Aviation Investigation Final Report

Location:	St. Mary's, Alaska	**Accident Number:**	ANC23FA074
Date & Time:	September 12, 2023, 20:47 Local	**Registration:**	N109T
Aircraft:	Piper PA-18-150	**Aircraft Damage:**	Substantial
Defining Event:	Loss of control in flight	**Injuries:**	1 Fatal
Flight Conducted Under:	Part 135: Air taxi & commuter - Non-scheduled		

Analysis

The pilot ferried a group of hunters into a remote wilderness area over the days leading up to the accident flight. The hunters then killed a moose, and the pilot ferried the first of two loads of meat back to the departure airport. The first ferry flight was uneventful, with the airplane departing to the north before initiating a climbing right turn toward the destination.

During the second flight, the airplane was more heavily loaded with meat and the pilot had mounted a set of moose antlers to the right wing strut. The hunters observed that the accident takeoff was more labored than before; the airplane took off in the same direction, and they watched as it rolled to the right after rotation and flew out of sight behind an adjacent ridgeline. They were all initially relieved that the airplane had managed to become airborne, but it did not reappear from behind the ridge, and had crashed just beyond their view in the opposite direction of takeoff.

The initial takeoff phase of both the accident and a previous flight were captured on video. Audio analysis of the recordings indicated that the engine was operating at the same high power setting during both flights; it was not trailing any smoke or vapor. Postaccident examination of the airframe and engine did not reveal any anomalies that would have precluded normal operation.

Examination of the cargo at the accident site indicated that it was still secured within the airframe, but was not secured within the cargo pod. Review of the takeoff video indicated that the airplane did not pitch up aggressively enough during the takeoff to have caused the unsecured meat in the cargo pod to shift. The antlers were still secured to the right wing strut and did not impede any of the flight control cables.

The pilot did not use scales to weigh the cargo, and the airplane was loaded 117 lbs, or about 6%, over its maximum takeoff weight. It was so heavy that, even after consuming fuel enroute, the airplane still would have been about 180 lbs over its maximum landing weight upon reaching the destination.

The runway was situated at the crest of a hill, where terrain rapidly fell away into a valley at the northern departure end. The terrain then began to rise such that within about ¾ mile it was 400 ft higher than the runway. The wind at the time of takeoff was out of the north, and while this would have helped during the initial ground roll, once the airplane had left the runway and began a right turn over the valley to the south, it would have encountered downdrafts and mechanical turbulence induced by the terrain to the north and the runway drop-off. The downdrafts, along with the overweight airplane and the added drag and lateral weight imbalance caused by the antlers on the right wing, would likely have resulted in the airplane having insufficient power and/or control authority to maneuver above terrain.

Although carrying antlers externally is a common practice in Alaska, it requires formal FAA approval with a notation in the airplane's airworthiness and maintenance logbooks. There was no evidence that such approval had been granted for the accident airplane.

The airplane was manufactured about 70 years before the accident and had undergone dozens of major repairs and alterations such that at the time of the accident, almost none of the original airplane existed. Although the repairs and alterations were approved through supplemental type certificates (STCs), at the time those alterations were performed the FAA did not provide guidance for installers to determine the interrelationship between all STCs incorporated into an aircraft. Therefore, the airplane's true flight performance characteristics under normal operations, and particularly when the airplane was flying outside of its weight envelope, were unknown.

The pilot had cardiovascular disease, including focally severe narrowing of a branch coronary artery. Such disease may develop without major symptoms, but conveys an increased risk of sudden impairing or incapacitating cardiovascular events, such as arrhythmia, chest pain, or heart attack. There was no autopsy evidence that such an event occurred, although such an event would not leave reliable autopsy evidence if it occurred just before death. Based on the circumstances, there was no evidence that the pilot's medical condition or use of medications contributed to the accident.

Although the pilot survived the initial impact, he succumbed to his injuries within a few hours. The occupiable space within the cabin was compromised by impact to such an extent that it could no longer provide protection to the pilot even with the use of a shoulder harness. Given the remote location of the accident site, which was about 400 miles from a hospital, and accessible only by air, providing the pilot with prompt medical treatment following the accident was not possible.

Probable Cause and Findings

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

The pilot's decision to operate the airplane above its maximum certificated gross weight, and his installation of an unapproved external load that degraded takeoff performance and flight characteristics resulting in a loss of airplane control during takeoff into an area of mechanical turbulence and downdrafts.

