Aviation Investigation Final Report

Location:	Lake Placid, New York	**Accident Number:**	ERA24FA001
Date & Time:	October 1, 2023, 16:08 Local	**Registration:**	N545PZ
Aircraft:	Cessna 177RG	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (partial)	**Injuries:**	2 Fatal
Flight Conducted Under:	Part 91: General aviation - Other work use		

Analysis

The purpose of the flight was to photograph the accident airplane while airborne for a magazine article. There were two airplanes that made up the flight. The lead airplane (a Beech A36) took off first from the departure airport's only runway with a photographer onboard and the aft right door removed. The accident airplane took off about 700 ft behind the Beech. The owner was to fly the accident airplane during the takeoff and climb-out, and after joining up in formation the pilot-rated passenger was to take over the controls and fly the airplane during the formation photo shoot.

During the taxi to the runway, the accident airplane's engine was running when the Beech pulled up next to it. The engine then shut off. About 5 seconds later, the engine restarted. During the takeoff roll, the engine sounded to a witness as if the propeller was set for climb and not takeoff; he then heard the engine surge. During the initial climb, it sounded to the witness as if it were not running at full power. The accident airplane then made a gentle left turn while it was 300 to 400 ft above ground level (agl) to join up with the Beech. After closing to about 1,000 ft away from the Beech, the accident airplane suddenly entered a hard right turn back toward the airport.

During the turn, the pilot of the Beech heard the pilot-rated passenger transmit on the common traffic advisory frequency something similar to, "we have a problem and we're returning to the airport." The airplane then struck an embankment in a right-wing, nose-low attitude about 440 ft from the approach end of the runway and about 250 ft left of the centerline. The pilot and pilot-rated passenger were fatally injured, and the airplane was substantially damaged.

An airplane- and glider-rated pilot also observed the accident from the opposite side of the airport while pushing back a glider after landing on grass near the runway. A short while after the Beech took off, he saw the accident airplane take off, noting that it took longer (an estimated 100 additional ft) compared to the Beech. When the accident airplane was "just barely off" he saw "white smoke" briefly come out its exhaust pipes before smoke stopped being emitted. One or two seconds later, the accident airplane turned slowly to the left about 20° to 30° and was "barely going up." It continued in this direction for about 1 mile, then turned right "to come back to the airport." The airplane at this time was about 300 to 400 ft in altitude on a right base leg for the approach end of the runway "but was always turning right" and not on a square base leg. When the airplane's heading was 80° to 90° off the runway heading and it was still 300 to 400 ft agl, the "nose dropped down" and the airplane continued to turn right heading for the runway threshold. The witness did not remember hearing the engine and postulated that it might be because he was too far away. The airplane then disappeared short of the runway threshold on what appeared to be the runway centerline.

Both the accident pilot and pilot-rated passenger had accrued thousands of hours of flight time. However, the pilot had only about 10 hours of flight experience in the accident airplane make and model; it could not be determined if the pilot-rated passenger had any flight experience in the accident airplane make and model because no pilot logbooks were recovered or provided.

Review of images captured by the photographer on board the Beech showed no evidence of any open doors, smoke, or liquids leaking from the accident airplane. The photographs also indicated that the flaps were partially extended and that, just before impact, the landing gear may have been in transit and a nose-up pitch input was being applied.

A review of maintenance records did not reveal any evidence of discrepancies or abnormalities with the airplane, propeller, or engine. However, examination of the airplane, propeller, and engine did reveal some discrepancies. The hydraulic lifters had not been replaced during the last engine overhaul as required by the engine manufacturer; however, examination of the plungers per the engine manufacturer's inspection guidelines did not reveal any anomalies or evidence of a leaking plunger in any of the lifters. Two of the hydraulic lifters exhibited a slower bleed-down rate during testing; however, this would have had little effect on valve timing at higher engine rpms.

Additionally, the extension portion of the fuel reservoir drain control was found to be improperly installed, 90° forward on the arm assembly with the tang over the aft side of the arm. Despite this condition, it could still be moved slightly even though the actuating cables for both drain valves were bent due to impact damage. None of the discrepancies found were likely to have resulted in any preimpact failures or malfunctions that would have affected normal operation.

Around the time of the accident, the density altitude was about 2,758 ft above mean sea level (msl). The airplane would have had a takeoff distance that was about 37% longer than normal with an approximate 28% decrease in the rate of climb. Given the conditions, the pilot could have reasonably anticipated that the airplane would have used more of the runway length during the takeoff and would have had a more sluggish climb rate than normal.

Two video cameras mounted on a nearby residential building recorded the airplane just before impact as it passed --right to left--in a right-banked, descending turn. Spectrum analysis of a sound consistent with the airplane's engine that was recorded on one of the videos was used to estimate the engine speed was 2,125 rpm (±45 rpm) during a 7-second period that ended 2 seconds before ground impact. Based on this analysis, the engine was likely operating at that time.

Although a calculated weight and balance for the flight was not found, the airplane's weight was estimated using information from the pilot's operating handbook (POH) and balance form found in the airplane's maintenance records. With an estimated fuel load of 40 gallons (out of a 60-gallon usable fuel capacity), plus the reported weight of the occupants, the airplane's total weight would have been about 292 lbs below its maximum gross weight and the center of gravity (CG) would have been about 1 inch forward of the CG limit. Assuming a fuel load of 60 gallons, the airplane's total weight would have been 172 lbs below its maximum gross weight and the CG would have been about 1.2 inches forward of the CG limit.

The airplane was equipped with a portable GPS receiver that captured accident flight data. An airplane performance study using the recovered GPS data showed that after takeoff, a little more than 1,140 ft from the runway threshold, the airplane's total energy (potential plus kinetic) reached a peak and then began to decrease, consistent with a decrease in engine power. The airplane then began to transition from rolling left to rolling right, and the lift coefficient began to increase sharply.

The lift coefficient then exceeded the airplane's expected maximum lift coefficient (which was calculated based on data from the POH), which was indicative of an aerodynamic stall. The roll angle then reached a maximum of 39°, the airspeed reached a minimum of 52 kts calibrated airspeed (KCAS), and the altitude reached a maximum of 1,929 ft msl, followed by a sharp drop at -1,300 ft/min; all of these parameters showed behavior consistent with an aerodynamic stall.

