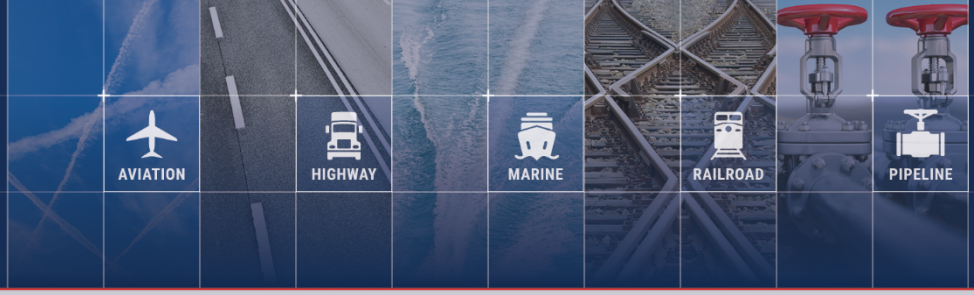

Aviation Investigation Final Report

Location:	Hood River, Oregon	**Accident Number:**	WPR21LA250
Date & Time:	June 28, 2021, 10:30 Local	**Registration:**	N10TA
Aircraft:	L-BIRD LLC CCX-2000	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (total)	**Injuries:**	1 None
Flight Conducted Under:	Part 91: General aviation - Flight test		

Analysis

The experimental, amateur-built airplane was retrofitted with an experimental exhaust system that comprised a titanium exhaust header and aluminum muffler.

On the first flight with the new exhaust system, the engine lost total power just after takeoff. The pilot performed a forced landing during which the airplane impacted trees, resulting in substantial damage.

Examination of the engine revealed that the muffler inner tube failed due to creep fatigue and fractured into several fragments. Components of the muffler included a perforated inner tube, surrounded by fiberglass packing material held in place by five clamps; an outer shell; end caps; and an inlet and exhaust tube, all constructed out of 6061-T6, an aluminum alloy not suited for use above 350°F to 400°F. Any use near or above that temperature will cause additional heat treatment and changes to the properties and performance of the material. The observation of the creep separation indicates that the material was exposed to much higher temperatures than this, likely between 600°F and 1000°F. It is likely that, when exposed to the hot exhaust gasses during takeoff, the fragments, clamps, and fiberglass packing material migrated aft and collapsed the remaining section of the inner tube, which plugged the exhaust port and resulted in a total loss of power. A postaccident test run of the engine without the muffler revealed no anomalies.

Probable Cause and Findings

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

The total loss of engine power due to improper construction of the muffler, which resulted in separation of the internal components.

Findings

Aircraft	(general) - Design
Aircraft	Noise suppressor - Failure
Environmental issues	Tree(s) - Effect on equipment

Factual Information

History of Flight

Initial climb	Loss of engine power (total) (Defining event)
Landing-landing roll	Collision during takeoff/land

On June 28, 2021, about 1030 Pacific daylight time, an experimental, amateur-built, CCX-2000 airplane, N10TA, was substantially damaged when it was involved in an accident near Hood River, Oregon. The pilot was not injured. The airplane was operated as a Title 14, *Code of Federal Regulations* Part 91 personal flight.

The pilot was the director of maintenance for a maintenance facility contracted to perform work on the airplane. He reported that, at the request of the owner, the airplane was retrofitted with an experimental exhaust system designed to quiet the engine. The replacement exhaust system comprised a titanium exhaust header and an aluminum muffler. The pilot stated that, following the installation of the exhaust, an uneventful full-engine-power ground run was conducted. After the ground run, the pilot initiated the airplane's first flight with the new exhaust system. Shortly after takeoff, the engine lost total power, and the pilot performed a forced landing to a field. During the landing roll, the airplane impacted trees before it came to rest upright in the field resulting in substantial damage to the rear spar carrythrough.

A video recording of the takeoff revealed, about 24 seconds after takeoff, metallic shiny debris trailing from the airplane, as seen in figure 1.