Findings

Personnel issues	Decision making/judgment - Pilot
Aircraft	Maximum weight - Capability exceeded
Aircraft	CG/weight distribution - Capability exceeded
Aircraft	Climb capability - Attain/maintain not possible
Aircraft	Directional control - Attain/maintain not possible
Environmental issues	Downdraft - Effect on equipment

Factual Information

History of Flight

Prior to flight	Aircraft loading event
Takeoff	Other weather encounter
Takeoff	Loss of control in flight (Defining event)
Takeoff	Collision with terr/obj (non-CFIT)

On September 12, 2023, about 2047 Alaska daylight time (AKDT), a Piper PA-18-150, N109T, sustained substantial damage when it was involved in an accident near St. Mary's, Alaska. The pilot was fatally injured. The airplane was operated as a Title 14 *Code of Federal Regulations (CFR)* Part 135 on-demand flight.

Two days before the accident, the pilot ferried a group of five hunters, a guide, and their equipment from the operator's base in Holy Cross, Alaska, to an airstrip in St Mary's. The group then set up camp next to the runway, which was oriented north-south within hilly terrain about 70 miles northwest of Holy Cross.

The group planned to hunt for a moose and prepare it for transportation back to the operator's base. The day before the accident, the group successfully hunted a moose and coordinated with the pilot via satellite messaging devices to ferry the meat the next day. On the day of the accident, the pilot arrived at the camp about 1540. The pilot and hunters loaded the airplane with the first batch of meat, and the airplane departed on the north runway. After takeoff, the airplane made an uneventful climbing right turn over an adjacent ridgeline that paralleled the airstrip to the east and then continued in the general direction of Holy Cross.

The pilot returned to camp about 1940 for the second and final load. The meat was strapped into the rear passenger seat area by the pilot with both the seatbelt and rope and was also loaded into the airplane's belly pod, which did not have tie-down provisions. The pilot then tied the moose antlers to the right wing strut; the antlers were cupped outward and perpendicular to the direction of flight.

They discussed the weather and observed that the wind at the airstrip was generally calm and from the north, but was also intermittently variable and gusting. Members of the group reported to the pilot that the wind was gusting much stronger at the northern (departure) end of the airstrip.

The pilot then boarded the airplane and positioned it for a takeoff to the north. The hunters noticed that the ground roll was slightly longer than before, and that the airplane appeared to

be more heavily loaded and “labored” than during the previous flight. They stated that, as the airplane reached the end of the airstrip, it pitched up and turned sharply to the right; however, rather than climbing as before, it flew behind the adjacent ridgeline and out of view. The group initially thought that the pickup had been successful, and they cheered with relief, but the airplane did not reappear from behind the ridge. They ran to the top of the ridgeline, looked down, and saw that the airplane had crashed.

One of the hunters recorded a video of the takeoff. The video showed that the airplane began the ground roll at the southern end of the airstrip and departed uphill to the north. The flaps were retracted, and the tail of the airplane came up as soon as the pilot applied engine power (see figure 1). The ground roll lasted about 530 ft, and immediately after takeoff, the airplane pitched up and rolled right (see figure 2). The airplane then rolled to a wings-level attitude, and the video ended a few seconds later. The engine was heard operating during the recording and the airplane was not trailing smoke or vapor.

Figure 1. Airplane during the takeoff roll (Source: hunter video).

Figure 2 - Airplane rolling right immediately after takeoff (Source: hunter video).

Pilot Information

Certificate:	Commercial	**Age:**	57,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Front
Other Aircraft Rating(s):	None	**Restraint Used:**	4-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	August 11, 2023
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	September 1, 2023
Flight Time:	(Estimated) 6707 hours (Total, all aircraft)		

The pilot was first issued his pilot certificate in 1993. His logbook was not recovered; however, at the time of his last FAA medical examination on August 11, 2023, he reported a total flight experience of 6,707 hours.

The pilot was the operator's sole pilot. He was added to the company's operating specifications and underwent a checkride with an FAA inspector, in accordance with 14 *CFR* 135.293 and 135.299, ten days before the accident. The series of flights that preceded the accident were the first in his capacity as a pilot for the operator. He had been a friend of the

operator for many years, and according to the operator he had flown the airplane many times before.