Several days before the accident, the pilot asked a flight instructor if he would sit in the right seat of the accident airplane to accompany him on a practice flight to prepare for the photo flight. The flight instructor agreed, having already flown the airplane several times. The flight instructor read off the checklist for the pilot and they discussed what the pilot in command (PIC) would do in an emergency during the takeoff roll and departure. Upon takeoff from the same departure airport, when about 200 ft in the air, they heard a noise and then felt a draft. The flight instructor turned around and saw that the baggage door was wide open. The flight was roughly 500 to 800 ft above the ground. The pilot "immediately made a very steep bank to the left to turn back to the runway's approach end" and landed.

Review of the GPS data from the practice flight revealed that the airplane had lifted off from the runway and began a sharp roll to the left, reaching a roll angle of 40° before rolling back to the right. The airplane then reached a roll angle of 27° as it aligned with the runway. During the left turn, the track angle changed by about 9.6° per second, compared with a standard-rate turn of 3° per second. The airplane reached a maximum altitude of about 400 ft agl during the left turn before it descended and landed. Analysis of this previous air turnback to land revealed that it was similar in nature to the aggressive air turnback observed during the accident flight.

Operation of an airplane outside the approved CG limits will result in control difficulty. The primary concern in balancing an aircraft is the fore and aft location of the CG along the longitudinal axis. If the CG is displaced too far forward on the longitudinal axis, a nose-heavy condition will result which can cause problems in controlling and raising the nose, especially in takeoff and landing. During landing, one of the most critical phases of flight, exceeding the forward CG limit often results in decreased performance, higher stalling speeds, and higher control forces. In extreme cases, a CG location beyond the forward limit may result in nose heaviness, making it difficult or impossible to flare for landing.

Limits for the location of the CG are established and published by the manufacturer and are often established at a location that is determined by the landing characteristics of an airplane. Manufacturers place the forward CG limit as far rearward as possible to aid pilots in avoiding damage when landing and to assure that sufficient elevator/control deflection is available at minimum airspeed. The actual location of the CG can be altered by many factors controlled by the pilot. Placement of baggage and cargo items, etc. determines the CG location; for the accident flight, the pilot could have added ballast in the baggage compartment to obtain a favorable balance. However, no evidence of added ballast was discovered despite the charts and graphs provided in the POH to enable pilots to make weight and balance computations.

The pilot’s failure to perform weight and balance calculations led to the airplane taking off outside its forward CG limit, which likely degraded the controllability of the airplane. The subsequent partial loss of power during the takeoff and climb and along with the higher-than-normal density altitude, likely reduced the airplane’s climb performance substantially. The pilot’s subsequent aggressive use of the flight controls to turn back to the airport ultimately resulted in the airplane exceeding its critical angle of attack and entering an aerodynamic stall at an altitude from which a safe recovery by the pilot was not possible.

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 for undetermined reasons. Contributing to the accident was the pilot’s inadequate preflight weight and balance planning and his aggressive low altitude maneuvering, which resulted in an aerodynamic stall and loss of control.

Findings

Personnel issues	Weight/balance calculations - Pilot
Personnel issues	Performance calculations - Pilot
Personnel issues	Aircraft control - Pilot
Personnel issues	Incorrect action performance - Pilot
Aircraft	(general) - Unknown/Not determined
Aircraft	Angle of attack - Not attained/maintained

Factual Information

History of Flight

Takeoff	Loss of engine power (partial) (Defining event)
Initial climb	Loss of engine power (partial)
Maneuvering	Abrupt maneuver
Maneuvering	Loss of control in flight
Maneuvering	Aerodynamic stall/spin
Maneuvering	Attempted remediation/recovery
Uncontrolled descent	Collision with terr/obj (non-CFIT)

On October 1, 2023, about 1608 eastern daylight time, a Cessna 177RG, N545PZ, owned and operated by Lake Placid Air Service, was substantially damaged when it was involved in an accident at Lake Placid Airport (LKP), Lake Placid, New York. The pilot and pilot-rated passenger sustained fatal injuries. The airplane was operated as a Title 14 *Code of Federal Regulations* (*CFR*) Part 91 aerial photography flight.

The purpose of the flight was to photograph the airplane while airborne for a magazine article. According to witnesses, there were two airplanes that made up the flight. The lead airplane was a Beech A36, N4GA, which took off first from runway 32, with a photographer onboard and the aft right door removed. Then the accident airplane took off about 700 ft behind the Beech. The owner of the accident airplane was to fly it during the takeoff and climb-out, and after joining up in formation, the pilot-rated passenger was to take over the controls and fly the airplane during the formation photo shoot.

During the taxi to the runway, the pilot of the Beech observed that the Cessna's engine was running when he pulled up next to it. He then heard the engine stop and saw the propeller stop; about 5 seconds later he saw the engine restart and the propeller turn again. During the takeoff roll the engine sounded to a witness as if the propeller was set for climb and not takeoff; he then heard the engine surge. During the initial climb, it sounded to the witness as if it were not running at full power. The airplane was then observed to make a gentle left turn when it was 300 to 400 ft agl to join up with the Beech while still about 1,000 ft away from it. The accident airplane suddenly made a hard right turn in the direction of the airport. During the turn, the pilot of the Beech heard the pilot-rated passenger transmit on the common traffic advisory frequency something similar to, "we have a problem and we're returning to the airport."

The airplane subsequently struck an embankment in a right-wing, nose-low attitude about 15 ft below the top of a plateau on airport property. The airplane then slid about 30 ft down the embankment and came to rest on the side of the slope upright, perpendicular to the embankment, with its left wing facing uphill and its right wing facing downhill. Measurements indicated that the embankment was located about 440 ft from the approach end of runway 14, about 250 ft left of centerline, and had an approximate 70° slope that led down to a ravine located off the approach end of the runway.

An airplane- and glider-rated pilot also observed the accident from the opposite side of the airport while pushing back a glider after he landed on the grass near runway 32. He noticed the Beech taking off, so he stopped and watched. He said to his wife, "look there is no door because I think they will take aerial pictures." A short while later, they saw the accident airplane also take off. That takeoff took longer (maybe 100 ft more) compared to the Beech. When the accident airplane was "just barely off" they saw "white smoke" come out from its exhaust pipes, "like: pouf…pouf…pouf…then nothing."

One or two seconds later, the airplane turned slowly to the left about 20° to 30° and was "barely going up." It continued in this direction for about 1 mile, then turned right "to come back to the airport." The airplane at this time was about 300 to 400 ft in altitude on a right base leg for runway 14, "but was always turning right" and not on a square base leg. When the airplane's heading was 80° to 90° off the runway heading and the airplane was still 300-400 ft above the ground, the "nose dropped down" and the airplane continued to turn right toward the runway 14 threshold. The pilot did not remember hearing the engine and postulated that it might be because they were too far away. The airplane then disappeared short of the runway 14 threshold, on what appeared to be the runway centerline.

