Aviation Investigation Final Report

Location:	Payette, Idaho	**Accident Number:**	WPR17FA128
Date & Time:	June 17, 2017, 11:45 Local	**Registration:**	N177TT
Aircraft:	PRESCOT E. WILKIE RV-3	**Aircraft Damage:**	Destroyed
Defining Event:	Aircraft structural failure	**Injuries:**	1 Fatal
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The airline transport pilot purchased the experimental, amateur-built airplane not fully assembled, and he subsequently completed the assembly. The Federal Aviation Administration (FAA) subsequently granted the airplane an airworthiness certificate in the experimental category. About 7 years later, the airplane was disassembled and shipped to the pilot's new home. The accident flight was the airplane's first flight after being reassembled.

A review of a video of the accident sequence showed that the left wing failed during a relatively benign maneuver as the airplane was descending. Several seconds earlier, the pilot had performed a high-speed, low-altitude pass over the runway with a sharp pullup. This maneuver would have produced much higher wing loads than those at the time of wing failure, and it is possible that the pull-up maneuver caused a localized buckling failure of the left-wing upper spar cap that further reduced its strength.

The accident airplane model has a history of in-flight wing separations. After a series of accidents, the kit manufacturer conducted extensive testing and provided owners/builders with suggested modifications for the airplane. The testing showed that the optional bonding of the spar caps together as a unit during assembly provided better resistance to buckling. The testing also showed that the initiating failure of the RV-3 wing was the buckling of the upper spar cap. The first modification to the RV-3 wing (Change Notice [CN] -1 issued in 1984) involved reinforcing the rear spar attachment point and strengthening the wing root rib. The second modification to the RV-3 wing (CN-2-I or CN-2-II, issued in 1996) involved the addition of stiffening angles to the main spar, which it deemed necessary for aerobatic strength.

Examination of the accident airplane revealed that the wing spar and carry-through had been modified by the addition of 0.125-inch-thick doublers on both the rear spar and center section. However, the rear spar attachment point was still a single-shear configuration. The wing root rib on both wings was 0.020 inch thick and had not been modified. This evidence indicates that the airplane had not been modified in

accordance with CN-1. The FAA prohibited aerobatic operation of the RV-3 without the CN-1 modification.

The accident airplane was equipped with a Type I spar in accordance with its original design. No adhesive was found between the spar cap layers on the right or left wings. No modifications were made to the spar from its original design. Therefore, the accident airplane was not modified in accordance with CN-2-I.

The left and right wing attachment joint at the center of the airplane should have NAS 1304 or NAS 1305 bolts installed per the assembly instructions. Only three bolts of 10 bolts in the upper wing fittings and four bolts of 10 bolts in the lower wing fittings were NAS bolts. The type of bolt in two holes in the lower wing fittings could not be determined. The remaining bolts in the upper and lower wing fittings were AN5 bolts, which have a lower strength rating than the NAS bolts per the specifications. Most of the hardware installed in the upper and lower wing fittings was incorrect, and it was installed incorrectly, which significantly reduced the wing's tension capabilities. In addition, based on the condition of the left wing in the root area, it is likely that three bolts (those for upper hole 11 and upper and lower holes 10 and 11) were not installed in the left main spar caps when the airplane was reassembled.

Furthermore, examination of the left and right spar caps in the wing joint area revealed that the left upper spar cap was missing a 0.040-inch-thick shim, which would cause a mismatch in the spar cap stackup dimension at the airplane centerline where the wing fittings are installed. The mismatch would cause slightly abnormal loads in the wing fitting.

Lastly, no adhesive was found between the spar cap layers; therefore, the increased buckling strength that it may have provided was not achieved.

In summary, the omission of the bolts would produce a decrease in the buckling stability of the spar caps due to the lack of a clamping force holding the spar cap layers together. Adjacent to the missing bolts, the incorrect bolts were installed that had a significantly reduced tension capability further decreasing the buckling stability of the spar cap. Testing showed that the critical area of a correctly assembled RV-3 wing was the upper spar cap in the wing root area and the initiating failure was buckling of the upper spar cap. The wings on the accident airplane had further reduced strength due to the lack of adhesive, the missing bolts in the spar caps, and the incorrect bolts installed in the spar caps. The splaying and S-bending of the left wing upper spar cap layers around the fracture area is indicative of compressive buckling. The left wing failure likely initiated with a buckling failure of the upper spar cap in the wing root area.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The in-flight failure of the left wing due to the owner's use of improper hardware and his improper assembly of the airplane, which reduced the strength of the left wing and resulted in its subsequent failure following a sharp pullup maneuver.

