land and instrument airplane. She also held a flight instructor certificate with a rating for airplane single-engine. Her most recent Federal Aviation Administration (FAA) first-class medical certificate was issued February 14, 2019. An examination of the flight instructor's logbook revealed 977.5 total hours of flight experience, of which 507.2 hours were in the accident airplane make and model. Her most recent flight review was completed February 27, 2019, and she had logged about 340 hours of instruction in the previous 90 days.

A review of the student pilot's logbook revealed that he had accumulated about 16 hours of total flight experience in the previous 3 years, all of which were in the accident airplane make and model. The student pilot had not yet flown solo and no flights were logged in the preceding year.

Aircraft and Owner/Operator Information

Aircraft Make:	Piper	**Registration:**	N5542U
Model/Series:	PA28 140	**Aircraft Category:**	Airplane
Year of Manufacture:	1969	**Amateur Built:**	
Airworthiness Certificate:	Normal; Utility	**Serial Number:**	28-26264
Landing Gear Type:	Tricycle	**Seats:**	4
Date/Type of Last Inspection:	March 12, 2019 Annual	**Certified Max Gross Wt.:**	2150 lbs
Time Since Last Inspection:	94 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	6985.78 Hrs at time of accident	**Engine Manufacturer:**	Lycoming
ELT:	C91 installed, activated, did not aid in locating accident	**Engine Model/Series:**	O-320-D3G
Registered Owner:		**Rated Power:**	140 Horsepower
Operator:		**Operating Certificate(s) Held:**	Pilot school (141)

According to FAA airworthiness records, the four-seat, low-wing, tricycle gear airplane was manufactured in 1969. It was powered by a Lycoming O-320-D3G, 140-horsepower engine which drove a metal, two-bladed, fixed-pitch Sensenich propeller. According to airplane maintenance logbooks, an annual inspection was completed on March 12, 2019, at a tachometer time of 6,891.92 hours. The tachometer located in the airplane at the time of the accident indicated 6,985.78 hours, which was 93.86 hours since the annual inspection and 1,976.42 hours since the engine's most recent major overhaul.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KJKA,17 ft msl	**Distance from Accident Site:**	8 Nautical Miles
Observation Time:	12:55 Local	**Direction from Accident Site:**	201°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	11 knots /	**Turbulence Type Forecast/Actual:**	None / None
Wind Direction:	170°	**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	30.03 inches Hg	**Temperature/Dew Point:**	26°C / 17°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Foley, AL (5R4)	**Type of Flight Plan Filed:**	None
Destination:	Foley, AL (5R4)	**Type of Clearance:**	None
Departure Time:	12:47 Local	**Type of Airspace:**	Class G

The 1255 recorded weather observation at Sonny Callahan Airport, Fairhope, Alabama, about 8 miles west of the accident location, included wind from 270° at 3 knots, 10 miles visibility, clear skies, temperature 26°C, dew point 17°C, and an altimeter setting of 30.03 inches of mercury.

Airport Information

Airport:	Foley Municipal Airport 5R4	**Runway Surface Type:**	Asphalt
Airport Elevation:	74 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	36	**IFR Approach:**	None
Runway Length/Width:	3700 ft / 74 ft	**VFR Approach/Landing:**	Touch and go;Traffic pattern

Wreckage and Impact Information

Crew Injuries:	1 Fatal, 1 Serious	**Aircraft Damage:**	Destroyed
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal, 1 Serious	**Latitude, Longitude:**	30.432777,-87.702224

Examination of the accident site and wreckage revealed several impression marks on the ground along a 243° heading. The airplane came to rest upright on the edge of airport property. All major airplane components were located at the site. The left wing was separated from the fuselage at the wing root and came to rest inverted 18 ft from the main wreckage.

The empennage was crushed and folded inverted along the left side of the passenger cabin. The vertical stabilizer was attached and bent 90° to the right at the attachment points. The rudder remained attached and was bent and impact damaged along its entire length. The outboard 3 ft of the right stabilator was impact crushed and the left side of the stabilator and trim tab was undamaged. The top of the fuselage aft of the front seats was folded back on top of the aft cabin. The forward end of the fuselage, including the instrument panel, forward cabin door, firewall, and engine, were folded down and under the forward cabin floor. The engine remained attached to the mount. The propeller was separated from the crankshaft propeller flange. The left aileron bellcrank, which remained attached to the aileron and balance cables, was located with the fuselage and had been pulled from its mounting and separated from the wing. Control cable continuity was confirmed from the cockpit to each of the control surfaces except the left aileron, which was continuous to the aileron bellcrank.

The left wing, including the attached flap and aileron, was impact fractured and damaged on all surfaces. The fuel tank was breached, and the grass around the wing displayed fuel blighting. The landing gear was fractured off and connected by the brake hose. The right wing, including the attached flap and aileron, was crushed from the wingtip to mid-wing and displaced upward with multiple fractures. The outer 2 ft of the flap was crushed in a negative direction, and the inboard 2 ft of aileron was impact fractured, bent, and crushed. The landing gear remained attached. The fuel filler cap remained installed in the filler opening, and fuel was observed in the fuel tank when the cap was removed.