Aircraft and Owner/Operator Information

Aircraft Make:	Piper	**Registration:**	N109T
Model/Series:	PA-18-150	**Aircraft Category:**	Airplane
Year of Manufacture:	1952	**Amateur Built:**	
Airworthiness Certificate:	Normal; Utility	**Serial Number:**	18-2223
Landing Gear Type:	Tailwheel	**Seats:**	2
Date/Type of Last Inspection:	August 28, 2023 Annual	**Certified Max Gross Wt.:**	2000 lbs
Time Since Last Inspection:	5 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	9593.57 Hrs as of last inspection	**Engine Manufacturer:**	LYCOMING
ELT:	C126 installed, activated, aided in locating accident	**Engine Model/Series:**	O-320
Registered Owner:	On file	**Rated Power:**	160 Horsepower
Operator:	NEITZ AVIATION INC	**Operating Certificate(s) Held:**	On-demand air taxi (135)

The airplane was originally manufactured in 1952 as a Piper PA-18-105 (“Special”), under the Type Certificate number 1A2. At that time, it was equipped with a Lycoming O-235-C1 engine. A series of major alterations were performed through STC in 2013. These included a replacement fuselage and new horizontal and vertical stabilizers, rudder, and elevators. Additional major alterations and repairs included the replacement of the original engine with a Lycoming O-320, 160-hp engine; a belly-mounted cargo pod; new seats; replacement of both forward wing spars and one rear wing spar; replacement of a series of wing ribs; extended flaps; installation of vortex generators; and 35-inch Alaska Bushweel main wheels and tires (which included an upgraded landing gear strut/suspension assembly).

The FAA released Advisory Circular (AC) 20-188 on December 9, 2016. The AC provided engineering guidance to installers for determining the compatibility of the installation of approved changes via STC where previously approved changes were installed on aircraft.

The airplane was involved in an accident in 2017, which required replacement of the vertical stabilizer and rudder, along a series of wing ribs, the aft spar of the right wing, and the forward spar of the left wing.

As a result of the major repairs and alterations performed at the time of the accident, almost none of the original airplane remained.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Dusk
Observation Facility, Elevation:	PASM,312 ft msl	**Distance from Accident Site:**	64 Nautical Miles
Observation Time:	20:56 Local	**Direction from Accident Site:**	222°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	Overcast / 2700 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	8 knots / None	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	340°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.71 inches Hg	**Temperature/Dew Point:**	6°C / 4°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	St. Mary's, AK	**Type of Flight Plan Filed:**	None
Destination:	Holy Cross, AK (PAHC)	**Type of Clearance:**	None
Departure Time:		**Type of Airspace:**	Class G

The National Weather Service (NWS) Surface Analysis Chart centered over Alaska for 2200 AKDT depicted a low-pressure system at 1000-hectopascals (hPa) located along the Alaskan Peninsula with two low-pressure systems at 1001-hPa located in the northern Bering Strait with a trough stretched from the 1000-hPa to the 1001-hPa low pressure systems. The accident site was located west of the surface trough.

The station model closest to the accident site depicted an air temperature of 42°F, a dew point temperature of 40°F, cloudy skies, and a northwest wind at 10 knots (kts). These findings were corroborated by the witnesses at the accident site and the video recording of the takeoff.

Before takeoff, the pilot discussed the weather with the hunting group, and they noted that while winds on the runway were generally out of the north, there were intermittent gusts from random directions. They discussed how, during the previous flight that day, the winds in the valley below were gusting and generally out of the east and southeast, but were calm on the runway.

Archived Weather data retrieved from the NWS Aviation Weather Center (AWC) experimental website for 2045 included low-level wind data from the surface. This data indicated a 10- to 15-knot north wind over the accident site at 2045.

The NWS Winds and Temperature Aloft forecast issued at 1759 and valid for the closest points to the accident indicated wind at 3,000 ft msl out of the north at 12-13 kts.

A search of archived information indicated that the pilot did not request weather information from Alaskan Flight Services. A search of ForeFlight information indicated that he did not have a ForeFlight account. It is unknown what weather information, if any, the pilot checked or received before or during the accident flight.