Findings

Aircraft	Spar (on wing) - Failure
Aircraft	Spar (on wing) - Capability exceeded
Aircraft	Spar (on wing) - Incorrect service/maintenance
Personnel issues	Fabrication - Owner/builder
Personnel issues	Installation - Owner/builder
Personnel issues	Decision making/judgment - Owner/builder
Aircraft	Fasteners - Incorrect use/operation
Aircraft	Fasteners - Not installed/available

Factual Information

History of Flight

Maneuvering-aerobatics	Aircraft structural failure (Defining event)
Maneuvering-aerobatics	Part(s) separation from AC
Maneuvering-aerobatics	Loss of control in flight
Uncontrolled descent	Collision with terr/obj (non-CFIT)

On June 17, 2017, about 1145 mountain daylight time, an experimental, amateur-built Vans RV-3 airplane, N177TT, impacted terrain following an in-flight separation of the left wing while maneuvering near Payette Municipal Airport (S75), Payette, Idaho. The airline transport pilot sustained fatal injuries, and the airplane was destroyed. The airplane was registered to and was being operated by the pilot as a Title 14 *Code of Federal Regulations* Part 91 personal flight. Visual meteorological conditions prevailed, and no flight plan had been filed for the local flight, which departed S75 about 1140.

A review of a video of the accident sequence revealed that the airplane departed runway 31 and then made a shallow ascending right turn to the north. Seconds later, the airplane made a sweeping left descending turn to align with runway 13. The pilot proceeded to make a high-speed, low-altitude pass over the runway, during which the airplane descended to less than 20 ft above ground level (agl), before the pilot executed a sharp pull-up maneuver at the departure end of the runway. After climbing the airplane several hundred feet, the pilot initiated a left turn to a northerly heading. Several seconds later, the airplane entered a descent, and the left wing separated from the airplane. The airplane impacted flat farmland about 3,025 ft northeast of the departure end of runway 31.

Pilot Information

Certificate:	Airline transport; Flight instructor	**Age:**	74,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Helicopter	**Second Pilot Present:**	No
Instructor Rating(s):	Airplane single-engine; Helicopter	**Toxicology Performed:**	Yes
Medical Certification:	Class 2 With waivers/limitations	**Last FAA Medical Exam:**	April 27, 2016
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:	16700 hours (Total, all aircraft)		

The 74-year-old pilot held an airline transport pilot certificate with airplane single engine land, airplane multiengine land, and helicopter ratings. He also held a flight instructor certificate for airplane single engine and helicopter. The pilot was issued a Federal Aviation Administration (FAA) second-class

medical certificate on April 27, 2016, with the restriction that he "must wear corrective lenses." At that time, he reported 16,700 total hours of flight experience, about 20 hours of which were in the preceding 6 months.

The pilot also held an FAA mechanic certificate with airframe and powerplant ratings and an inspection authorization.

Aircraft and Owner/Operator Information

Aircraft Make:	PRESCOT E. WILKIE	**Registration:**	N177TT
Model/Series:	RV-3	**Aircraft Category:**	Airplane
Year of Manufacture:	2006	**Amateur Built:**	Yes
Airworthiness Certificate:	Experimental (Special)	**Serial Number:**	10508
Landing Gear Type:	Tailwheel	**Seats:**	1
Date/Type of Last Inspection:	July 1, 2010 Continuous airworthiness	**Certified Max Gross Wt.:**	2952 lbs
Time Since Last Inspection:		**Engines:**	1 Reciprocating
Airframe Total Time:		**Engine Manufacturer:**	Lycoming
ELT:	Not installed	**Engine Model/Series:**	O-235-N2C
Registered Owner:		**Rated Power:**	118 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

The single-seat, single-engine, low-wing, kit airplane was a metal monocoque construction, had a conventional tail, and was equipped with fixed conventional landing gear. The airplane was powered by a four-cylinder Lycoming O-235 engine and was equipped with a two-bladed fixed-pitch wooden propeller. The airplane was modified from a standard RV-3 to have an open cockpit configuration. According to Vans Aircraft, the kit manufacturer, the accident airplane was sold as a kit in 1978.

