

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



WPR23FA219

INVESTIGATION MATERIALS SUPPLEMENT

ACCIDENT

Location: Rio Vista, California
Date: 06/08/2023
Time: 1124 Pacific daylight time
Airplane: Steen Skybolt

IIC Zoë Keliher
National Transportation Safety Board
Portland, Oregon

HISTORY OF FLIGHT

On June 08, 2023, about 1124, a Steen Skybolt experimental biplane, N202GM, was substantially damaged when it was involved in an accident in Rio Vista, California. The two pilots were fatally injured. The airplane was operated as a Title 14 *Code of Federal Regulations* (CFR) Part 91 personal flight.

On the morning of the accident, the front-seated pilot asked the aft-seated pilot to pick him up at Sacramento Mather Airport, Sacramento, California. The aft-seated pilot departed about 1000 from Concord, California, where the airplane was based. The front-seated pilot had dropped off a jet earlier and needed to get back to Concord.

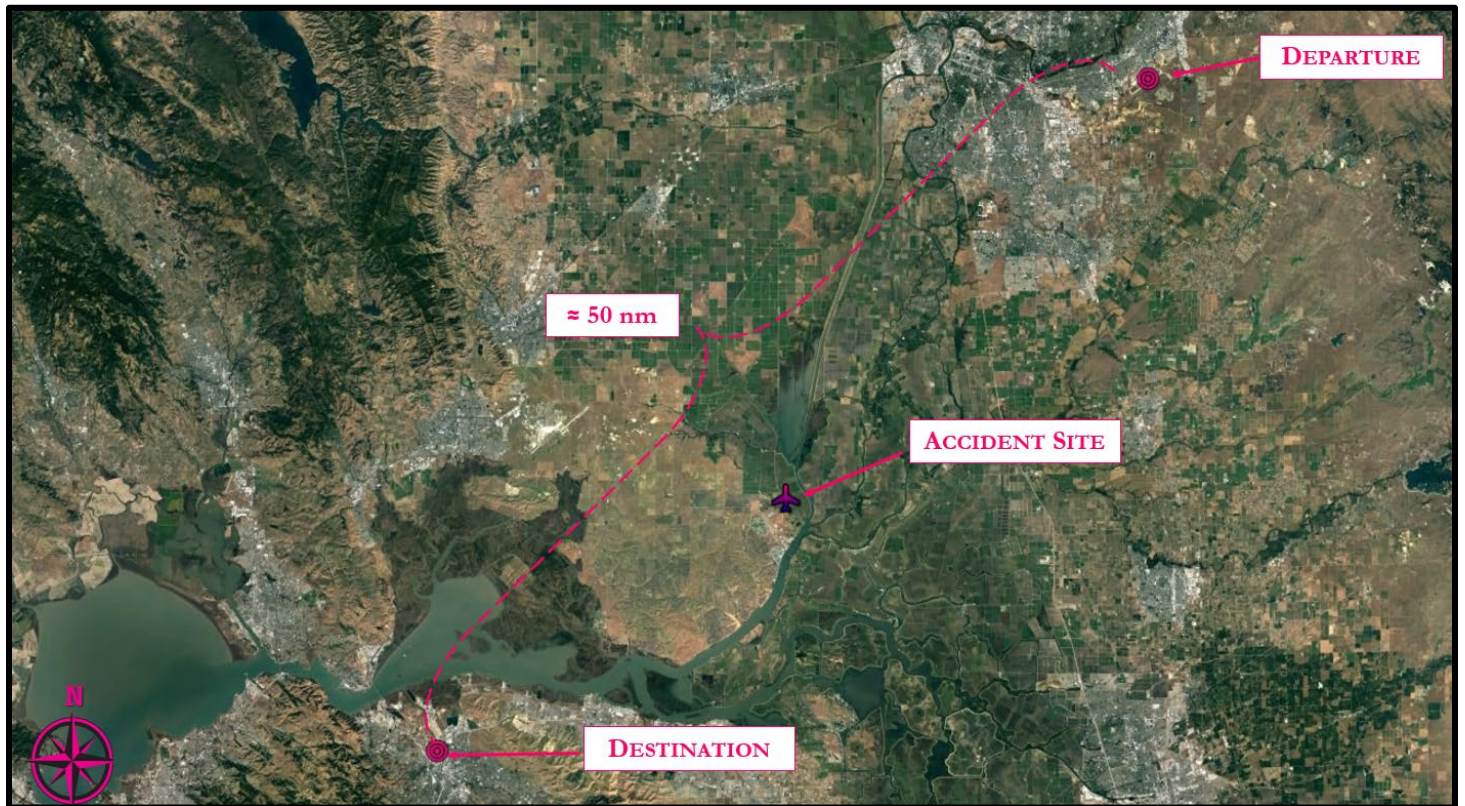


Figure 1: The planned accident flight

Recorded radar data was obtained and reviewed by a National Transportation Safety Board investigator. Recorded radar data covering the area of the accident was examined for the time frame, and a primary beacon code target was observed that terminated near the accident site and started near the airplane's known departure. The radar data consisted of about 25 minutes of returns from 1059:09 to 1124:20. The returns were consistent with the airplane flying in a southwesterly direction. At 1115:30, the returns are clumped together, consistent with the airplane making a 360° turn or maneuvering. At 1116:15, the returns begin to follow a more southerly path along the Sacramento River Deep Water Ship Channel. The returns then became sparse and continued on a flight path over the middle of the airport. The returns make a left bank consistent with adjoining the downwind and then the left base leg of the traffic pattern to runway 25. The returns then make a left hook-shape at the end of the track, consistent with a spiral.