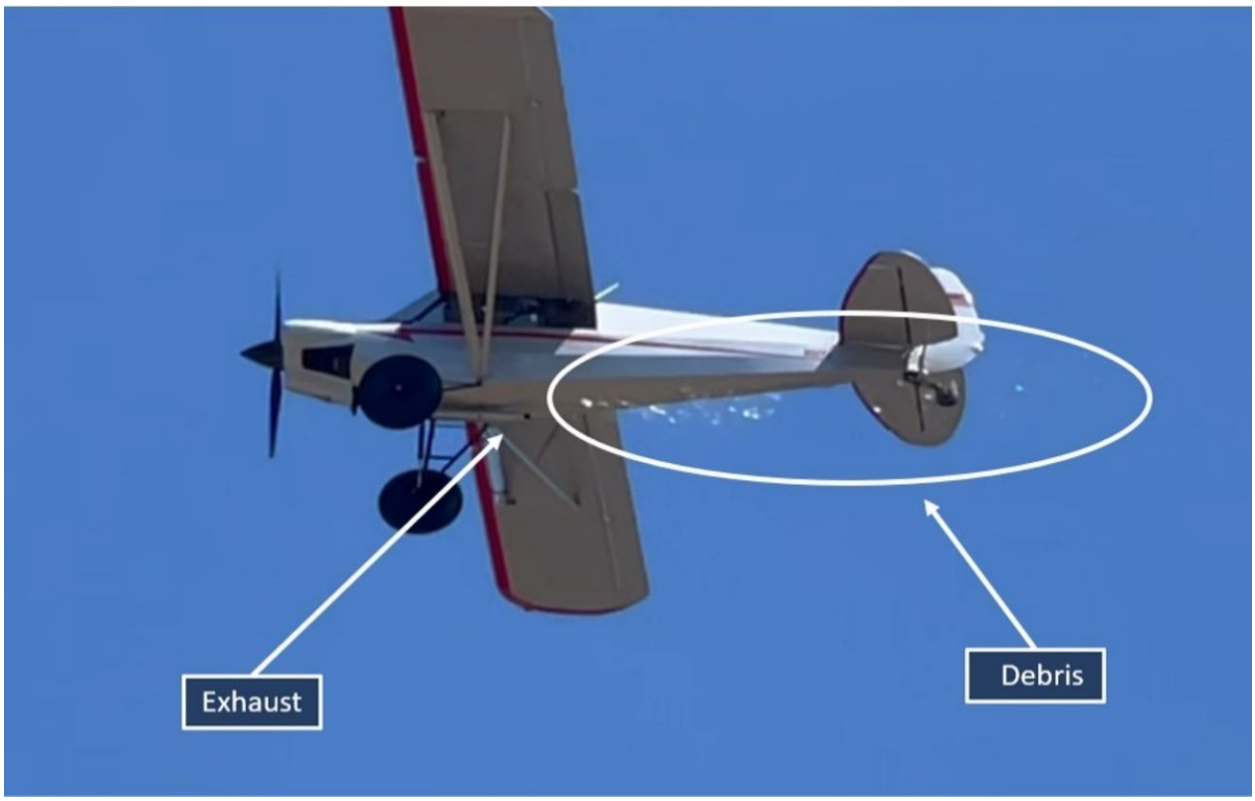

Figure 1: Airplane during takeoff.

According to the manufacturer, the exhaust system was similar to a Carbon Cub design but with a header constructed out of titanium and a “Swiss style” muffler constructed out of aluminum. The manufacturer stated that the company had no trends with an aluminum muffler and stated this to the company requesting the design.

The aluminum muffler was examined by the NTSB Materials Laboratory. Examination revealed that the muffler, as it was manufactured, comprised an inner cylindrical perforated hollow tube (approximately 2.5-inch diameter) surrounded by fiberglass packing material. The packing material was secured to the tube outer diameter by five band clamps and wire. This assembly was inserted into an approximate 3.5-inch diameter by 36-inch-long tube, which served as the outer shell of the muffler body. The packing material volume was sized to fill the volume between and nominally center the inner tube and outer shell. Designs of this type are sometimes referred to as “Swiss style” mufflers. End caps, an inlet tube, and an exhaust tube were then welded onto the assembly. The muffler inner tube, muffler shell, and inlet and exhaust tube were identified as 6061-T6, an aluminum alloy.