Pilot Information

Certificate:	Commercial; Private	**Age:**	70,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	Helicopter	**Restraint Used:**	3-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	January 6, 2023
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	August 22, 2023
Flight Time:	(Estimated) 9000 hours (Total, all aircraft), 10 hours (Total, this make and model)		

Pilot-rated passenger Information

Certificate:	Commercial; Flight instructor; Remote	**Age:**	63,Male
Airplane Rating(s):	Single-engine land; Single-engine sea; Multi-engine land; Multi-engine sea	**Seat Occupied:**	Right
Other Aircraft Rating(s):	Unmanned (sUAS)	**Restraint Used:**	3-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane single-engine	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	May 2, 2023
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:	(Estimated) 5800 hours (Total, all aircraft)		

According to FAA records, the pilot held a commercial pilot certificate, with ratings for airplane single engine land, multiengine land, and instrument airplane. He also possessed a type rating for the DC-3, and private pilot privileges for rotorcraft-helicopter. His most recent FAA second-class medical certificate was issued on January 6, 2023. He reported on that date that he had accrued about 9,000 total flight hours.

The pilot-rated passenger held a commercial pilot certificate with ratings for airplane single engine land, airplane single engine sea, airplane multiengine land, airplane multiengine sea, and instrument airplane. He also held a flight instructor certificate with ratings for airplane single and multiengine, and instrument airplane. Additionally, he possessed a type rating for the CE525 and a remote pilot certificate with a rating for small unmanned aircraft system. His most recent FAA second-class medical was issued on May 2, 2023. He reported on that date that he had accrued about 5,800 total flight hours. The pilot-rated passenger had also applied for BasicMed, with a BasicMed course date of July 20, 2023, and Comprehensive Medical Examination Checklist dated July 14, 2023.

Aircraft and Owner/Operator Information

Aircraft Make:	Cessna	**Registration:**	N545PZ
Model/Series:	177RG	**Aircraft Category:**	Airplane
Year of Manufacture:	1976	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	177RG1023
Landing Gear Type:	Retractable - Tricycle	**Seats:**	4
Date/Type of Last Inspection:	April 7, 2023 Annual	**Certified Max Gross Wt.:**	2800 lbs
Time Since Last Inspection:	39.2 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	7161.6 Hrs as of last inspection	**Engine Manufacturer:**	LYCOMING
ELT:	C91 installed, not activated	**Engine Model/Series:**	IO-360-A1B6D
Registered Owner:	LAKE PLACID FLYING SERVICE INC	**Rated Power:**	200 Horsepower
Operator:	LAKE PLACID FLYING SERVICE INC	**Operating Certificate(s) Held:**	On-demand air taxi (135)
Operator Does Business As:		**Operator Designator Code:**	BPYA

The accident airplane was equipped with a 2-blade, variable pitch, constant speed propeller. According the airplane’s maintenance records, the engine had accumulated about 76 hours of operation since major overhaul.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KSLK,1659 ft msl	**Distance from Accident Site:**	13 Nautical Miles
Observation Time:	15:51 Local	**Direction from Accident Site:**	307°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	7 knots / None	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	10°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.23 inches Hg	**Temperature/Dew Point:**	23°C / 12°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Lake Placid, NY (LKP)	**Type of Flight Plan Filed:**	None
Destination:	Lake Placid, NY (LKP)	**Type of Clearance:**	None
Departure Time:	16:05 Local	**Type of Airspace:**	Class G

The recorded weather at Adirondack Regional Airport, Saranac Lake, New York, about 13 nautical miles northwest of LKP, at 1551, included: wind 010 at 7 knots, 10 statute miles visibility, clear skies, temperature 23° C, dew point 12° C, and an altimeter setting of 30.20 inches of mercury.

Airport Information

Airport:	LAKE PLACID LKP	**Runway Surface Type:**	Asphalt
Airport Elevation:	1747 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	14	**IFR Approach:**	None
Runway Length/Width:	4196 ft / 60 ft	**VFR Approach/Landing:**	Unknown

Lake Placid Airport is located 1 mile southeast of the central business district of the Village of Lake Placid.

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 Fatal	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 Fatal	**Latitude, Longitude:**	44.269042,-73.968803

On-Scene Wreckage Examination

On scene examination of the wreckage revealed that during the impact sequence the right wing sustained upward buckling from the wingtip inboard to the aileron/flap junction. The fuselage and empennage were slightly buckled along the right side from the aft side of the cabin door to about fuselage station (FS) 225.

Control cable continuity was established from the flight control surfaces to the cockpit controls. The flaps were extended approximately 10°; the speed brakes were in the stowed position and the stabilator trim was neutral. The airplane’s stall warning system sustained impact-related damage that precluded any postaccident functional testing.

The fuel strainer bowl was fractured during the impact sequence and only a portion of it was observed. The fuel strainer screen was clean. The fuel selector handle operated normally in all positions and positively engaged in the detents. The position of the fuel selector valve was confirmed to be in the BOTH position by rotating the handle through all positions while defueling the airplane through the inlet line of the fuel strainer. The fuel caps were closed and secured. The position of the fuel pump switch could not be determined due to impact damage. There were no obstructions noted in the fuel or fuel vent system from the wing tanks to the inlet of the fuel strainer. First responders reported that fuel was draining from the airplane upon arrival.

The nose landing gear was crushed aft consistent with impact, which separated the actuator; its position could not be determined. The landing gear was in an intermediate position. The single main landing gear actuator was observed attached to its frame. The sector gear teeth were intact. There was no observable damage to the main landing gear down locks or gear legs. The main landing gear wheels were also observed to be in contact with the buckled lower fuselage and not in the wheel wells.

The electrical and lighting switch positions were damaged during the impact sequence and their positions could not be determined. The cowl flap handle was in the OPEN position. The mixture control was in the full rich position, the propeller control was in the high rpm/fine pitch position, and the throttle was out about 2 inches and bent slightly up and to the left about 30°.

The fuel selector was found in the Both position. All detents were functional. No blockages were discovered in the fuel system and 17 gallons of fuel were recovered from the right-wing fuel tank. The fuel was tested using water finding paste with a negative result.

The engine remained attached to the firewall through the engine mount. The engine mount sustained damage consistent with impact in the form of fractures and bends to various tube sections; it was canted to the right of the airplane's centerline. The engine mount was cut using a reciprocating saw to free the engine from the firewall along with disconnecting or separating various fuel hoses and control cables.

