Aviation Investigation Final Report

Location:	Rawlins, Wyoming	**Accident Number:**	WPR20LA301
Date & Time:	August 25, 2020, 07:00 Local	**Registration:**	N93AB
Aircraft:	Lake LA4	**Aircraft Damage:**	Substantial
Defining Event:	Flight control sys malf/fail	**Injuries:**	1 Fatal, 3 Serious
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The pilot reported that, during a flight on the day before the accident, a trim anomaly caused the airplane to enter a nose-down pitch attitude and descend. The pilot had to manually reset the trim position about every 8 seconds to maintain level flight and prevent the airplane from prematurely descending. After landing, the pilot had a discussion with a mechanic to troubleshoot the mechanical issue, and no anomalies were identified.

Before the accident takeoff, one of the two passengers had the airplane fueled with 20 gallons of fuel, for total fuel of 30 gallons. The pilot thought that the airplane was fueled with 12 gallons, for a total fuel of 22 gallons. This miscommunication between the pilot and passenger resulted in the airplane being fueled more than the pilot expected, which likely resulted in the airplane being near or slightly over the maximum allowable gross weight at the time of takeoff.

The pilot performed a short-field takeoff during the accident flight. The pilot reported that, when the airplane reached an altitude of about 500 ft above ground level, he experienced an "abnormal heaviness" in the control wheel that was consistent with the pitch trim anomaly during the flight on the day before. The airplane would not climb any further, so the pilot made a left turn back to the runway, during which the airplane descended and subsequently collided with terrain.

Postaccident examination of the trim actuator revealed an anomaly of the O-rings, which prevented the hydraulic pressure from maintaining the desired trim position. Consequently, the trim surface could move without command and could thus not hold the required takeoff position.

In addition, the density altitude at the time of the accident takeoff was about 8,600 ft mean sea level, and the airplane was close to its maximum allowable gross weight. The effects of high-density altitude conditions and a heavy airplane weight on takeoff performance include

increased takeoff roll distance and reduced rate of climb. It is likely that while the pilot was dealing with a high-density altitude takeoff which may have affected the performance of the engine, he did not adequately monitor the trim that was not holding its required takeoff position and that he knew was malfunctioning before departure.

Probable Cause and Findings

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

The pilot's decision to depart despite a known mechanical trim malfunction and with a high-density altitude and the airplane at or above its maximum gross weight.

Findings

Personnel issues	Decision making/judgment - Pilot
Aircraft	(general) - Malfunction
Environmental issues	High density altitude - Effect on equipment
Aircraft	Maximum weight - Not specified

Factual Information

History of Flight

Takeoff	Flight control sys malf/fail (Defining event)
Takeoff	Sys/Comp malf/fail (non-power)

On August 25, 2020, about 0700 mountain daylight time, an Aerofab Lake LA-4-200, N93AB, was substantially damaged when it was involved in an accident near Rawlins Municipal Airport/Harvey Field (RWL), Rawlins, Wyoming. One passenger sustained fatal injuries, and the pilot and another passenger sustained serious injuries. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

The pilot reported that, during a cross-country flight from Searle Field Airport (OGA), Ogallala, Nebraska, to RWL on the day before the accident, the hydraulic pitch trim system appeared to malfunction while the airplane was flying straight and level. The pilot recorded a cell phone video during the flight that showed that the nose of the airplane pitched downward during straight-and-level flight. The pilot had to reset the trim position about every 8 seconds for the last half of the 166-nautical mile flight. The pilot had his passengers monitor the trim position indicator, and they took turns applying aft pressure to the trim handle when the nose of the airplane pitched down.

Upon arrival at RWL, the pilot continued to troubleshoot the trim anomaly along with a mechanic via telephone. The pilot searched for hydraulic leaks and saw no visual mechanical anomalies. While troubleshooting the trim anomaly, the pilot asked the mechanic (via text message) about a good mixture setting at 8,000 ft. The mechanic advised the pilot to lean the mixture and monitor the exhaust gas temperature, emphasizing that, “at that high of an altitude with the mixture full rich, you are most likely flooding it [the engine].”