Most of the airplane was assembled by at least three previous owners. The accident pilot bought the airplane not fully assembled in 1998, and he completed assembling it in 2007. The airplane was granted an FAA airworthiness certificate in the experimental category on May 2, 2007. Standard operating limitations, including requiring an annual condition inspection and prohibiting aerobatic flight, were issued in conjunction with the airworthiness certificate.
In 2014, the airplane was disassembled and shipped in a container from Hawaii to Idaho. The pilot reassembled the airplane in a hangar at S75 before the accident flight. The accident flight was the first flight after the airplane had been reassembled.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KONO,2193 ft msl	**Distance from Accident Site:**	7 Nautical Miles
Observation Time:	11:53 Local	**Direction from Accident Site:**	214°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	/	**Turbulence Type Forecast/Actual:**	/ None
Wind Direction:		**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.13 inches Hg	**Temperature/Dew Point:**	22°C / 5°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Payette, ID (S75)	**Type of Flight Plan Filed:**	None
Destination:	Payette, ID (S75)	**Type of Clearance:**	None
Departure Time:	11:40 Local	**Type of Airspace:**	Class G

At 1153, the recorded weather observation at Ontario Municipal Airport, Ontario, Oregon, located 7 nautical miles northeast of the accident site, reported calm winds, visibility 10 statute miles, sky clear, temperature 22°C, dew point 5°C, and an altimeter setting of 30.14 inches of mercury. The density altitude at the time of the accident was about 2,899 ft.

Airport Information

Airport:	Payette S75	**Runway Surface Type:**	
Airport Elevation:	2228 ft msl	**Runway Surface Condition:**	
Runway Used:		**IFR Approach:**	None
Runway Length/Width:		**VFR Approach/Landing:**	None

S75 is publicly owned and operated by the City of Payette. The airport is not equipped with an operating control tower. Runway 13/31 is 3,000 ft by 50 ft with displaced thresholds at both ends. The airport elevation is 2,228 ft mean sea level.

Wreckage and Impact Information

Crew Injuries:	1 Fatal	**Aircraft Damage:**	Destroyed
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal	**Latitude, Longitude:**	44.102779,-116.896942(est)

The main wreckage included the fuselage, engine, empennage, and right wing. The left wing was located about 1,450 ft southeast of the main wreckage, and the left flap was located about 1,150 ft south-southeast of the main wreckage. There was no evidence of a postcrash fire. The wreckage was crushed and deformed consistent with impact. The vertical stabilizer, rudder, horizontal stabilizer, and elevators remained attached to the empennage, and they all displayed extensive impact damage. Rudder control continuity was established from the surface to the rudder pedals.

Control continuity was established from the elevators to the control horn in the empennage, and the elevators moved freely when actuated by hand. The aft elevator control tube was bent in multiple places and fractured at the forward end. The forward elevator control tube was fractured at the aft rod end about 2 ft aft of the control stick. All control tube separations had a dull, grainy appearance consistent with overstress separation.

The right wing had extensive crushing damage and fragmentation. The right main wing spar was mostly intact but damaged, and it was deformed from wing station (WS) 0 to the right-wing tip. The right aileron control tube was separated in multiple places, and the right aileron remained attached to the wing. The aileron control tube fracture surfaces had a dull, grainy appearance consistent with overstress separation. The right flap remained attached to the wing. Right aileron control continuity was established from the fracture points to the right aileron and the control stick.

The left wing separated from the airplane in the wing root area during the accident sequence. The left aileron remained attached to the wing, and the left flap was separated. The left-wing root rib and the inboard portion of the wing were buckled and deformed upward, consistent with wing separation in an upward direction. The left-wing root rib was 0.020-inch thick, and no stiffeners or additional angles were installed on it. No additional wing ribs were installed in the wing walk area outboard of the root rib. The left aileron control tube was fractured at the wing separation point. The aileron control tube fracture surfaces had a dull, grainy appearance consistent with overstress separation. Left aileron control continuity was established from the fracture point to the left aileron and control stick.