The spinner was fractured consistent with impact and only half of it remained attached to the propeller hub. The propeller hub was found to be cracked from the impact sequence with a section missing, and one blade was partially dislodged from the hub. The propeller remained attached to the engine crankshaft. One of the blades was loose in the hub and exhibited leading edge scratches and gouges. The other blade was bent slightly aft at midspan with an approximate 2-inch curled section of the tip separated. The blade exhibited chordwise scratching and leading edge gouging on the outer 1/3 of the blade. The propeller governor was found securely installed to the rear of the engine. Its screen was found free and clear of any debris and oil flowed from the unit when rotated by hand.

The top sparkplugs were all found intact, undamaged, and tightly installed in each cylinder. The top sparkplugs were removed, and a lighted borescope examination was conducted. No abnormalities were observed within the cylinders. The engine drivetrain was rotated by the propeller in its normal direction of rotation. Suction and compression were noted on all cylinders through the top spark plug holes, with movement of all rocker arms noted during rotation.

All eight sparkplugs were removed and compared to a Champion Aerospace AV-27 "Check-A-Plug" chart. Coloration across the plugs ranged from normal to black carbon fouled, with normal wear to the electrodes. No mechanical electrode damage was noted or observed on any of the sparkplugs. The bottom sparkplugs for cylinder Nos. 1 and 3 were oil soaked, consistent with the orientation of the engine at the accident site and oil within the cylinders.

The single-drive dual magneto unit was found securely installed to the rear of the engine. After the removal of the unit, the single drive was rotated using an electric drill. The magneto produced spark at all ignition leads. No damage was observed to the magneto housing, but both ignition harnesses sustained various levels of damage consistent with impact in the form of cuts and abrasions to multiple leads.

The oil dipstick was found securely installed in the filler neck and indicated that 6 quarts of oil were contained in the engine oil sump. Oil was found draining from impact damage on the No. 3 cylinder exhaust tube, consistent with the orientation of the airplane at the accident site. Oil was also found on the accessory section of the engine around the oil filter where the filter had sustained a high level of impact damage and had separated from its threaded base. A portion of the filter element was removed and examined and found to be clean with no metallic particles or debris. The oil suction screen plug was found to be tight and safety-wired to the oil sump. The screen was found unobstructed and clear of any debris.

The fuel system, including the engine-driven fuel pump, fuel manifold, and fuel servo, were all found attached to the engine. The fuel pump’s 45° outlet fitting was found slightly loose, with the mating hose tight to the fitting. No fuel staining was observed from the fitting or on the fuel pump housing itself. The fuel divider was tightly installed to the top of the engine with all injection lines tight and secure to each injection nozzle. The fuel injection manifold was disassembled with no debris or tears noted to its diaphragm. The fuel servo was attached to the lower side of the engine with all lines tight and secure; however, all four hold down nuts were found loose when slight pressure with a wrench was applied. Torque stripes were present on the studs and nuts; the torque stripes did not appear to be disturbed or misaligned. The throttle plate was found in the closed position. When the throttle arm was actuated manually, the throttle plate moved freely within the servo, but the threaded rod for the idle thumb screw adjustment was found fractured and not connected. The fuel injection nozzles were found to be free and clear of any debris.

The vacuum pump was found to be securely installed on the accessory section of the engine. The rotor and vanes were all intact with no fractures or damage observed. The drive coupling was present with no damage observed and the entire unit spun freely when rotated by hand.

Follow-on Wreckage Examination

During a follow-on wreckage examination, the extension portion of the fuel reservoir drain control was found to be installed 90° forward on the arm assembly with the tang over the aft side of the arm; little to no movement was observed at either drain valve assembly when the extension was pulled forward and no fuel drained from either drain tube. The actuating cables for both drain valves were found to be bent approximately 50° consistent with impact damage. The extension portion of the reservoir drain control was then removed from the arm assembly and installed in line with the arm per the engineering drawing; a small amount of movement was observed at both drain valve assemblies when the extension was pulled forward and fuel was observed dripping from the right drain tube. No fuel was observed from the left drain tube. Approximately 16 ounces of blue aviation fuel was drained from the right reservoir tank; no fuel was drained from the left reservoir tank, as the vent line was disconnected during the on-scene portion of the investigation.

The interior of each reservoir tank was examined; no anomalies were noted in the right tank. A small amount of debris was observed in the left tank. The left reservoir tank was then removed from the airplane and shaken over a clean paper towel. A small amount of debris which appeared to be dirt/sand was expelled from the tank. The fuel selector valve was removed from the airplane and compressed air was blown through the valve in each of the four positions. No obstructions were noted and the valve operated normally. The auxiliary fuel pump was also operationally tested with no discrepancies noted.

Flight recorders

The airplane was not equipped with a flight recorder nor was it required to be. It was equipped with a Garmin GPSMAP 396 12-channel GPS receiver. The unit stored date, route-of-flight, and flight time information for up to 50 flights. A flight record was triggered when groundspeed exceeded 30 knots and altitude exceeded 250 ft, and the flight record would end when the groundspeed dropped below 30 knots for 10 minutes or more. A detailed track log, including latitude, longitude, date, time, and GPS altitude information was stored within the unit when the receiver had a lock on a GPS navigation signal. The downloaded data contained 44 sessions, from May 26 to October 1, 2023. The last session, recorded on October 1, 2023, was identified as the accident flight. The recording was about 4 minutes and 15 seconds long, from 1604:32 to 1608:47. The recording rate ranged from 2 to 23 seconds per sample.

The recorded information also included a session from September 17, 2023, which contained a flight with a similar turnback maneuver shortly after the takeoff from the same airport as the accident flight.

Medical and Pathological Information

Pilot

According to the Essex County coroner’s autopsy report, the pilot’s cause of death was multiple blunt traumatic injuries and his manner of death was accident.

Toxicology testing performed by the FAA Forensic Sciences Laboratory on the pilot’s blood, vitreous, and urine, did not identify any substances that are generally considered impairing.

Pilot-Rated Passenger

According to the Essex County coroner’s autopsy report, the pilot-rated passenger’s cause of death was multiple blunt traumatic injuries and his manner of death was accident.

Toxicology testing performed by the FAA Forensic Sciences Laboratory on the pilot-rated passenger's blood and urine detected the enlarged prostate medication tamsulosin, commonly marketed as Flomax, which is not generally considered impairing.