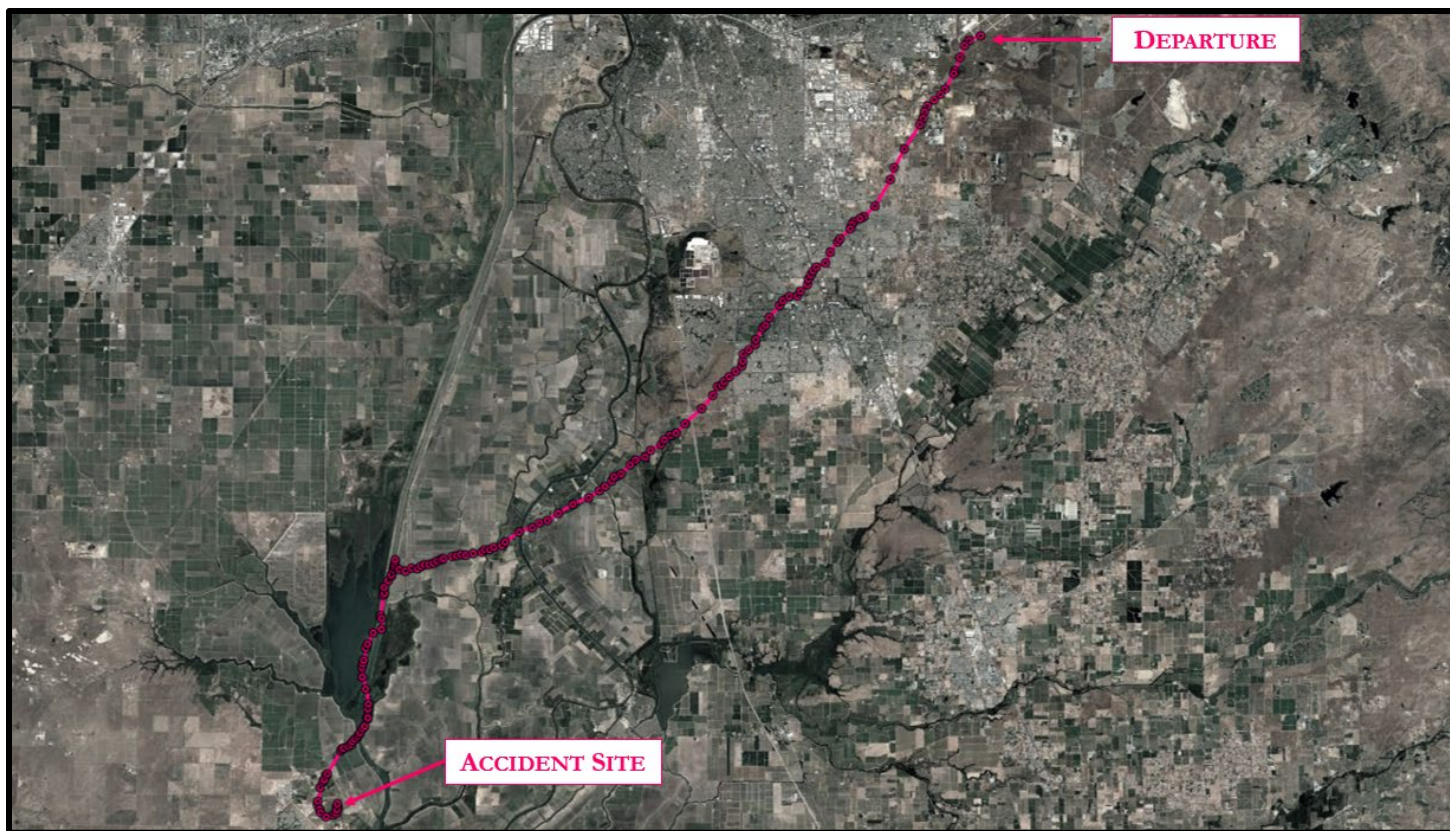


Figure 2: Flight track

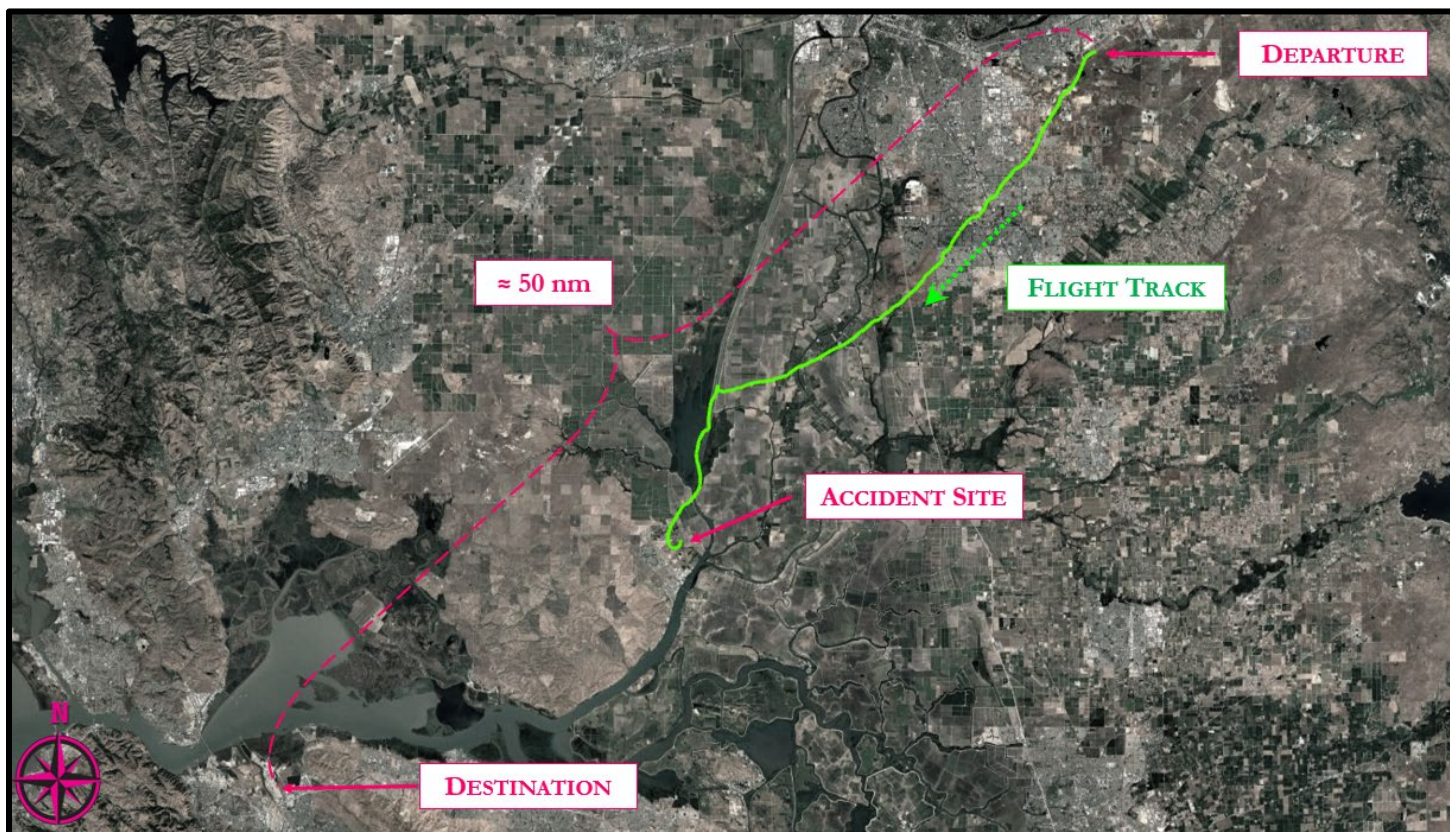


Figure 3: Flight track with reference to the destination

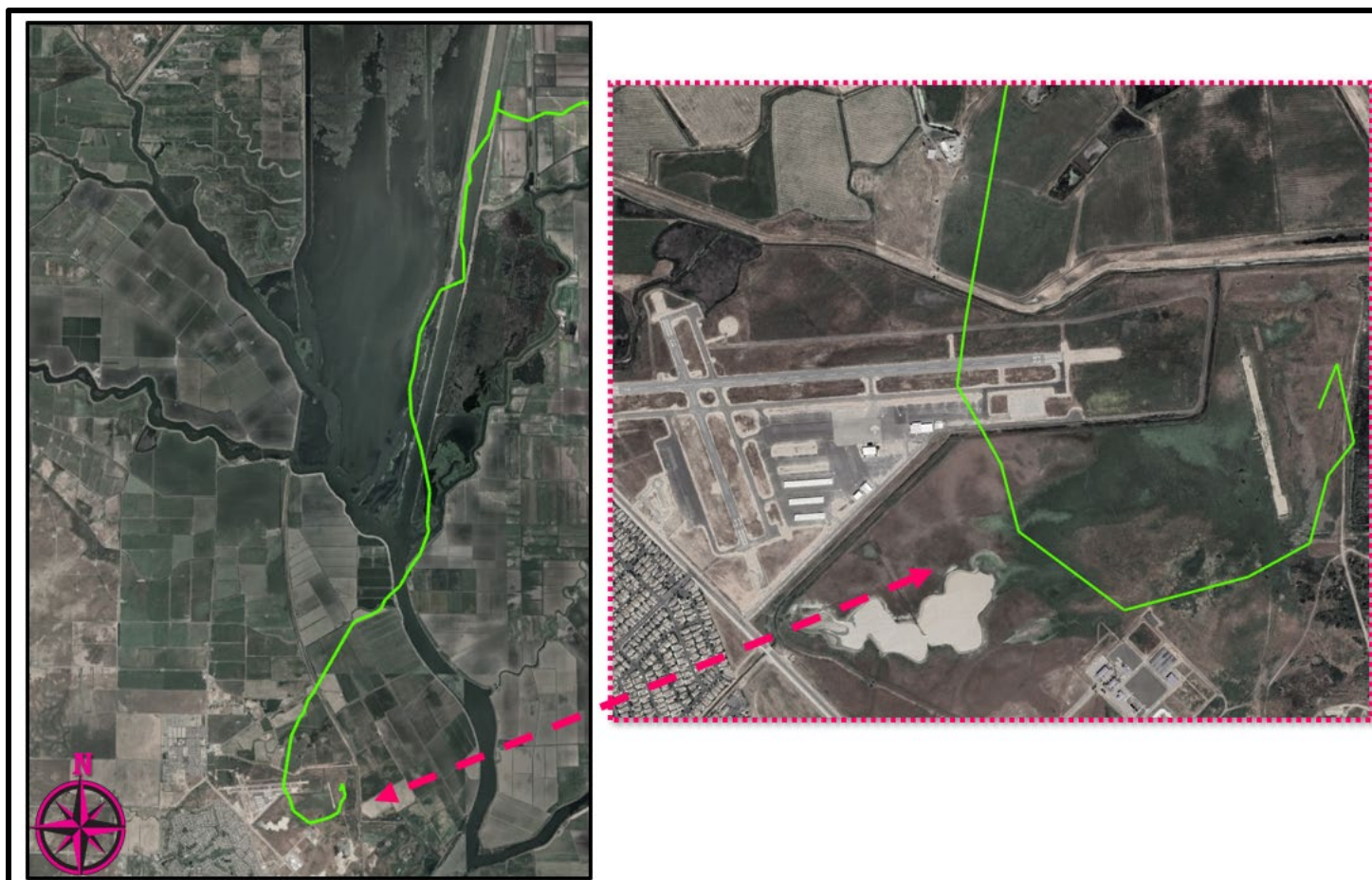


Figure 4: End of flight track as approaching airport

A witness, who was a commercial-pilot, reported that he was listening to the common UNICOM frequency while on his bicycle leaving the airport. He heard a transmission on the radio stating “Experimental biplane, engine out.” He looked up and observed the accident airplane flying from the north on a southerly heading and pass over the airport at midfield of runway 25. The airplane then joined a non-standard left downwind leg for runway 25 at an estimated altitude of about 1,000 feet above ground level. Thereafter, the airplane banked left, presumably onto the left base leg for runway 25. After turning onto the base leg, he observed the airplane experience a total loss of control and within 10 seconds, it impacted the ground. He stated that the airplane assumed a nose-down attitude at a rapid speed. The witness stated that he could hear the engine and thought it sounded normal. The witness added that the pilot could have said “simulated engine-out,” but he could not recall.

ITINERARY

A pilot's iPad was located in the wreckage. It revealed that the pilot was using Foreflight and had entered the destination of Rio Vista on the way to Sacramento Mather Airport, Sacramento, California.