The left main wing spar was fractured in the left-wing root area and damaged adjacent to the fracture point. The outboard portion of the left main wing spar was intact and installed in the left wing. The inboard portion of the left main wing spar remained attached to the right main wing spar at WS 0. All 4 four wing fittings were intact and installed at the center portion of the main spar. The wing bolts were numbered starting at 1 adjacent to WS 0 on both the left and right main wing spars and ending at 15.The right upper spar cap at WS 0, from forward to aft, consisted of a 0.250-inch-thick steel wing fitting, seven 0.125-inch-thick aluminum bars, a 0.040-inch-thick aluminum shim, a 0.125-inch-thick aluminum web, a 0.040-inch-thick aluminum aft fuselage bulkhead, and a 0.250-inch-thick steel wing fitting. The

0.040-inch-thick forward fuselage bulkhead only engaged holes 9 and 10 on the right upper spar cap. Bolts were installed in holes 1 to 10 and 12 to 15 with the heads of the bolts on the forward side of the spar cap. Washers were installed underneath the bolt heads in holes 3, 5 to 10, and 13 to 15. No bolt was installed in hole 11. The head markings on the bolts installed in holes 1 to 4 indicated that they were AN5-X(A) bolts. The aft side of the spar cap was inaccessible, so the grip length, drilling of the shank, and type of nut or washer could not be determined. Hole 5 had an NAS1304-27H bolt installed. The aft side of the spar cap was inaccessible, so the drilling of the shank and the type of nut or washer could not be determined. Holes 6 to 10 and hole 12 had AN3HX bolts installed with L, X, and SC marked on the head. Holes 13 to 15 had AN3-XA bolts installed with C, X, and S marked on the head. Self-locking nuts with no washers were installed on the bolts in holes 6 to 10 and 12 to 15. An L-angle stiffener was installed between the upper and lower spar caps at hole 12. No evidence of adhesive was found between the spar cap layers.

The right lower spar cap at WS 0, from forward to aft, consisted of a 0.250-inch- thick steel wing fitting, a 0.040-inch thick aluminum forward fuselage bulkhead, seven 0.125-inch- thick aluminum bars, a 0.040-inch- thick aluminum shim, a 0.125-inch- thick aluminum web, a 0.040-inch- thick aluminum aft fuselage bulkhead, and a 0.250-inch- thick steel wing fitting. Bolts were installed in holes 1 to 9 and 12 to 15. The heads of the bolts were on the forward side of the spar cap except for hole 4, which had the head on the aft side. Washers were installed underneath the bolt heads in holes 2, 3, 5 to 9, and 13- to 15. No bolts were installed in holes 10 or 11, and there was no hole drilled in the forward fuselage bulkhead at the hole 10 location. Holes 1-3 had AN5-X(A) bolts installed based on the head markings. The aft side of the spar cap was inaccessible, so the type of bolt in hole 4 and the grip length, drilling of the shank, and type of nut or washer in the other locations could not be determined. The bolt in hole 4 had a washer and self-locking nut installed. Hole 5 had a NAS1304-27H bolt installed. The aft side of the spar cap was inaccessible, so the drilling of the shank and type of nut or washer could not be determined. Holes 6-9 and hole 12 had AN3HX bolts installed with L, X, and SC marked on the head. Holes 13-15 had AN3-XA bolts installed with C, X, and S marked on the head. Self-locking nuts with no washers were installed on the bolts in holes 6-9 and 12-15. There was an L-angle stiffener installed between the upper and lower spar caps at hole 12. There was no evidence of adhesive between the spar cap layers. There was some evidence of corrosion between the right lower spar cap layers.