Tests and Research

Fuel Servo Examination and Testing

The fuel servo throttle arm that was fractured and disconnected was examined by the NTSB Materials Laboratory. The throttle arm operated similarly to a turnbuckle with a threaded section joining the two end blocks. The threaded section where the fracture was exhibited plastic deformation. The fracture surface did not exhibit any evidence of preexisting cracks and the fracture was found to be consistent with bending overstress.

The fuel servo was subsequently tested and examined at Precision Airmotive. Flow testing indicated that the fuel servo was functional and the examination did not reveal evidence of any preimpact malfunctions.

Engine Teardown and Examination

An engine examination was conducted at Lycoming Engines. All cylinders were removed from the engine along with corresponding pistons from each cylinder. All rocker arms, valves, and springs were removed from each cylinder. No anomalies were discovered. The valve stems showed no signs of material transfer, scoring, or damage. All pushrods were removed and found to be straight with no bending along the length of each rod. The engine case was separated allowing examination of the crankshaft and camshaft. Both were found to be unremarkable with the journals and lobes to be in good condition. The connecting rod bearings and main bearings were present and in good condition.

The engine-driven oil pump was removed from the accessory housing and both the gears and housing were unremarkable. The accessory housing portion of the oil pump showed some pitting and wear to the aluminum surface, which may have been present from past operation before engine overhaul. The remaining portion of the oil system was examined starting with the oil pressure relief valve spring. The spring was tested to new production limits and found to be within tolerance at 8.6 lbs. The acceptable range per the Lycoming drawing is 8.5 to 9.5 lbs under compressed load. The vernatherm (thermostatic bypass valve), which regulated oil temperature in the engine by controlling the flow of oil to the oil cooler, was present within the oil filter adapter and was removed for examination. The vernatherm was tested within a heated oil bath and measuring fixture used for vernatherm testing. The subject unit was placed in the oil bath and heated to various temperatures during the test. Results of the test showed the vernatherm moved at all testing temperatures and met the required length of travel between the 150° and 185° test points.

Hydraulic Lifter Testing and X-Ray Examination

The engine was equipped with hydraulic tappets (valve lifters) that would automatically keep the valve clearance at zero, eliminating the necessity for any valve clearance adjustment mechanism.

According to the FAA's *Aviation Maintenance Technician Handbook* (FAA-H-8083-32B), when an engine valve is closed, the face of the tappet body would be in contact with the back of the cam. A light plunger spring would lift the hydraulic plunger so that its outer end would contact the push rod socket and exert light pressure against it, thus eliminating any clearance in the valve linkage. As the plunger moved outward, the ball check valve would move off its seat. Oil from the supply chamber, which was directly connected to the engine lubrication system, would flow in and fill the pressure chamber. As the camshaft rotated, the cam would push the tappet body and the hydraulic lifter cylinder outward. This action would force the ball check valve onto its seat; thus, the body of oil trapped in the pressure chamber would act as a cushion. During the interval when the engine valve was off its seat, a predetermined leakage would occur between the plunger and cylinder bore, which would compensate for any expansion or contraction in the valvetrain. Immediately after the engine valve closed, the amount of oil required to fill the pressure chamber would flow in from the supply chamber, preparing for another cycle of operation.

Examination of the plungers per the inspection guidelines contained in Lycoming Service Instruction No.1011N did not reveal any anomalies or evidence of a leaking plunger in any of the lifters.

Testing of the hydraulic lifters from the accident engine was conducted at Lycoming Engines. All of the lifters were prepared for testing with test fluid before being placed onto a test fixture. Lycoming used this fixture to test all new production lifter assemblies for to determine that they met the requirements of traveling .125 inches in 0 to 50 seconds. All the lifters were found to be operational and functional as part of the test with no stuck or frozen lifter assemblies. All the units bled down at varied rates. The test fixture was calibrated to test from 0 to 50 seconds and would cease the test at 50 seconds. Two of the lifters tested (the No.1 exhaust and No.2 intake) would not bleed down within 50 seconds.

Hydraulic valve lifters were normally adjusted at the time of overhaul. They were assembled dry (no lubrication), the clearances were checked, and adjustments were made by using push rods of different lengths. A minimum and maximum valve clearance was established, and any measurement between these extremes was acceptable; about halfway between the extremes was desired. Hydraulic valve lifters require less maintenance, are better lubricated, and operate more quietly than the screw adjustment type.

A date code of “M-V” was noted on the lifter assemblies; this indicated that they had been manufactured by Eaton in December of 1999. A review of the overhaul records did not show the lifters had been installed as part of the last documented engine overhaul, though Lycoming Service Bulletin No. 240W and Lycoming Service Instruction No.1011N required they be replaced at the time of overhaul.

An X-ray examination was subsequently conducted at Lycoming on all the lifters from the accident engine. No anomalies, foreign object damage, or cracks were discovered with any of the lifter assemblies. The check valve portion was then mechanically removed from each lifter body, X-rayed, and examined with a scanning electron microscope. No anomalies were found with any of the check balls and corresponding seats. The seat surfaces were uniform and shiny with no burrs or corrosion noted.

Propeller and Governor Examination and Testing

The propeller and propeller governor were examined and tested at McCauley Propeller Systems. The propeller displayed sudden-failure type damage and gross part deflections typically associated with impact forces. Approximately the aft half of the circumference of one of the blade sockets was missing. Only a small portion of the missing hub was recovered. The fracture surface of the hub was consistent with gross structural overload. All six propeller attachment studs were present and straight. There was no evidence of fatigue failure. There were no indications of propeller failure or malfunction before the impact sequence.

The blade angle actuation components exhibited gross part deflection and structural overload failure associated with the impact sequence. Both blades were able to be twisted by hand in their sockets. Both links were broken and the piston rod was bent. The piston was captured inside the deformed cylinder in a position consistent with the propeller blades being at or near the low pitch stop. Witness marks on the spacer in front of the piston and witness marks on the front of the piston were consistent with the propeller being at the low pitch stop at the time of impact. Witness marks consistent with the coils of the piston return spring were found on the butt face of both propeller blades. The orientation of the spring coil indentations was consistent with both propeller blades being at or near the low pitch stop at the time of impact.

Lubricating grease was found inside the propeller hub and on the blade retention bearing components. Engine oil was found inside the actuating cylinder. Both were consistent with normal propeller function.

The governor cable mounting bracket and a short piece of governor control cable were attached to the top of the governor. The bracket was slightly deformed and one of its four attachment screws was missing; however, witness marks were consistent with a screw and washer having previously been installed at that location. While on site the governor had to be removed and was not separated from the engine during the accident. The control cable had been cut by the recovery team to remove the governor. The remaining portion of the control cable was intact.