The pilot reported that the airplane landed with 10 gallons of fuel and that one of the passengers refueled the airplane. The pilot thought that the airplane was fueled with 12 gallons, for a total fuel of 22 gallons, but the airplane was fueled with 20 gallons, for total fuel of 30 gallons.

On the morning of the accident, the pilot completed the airplane’s run-up performance checks and confirmed that the airplane was set to a “standard configuration” for the takeoff roll. According to the Lake L-4-200 owner’s manual, for the standard takeoff configuration, “it is wise to check [trim] tabs visually for about 30° up trim.” Additionally, the owner’s manual indicated, “check the mixture control for ‘rich,’ and set the propeller for full RPM.” The pilot completed the standard configuration checklist and taxied onto runway 29 to start the takeoff roll.

The pilot held the brakes, applied full power, and released the brakes. The pilot kept his right hand on the throttle control (located above his head) and his left hand on the control wheel. Once the airplane became airborne, the pilot immediately retracted the landing gear as it flew over the last one-third of the runway. The pilot determined that the airplane had established a positive rate of climb and thus decided to continue the takeoff. The pilot recalled that, during the initial climb, when the airplane was at an altitude of about 500 ft above ground level, he experienced an “abnormal heaviness “in the control wheel that was consistent with the pitch trim anomaly that he had experienced during the previous flight.

The pilot reported that the airplane would not climb and that he turned the airplane to the left, toward the airport runway, and the airplane began to descend. During the descending left turn, the airplane impacted a 30-ft wide, and 10-ft high mound of construction material located in the northeast quadrant of the airport property. The initial point of impact was about 355 ft southeast of the runway 4 threshold.

Pilot Information

Certificate:	Private	**Age:**	45,Male
Airplane Rating(s):	Single-engine land; Single-engine sea	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Lap only
Instrument Rating(s):	None	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 3 Without waivers/limitations	**Last FAA Medical Exam:**	July 8, 2020
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	July 8, 2020
Flight Time:	(Estimated) 507 hours (Total, all aircraft), 52 hours (Total, this make and model), 396 hours (Pilot In Command, all aircraft), 69 hours (Last 90 days, all aircraft), 52 hours (Last 30 days, all aircraft), 4 hours (Last 24 hours, all aircraft)		

Passenger Information

Certificate:		**Age:**	
Airplane Rating(s):		**Seat Occupied:**	Right
Other Aircraft Rating(s):		**Restraint Used:**	Lap only
Instrument Rating(s):		**Second Pilot Present:**	No
Instructor Rating(s):		**Toxicology Performed:**	No
Medical Certification:		**Last FAA Medical Exam:**	
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:			

Passenger Information

Certificate:		**Age:**	
Airplane Rating(s):		**Seat Occupied:**	Rear
Other Aircraft Rating(s):		**Restraint Used:**	Lap only
Instrument Rating(s):		**Second Pilot Present:**	No
Instructor Rating(s):		**Toxicology Performed:**	No
Medical Certification:		**Last FAA Medical Exam:**	
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:			

Aircraft and Owner/Operator Information

Aircraft Make:	Lake	**Registration:**	N93AB
Model/Series:	LA4 200	**Aircraft Category:**	Airplane
Year of Manufacture:	1977	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	835
Landing Gear Type:	Retractable - Tricycle; Amphibian	**Seats:**	3
Date/Type of Last Inspection:	January 3, 2020 Annual	**Certified Max Gross Wt.:**	2600 lbs
Time Since Last Inspection:		**Engines:**	1 Reciprocating
Airframe Total Time:	1100 Hrs as of last inspection	**Engine Manufacturer:**	Lycoming
ELT:	C126 installed, activated, did not aid in locating accident	**Engine Model/Series:**	IO-360
Registered Owner:	On file	**Rated Power:**	200 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

According to the airplane maintenance logbook, the airframe total time was 2,735 hours when the most recent annual maintenance inspection was completed (about 1 1/2 years before the accident). The engine logbook indicated that the engine was overhauled with 859 total hours on April 30, 2014. The last 100-hour inspection (performed during the most recent annual inspection) indicated a tachometer time of 1,144.7 hours. Maintenance was performed on August 6, 2020, during which the trim tabs were adjusted at a tachometer time of 1,162 hours and an airframe total time of 2,752.8hours. The pilot reported that no known maintenance issues existed until the flight on the day before the accident.

