Aviation Investigation Final Report

Location:	Lady Lake, Florida	**Accident Number:**	ERA19FA265
Date & Time:	September 6, 2019, 13:12 Local	**Registration:**	N767FS
Aircraft:	Vans RV-12	**Aircraft Damage:**	Destroyed
Defining Event:	Loss of control in flight	**Injuries:**	1 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The pilot departed with the intent of remaining in the airport traffic pattern. Automatic Dependent Surveillance-Broadcast (ADS-B) data indicated that the airplane departed and climbed to an altitude of about 1,000 ft above ground level. Near the end of the downwind leg, the airplane entered a brief 50-ft climb, followed by a rapid descent to impact with the ground.

Examination of the engine and airframe revealed no evidence of any preimpact mechanical malfunctions that would have precluded normal operation. Examination of the canopy roll bar and the tip-up canopy bow, which are connected in flight when the canopy is latched, indicated that they deformed in a dissimilar manner at impact. The roll bar and canopy bow were located about 12 ft apart at the accident site, and there was little damage to the handle and latch block, indicating that the canopy was likely not latched at the time of impact. Examination of the canopy and latch handle revealed that the handle and washers did not match any of the manufacturer's drawings. The kit manufacturer issued a service letter about 3 years before the accident advising that, in the event of an inflight opening of a forward opening, tip-up canopy, the airplane would "most likely pitch down abruptly."

The pilot had recently modified the latch on the airplane's tip-up canopy. The pilot had purchased a latch replacement kit from the airplane manufacturer; however, only the handle from the new latch kit was installed at the time of the accident, and additional washers that were not part of the kit had been added, likely to compensate for the longer dimensions of the new handle assembly. Whether full engagement of the latching mechanism could be achieved in this configuration could not be determined. Additionally, it could not be determined whether the pilot departed with the canopy unlatched or it became unlatched in flight, but it is likely that when the pilot reduced engine power to begin a descent for landing, the canopy opened enough to affect the airplane's pitch control, resulting in a subsequent abrupt descent and impact with terrain.

Probable Cause and Findings

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

The pilot's loss of pitch control due to the in-flight opening of the canopy for reasons that could not be determined.

Findings

Aircraft	Pitch control - Attain/maintain not possible
Aircraft	Flight compartment windows - Unintentional use/operation
Not determined	(general) - Unknown/Not determined

Factual Information

History of Flight

Approach-VFR pattern downwind	Inflight upset
Approach-VFR pattern downwind	Loss of control in flight (Defining event)
Uncontrolled descent	Collision with terr/obj (non-CFIT)

On September 6, 2019, at 1312 eastern daylight time, a Vans Aircraft Inc. RV-12 airplane, N767FS, was destroyed when it impacted terrain in Lady Lake, Florida. The pilot was fatally injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

According to two pilots and one pilot/mechanic who were scheduled to practice a formation flight with the accident pilot, the accident pilot stated that he was unable to start his airplane's engine before the flight. The three pilots flew for about 45 minutes and returned to Love Field Airport (97FL), Weirsdale, Florida, to debrief. The accident pilot joined them at the debrief and stated that he had likely flooded his engine, and the group went to his hangar to assist him. After cleaning and reinserting some spark plugs, the engine started on the first attempt. The mechanic asked the pilot to perform an ignition check and a full static rpm check, and the engine responded appropriately. One of the group noted that the pilot's response to this request seemed unusually slow, and it concerned him since he believed he had been in the heat for at least an hour. The mechanic then asked the pilot to turn off the engine, then restart it. After a normal engine start, the pilot stated that he would fly the airplane around the airport traffic pattern once. The group left him to replace the engine cowling, which they estimated took 30 minutes. One of the pilots observed the airplane taxi and take off and noted that the engine "sounded good" as the airplane departed runway 27 and began a left turn. The mechanic reported that he heard the accident pilot perform an engine run-up before takeoff.

Automatic Dependent Surveillance-Broadcast (ADS-B) data obtained from the Federal Aviation Administration (FAA) indicated that the airplane departed runway 27 and climbed to an altitude of about 1,000 ft above ground level in an enlarged left traffic pattern. Near the end of the downwind leg, the data indicated a brief 50-ft climb followed by a rapid descent to the ground, while the flight path remained consistent on a downwind leg for runway 27.