The screws that attached the top cap of the governor were flat-slotted screws drilled for lockwire, where socket head cap screws were expected to be found. According to FAA Advisory Circular 43.13-1B, *Acceptable Methods, Techniques, and Practices—Aircraft Inspection and Repair* (Chapter 7, Section 3), this hardware substitution was permitted. The input shaft and control arm of the governor were free to move by hand. The mounting gasket and mounting face of the governor, though dirty, were otherwise in good condition.

After removing the bracket and control cable and cleaning the dirt from the mounting face, the governor was mounted to a governor test bench and operationally tested. Given the governor drive pad ratio of 0.850 for the IO-360-A1B6D, a governor rpm of 2,240 would result in a propeller speed of 2,240 / 0.850 = 2,635 rpm. It should be noted that the maximum rpm achieved on governor test benches is subject to vary from the maximum rpm achieved on the airplane installation. Final rpm adjustments must be made after governors are installed on the airplane.

After recording the maximum governor rpm with the governor in the as-received condition, the safety wire was removed from the set screw that limits the maximum movement of the control arm. The set screw was adjusted and it was confirmed that the governor was able to be adjusted to run at the specified maximum rpm.

Magneto Examination and Testing

The single-drive, dual magneto was examined and tested at Hartzell Engine Technologies. The impulse coupling and magneto operated normally at rpms up to 2,700. There was nothing found that would preclude normal operation. The magneto was in good condition with no appreciable wear or remarkable damage. Despite having lower than nominal point gaps and slightly late internal timing, the single-drive dual magneto operated normally and generated a spark at each ignition lead.

Review of Videos and Sound Spectrum Study

Video recordings from two videos cameras mounted on a residential building were provided to the NTSB. Reviews of the two videos (one of which was able to be used for sound spectrum analysis) indicated that a sound similar to the airplane’s engine was audible (as the airplane passed the cameras from right to left in a right-banked, descending turn toward the area off the approach end of runway 14).

The speed of the engine was assessed via spectrum analysis of the sound recorded in one of the videos. The analysis estimated that the engine speed was about 2,125 rpm (±45 rpm) during a 7-second period that ended 2 seconds before ground impact.

Weight & Balance and Performance Study

During the investigation, detailed weight and balance information for the flight was not found. Weight was estimated using information from the POH and a weight and balance form dated December 28, 2009, that was found in the airplane’s maintenance records and listed the empty weight as 1,828 lbs at a moment arm of 103.2 inches. Using that empty weight and moment arm, and assuming a fuel load of 40 gallons (out of a 60-gallon usable fuel capacity) plus the reported weight of the occupants, gave a weight of 2,508 lbs at a moment arm of 102.5 inches, which was about 1 inch forward of the center of gravity (CG) limit indicated in the POH. Assuming a fuel load of 60 gallons, the weight would have been 2,628 lbs at a moment arm of 102.9 inches, about 1.2 inches forward of the CG limit. The maximum takeoff weight was listed as 2,800 lbs.

The normal takeoff procedure in the POH indicated that 10° of wing flaps were preferred, and examination of the wreckage found that the wing flaps were at 10°. Rotation was expected at 55 knots indicated airspeed (KIAS), with subsequent climb at 65 to 75 KIAS.

The POH listed the power-off, flaps-up, wings-level stall speed at a weight of 2,800 lbs as 57 kts calibrated airspeed (KCAS) at the most rearward cg and 61 KCAS at the most forward cg. At a weight of 2,800 lbs, a stall speed of 57 KCAS corresponded to a maximum lift coefficient (CLmax) of 1.46 and a stall speed of 61 KCAS corresponded to a maximum lift coefficient CLmax of 1.28.

The POH listed the power-off, flaps 10°, wings-level stall speed at a weight of 2,800 lbs as 53 KCAS at the most rearward cg and 57 KCAS at the most forward cg. At a weight of 2,800 lbs, a stall speed of 53 KCAS corresponded to a CLmax of 1.69 and a stall speed of 57 KCAS corresponded to a CLmax of 1.46.

A note in the POH indicated that the stall speeds were independent of whether the landing gear was up or down. Another note indicated that the maximum altitude loss during a stall recovery was approximately 190 ft. The POH included a table showing that for wing flaps up or wing flaps 10°, indicated airspeeds were 1-2 kts less than calibrated airspeeds for airspeeds below 100 kts.

A performance study based on data recovered from the GPS onboard the accident airplane indicated that after takeoff (a little more than 1,140 ft from the threshold of runway 32), the total energy (potential plus kinetic) reached a peak at 1608:32 and then began to decrease, which was consistent with a decrease in engine power. Additionally, at 1608:32, the airplane began to transition from rolling left to rolling right, and the lift coefficient began to increase sharply.

At 1608:41, the lift coefficient exceeded the airplane's expected value of CLmax calculated from the POH, which was indicative of an aerodynamic stall. Also at 1608:41, the roll angle reached a maximum of 39°, the airspeed reached a minimum of 52 KCAS, and the altitude reached a maximum of 1,929 ft msl, followed by a sharp drop at -1,300 ft/min; all of these parameters showed behavior consistent with an aerodynamic stall. At 1608:41, the airplane was turning right, but the recorded ground track angle at that time was 330.8°, an angle of about 25° relative to the true alignment of runway 32 at 306°, which indicated that the airplane was still traveling away from the airport at that time. Figure 1 shows the airplane's position and altitude during the accident flight with respect to the takeoff runway and the crash site.

Figure 1 - Overhead view of the accident flight path overlaid on top of an aerial image of the airport. Annotations indicate the time (hh:mm:ss) and recorded altitude (ft msl). The crash site is indicated by a red circle.

Previous Air Turnback and Performance Supplement

According to a flight instructor, about 2 weeks before the accident the pilot asked the flight instructor if he would sit in the right seat of the accident airplane to accompany him on a practice flight to prepare for the photo flight. The flight instructor agreed, having flown the airplane a handful of times over the past couple of years.

Start up, taxi, and runup for the practice flight were all normal. The flight instructor read off the checklist for the pilot and they discussed what the pilot-in-command would do in an emergency during the takeoff roll and departure. Upon takeoff from runway 32, about 200 ft in the air, they heard a noise and then felt a draft. The flight instructor turned around and saw that the cargo door was wide open. He told the pilot at this point they were roughly 500 to 800 ft above ground and over the trailer park off the departure end of runway 32. The pilot “immediately made a very steep bank to the left to turn back to runway 14.” The flight instructor said, “It was upsetting to say the least.” The pilot continued the landing as normal.