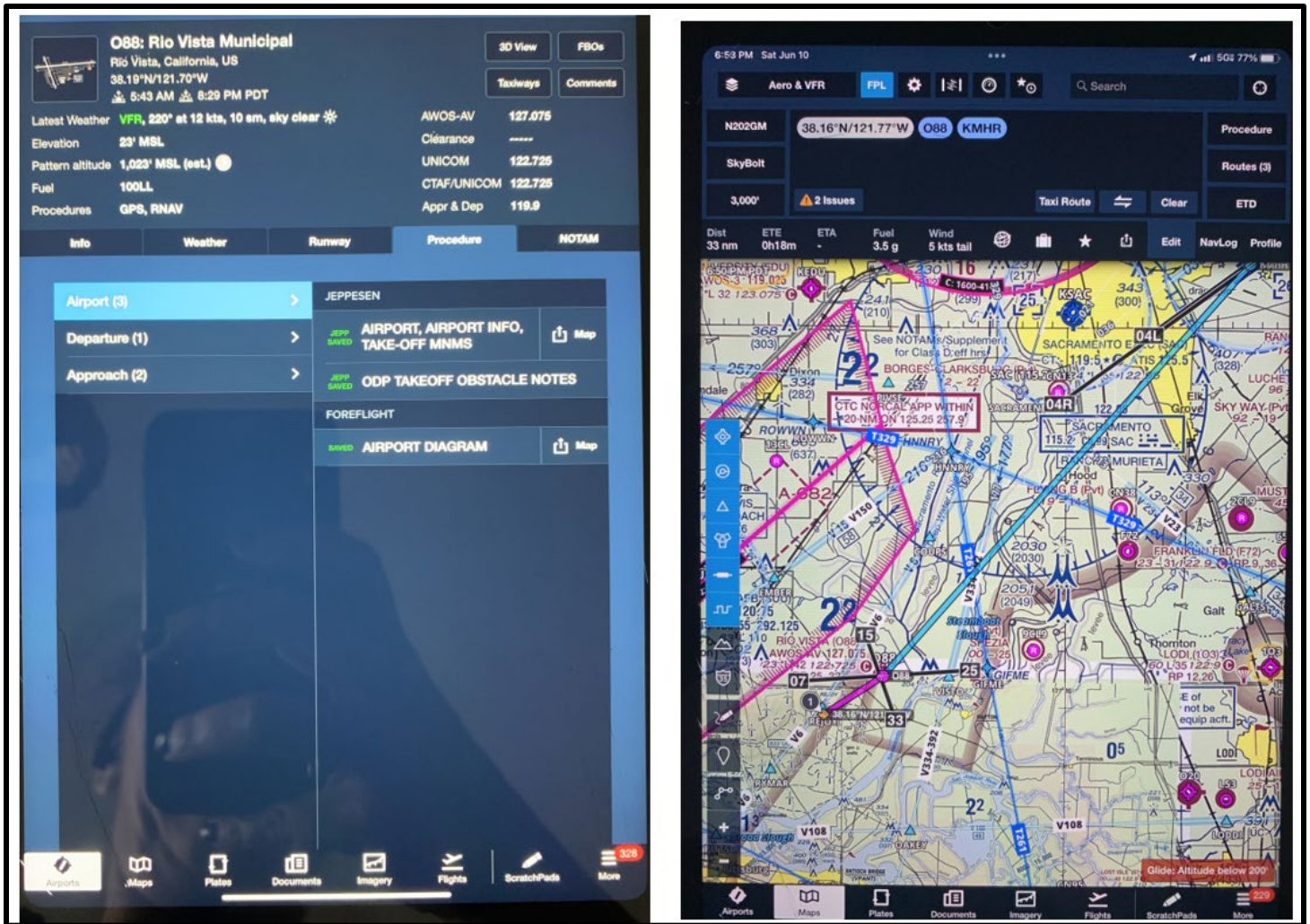


Figure 7: iPad screenshots

WRECKAGE AND IMPACT

The accident site was located about 2,615 feet from the beginning of runway 25 at the following coordinates: 38.1928796, -121.6860844. The wreckage was found distributed over about 45-feet on a true heading of 350°. The nose was pointed on a median true heading of about 20°. The first identified piece of debris was paint chips and air scoop from the lift side fuselage.



Figure 8: Accident site in reference to the runway

The furthest wreckage was large splinters of wood from the two-bladed propeller.

There were small plexiglass shards throughout the start of the debris field that led to the frame of the canopy with a majority of the plexiglass intact. There was no evidence of soot or oil.

AIRFRAME



Figure 9: Airplane before the accident

The fuselage came to rest upright, and the lower wings remained attached at their respective wing roots. Both upper wings were still attached to their structure but had partially collapsed onto the lower wings. The lower right wing exhibited crush damage in the inboard 44 inches caused by the right landing gear on which it rested, and about one foot of the outboard leading edge sustained aft crush damage. The upper right wing's outboard leading edge and underside displayed aft and upward crush damage. Opening the wing skin revealed fractured wing ribs that were splintered and loose. The lower aileron control surface remained attached at its outboard fitting, while the inboard fitting had broken free, though the control rods remained affixed. The upper aileron's outboard fitting stayed attached, and the inboard fitting was disconnected. The control tube between the ailerons was attached at both ends but had buckled in the middle. The control tubes were joined through the outboard lower bellcrank, one arm of which had a dark appearance. Those tubes remained continuous through the fuselage and attached at the control stick interconnect tube under the pilot's floor.

The lower left wing sustained crush damage in the inboard 56 inches from resting on the left landing gear. The aft portion of the wing, adjacent to the aileron, bent about five inches downward for approximately nine inches inboard, and the outboard two feet of the forward lower wing showed additional damage. The upper left wing's outboard underside exhibited aft crush deformation, and opening the wing skin indicated that many of the ribs were fractured and splintered. Both the lower and upper aileron control surfaces remained attached at their fittings, and the control rods remained affixed between the ailerons and the cockpit, where they attached to their respective bellcranks. The control tubes continued through the fuselage and connected at the control stick interconnect tube under the pilot's floor.

Cockpit readings:

Acceleration unit -1.2 and pegged out at +10, with a current reading at +5.4.

Altitude was set at 29.90

The airspeed was pegged at 128 mph



Figure 10: Cockpit gauges

The vertical speed indicator was pegged at a climb of about 1,200

The oil pressure, CHT, oil temp all showed zero.

The fuel gauge was pegged just over half (which said 20 gallons total on the gauge).

The tachometer had come free from the instrument panel. It was pegged at 1,100 rpms and had a total time of 643.9 hours, but the "6" was askew, making the reading more likely to be 543.9.

The master switch was on.

The alternator was off

The "main fuel level" was off

The fuel pump would only have one position.

The ignition key was on both.

The fuselage sustained aft, right-aft, and upward crush deformation, which compromised the cockpit space. Damage primarily extended from the firewall area to the aft bulkhead near the pilot's seatback. The empennage, vertical stabilizer, and rudder remained relatively intact. Both horizontal stabilizers were severely deformed downward and aft at the inboard ends and slightly bent upward at the outboard ends. The upper wires were slack. On the left side, the horizontal stabilizer fractured at the aft tube where a wire attach fitting was located. The left elevator was attached at its fittings and aligned with the stabilizer root until about 22 inches outboard, where it bent downward; the balance weight remained intact. The right elevator remained attached at its fittings, but the balance weight hung downward.

The rudder and elevator control cables were continuous from the cockpit to their respective attach fittings. The rudder control horn moved freely, and its stops showed no damage. The elevator would not move freely, presumably due to severe aft deformation in the forward structure. The rudder's left side fabric displayed slight rubbing, and a corresponding rub mark was found on the adjacent left elevator, indicating contact between the two surfaces.

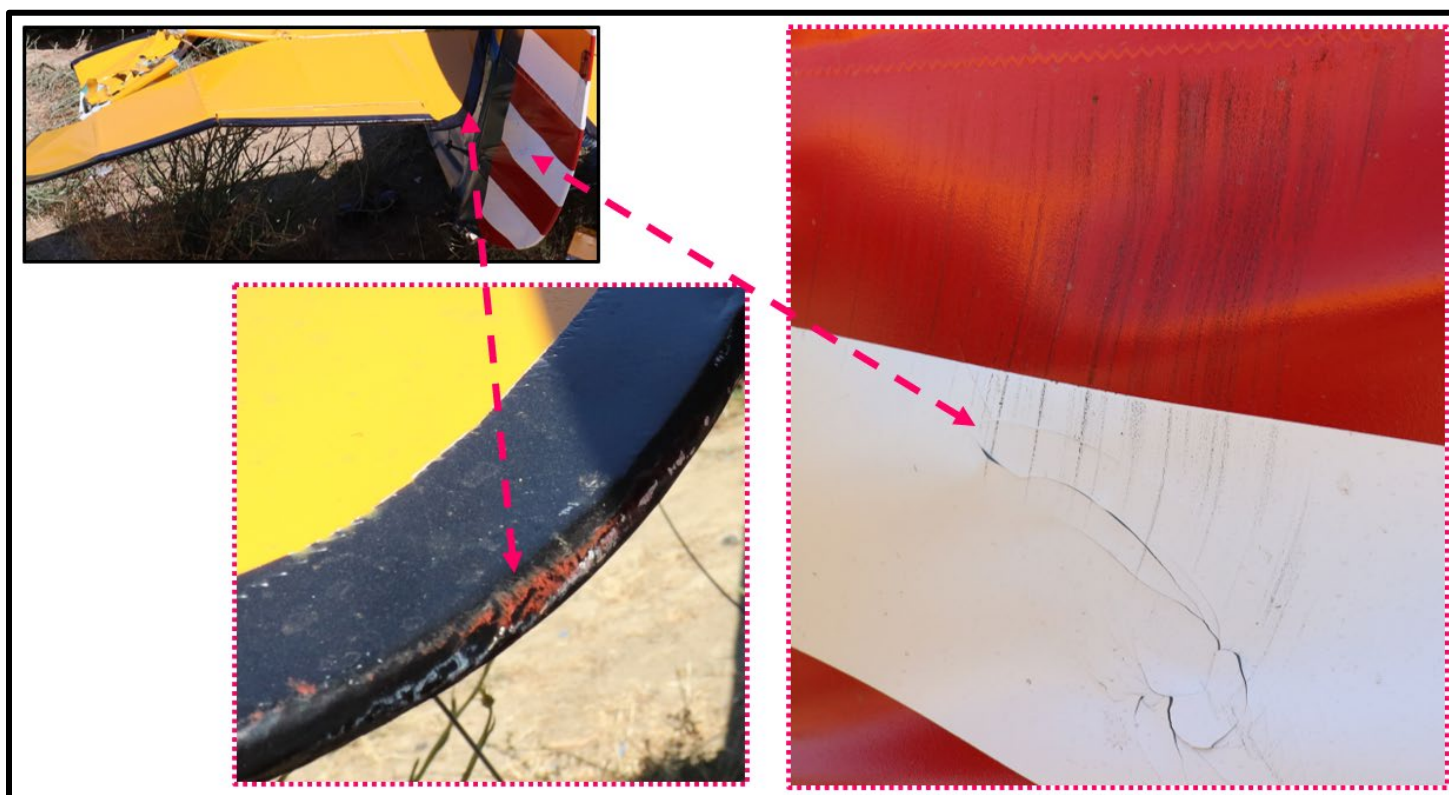


Figure 11: Rudder control

An emergency locator transmitter (ELT) was installed in the airplane and appeared to be set to the armed position, but it did not activate.