Pilot Information

Certificate:	Commercial	**Age:**	83,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	5-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	Yes
Medical Certification:	BasicMed Unknown	**Last FAA Medical Exam:**	June 1, 2017
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	November 8, 2017
Flight Time:	(Estimated) 10075 hours (Total, all aircraft), 102 hours (Total, this make and model)		

The pilot held a commercial pilot certificate with ratings for airplane single- and multi-engine land and instrument airplane. The pilot was operating under the provisions of BasicMed and his most recent physical examination was completed on June 1, 2017. On a 2018 aviation insurance application, the pilot reported 10,075 total hours of flight experience, with 90 hours in the accident airplane make and model. Review of his logbook revealed that he had accrued 12.2 hours in the accident airplane since his most recent flight review on November 8, 2017.

Aircraft and Owner/Operator Information

Aircraft Make:	Vans	**Registration:**	N767FS
Model/Series:	RV-12 No Series	**Aircraft Category:**	Airplane
Year of Manufacture:	2010	**Amateur Built:**	Yes
Airworthiness Certificate:	Experimental light sport (Special)	**Serial Number:**	120053
Landing Gear Type:	Tricycle	**Seats:**	2
Date/Type of Last Inspection:	July 1, 2019 Condition	**Certified Max Gross Wt.:**	1320 lbs
Time Since Last Inspection:	0 Hrs	**Engines:**	Reciprocating
Airframe Total Time:	123.8 Hrs as of last inspection	**Engine Manufacturer:**	Rotax
ELT:		**Engine Model/Series:**	912ULS
Registered Owner:	On file	**Rated Power:**	100 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

The airplane was built from a kit manufactured by Van's Aircraft Inc. and was issued an experimental light sport airworthiness certificate on August 10, 2010. FAA records indicated that the pilot purchased the airplane in 2013. The most recent condition inspection was completed on July 1, 2019, at which time the airplane had accrued 123.8 total hours.

The airplane was equipped with a forward-hinged, tip-up canopy with a locking mechanism. The mechanism was a handle attached near the center and at the rear of the canopy frame. Once closed, the handle was turned 90° so that a tang on the end of the handle extended under the adjacent fuselage roll bar frame, where the tang was retained under a latch block. This mechanism was the original latch design. When the canopy was opened, it moved up and forward (toward the front of the airplane) about 90° vertical.

Witnesses stated that the canopy handle latch had become bent, and the pilot had recently purchased and installed a new latch. Van's Aircraft records show that the pilot purchased the new latch on August 1, 2019.

The kit manufacturer supplied an excerpt from the Pilot's Operating Handbook from the closest available revision to the one sent with the kit to the builder. The handbook's before takeoff checklist, in part, stated, "Canopy – CHECK Latched."

A canopy-open warning system was developed by the kit manufacturer; however, the warning system was not compatible with the electronic flight instrument system in the accident airplane and was not installed on the accident airplane.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	LEE,759 ft msl	**Distance from Accident Site:**	8 Nautical Miles
Observation Time:	16:53 Local	**Direction from Accident Site:**	157°
Lowest Cloud Condition:	Few / 4100 ft AGL	**Visibility**	10 miles
Lowest Ceiling:		**Visibility (RVR):**	
Wind Speed/Gusts:	6 knots /	**Turbulence Type Forecast/Actual:**	Unknown / Unknown
Wind Direction:	270°	**Turbulence Severity Forecast/Actual:**	N/A / N/A
Altimeter Setting:	29.9 inches Hg	**Temperature/Dew Point:**	33°C / 22°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Lady Lake, FL (97FL)	**Type of Flight Plan Filed:**	None
Destination:	Lady Lake, FL (97FL)	**Type of Clearance:**	None
Departure Time:	13:10 Local	**Type of Airspace:**	Class G

Airport Information

Airport:	Love Field 97FL	**Runway Surface Type:**	Grass/turf
Airport Elevation:	80 ft msl	**Runway Surface Condition:**	Dry;Vegetation
Runway Used:	27	**IFR Approach:**	None
Runway Length/Width:	2500 ft / 100 ft	**VFR Approach/Landing:**	Traffic pattern

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:		**Aircraft Fire:**	On-ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal	**Latitude, Longitude:**	28.944999,-81.869163

The airplane impacted a grass field in a near-vertical, nose down attitude about 1.8 nautical miles and 134° from the departure end of runway 27. All major components of the airplane were present at the accident site. The airplane was significantly fragmented and partially consumed by a postcrash fire. Two linear ground scars, consistent with the length of each wing, radiated from the center of the wreckage. The debris field extended about 120 ft from the main wreckage on a heading of about 80° and was surrounded by an area of burned grass about 200 ft long by 150 ft wide.