The muffler inlet and exhaust tubes were sectioned from the muffler body. At the inlet end, the inner tube was fractured 360° around its circumference approximately 3.5 to 4.0 inches from the inlet end and the fiberglass packing had fallen inward, obstructing the view further inside

the muffler. At the exhaust end, the inner tube had collapsed inward in three nominally symmetric segments, pinching the outlet end shut. (see figures 2 and 3.)

Figure 2. Image of the muffler body inlet, showing the fractured perforated inner tube and the fiberglass packing that had fallen inward.

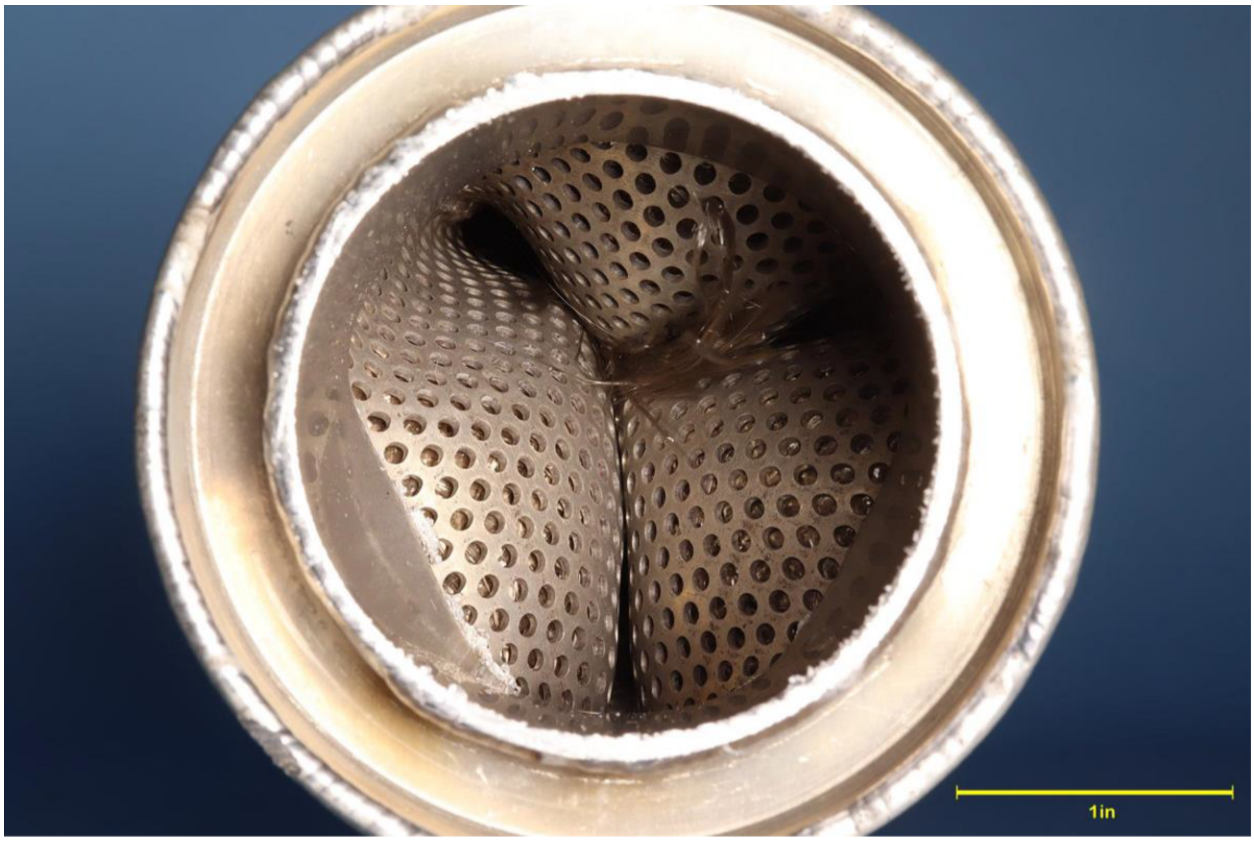

Figure 3. Image of the muffler body outlet, showing the collapsed inner tube.