TRIM SYSTEM

The build manuals provided only showed a trim tab system with a McKenzie Vernier system, which was not installed on the airplane. The manual stated to prevent flutter, the free play in all control surfaces must not exceed 2% of the chord length, measured at the trailing edge. A trim tab with a width of 4 inches should not exhibit more than 3/32 inches of vertical movement. The drawing showed a system with Adel clamps.

The left trim tab stayed attached at its surfaces, and the control rod was continuous from the fuselage bellcrank. The right trim tab sheared off the piano hinge and lay under the elevator yet remained connected to the bellcranks and continuous to the fuselage bellcrank. Neither trim tab moved freely. The cockpit trim control, folded into the cabin, was still attached to the deformed frame, with its selector found in the neutral position. Moving the control to nose-down shifted the surface upward, but the control would not move toward nose-up, indicating binding. When attempting to move the control aft, the wires remained continuous to the aft bellcrank; however, a sleeve on the end attachment floated loosely and caused additional binding.

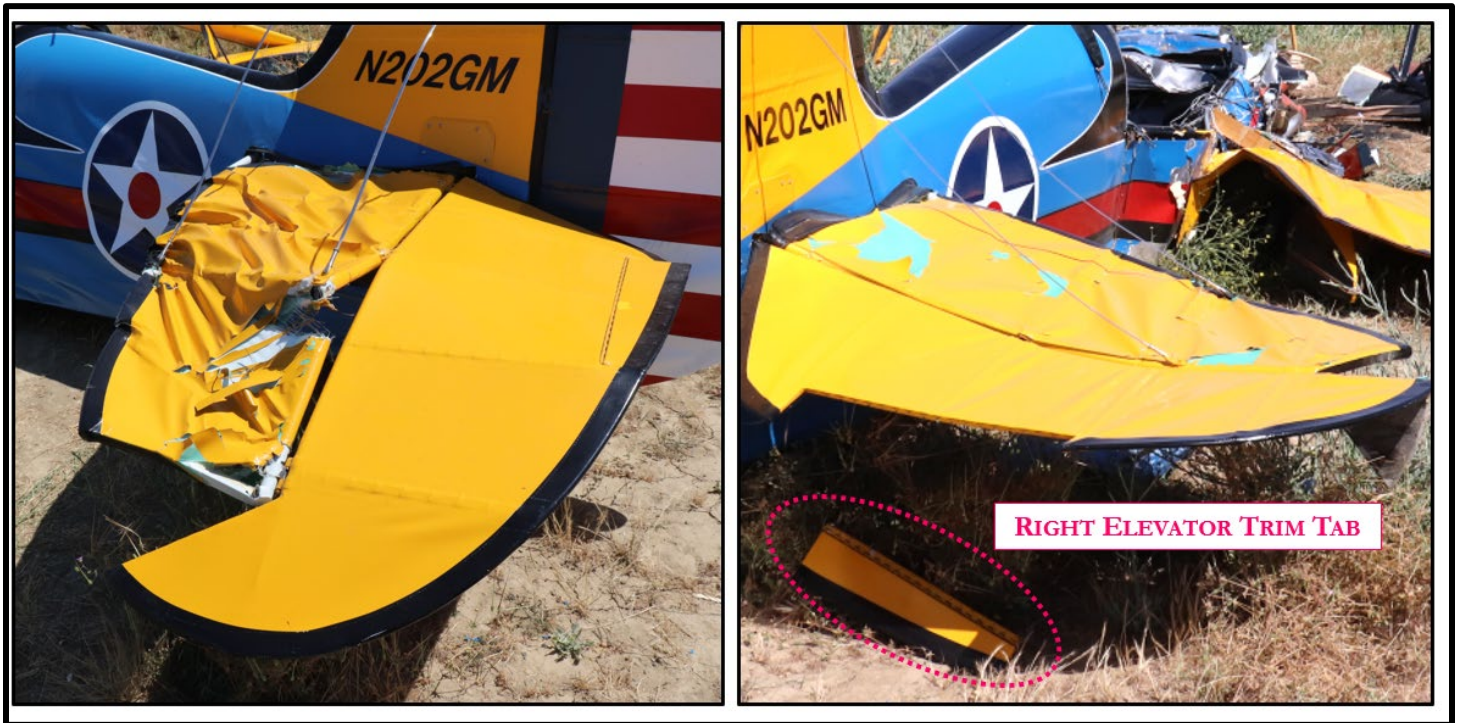


Figure 12: Trim tabs

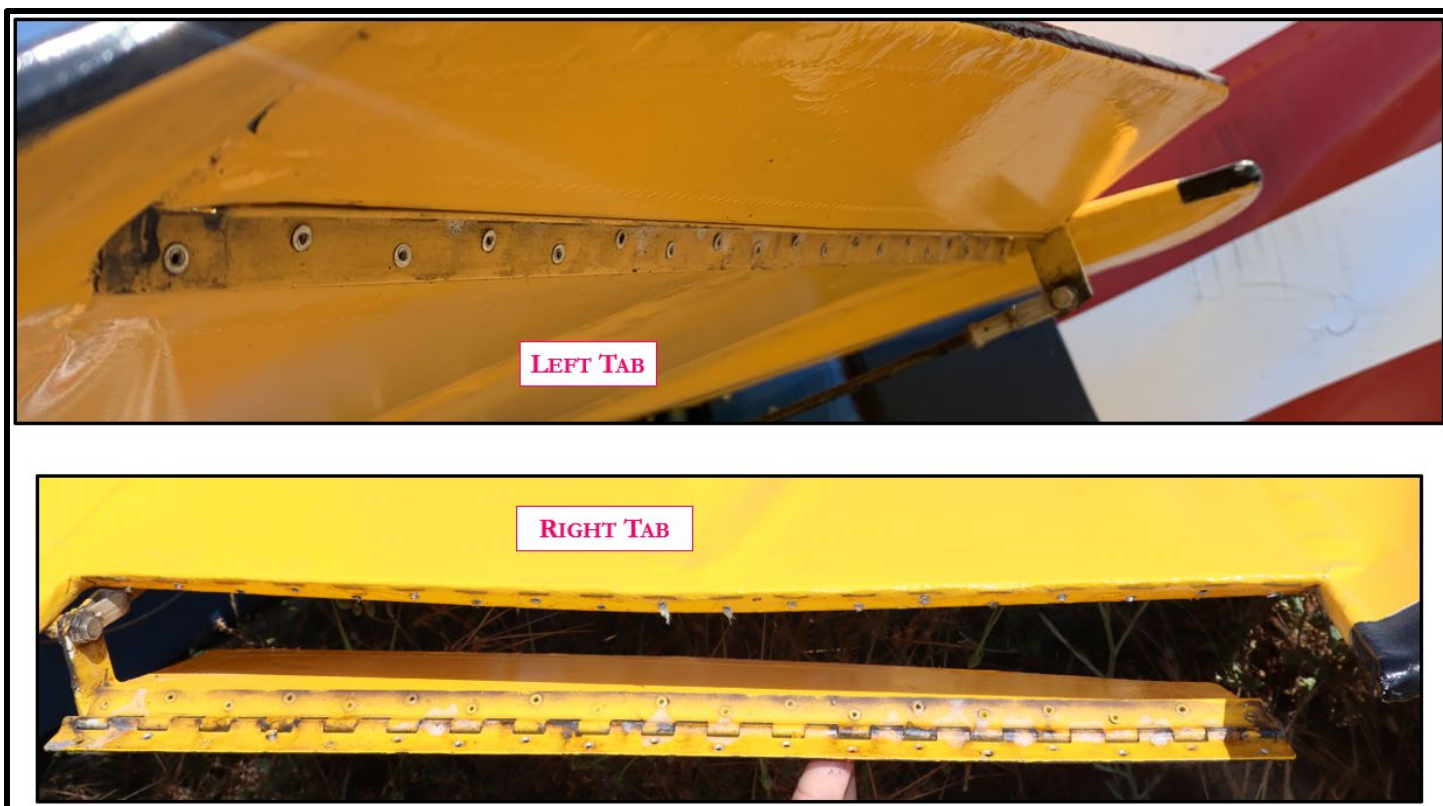


Figure 13: Trim tab piano hinges

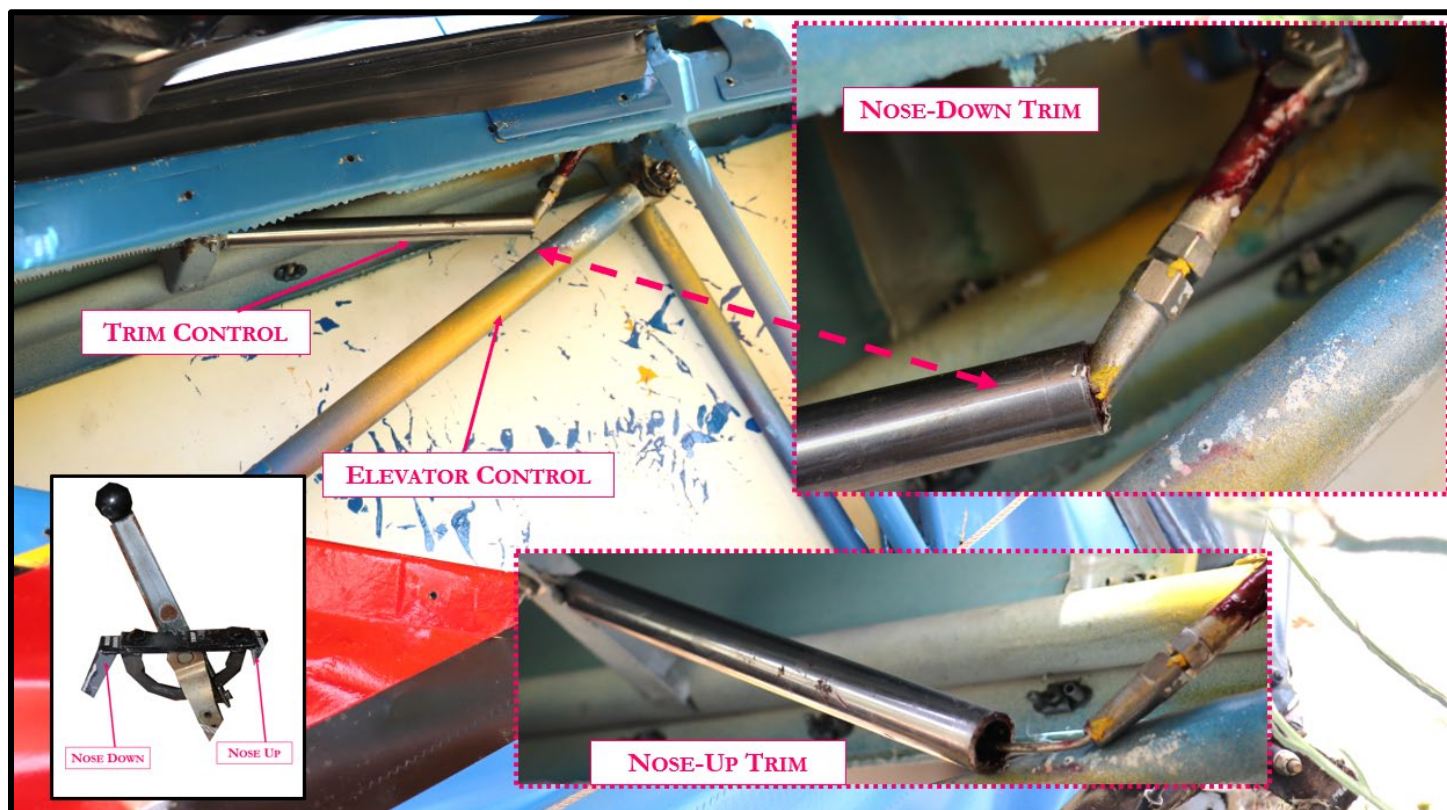


Figure 14: Trim tab function

FUEL SYSTEM

According to the builder's manual, cone pads may be used on the top of the fuel tank and the top plywood is fitted around the filler neck. Similar silicone pads are applied to the top of the tank, and the plywood cover is bonded in place. The manual cautions that under no circumstances should a removable metal cover be used, as this compromises the structural integrity of the box section and creates an unsafe condition.

Regarding fuel system plumbing, the manual states that it should extend no more than a few inches behind the firewall and ideally slope downward from the tank to a selector valve, then proceed to a series boost pump. From there, the fuel line should pass through the firewall to a gascolator, serving as the system's low point. The selector valve should only draw from the wing tank or main tank, never both simultaneously, and the wing tank must not be used as a smoke oil tank.