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Substantial
Passenger Injuries:	N/A	**Aircraft Fire:**	None
Ground Injuries:		**Aircraft Explosion:**	None
Total Injuries:	1 Fatal	**Latitude, Longitude:**	62.863731,-161.77257

The runway was situated at the crest of a hill, where terrain rapidly fell away into a valley at the northern departure end. The terrain then began to climb, such that within about ¾ mile, it was 400 ft higher than the runway.

The airplane came to rest on a 30° downward slope on the other side of the adjoining ridgeline, at an elevation of 1,210 ft mean sea level, about 10 ft lower and 600 ft east of the departure end of the airstrip (see figure 3). The surrounding area consisted of rolling hills covered in tundra, grass, and low-lying shrubs and bushes.

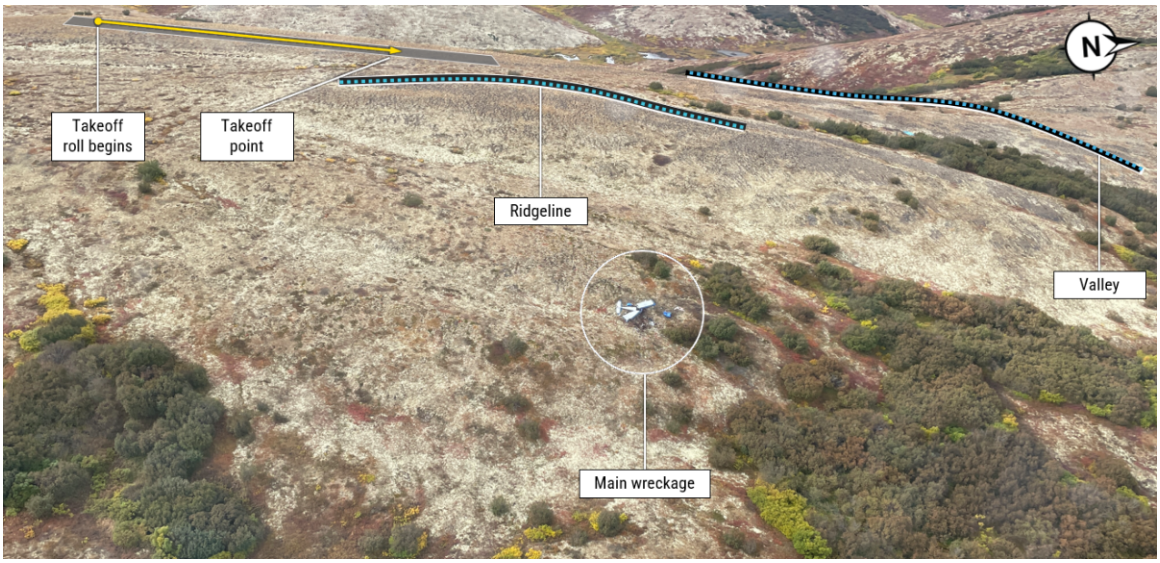

Figure 3 - Accident site.

The fuselage came to rest on a northerly heading, and both wings remained partially attached and generally in line with each other on a northwest-southeast orientation. The first identified point of impact was located about 20 ft below the main wreckage, and consisted of a divot in the soil that contained blue and white fragments that matched the right wingtip (see figure 4). The right wing landing light assembly and right window frame were located about 5 ft uphill in a westerly direction. A large divot in the soil, which was located 5 ft farther uphill, matched the general dimensions of a main landing gear tire. Adjacent to this hole was the propeller, which had separated from the crankshaft.

Figure 4 - Accident site with the first point of impact in the foreground.

The engine contained oil, and there was no evidence to indicate a catastrophic engine failure. Although the wing tank fuel lines had been breached, residual quantities of fuel were observed in both tanks. Both propeller blades exhibited similar damage, including tip twisting, leading-edge nicks and dents, trailing-edge S-bending, and chordwise scratches.

Medical and Pathological Information

At the time of the pilot's last FAA medical examination, he reported having high blood pressure and using the prescription blood pressure medication atenolol. His high blood pressure was noted to be qualified under the conditions aviation medical examiners can issue (CACI) criteria. He was issued a second-class medical certificate limited by a requirement to use corrective lenses to meet vision standards at all required distances.

According to the pilot's autopsy report, his cause of death was the result of multiple blunt force injuries. His autopsy identified hypertensive and atherosclerotic cardiovascular disease,

including thickening of the left cardiac ventricle and an area of plaque causing 90% narrowing of a proximal diagonal branch of the left anterior descending coronary artery. The coronary arteries were otherwise without evidence of disease. The remainder of the autopsy, including visual and microscopic examination of the heart, did not identify other significant natural disease.