The engine and cockpit area were found in an impact crater about 2 ft deep. Both wings were crushed aft from the leading edge against the main spar, and from the trailing edge forward to the main spar. The right flaperon was impact and fire damaged, and the inboard half was separated from the wing. The left flaperon was impact and fire damaged and completely separated from the wing. The fuselage forward of the stabilator was severely fragmented and partially fire damaged. The stabilator, vertical stabilizer, and rudder were separated from the aft fuselage. The stabilator was largely intact, with most of the fire and impact damage near its center. The stabilator spar was fractured at midspan. The pitch trim tab remained attached to the stabilator; however, the input control rod and attachment bracket were fractured and separated from the trim tab. The rudder remained attached to the vertical stabilizer; it was damaged and the lower 4 inches of the trailing edge was bent toward the right. Flight control continuity was established from the stabilator and the rudder from the control surface to the cockpit controls. Flaperon control continuity could not be established due to impact and fire damage. Control push-pull rod ends remained attached at the main cockpit control tube, and on the flaperon input control tubes. The fuel selector valve was not located. The electric fuel boost pump was sooted and thermally damaged. The nose landing gear was separated from the airplane and found near the wing ground scars. The roll bar and canopy bow were located about 12 ft apart.

The propeller hub separated from the engine, and both blades separated from the hub. The engine would

not rotate by hand. A borescope inspection of all four cylinders revealed normal coloration and condition of the piston tops, cylinder walls, and valves. All rocker arms and valve spring assemblies remained intact and were undamaged. The gascolator was breached, empty of fuel, and contained a small amount of debris in the filter screen. The inside of the gascolator bowl was sooted. Both carburetors were thermally damaged and separated from the engine and found hanging by their control cables. Each throttle control cable remained attached to its respective control arm on the carburetor. Both carburetor bowls were thermally destroyed, and the floats were not present. Both slides remained in place but were unable to move. The sparkplug electrodes and insulators appeared normal and were clean, except for the No. 2 top spark plug, which had white deposits on the bottom of the electrode. The Nos. 1 and 3 bottom sparkplugs were slightly wet with oil. None of the intake or exhaust manifold tubing remained attached to the intake and exhaust ports of the engine. The muffler remained partially attached and the springs were in place, with the case, inlet and exit tubes partially damaged. The engine driven fuel pump remained attached to the engine case; however, the fittings were separated, and the ports were partially fractured. The pump was removed and could be rotated by hand with some binding. A small amount of debris was found inside the pump, primarily on the side exposed by the fractured fitting port.

Examination of the elevator trim actuator control assembly at the NTSB Materials Laboratory, Washington, D.C., revealed that fracture surfaces on the control rod were on slant angles consistent with ductile overstress fracture, and the rod was deformed adjacent to the fracture consistent with bending deformation. The bending deformation at the fracture and the mid-point were in opposite directions, consistent with a buckling failure under compression loading.

Follow-up examination of the metal canopy roll bar frames and latching mechanism revealed that the fixed portion of the canopy bow was separated at the midspan attachment point. The left side of the roll bar was impact twisted 180° while the right side of the roll bar displayed little deformation in shape. The latch block remained affixed to the left side of the roll bar. The canopy bow that connected to the fixed portion of the canopy at the latching mechanism was fractured at the handle but displayed no twisting. The latch handle was intact and slightly bent in the portion of the handle opposite where it latched over the latch block.

Examination of the canopy and latch handle revealed that, although the pilot had purchased the latch replacement kit, only the handle from the new latch kit was installed, and additional washers were added that were not a part of the replacement kit. On the new latch, the tube that protruded through the canopy was ¼ inch longer than the original handle tube. (see Figure 1.) The pre-impact functionality of the modified latching mechanism could not be established.