The manual specifies 3/8-inch lines for all fuel lines and 1/4-inch for vents, which should exit at the gear legs in an area of positive pressure by pointing forward or using a chamfer. Exiting vents at the belly is discouraged because fuel might vent near the hot exhaust. For safe aerobatics with low fuel levels, the flop tube must exit at the front, and an access panel on the firewall is suggested to facilitate maintenance. The manual advises taking off on the main tank, switching to the wing tank in cruise, and allowing the wing tank to drain until the fuel flow meter indicates fluctuation, then switching back to the main tank. All vents should remain covered when the airplane is not flying to prevent obstructions.

The manual strongly warns not to use Aeroquip 601 hose for aviation fuels due to the rubber compound's tendency to degrade quickly and weep fuel through the steel braid. Instead, Teflon lines are recommended to avoid vaporized fuel near exhaust components.

QUANTITY

The main tanks held 20 gallons and the top tanks held 9 gallons. The fuel receipt from the last known fueling was the day before the accident, where the aft-seated pilot added 8.7 gallons, topping off the main 20-gallon tank. The spouse of the front-seated pilot stated that there was an agreement that after someone would take out the airplane, they would refuel when they returned back to the hangar.

EXAMINATION

The fuel selector was positioned on the main fuel tank position. There was no fuel found in the upper tank. Upon removing the fuel selector there was trace amount of fluid that came out of the lines. The blue liquid was consistent in odor with that of 100LL Avgas. A water detection paste showed there was no water in the liquid.

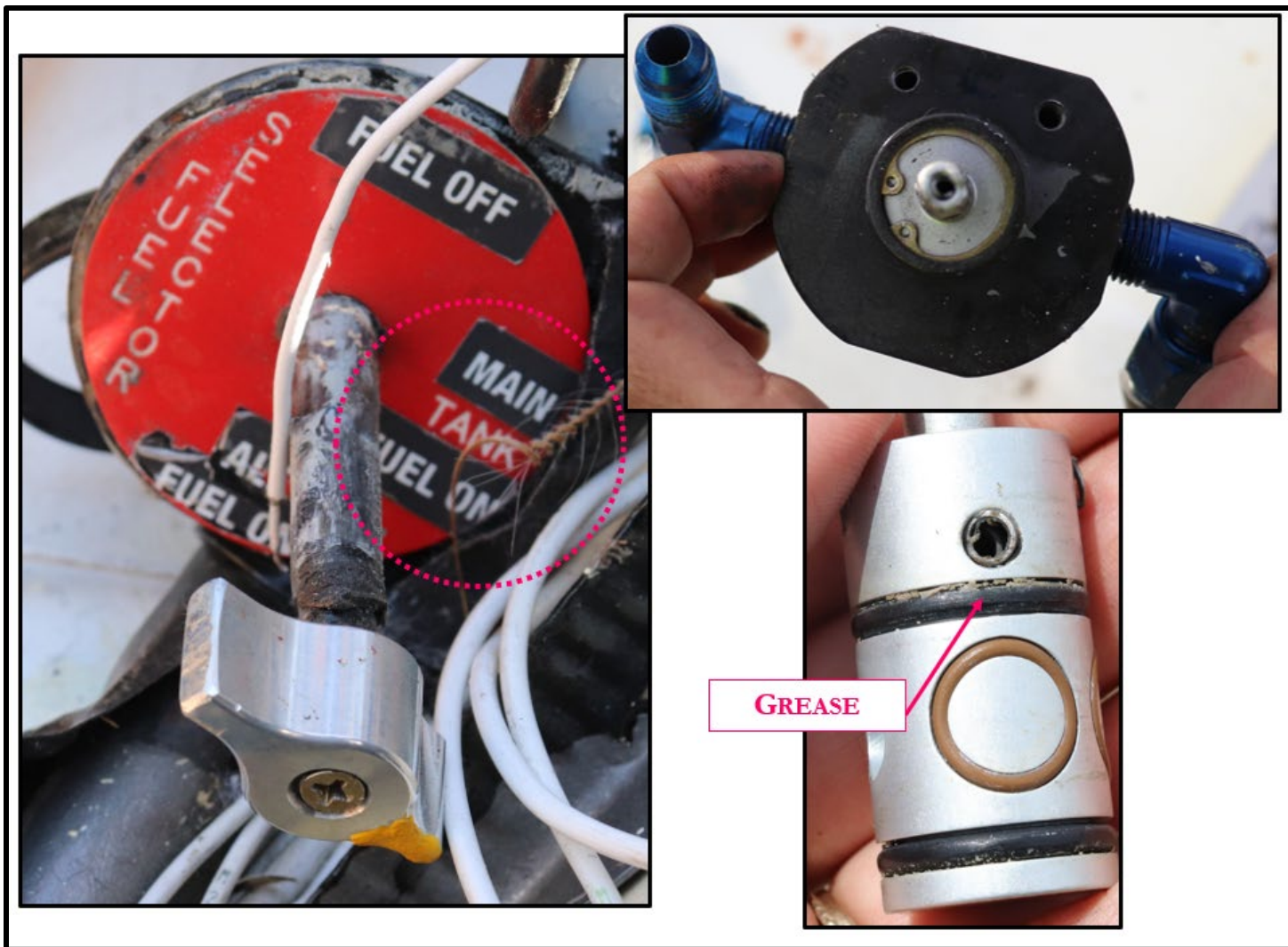


Figure 15: Fuel selector

Removal of the faucet electrical fuel pump revealed there was fuel between the pump and gascolator. A battery was hooked up to the pump and it could be felt puffing out air and the motor could be heard. The gascolator was crushed open; the screen was clean of debris. The mechanical fuel pump was broken at the plunger. The cavity contained blue liquid and trace amounts of fine debris.