The FAA Forensic Sciences Laboratory performed toxicological testing of postmortem specimens from the pilot; this testing detected metoprolol in femoral blood and urine. Metoprolol is a prescription medication that can be used as part of treatment for high blood pressure, certain arrhythmias, and certain types of heart failure. Metoprolol is not generally considered impairing. Metoprolol and atenolol belong to the same medication class (cardioselective beta-blockers).

Survival Aspects

One of the hunters approached the airplane after the accident and found the pilot still conscious in the front seat, but with facial injuries. He unbuckled the pilot's lap belt and extricated the pilot. He then stabilized the pilot by the airplane, covered him in multiple blankets, and set up a heater upwind to keep him warm. However, the pilot succumbed to his injuries within about two hours.

Although the hunter could not recall if the pilot was wearing his shoulder harness, review of the video of the accident takeoff indicated that he likely was.

Damage to the overall exterior of the airplane, as well as the cabin, was consistent with a high-energy impact in the forward direction, with considerable damage to the forward fuselage, wings, and landing gear. The structure surrounding the pilot was damaged to the extent that it resulted in a significant loss of occupiable space. The loss was such that even with the shoulder harness in use, the damage to the surrounding structure was too great to protect the pilot.

The accident site was outside of the range of any Medevac providers, and the closest hospital was in Anchorage, about 400 miles away.

Shortly after the accident, one of the hunters activated the SOS feature on his satellite messenger device. In addition, the airplane's emergency locator transmitter triggered at impact, and an alert signal was received by the Alaska Rescue Coordination Center about 2048. An Alaska Air National Guard helicopter deployed from Anchorage and arrived at the accident site between 0130 and 0200 the following morning.

Tests and Research

Video

The cell phone video was analyzed by specialists in the NTSB Vehicle Performance Division.

Analysis revealed that the estimated pitch angle during takeoff was about 16.2°, and the right bank angle after rotation was 16.6°. The bottom of the cargo pod that was mounted under the fuselage sloped up by 13° toward the tail of the airplane when the airplane pitch angle was zero. Therefore, at the highest airplane pitch angle, the bottom of the cargo pod sloped down toward the tail by 3.2°, with an uncertainty of ±1.5°.

Analysis of the audio revealed that the engine speed throughout the takeoff was about 2,500 rpm. Review a video of the previous takeoff indicated the engine was operating at the same speed.

Engine Monitor

The airplane was equipped with an Electronics International Inc. MVP-50P engine monitor, which was configured to record oil temperature and pressure, fuel flow, engine speed, and both cylinder head and exhaust gas temperatures (CHT, EGT) at 1-second intervals.

The data for the outbound flight from Holy Cross showed the engine speed during takeoff was about 2,600 rpm. For the cruise portion of the one-hour flight, engine speed and fuel flows were about 2,450 rpm and 7.3 gph, respectively, with equally stable CHT and EGTs.

The unit did not record the final stages of the accident sequence, but did capture the first 1.5 minutes of operation after engine start. The data revealed similarly stable and climbing CHT and EGTs after the engine was started. The last 5 seconds of the data showed the engine speed advancing to 2,000 rpm with an appropriate climb in fuel flow to 6 gph, consistent with the pilot beginning the takeoff roll.

GPS

The airplane was fitted with a panel-mounted Garmin GPSMAP 696 GPS receiver and multi-function display. The unit recorded multiple flight tracks with data including latitude, longitude, altitude, date, time, and groundspeed. Review of the flight track for the previous takeoff showed that the airplane took off in the same general direction as the accident flight, and reached 49 kts groundspeed just before takeoff, and 52 kts as the terrain dropped away. After

takeoff, the airplane performed a climbing right turn to the southeast. The radius of the turn was about 500 ft, and within about 1 minute, the airplane had climbed about 350 ft (1,658 ft msl). From there, the flight continued direct to Holy Cross.

During the accident flight, the airplane was traveling at the same ground speed along the runway as the previous flight. By the time the data ended, just as terrain dropped away in the vicinity of the previous flight's takeoff point, the ground speed was 41 kts. The wreckage was located about 500 ft east southeast of the last recorded position.