Review of the GPS data revealed that the practice flight occurred on September 17, 2023, and that the airplane departed LKP and immediately returned to the airport. The airplane lifted off from runway 32 shortly after 1012:20, but it began a sharp roll to the left at 1012:56, reaching a roll angle of -40° at 1013:20 before rolling back to the right. The airplane then reached a roll angle of 27° at 1013:37 as it aligned with runway 14. During the left turn, the track angle changed by about 9.6° per second, as compared with a standard rate turn of 3° per second. The airplane reached an altitude of about 400 ft agl during the left turn and subsequently descended and landed on runway 14 about 1013:46. Figure 2 shows the airplane’s position and altitude during the September 17 flight with respect to the takeoff runway.

Figure 2 - Flight track for the practice flight 2 weeks before the accident flight overlaid on top of an aerial image of the airport. Annotations indicate the time (hh:mm:ss) and recorded altitude (ft msl).

Additional Information

Review of Photographs

Review of images captured by the photographer onboard the Beech did not reveal any evidence of any open doors, smoke, or liquids leaking from the airplane. Photographs also indicated that the flaps were partially extended; just before impact the landing gear may have been in transit and a nose up pitch input was being applied.

Density Altitude and Performance

Review of the meteorological conditions around the time of the accident also indicated that with a field elevation of 1,747 ft, an altimeter setting of 30.20 inches of mercury, and an outside air temperature of 23° C, the density altitude at the time was about 2,758 ft msl.

Review of an FAA Koch chart indicated that under these conditions, the airplane would have had a takeoff distance that was about 37% longer than normal with an approximate 28% decrease in the rate of climb.

Balance, Stability, and Center of Gravity

The FAA publication *Pilot's Handbook of Aeronautical Knowledge* (FAA-H-8083-25C) says in part that operation with the center of gravity (CG) outside the approved limits results in control difficulty.

The primary concern in balancing an aircraft is the fore and aft location of the CG along the longitudinal axis. The CG is not necessarily a fixed point; its location depends on the distribution of weight in the aircraft. As variable load items are shifted or expended, there is a resultant shift in CG location. The distance between the forward and back limits for the position of the center for gravity or CG range is certified for an aircraft by the manufacturer. The pilot should realize that if the CG is displaced too far forward on the longitudinal axis, a nose-heavy condition will result. Conversely, if the CG is displaced too far aft on the longitudinal axis, a tail-heavy condition results. It is possible that the pilot could not control the aircraft if the CG location produced an unstable condition.

Loading in a nose-heavy condition causes problems in controlling and raising the nose, especially during takeoff and landing. Loading in a tail-heavy condition has a serious effect upon longitudinal stability and reduces the capability to recover from stalls and spins. Tail heavy loading also produces very light control forces, another undesirable characteristic. This makes it easy for the pilot to inadvertently overstress an aircraft.

Limits for the location of the CG are established by the manufacturer. These are the fore and aft limits beyond which the CG should not be located for flight. These limits are published for each aircraft in the Type Certificate Data Sheet (TCDS), or aircraft specification and the airplane flight manual (AFM) or pilot's operating handbook (POH). If the CG is not within the allowable limits after loading, it will be necessary to relocate some items before flight is attempted.

The forward CG limit is often established at a location that is determined by the landing characteristics of an aircraft. During landing, one of the most critical phases of flight, exceeding the forward CG limit, may result in excessive loads on the nosewheel, a tendency to nose over on tailwheel type airplanes, decreased performance, higher stalling speeds, and higher control forces. In addition to decreased static and dynamic longitudinal stability, other undesirable effects caused by a CG location aft of the allowable range may include extreme control difficulty, violent stall characteristics, and very light control forces which make it easy to overstress an aircraft inadvertently.

A restricted forward CG limit is also specified to assure that sufficient elevator/control deflection is available at minimum airspeed. When structural limitations do not limit the forward CG position, it is located at the position where full-up elevator/control deflection is required to obtain a high AOA for landing.

The actual location of the CG can be altered by many variable factors and is usually controlled by the pilot. Placement of baggage and cargo items determines the CG location. The assignment of seats to passengers can also be used as a means of obtaining a favorable balance. If an aircraft is tail heavy, it is only logical to place heavy passengers in forward seats. Fuel burn can also affect the CG based on the location of the fuel tanks. For example, most small aircraft carry fuel in the wings very near the CG and burning off fuel has little effect on the loaded CG.

Management of Weight and Balance Control

14 *CFR* Part 23, Section 23.23, requires establishment of the ranges of weights and CGs within which an aircraft may be operated safely. The manufacturer provides this information, which is included in the approved AFM, TCDS, or aircraft specifications.

While there are no specified requirements for a pilot operating under 14 *CFR* Part 91 to conduct weight and balance calculations prior to each flight, 14 *CFR* Part 91.9 requires the PIC to comply with the operating limits in the approved AFM. These limits include the weight and balance of the aircraft. To enable pilots to make weight and balance computations, charts and graphs are provided in the approved AFM.

According to the *Pilot's Handbook of Aeronautical Knowledge*, weight and balance control should be a matter of concern to all pilots. The pilot controls loading and fuel management (the two variable factors that can change both total weight and CG location) of a particular aircraft.

The aircraft owner or operator should make certain that up-to-date information is available for pilot use and should ensure that appropriate entries are made in the records when repairs or modifications have been accomplished. The removal or addition of equipment results in changes to the CG.

Weight changes must be accounted for and the proper notations made in weight and balance records. The equipment list must be updated, if appropriate. Without such information, the pilot has no foundation upon which to base the necessary calculations and decisions.

Angle of Attack

According to the *Airplane Flying Handbook*, The angle of attack (AOA) is the angle at which the chord of the wing meets the relative wind. The chord is a straight line from the leading edge to the trailing edge. At low angles of attack, the airflow over the top of the wing flows smoothly and produces lift with a relatively small amount of drag. As the AOA increases, lift as well as drag increases; however, above a wing's critical AOA, the flow of air separates from the upper surface and backfills, burbles, and eddies, which reduces lift and increases drag. This condition is a stall, which can lead to loss of control if the AOA is not reduced.

It is important for the pilot to understand that a stall is the result of exceeding the critical AOA, not of insufficient airspeed. The term "stalling speed" can be misleading, as this speed is often discussed when assuming 1G flight at a particular weight and configuration.