The left cockpit seat was separated from its seat rails and from the fuselage. The lap belt was buckled. The outboard end of the lap belt remained attached to its mounting bracket, which was separated from the fuselage. The right cockpit seat remained attached to its seat rails. The lap belt was unbuckled. The airplane was not equipped with shoulder harnesses.

Examination of the airframe revealed no preimpact failures of any flight control surface or flight control system components.

The engine and its accessories were examined. The top spark plugs were removed, and visual examination revealed no anomalies. The rocker box covers were removed, and no anomalies were noted with the valve springs and rocker arms. Manual rotation of the engine's crankshaft produced compression on all four cylinders. The left and right magnetos were removed, and sparks were observed on all towers when each magneto was rotated by hand. Examination of the cylinders with a lighted borescope revealed a circular impact mark consistent with an exhaust valve strike on the No. 4 piston. The No. 4 cylinder was removed from the crankcase. The rocker arm, valve keepers, and springs were removed. The exhaust valve could not be removed from the valve guide by hand and was removed utilizing a hammer and a drift. The exhaust valve exhibited combustion deposits on the stem close to the rear of the valve face. Carbon build-up was observed in the valve guide.

The engine-driven fuel pump was removed from the engine and actuated by hand. Bubbles were observed around the gasket when the pump arm was actuated. Four screws on the periphery of the pump

were found to be loose.

Examination of the propeller blades revealed that one blade was bent forward about mid-span. The blade exhibited leading edge polishing and spanwise scratches on the forward face. The other blade was bent aft about mid-span with twisting towards low pitch. The outer portion of the blade exhibited leading edge polishing and chordwise scratches.

Additional Information

Valve sticking in Lycoming reciprocating aircraft engines is addressed in Lycoming Service Instruction No. 1425A, dated January 19, 1988, Suggested Maintenance Procedures to Reduce the Possibility of Valve Sticking. The Service Instruction is applicable to all Lycoming direct-drive engines and states in part, that:

Investigations have shown that exhaust valve sticking occurs more frequently during hot ambient conditions. The lead salts that accumulate in the lubricating oil from the use of leaded fuels contribute to the deposit build up in the valve guides. This condition is eliminated each time the oil and filter are changed. Depending on the amount of deposits, sticking between the valve stem and guide can restrict the valve movement, which is often identified by an intermittent engine hesitation or miss.

The Service Instruction further states that, "exposing the engine to sudden cool down, as in a rapid descent with the power reduced, or shutting the engine down before it has sufficiently cooled down can also induce valve sticking." Textron Lycoming recommends 50-hour interval oil change and filter replacement for all engines using full-flow filtration system. Review of the accident airplane maintenance logs revealed that the engine had accrued 44.48 hours since the last oil change.

Valve sticking in Lycoming reciprocating aircraft engines is further addressed in Lycoming Mandatory Service Bulletin 388C and Lycoming Service Instruction 1485A. Mandatory Service Bulletin 388C, which, according to FAA regulations, is not mandatory for aircraft operated under 14 CFR Part 91, calls for all Lycoming reciprocating aircraft engines to be inspected at 400-hour intervals or earlier if valve sticking is suspected. If the valve and guide do not pass the inspection, then corrective action is to be taken as defined in Service Instruction 1485A. Once the guides are replaced with the newer Hi-Chrome guides, inspection is called for every 1,000 hours, half of the published time between overhauls (TBO), or when valve sticking is suspected, whichever occurs first.

Review of the accident airplane maintenance logs revealed that the No. 4 cylinder had accumulated a total of 591.85 hours since replacement with an Engine Component Inc. (ECI) Titan cylinder, part number TIST-04-1CA. ECI does not offer guidance regarding the frequency of inspection of the Hi-Chrome valve guides in order to detect valve sticking. A valve inspection was not performed after the flight instructor reported engine roughness the day before the accident flight.

FAA Order 8620.2A, National Policy, Applicability and Enforcement of Manufacturer's Data states in part, "…unless any method, technique, or practice prescribed by an OEM in any of its documents is specifically mandated by a regulatory document, such as Airworthiness Directive (AD), or specific regulatory language such as that in Federal Aviation Regulation Part 43.15(b), those methods, techniques, or practices are not mandatory."

Medical and Pathological Information

Student Pilot

The Deputy Chief Medical Examiner of the Alabama Department of Forensic Sciences, Mobile, Alabama, performed an autopsy of the student pilot. The cause of death was determined to be from blunt force injuries. Toxicology testing yielded negative findings for ethanol and tested-for drugs.

Flight Instructor

The FAA's Bioaeronautical Sciences Research Laboratory, Oklahoma City, Oklahoma, performed toxicology testing on submitted specimens from the flight instructor. The test results yielded negative findings for ethanol and tested-for drugs.

Administrative Information

Investigator In Charge (IIC):	Spencer, Lynn
Additional Participating Persons:	Todd T Pryor; FAA/BHM FSDO; Birmingham, AL Troy Helgeson; Lycoming Engines; Williamsport, PA Jon Hirsch; Piper Aircraft; Vero Beach, FL
Original Publish Date:	May 19, 2020
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=99387