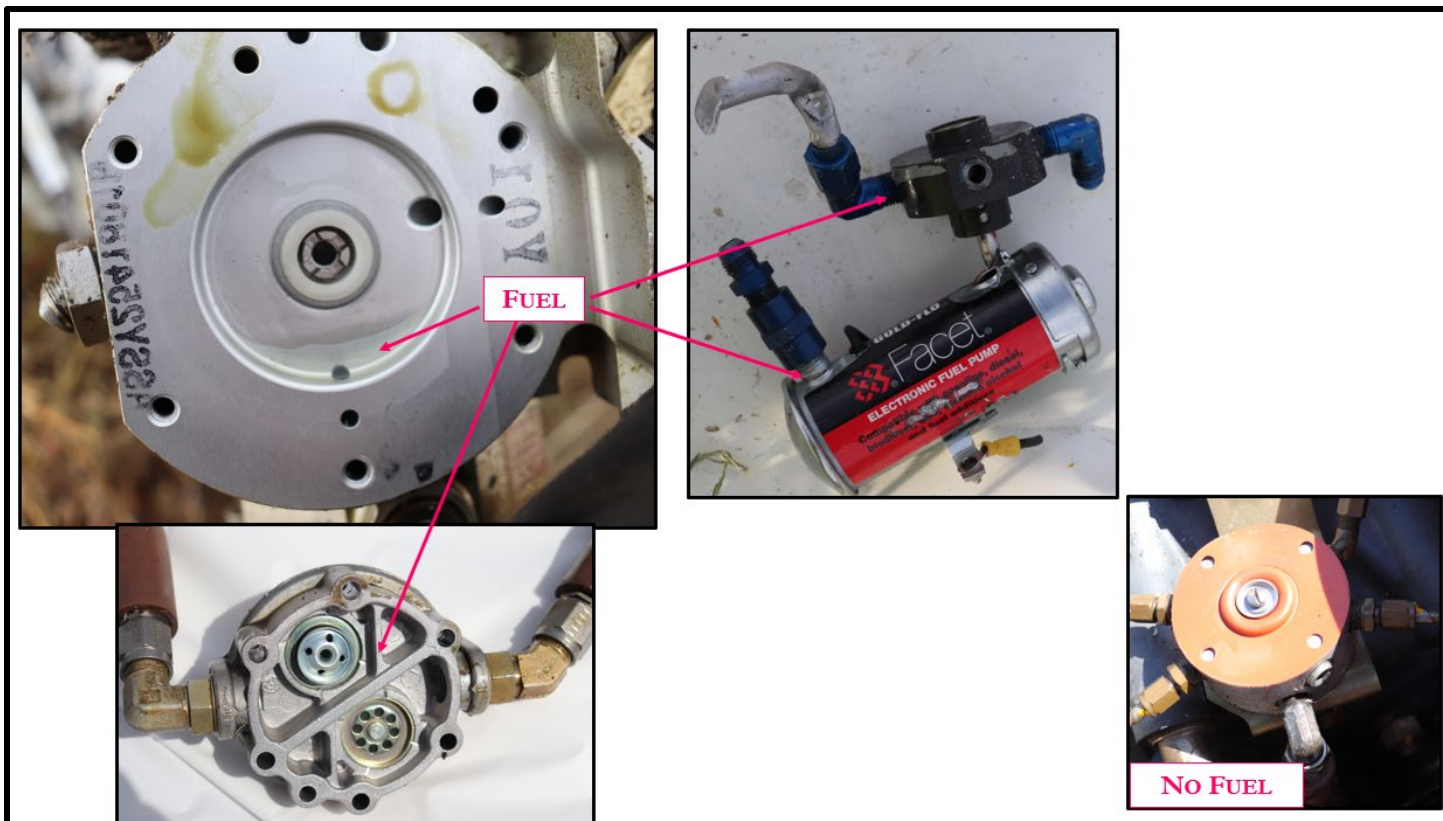


Figure 16: Fuel found in the fuel system

The fuel servo, Precision EX-5VA2, was crushed up into the engine and fuel line was broken off. The throttle and mixture cables remained attached. The throttle did not move stop-to-stop and would slightly bind at the stop. The mixture was difficult to turn throughout the rotation. There was a white residue and debris at the base. Removal of the arm revealed that the spring and grommet were intact; the shaft appeared slightly bent. Disassembly revealed the diaphragm were intact. Trace amounts of fuel with small debris. There was corrosion in the servo.

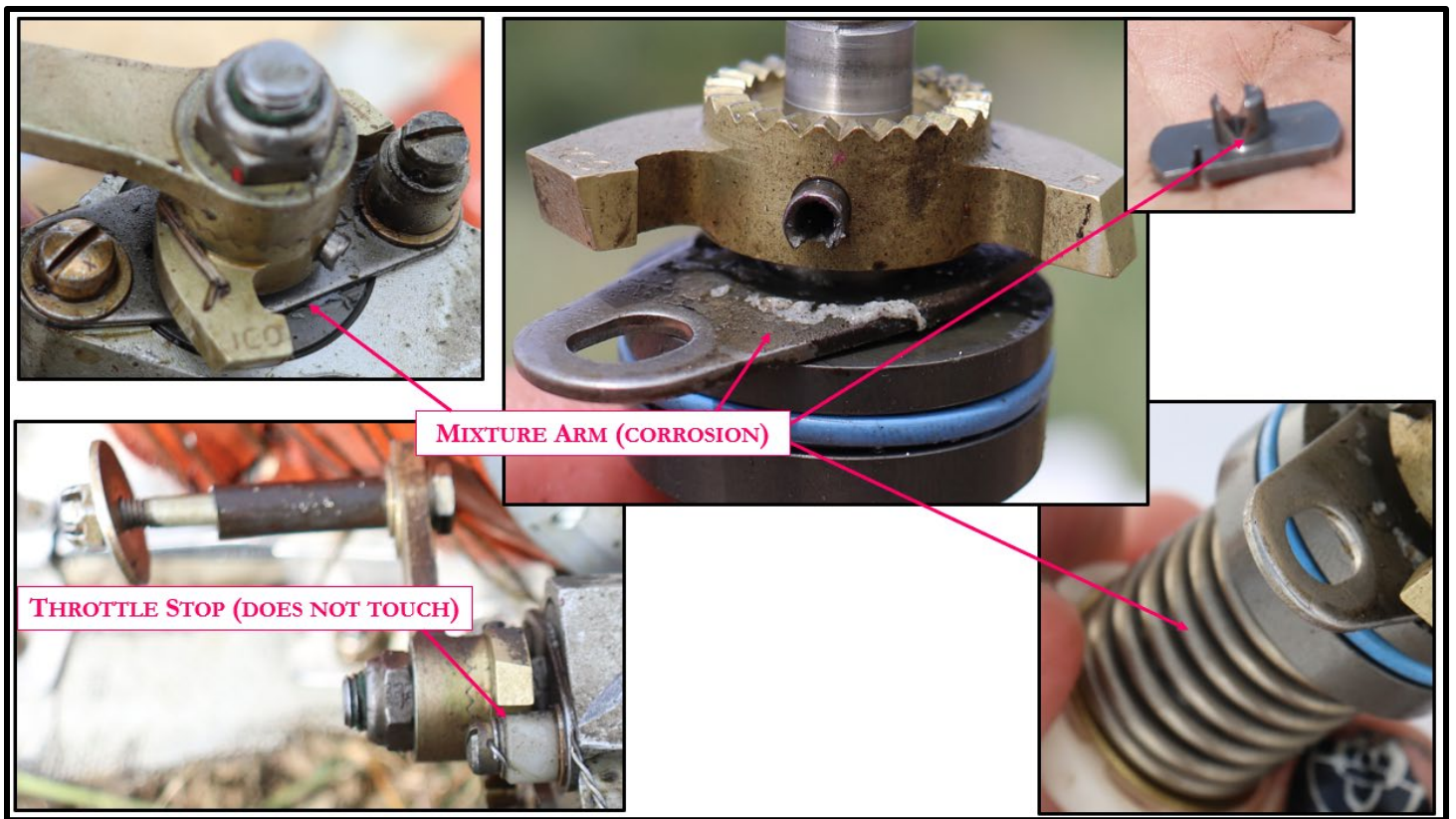


Figure 17: Fuel servo throttle and mixture arms



Figure 18: Air cavity of fuel servo

There was no fuel in the spider; the diaphragm was pliable and free of tears. There was a trace amount of sandy/greasy debris in the bottom air-only cavity as well as an oily substance around it..

ENGINE

The Superior SL-IO-360-A1AA2 (s/n 36H060968), 180-horsepower engine, was installed on the airplane at the time of the build.

An external examination revealed multiple fractures in the crankcase, with the oil sump and intake manifold broken apart. Investigators removed and examined the top spark plugs. The spark plug electrodes were undamaged, and, according to the Champion Spark Plugs Check-A-Plug chart AV-27, were consistent with normal operation but in worn condition.



Figure 19: Top spark plugs

Investigators established continuity of the valve and gear train by rotating the crankshaft via the crankshaft flange (exerting force on the splintered propeller blades); compression was detected in all cylinders. Rust residue and oil was observed at all four rocker box areas. Removal of the cylinders revealed that the combustion chambers and barrels showed light scratches and corrosion. There was no evidence of foreign object ingestion or detonation. The valves were intact and undamaged; the No. 3 exhaust valve was red in color indicating it reached high temperatures.

There was no evidence of valve-to-piston face contact observed. The pistons and their respective rings were intact. The piston skirts were dark in color and had numerous scuffs/grooves.