According to the manufacturer, the airplane's maximum gross weight was 2,600 pounds. The pilot provided weight and balance calculations for the accident flight that indicated that the airplane's takeoff gross weight was 2,545 pounds. Utilizing the pilot provided weight and balance, plus the 48 pounds of fuel that were added unknown to the pilot, the airplane's gross weight at takeoff was calculated to be about 2,593 pounds. The IIC calculated the gross weight of the amphibious airplane using the details reported by the pilot, and the calculation revealed that the gross weight was 2,631 pounds.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KRWL,6743 ft msl	**Distance from Accident Site:**	0 Nautical Miles
Observation Time:	12:53 Local	**Direction from Accident Site:**	178°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	13 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	240°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.25 inches Hg	**Temperature/Dew Point:**	19°C / 4°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Rawlins, WY (RWL)	**Type of Flight Plan Filed:**	None
Destination:	Paris, ID (1U7)	**Type of Clearance:**	None
Departure Time:	07:00 Local	**Type of Airspace:**	Class E

The pressure altitude was 6,512 ft, and the density altitude was 8,588 ft.

Airport Information

Airport:	Rawlins Muni/Harvey Field RWL	**Runway Surface Type:**	Asphalt
Airport Elevation:	6816 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	29	**IFR Approach:**	None
Runway Length/Width:	4322 ft / 60 ft	**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	1 Serious	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 Fatal, 2 Serious	**Aircraft Fire:**	None
Ground Injuries:		**Aircraft Explosion:**	None
Total Injuries:	1 Fatal, 3 Serious	**Latitude, Longitude:**	41.805831,-107.20027(est)

The airplane came to rest inverted with the nose of the airplane on a heading of 010°. The left and right trim surfaces remained attached to the horizontal stabilizer and appeared to have sustained minor impact damage. The aft fuselage longerons sustained structural deformation, and the cabin revealed uninhabitable space encroachment. The nose of the airplane remained intact, and the lower fuselage sustained impact damage to the longerons, formers, and bulkheads. The left and right main landing gear remained attached and stowed within each respective wing wheel well. The left and right wing and their respective ailerons and flaps remained attached. Flight control continuity was established. The pusher-type two-blade propeller remained attached to the engine, which separated from the upper fuselage and came to rest underneath the right wing.

A postaccident examination focused specifically on the trim and hydraulic systems identified no anomalies, and the trim valve and trim actuator were removed from the airframe for further examination. Examination of the trim valve revealed no malfunction or anomaly.

Examination of the trim actuator revealed that the O-ring from the actuator piston was noticeably harder than a new O-ring. A mechanic reinstalled the accident airplane’s O-ring onto the piston and then inserted the piston into the cylinder by hand. The fit seemed looser than normal with little apparent resistance when the piston was inserted into the cylinder. The cylinder outlet was capped, and the piston again exhibited no resistance to compression. A new O-ring was installed on the accident piston. The fit exhibited compressive resistance, and the piston could not be inserted by hand into the cylinder.

The mechanic reported that the hardened O-ring, even with its reasonable dimensions, could apparently leak during flight. The hydraulic simulation, during which the cylinder retained pressure and position for days, did not include the restrictors, which provide an acceptable rate of trim travel for flight operations. According to the mechanic, an O-ring can be "forced" to seal on a piston in a cylinder with a quick application of pressure, which the simulation apparently provided. Without a complete seal, the flight load on the trim system would cause a bleed toward a neutral position.

Additional Information

The sea-level and altitude engine performance chart found in the Lake L-4-200 *owner's manual* indicated that an exemplar IO-360-A1B engine will produce 200 horsepower at sea level. Given the environmental conditions during the accident takeoff, only 158 horsepower would have been available. According to the engine manufacturer's Service Instruction No. 1094D, Fuel Mixture Leaning Procedures, for a density altitude of 5,000 ft and above or high ambient temperatures, roughness or reduction of power may occur with a full rich mixture.

Administrative Information

Investigator In Charge (IIC):	Hicks, Michael
Additional Participating Persons:	Chad Glaza; FAA; Casper, WY
Original Publish Date:	September 21, 2022
Last Revision Date:	
Investigation Class:	Class 3
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=101939