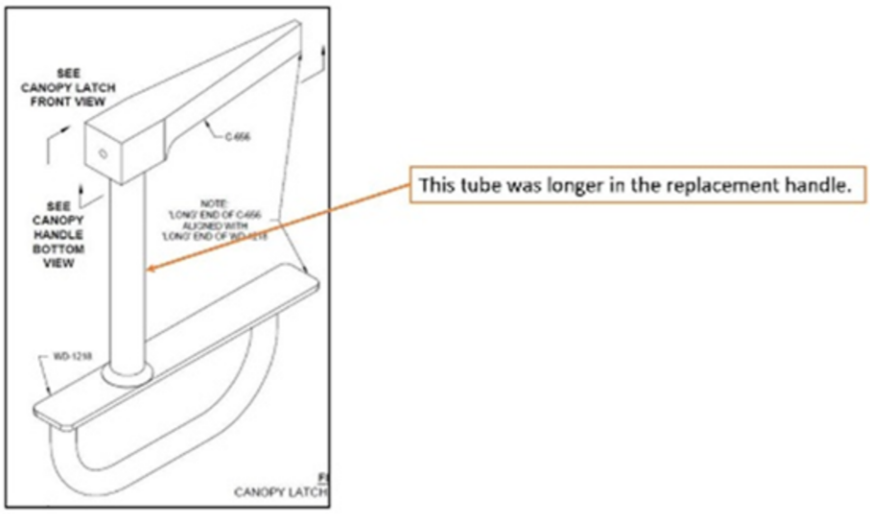

Figure 1. Original Latch Handle Design

Medical and Pathological Information

The Medical Examiner Districts 5 & 24 Office, Leesburg, Florida, performed the autopsy of the pilot on December 7, 2019. The autopsy report indicated that the pilot died as a result of multiple blunt force injuries.

The FAA's Forensic Sciences Research Laboratory performed toxicology testing on submitted specimens from the pilot. The test detected atorvastatin in the liver and 21 mg/dL of ethanol in muscle tissue. According to the FAA Forensic Toxicology Drug Information, atorvastatin is a prescription medication used to reduce blood cholesterol. It is not considered impairing. Ethanol may be produced in body tissues by microbial activity after death.

Additional Information

In November 2016, Van's Aircraft Inc. issued a service letter to builders and operators highlighting the consequences of a tip-up canopy opening in-flight. The letter recommended inspecting the canopy locking mechanism to confirm that it operated as designed and to ensure that the mechanism fully engaged when closed. It stated that, "if the canopy does become unlatched in flight, the aircraft will most likely pitch nose down abruptly. The severity of the pitching moment can depend on speed, attitude and weight and balance."

Canopy Open Inflight Events

The NTSB has investigated similar accidents involving tip-up canopies.

CEN13LA340: The pilot of an RV-12 airplane reported that, as the airplane became airborne after takeoff, the tip-up canopy popped open about 3 inches. The pilot grabbed the canopy and simultaneously lowered the airplane's nose and partially reduced power in an attempt to land on the remaining runway. As the airplane pitched down, the pilot lost grip of the canopy and it opened to the full vertical position. This reportedly caused the nose of the aircraft to pitch over further and, when the pilot applied back pressure on the control stick, there was no response from the elevator. The pilot also reported that there was no response from the rudder. The pilot was able to level the wings before landing hard. Van's stated that they had not conducted any testing on the aerodynamic effects of the RV-12 canopy opening in flight; therefore, they could not contest the pilot's claims that the canopy opened to the full vertical position.

CEN14FA306: A witness reported observing the RV-6 "rocking back and forth" before the "nose went down" and then seeing two objects come off the airplane when it entered a descent. Another witness reported hearing engine noise before observing the airplane enter a steep nose-down descent. The airplane impacted a house and was destroyed by a postimpact fire. The two objects that the witness observed coming off the RV-6, which were a headset and PVC material, were later located near the accident site and did not exhibit thermal damage or soot. The exit of the two objects from the airplane's interior indicated that the canopy likely opened in flight, which resulted in the loss of pitch control. Fire damage precluded examination of the airplane's canopy and systems; therefore, the reason for the canopy opening in flight could not be determined.

The Australian Transport Safety Bureau (ATSB) investigated an accident involving a tip-up canopy (AO-2014-164). Shortly after reaching a cruise altitude of 2,900 ft, the RV-6A aircraft descended to 2,500 ft. After that time, no further air traffic control radar returns were received from the aircraft. The airplane descended rapidly, and a witness reported observing objects falling from the aircraft. The airplane subsequently collided with the ground. The ATSB identified a safety issue regarding the potential for the in-flight opening of a tip-up, forward-hinged canopy to result in a significant pitch down tendency in a number of Van's Aircraft Inc. models that may affect aircraft control.

Administrative Information

Investigator In Charge (IIC):	Spencer, Lynn
Additional Participating Persons:	Ronnie L Faulkner; FAA/FSDO; Orlando, FL Mitch Lock; Van's Aircraft; Aurora, OR
Original Publish Date:	January 20, 2022
Last Revision Date:	
Investigation Class:	Class 3
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=100204