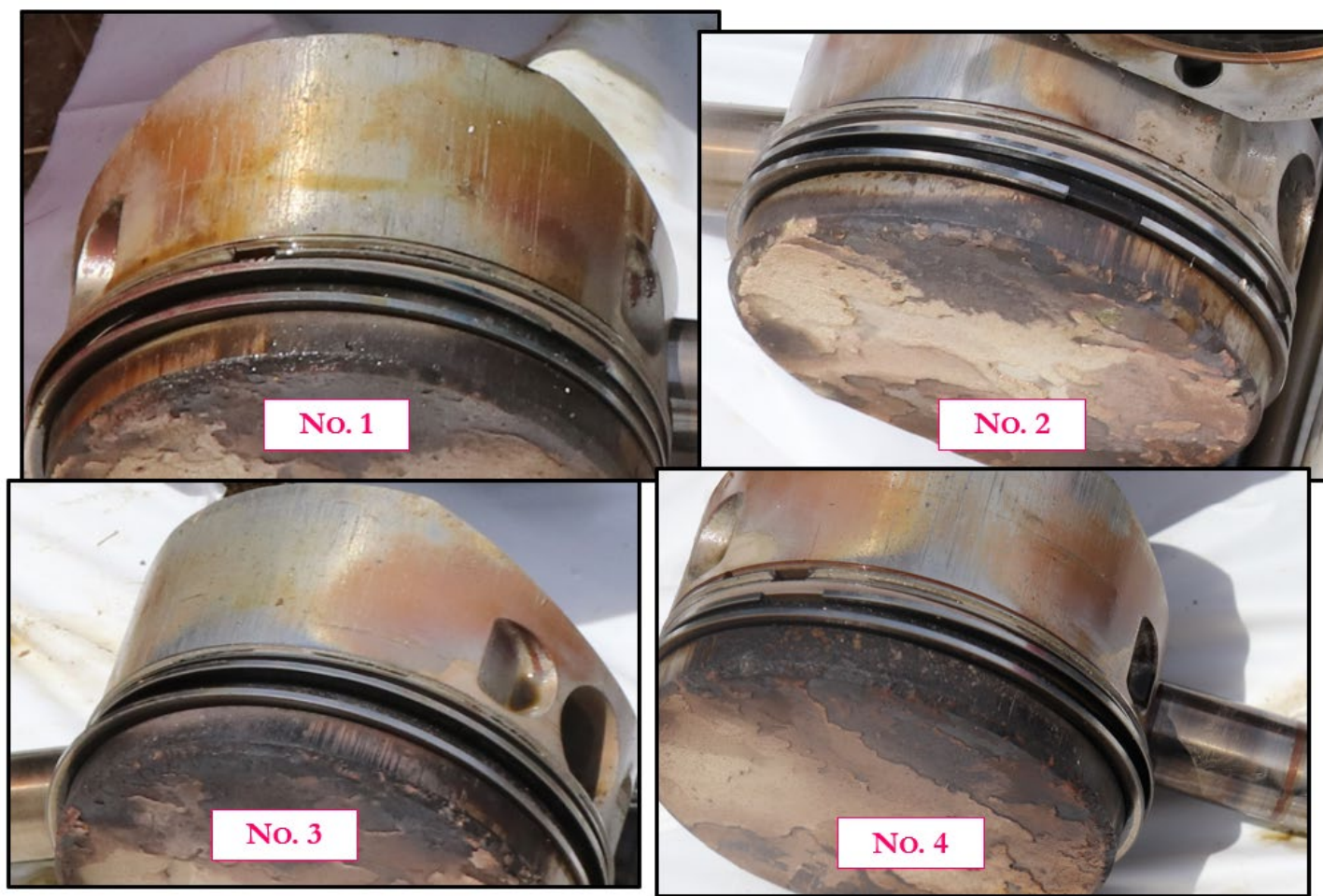


Figure 20: Pistons skirts

Removal of the pistons revealed that the cam lobes and lifter faces showed evidence of wear. There was severe spalling on the faces of all the intake lifters and several exhaust lifters; there was also evidence of galling noted. The camshaft lobes did not appear rounded and no material deformation was observed on the lobes.



Figure 21: Lifter faces and lobes showing #3 cylinder

Removal of the accessory case revealed the crankshaft gear, idler gear, and camshaft gears were all aligned with their respective alignment marks. The oil pump was disassembled revealing intact gears; the pump had light scoring and corrosion.

Both magnetos were broken away from the engine and timing could not be ascertained. The magneto lead on the No. 3 cylinder was severed at the spark plug. Both produced spark upon rotation.

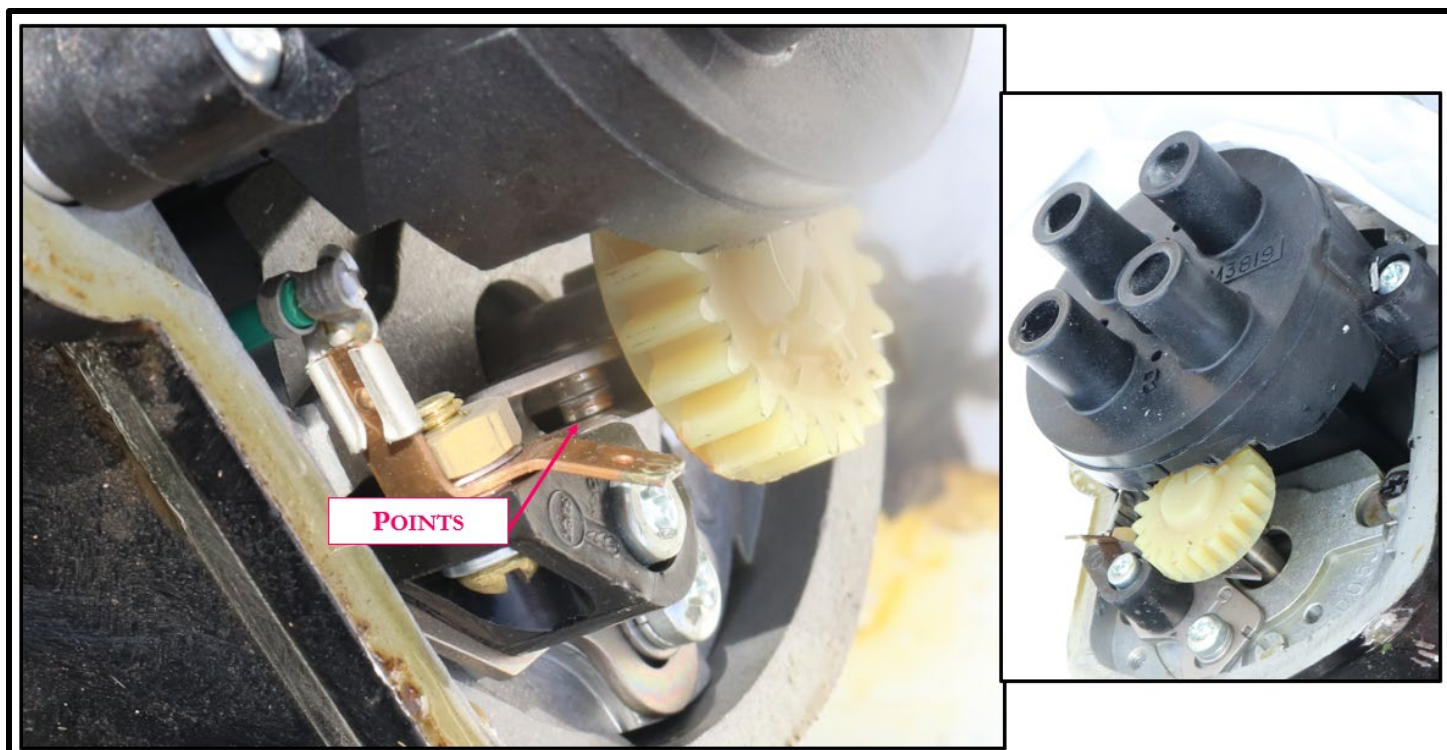


Figure 22: Magneto

The oil filter had broken from the mounting pad. The oil filter and suction screen were removed and examined. The oil filter was cut open to expose the filter media. Visually there was no evidence of pre-mishap metal contamination observed in the filter pleats, but a microscopic inspection revealed small metal particles. There were several small pieces of metal in the suction screen.

There was no evidence of pre-mishap mechanical malfunctions observed during the examination of the engine.

PROPELLER

The wooden Sensenich W76HM8-60 (s/n AG6732) was manufactured in January 2007 and was 76" in length at a pitch of 60. The last time it was recorded as being torqued was November 2022 at an engine tachometer time of 518 hours.

The two-bladed fixed-pitch wooden propeller remained attached to the crankshaft flange, with only 1/2 of both propeller blades remaining, splintered at their ends. The fiberglass propeller spinner was unevenly crushed aft, with the upper portion intact and the lower and front portions broken into pieces in the dirt.

RECORDS

The accident aircraft was a tricycle landing gear equipped, two seat, biplane. The pilots purchased the airplane on November 2, 2022. At the accident site the airplane's tachometer showed 643.9 hours, but a picture on the pilot's iPad showed a tachometer of 535.4 hours on April 14th, 2023. It is presumed it was actually 543.9 hours.

The maintenance records from the prior owner were located in the hangar and the most recent records were not found.

The last annual was recorded as being completed on March 13, 2022, at a tachometer time of 511.2 hours. Thereafter a pre-buy inspection was performed on June 28th at 515.4 hours. The last oil change was recorded as being completed on June 13, 2022, which corresponded to the date on the oil filter in the wreckage.