Increased load factor directly affects stall speed (as well as do other factors such as gross weight, center of gravity, and flap setting). Therefore, it is possible to stall the wing at any airspeed, at any flight attitude, and at any power setting. For example, if a pilot maintains airspeed and rolls into a coordinated, level 60° banked turn, the load factor is 2G, and the airplane will stall at a speed that is 41% higher than the 1G stall speed. In that 2G level turn, the pilot has to increase AOA to increase the lift required to maintain altitude. At this condition, the pilot is closer to the critical AOA than during level flight and therefore closer to the higher stalling speed. Because "stalling speed" is not a constant number, pilots need to understand the underlying factors that affect it in order to maintain aircraft control in all circumstances.

Stalls

The *Airplane Flying Handbook* also states in part that a stall is an aerodynamic condition that occurs when smooth airflow over the airplane's wings is disrupted, resulting in loss of lift. Specifically, a stall occurs when the AOA—the angle between the chord line of the wing and the relative wind—exceeds the wing's critical AOA. It is possible to exceed the critical AOA at any airspeed, at any attitude, and at any power setting.

For these reasons, it is important to understand factors and situations that can lead to a stall and develop proficiency in stall recognition and recovery. Performing intentional stalls will familiarize the pilot with the conditions that result in a stall, assist in recognition of an impending stall, and develop the proper corrective response if a stall occurs. Stalls are practiced to two different levels:

Impending Stall—an impending stall occurs when the AOA causes a stall warning, but has not yet reached the critical AOA. Indications of an impending stall can include buffeting, stick shaker, or aural warning.

Full Stall—a full stall occurs when the critical AOA is exceeded. Indications of a full stall are typically that an uncommanded nose down pitch cannot be readily arrested, and may be accompanied by an uncommanded rolling motion. For airplanes equipped with stick pushers, their activation is also an indicator of a full stall.

Although it depends on the degree to which a stall has progressed, some loss of altitude is expected during recovery. The longer it takes for the pilot to recognize an impending stall, the more likely it is that a full stall will result.

Stall Recognition

The *Airplane Flying Handbook* further states in part that a pilot should recognize the flight conditions that are conducive to stalls and know how to apply the necessary corrective action. This level of proficiency involves learning to recognize an impending stall by sight, sound, and feel.

Stalls are usually accompanied by a continuous stall warning for airplanes equipped with stall warning devices. These devices may include an aural alert, lights, or a stick shaker all which alert the pilot when approaching the critical AOA. Most vintage airplanes, and many types of light-sport and experimental airplanes, do not have stall warning devices installed. However, certification standards permit manufacturers to provide the required stall warning either through the inherent aerodynamic qualities of the airplane (pre-stall buffeting) or through a stall warning device that gives a clear indication of the impending stall.

Other sensory cues for the pilot include:

Feel—the pilot will feel control pressures change as speed is reduced. With progressively less resistance on the control surfaces, the pilot needs to use larger control movements to get the desired airplane response. The pilot will notice the airplane’s reaction time to control movement increases.

Vision—since the airplane can be stalled in any attitude, vision is not a foolproof indicator of an impending stall. However, maintaining pitch awareness is important.

Hearing—as speed decreases, the pilot should notice a change in sound made by the air flowing along the airplane structure.

Kinesthesia—the physical sensation (sometimes referred to as “seat of the pants” sensations) of changes in direction or speed is an important indicator to the trained and experienced pilot in visual flight. If this sensitivity is properly developed, it can warn the pilot of an impending stall.

Pilots should remember that a level-flight 1G published stalling speed is valid only:

1. In unaccelerated 1G flight
2. In coordinated flight (slip-skid indicator centered)
3. At one weight (typically maximum gross weight)
4. At a particular center of gravity (CG) (typically maximum forward CG)

Preventing Similar Accidents

Prevent Aerodynamic Stalls at Low Altitude (SA-019)

The Problem

While maneuvering an airplane at low altitude in visual meteorological conditions, many pilots fail to avoid conditions that lead to an aerodynamic stall, recognize the warning signs of a stall onset, and apply appropriate recovery techniques. Many stall accidents result when a pilot is momentarily distracted from the primary task of flying, such as while maneuvering in the airport traffic pattern, during an emergency, or when fixating on ground objects.

What can you do?

- Be honest with yourself about your knowledge of stalls and your preparedness to recognize and handle a stall situation in your airplane. Seek training to ensure that you fully understand the stall phenomenon, including angle-of attack (AOA) concepts and how elements such as weight, center of gravity, turbulence, maneuvering loads, and other factors affect an airplane’s stall characteristics.
- Remember that an aerodynamic stall can occur at any airspeed, at any attitude, and with any engine power setting.
- Remember that the stall airspeeds marked on the airspeed indicator (for example, the bottom of the green arc and the bottom of the white arc) typically represent steady flight speeds at 1G at the airplane’s maximum gross weight in the specified configuration. Maneuvering loads and other factors can increase the airspeed at which

the airplane will stall. For example, increasing bank angle can increase stall speed exponentially. Check your airplane's handbook for information.

- Reducing AOA by lowering the airplane's nose at the first indication of a stall is the most important immediate response for stall avoidance and stall recovery.
- Manage distractions when maneuvering at low altitude so that they do not interfere with the primary task of flying.
- Resist the temptation to perform maneuvers in an effort to impress people, including passengers, other pilots, persons on the ground, or others via an onboard camera. "Showing off" can be a deadly distraction because it diverts your attention away from the primary task of safe flying.
- Understand that the stall characteristics of an unfamiliar airplane may differ substantially from those of airplanes with which you have more flight experience.

See https://www.ntsb.gov/Advocacy/safety-alerts/Documents/SA-019.pdf for additional resources.

The NTSB presents this information to prevent recurrence of similar accidents. Note that this should not be considered guidance from the regulator, nor does this supersede existing FAA Regulations (FARs).

Administrative Information

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The National Transportation Safety Board (NTSB) is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant events in other modes of transportation—railroad, transit, highway, marine, pipeline, and commercial space. We determine the probable causes of the accidents and events we investigate, and issue safety recommendations aimed at preventing future occurrences. In addition, we conduct transportation safety research studies and offer information and other assistance to family members and survivors for each accident or event we investigate. We also serve as the appellate authority for enforcement actions involving aviation and mariner certificates issued by the Federal Aviation Administration (FAA) and US Coast Guard, and we adjudicate appeals of civil penalty actions taken by the FAA.

The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, “accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties … and are not conducted for the purpose of determining the rights or liabilities of any person” (Title 49 *Code of Federal Regulations* section 831.4). Assignment of fault or legal liability is not relevant to the NTSB’s statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report (Title 49 *United States Code* section 1154(b)). A factual report that may be admissible under 49 *United States Code* section 1154(b) is available here.