Weight and Balance

The hunter who witnessed the accident had assisted the pilot in loading the airplane and observed him secure the cargo in the cabin. He reported that, although they did not weigh the cargo, he estimated that the airplane was loaded with about 50 to 70 lbs more meat than the previous flight. The pilot told the hunter that he had performed fuel calculations and would be at reserve fuel levels upon arrival at Holy Cross.

Following the accident, the cargo was examined and weighed, revealing a load of about 520 lbs that consisted primarily of moose meat and the set of antlers. About 150 lbs of meat was found in the forward section of the belly pod; the remaining portions were secured in the rear cabin seating area. The antlers were secured to the inboard side of the right wing strut.

There was no evidence that any of the meat had shifted in flight, and the antlers remained firmly attached to the wing strut and were not interfering with any of the flight control cables.

The airplane's original maximum gross weight at the time of manufacture was 1,500 lbs. One of the alterations performed in 2013 resulted in a maximum gross weight increase to 1,750 lbs in the normal category. In 2017, Wipair Inc, STC SA00997CH was applied, which included a series of wing and airframe reinforcements that allowed for an increase in maximum gross weight to 2,000 lbs for takeoff, and 1,900 lbs for landing. According to the most recent weight and balance documentation, the airplane had a basic empty weight of 1,320.2 lbs.

Under a zero-fuel condition, using the pilot's reported weight at his last medical, along with the weight of the cargo measured at the accident site, the airplane would have been within the longitudinal boundaries of the weight and balance envelope, but 27.2 lbs over the maximum takeoff weight.

Based on the pilot's statement that he had enough fuel to return to Holy Cross with reserves (a fuel quantity of about 15 gallons), the airplane would have been within the longitudinal boundaries of the weight and balance envelope, but 117.2 lbs over the maximum takeoff weight.

The owner of the airplane stated that for the outbound flight when the pilot was returning to the hunters, the left-wing fuel tank was filled to about ½ capacity, and the right ¾. The fuel

supply valve was found in the “BOTH” position at the accident site; however, due to damage to the fuel lines and resultant leakage, the lateral fuel balance could not be determined.

Carriage of Antlers

FAA Order 8400.34 outlines the FAA’s policy for authorizing the carriage of external loads on fixed-wing airplanes operating solely within the State of Alaska. This policy establishes eligibility requirements for aircraft and operators, procedures for authorization, and additional requirements for operations under Part 135. The order also provides safety recommendations for operators conducting fixed-wing external load (FWEL) operations.

Eligible aircraft must be U.S.-registered, propeller-driven airplanes type certificated under 14 *CFR* Part 23 (or predecessor regulations) in the normal, utility, or acrobatic category, with a maximum certificated takeoff weight of 12,500 lbs. External loads are classified based on whether they constitute a minor or major alteration to the aircraft.

Minor alterations are defined as external loads that are small, lightweight, and temporarily attached and may be carried under a Standard Airworthiness Certificate without major modifications.

Major alterations cover loads requiring permanent fixtures or significant modifications. They require approval via either a Type Certificate (TC), STC, or a Special Airworthiness Certificate in the restricted category for the special purpose of Alaskan FWELs.

The order defines antlers as an item that would be considered a major alteration. There was no evidence in the airplane’s FAA airworthiness or maintenance records to indicate it had been approved for such an alteration.

The order provides multiple warnings regarding how external loads can affect the airplane’s handling characteristics, including increased asymmetric drag, undesirable airflow turbulence, and reduced flight control effectiveness.

Regarding antlers, the order included load-specific guidance, stating:

The carriage of antlers may be challenging because of their shape….Moose antlers are particularly heavy and, while they can be attached to the wing struts, the extra weight is a consideration. Flight with heavy antlers in turbulent air or during a hard landing will impose additional loads…It has been reported that, on some airplanes, antlers secured to the wing struts can cause a significant air flow disturbance to the tail surfaces. Antlers can also cause a significant amount of drag, which reduces airspeed, which should be considered in flight planning.

Administrative Information

Investigator In Charge (IIC):	Simpson, Eliott
Additional Participating Persons:	Heidi Kemner; FAA AVP-110 David Harsanyi; Lycoming Engines Jonathon Hirsch; Piper
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Last Revision Date:	
Investigation Class:	Class 2
Note:	
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=193053