The airplane had not been built by the pilot but had been built by a previous owner. At an aerobatic gross weight of 1,320 pounds, and at a center of gravity (cg) of -0.025 he determined the following speeds:

Stall Speed 51 mph

Best angle of climb: 65 mph

Best angle of climb: 80 mph

Maximum speed 138 mph (at a maximum rpm pf 2,700)

Barrel roll: 140 mph

Slow roll: 140 mph

Loop: 160 mph

Hammerhead: 150 mph

Immelman: 160 mph

The CG range was 3 inches forward of the leading edge of the lower wing to 2.5 inches aft of the leading edge of the lower wing.

The following tachometer times were provided by the previous owner:

Date	Tach Time
4/11/2007	6
4/1/2008	111
10/18/2009	165
9/21/2010	168
8/4/2011	186
9/12/2012	236
10/26/2013	262
7/7/2014	281
2/5/2015	296
1/17/2016	325
12/1/2017	394
8/28/2018	421
7/8/2019	449
7/6/2020	484
8/27/2021	509
6/28/2022	515

From Blackstone Laboratories: August 27, 2021

An oil analysis dated August 27, 2021, for airplane N202GM indicated that corrosion remained a concern, though the lab did not suspect a rapidly developing issue. The comments emphasized that prolonged corrosion can lead to excess pitting, which is more challenging to address than mild corrosion. The recommendation was to fly at least five hours per month or, if that is not feasible, change the oil more frequently to help mitigate corrosion.

Among the metals tested, lead (measured at 1428 parts per million) and iron (64 ppm) appeared notably higher than universal averages or expectations. The lab advised checking the oil filter for metal in case elevated iron indicates steel wear, and suggested scheduling a follow-up check later. Overall, the lab noted that flying regularly, along with vigilant oil changes and inspections, would be the best strategy for preventing further corrosion.

COMMENTS

GARY: Corrosion is still a concern for N202GM. The good news is things don't look much worse than what showed up last time, so we don't suspect a developing issue, but prolonged corrosion can result in excess pitting, which is harder to correct than mild corrosion. Flying at least 5 hours/month is the best way to keep corrosion out of the picture, but if that isn't an option, then changing the oil more frequently is another strategy. Check for oil filter metal in case any of the iron shows poor steel wear, and check back for another look. Fuel dilution is okay at 0.5%.

ELEMENTS IN PARTS PER MILLION

MI/HR on Oil	25	UNIT / LOCATION AVERAGES	18	18	28	28	33	UNIVERSAL AVERAGES
MI/HR on Unit	510		485	467	450	421	394	
Sample Date	8/27/2021		7/26/2020	11/11/2019	7/8/2019	8/28/2018	11/22/2017	
Make Up Oil Added	1 qt		0 qts	0 qts	1 qt	1 qt	1 qt	
ALUMINUM	12	9	11	11	20	17	22	8
CHROMIUM	5	6	6	7	14	7	7	10
IRON	64	30	67	49	103	33	29	26
COPPER	2	4	2	2	3	2	3	7
LEAD	1428	1761	1764	1723	3055	2464	2669	2510
TIN	1	1	0	0	0	0	1	1
MOLYBDENUM	0	0	0	0	0	0	0	0
NICKEL	2	1	2	2	2	1	1	1
MANGANESE	1	0	1	0	1	0	0	0
SILVER	0	0	0	0	0	0	0	0
TITANIUM	0	0	0	0	0	0	0	0
POTASSIUM	0	0	0	0	0	0	0	1
BORON	0	0	0	0	1	0	1	0
SILICON	3	7	4	4	5	5	5	5
SODIUM	2	1	2	1	2	1	2	2
CALCIUM	71	52	52	50	16	37	49	14
MAGNESIUM	3	5	4	3	8	6	8	2
PHOSPHORUS	71	101	73	74	16	55	77	279
ZINC	18	37	21	15	16	29	43	14
BARIUM	0	0	0	0	0	0	0	0

Values Should Be*

PROPERTIES

SUS Viscosity @ 210°F	87.1	86-105	86.1	94.6	93.4	95.7	92.0
cSt Viscosity @ 100°C	17.28	17.0-21.8	17.04	19.09	18.80	19.35	18.46
Flashpoint in °F	420	>430	460	460	460	455	445
Fuel %	0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5
Antifreeze %	-		-	-	-	-	-
Water %	0.0	0.0	0.0	0.0	0.0	0.0	POS
Insolubles %	0.4	<0.6	0.3	0.4	0.3	0.3	0.3

Figure 23: Most recent Blackstone Laboratories oil analysis testing

FUELING RECORDS

The families stated that the pilots would refuel the tank to full at the end of each flight. The fueling records from the base airport were as follows:

Date	Transaction #	Aircraft	Fuel Type	Quantity
1/18/2023	23-279677	N202GM	100LL	11.3
1/22/2023	23-279908	N202GM	100LL	13.3
1/26/2023	23-280179	N202GM	100LL	13.6
1/29/2023	23-280313	N202GM	100LL	11.9
2/1/2023	23-280553	N202GM	100LL	8.4
2/19/2023	23-281385	N202GM	100LL	2.9
3/3/2023	23-281880	N202GM	100LL	2.4
3/26/2023	23-282756	N202GM	100LL	8.6
3/27/2023	23-282793	N202GM	100LL	9.3
3/30/2023	23-282897	N202GM	100LL	6.9
4/13/2023	23-283801	N202GM	100LL	21.1
4/21/2023	23-283884	N202GM	100LL	10
4/28/2023	23-284756	N202GM	100LL	4.8
6/5/2023	23-286924	N202GM	100LL	9.2
6/5/2023	23-286946	N202GM	100LL	6.8
6/7/2023	23-287044	N202GM	100LL	8.7

On June 07, 2023 one of the pilots purchased an oil filter and 4 gallons of T5-40-1 oil at an auto parts store in Martinez, California.

TRIM SYSTEM

A 40-seconds video was located on the pilot's iPad that showed the pilot talking to the prior owner/builder about the airplane. The video was taken January 18, 2023. During the video, he narrates to the prior owner "here is what we found" and moves the right trim tab up and down. While moving it he says "see how much that moves."



Figure 24: Excerpt of video showing the slack in the left trim

He then goes to the left trim tab and moves it in the same up and down manner and says “that’s stiff.” Then he goes back to the right trim tab and moves it again while saying that he believes that is “what the problem was... it just started oscillating” and “throwing the elevator up and down.” He then concludes that he found the problem and was going to fix it.



Figure 25: Excerpt of video showing the left trim tab

PERSONNEL INFORMATION

AFT-SEATED PILOT

JESSE WILLIAM BUCKNER

ATP AMEL; COMMERCIAL PRIVILEGES ASEL; FLIGHTB INSTRUCTOR; REMOTE PILOT; MECHANIC), was a 33-year-old male. This pilot was 70 inches tall and weighed 185 lbs. at the time of the last exam. This pilot was issued a First Class Medical Certificate without limitation.

The pilot was employed as a contract pilot in command (PIC), holding ATP, CFI, MEI, and A&P mechanic credentials, along with a Class I medical. His total flight experience reached 3,044.8 hours, including 2,287.5 hours as PIC, 1,236.6 hours in multiengine airplanes, 844.0 hours in the CE-525, and 131.7 hours in the CE-560. He spent four years as a Part 91 CJ3 PIC, with further PIC time in the C25-B/C series.

He also served as a 135 charter SIC at Pacific Coast Jets in Oakland, California, and worked as a contract pilot in Concord. In addition to these roles, he performed duties as a flight instructor and an A&P mechanic for Part 141 and Part 91 schools. His background included jump pilot experience in several Cessna models, including the C-210, C-208, C-206, and C-205.

FONT-SEATED PILOT

BENJAMIN (BEN) ALLEN SHREVE

(ATP ASEL, AMEL; FLIGHT INSTRUCTOR; MECHANIC), was a 41-year-old male. This pilot reported civil flight experience that included 6100 total and 200 hours in last six months as of exam dated 5/19/2022. This pilot was 71 inches tall and weighed 200 lbs. at the time of the last exam. The last exam was conducted by

Aviation Medical Examiner (AME) 17575. This pilot was issued a First Class Medical Certificate without limitation.

WEATHER INFORMATION

Station	Time	Wind	Speed (kts)	Gust (kts)	Temp (°F)	Dew Point (°F)
KCARIOVI73	11:24 AM	WNW	9.8	17.9	69.9	53.9
KCARIOVI69	11:25 AM	SW	12	14.9	67.4	53.8
KCARIOVI73	11:24 AM	WNW	9.8	17.1	69.9	53.9
KCARIOVI69	11:24 AM	SW	12	14.9	67.4	53.8
KCAWALNU45	11:30 AM	WSW	6.3	11.8	72.2	52.8

The average wind was from about 255° at 10 kts gusting to 15kts

ADDITIONAL INFORMATION

The Federal Aviation Administration publication Airplane Flying Handbook, FAA-H-8083-3, stated that in absence of spin recovery techniques specific to a particular aircraft spin recoveries should be initiated by reducing engine power to idle, neutralizing the aileron position, applying full opposite rudder against the rotation of the spin, and providing a "positive and brisk" forward movement of the control stick to break the stall. Once the spin rotation stops, the rudder position should be neutralized and elevator pressure should be applied to raise the nose to level flight. The handbook noted that "aileron control opposite the direction of the spin may cause the down aileron to move the wing deeper into the stall and aggravate the situation. It also stated: "Slow and overly cautious control movements during spin recovery must be avoided. In certain cases it has been found that such movements result in the airplane continuing to spin indefinitely, even with anti-spin inputs. A brisk and positive technique on the other hand, results in more positive spin recovery."