The fracture features of the inner tube were consistent with a failure that started in tension near the 7 o'clock position and transitioned to bending as it progressed around both sides of the tube and terminated near the 1 o'clock position. The fractured ligaments, when viewed under magnification, had a specular appearance with no apparent crack growth features that would be typical of fatigue or overstress fractures. The ligament fractures were examined in a scanning electron microscope equipped with an energy-dispersive X-ray spectrometer (EDS). The observations were consistent with a high-temperature creep separation/fracture.

According to the Federal Aviation Administration, a postaccident test run of the engine without the aluminum muffler revealed that the engine started easily and responded well to throttle and propeller control adjustments. There were no issues noted during the engine run, and no mechanical malfunctions or failures that would have precluded normal operation.

Pilot Information

Certificate:	Commercial	**Age:**	25,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Front
Other Aircraft Rating(s):	None	**Restraint Used:**	4-point
Instrument Rating(s):	None	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	
Medical Certification:	Class 2 Without waivers/limitations	**Last FAA Medical Exam:**	November 9, 2020
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	June 30, 2019
Flight Time:	2100 hours (Total, all aircraft), 450 hours (Total, this make and model), 1950 hours (Pilot In Command, all aircraft), 60 hours (Last 90 days, all aircraft), 40 hours (Last 30 days, all aircraft), 0 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	L-BIRD LLC	**Registration:**	N10TA
Model/Series:	CCX-2000	**Aircraft Category:**	Airplane
Year of Manufacture:	2019	**Amateur Built:**	Yes
Airworthiness Certificate:	Experimental (Special)	**Serial Number:**	CCX-2000-0080
Landing Gear Type:	Tailwheel	**Seats:**	2
Date/Type of Last Inspection:	December 2, 2020 Condition	**Certified Max Gross Wt.:**	
Time Since Last Inspection:		**Engines:**	1 Reciprocating
Airframe Total Time:	127.1 Hrs	**Engine Manufacturer:**	LYCOMING
ELT:	C91 installed, not activated	**Engine Model/Series:**	CC363I
Registered Owner:	FLIGHT MANAGEMENT LLC	**Rated Power:**	187 Horsepower
Operator:	TACAero	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	K4S2,630 ft msl	**Distance from Accident Site:**	1 Nautical Miles
Observation Time:	10:35 Local	**Direction from Accident Site:**	105°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	3 knots /	**Turbulence Type Forecast/Actual:**	Unknown / Unknown
Wind Direction:	330°	**Turbulence Severity Forecast/Actual:**	Unknown / Unknown
Altimeter Setting:	29.79 inches Hg	**Temperature/Dew Point:**	34°C / 14°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Hood River, OR	**Type of Flight Plan Filed:**	None
Destination:	Hood River, OR	**Type of Clearance:**	None
Departure Time:		**Type of Airspace:**	Class G

Airport Information

Airport:	Ken Jernstedt Airfield 4S2	**Runway Surface Type:**	Asphalt
Airport Elevation:	638 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	25	**IFR Approach:**	None
Runway Length/Width:	3040 ft / 74 ft	**VFR Approach/Landing:**	Forced landing

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:		**Aircraft Explosion:**	None
Total Injuries:	1 None	**Latitude, Longitude:**	45.672404,-121.56234(est)

Administrative Information

Investigator In Charge (IIC):	Salazar, Fabian
Additional Participating Persons:	Jon Bergstrom; Federal Aviation Administration; Hillsboro, OR Lance Johnson; Federal Aviation Administration; Hillsboro, OR Keith Ruconich; Federal Aviation Administration; Portland, OR
Original Publish Date:	February 24, 2023
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=103360