The left upper spar cap at WS 0, from forward to aft, consisted of a 0.250-inch thick steel wing fitting, seven 0.125-inch thick aluminum bars, a 0.125-inch thick aluminum web, a 0.040-inch thick aluminum aft fuselage bulkhead, and a 0.250-inch thick steel wing fitting. There was no 0.040-inch thick shim installed between spar cap layer 7 and the 0.125-inch thick aluminum web. The 0.040-inch thick forward fuselage bulkhead only engaged holes 9 and 10 on the left upper spar cap. Bolts were installed in holes 1-10 with the heads of the bolts on the forward side of the spar cap. Washers were installed underneath the bolt heads in holes 1-10. There were no bolts installed in holes 11-15 in the area where the left upper spar cap fractured and there was no damage to the holes. None of the missing bolts were recovered. Holes 1, 2, and 4 had AN5-X(A) bolts installed based on the head markings. The aft side of the spar cap was inaccessible, so the grip length, drilling of the shank, and type of nut or washer could not be determined. Hole 3 had a NAS1305-26H bolt installed and hole 5 had a NAS1304-27H bolt installed. The aft side of the spar cap was inaccessible, so the drilling of the shank and type of nut or washer could not be determined. Holes 6-10 had AN3HX bolts installed with L, X, and SC marked on the head. Self-locking nuts with no washers were installed on the bolts in holes 6-10. The L-angle stiffener normally installed between the upper and lower spar caps at hole 12 was separated and remained attached to the

wing root rib. The upper hole in the stiffener was elongated. There was no evidence of adhesive between the spar cap layers. There was evidence of substantial corrosion between the left upper spar cap layers. The spar cap layer 1 was fractured about WS 17.25 through hole 15 and the outboard 3 inches was not recovered. Spar cap layers 2-7 were fractured about WS 16 through hole 14 and the fractures were matched with spar cap layers 2-7 on the left outboard wing. The upper spar cap layers were splayed open and exhibited S-bending in the area of fracture and the rivets through the spar cap were popped from about WS 17.5 to WS 22.5. The 0.125-inch thick aluminum web was intact to its production edge about WS 18. All the fractures exhibited a dull, grainy appearance consistent with overstress separation.

The left lower spar cap at WS 0, from forward to aft, consisted of a 0.250-inch thick steel wing fitting, a 0.040-inch thick aluminum forward fuselage bulkhead, seven 0.125-inch thick aluminum bars, a 0.040-inch thick aluminum shim, a 0.125-inch thick aluminum web, a 0.040-inch thick aluminum aft fuselage bulkhead, and a 0.250-inch thick steel wing fitting. Bolts were installed in holes 1-9. The heads of the bolts were on the forward side of the spar cap except for hole 4 which had the head on the aft side. Washers were installed underneath the bolt heads in holes 1-3 and 5-9. There were no bolts installed in holes 10-15 in the area where the left lower spar cap fractured and there was no damage to the holes. None of the missing bolts were recovered. There was no hole drilled in the forward fuselage bulkhead at the hole 10 location. Holes 1-3 had AN5-X(A) bolts installed based on the head markings. The aft side of the spar cap was inaccessible, so the type of bolt in hole 4 and the grip length, drilling of the shank, and type of nut or washer in the other locations could not be determined. The bolt in hole 4 had a washer and self-locking nut installed. Hole 5 had a NAS1304-27H bolt installed. The aft side of the spar cap was inaccessible, so the drilling of the shank and type of nut or washer could not be determined. Holes 6-9 had AN3HX bolts installed with L, X, and SC marked on the head. Self-locking nuts with no washers were installed on the bolts in holes 6, 9, and 10. The L-angle stiffener normally installed between the upper and lower spar caps at hole 12 was separated and remained attached to the wing root rib. There was no evidence of adhesive between the spar cap layers. There was some evidence of corrosion between the left lower spar cap layers. The spar cap layer 1 was intact to the production edge at WS 20. Heads of three rivets at the outboard end were installed but the rivets were fractured. Spar cap layer 2 fractured about WS 10.5 through hole 9, layers 3-6 fractured about WS 13 through hole 11, and layer 7 fractured about WS 10.5 through hole 9. The fractures on layers 2-7 were matched with layers 2-7 on the left outboard wing. The left lower spar cap layers were splayed open and twisted and the rivets through the spar cap were popped from about WS 17.5 to WS 20. The 0.040-inch thick aluminum shim was intact to its production edge at WS 14 and the 0.125-inch thick aluminum web was intact to its production edge at WS 18. All the fractures exhibited a dull, grainy appearance consistent with overstress separation.

The bolts in holes 7, 8, and 9 were removed from the left lower spar cap and examined. There were no nuts present on bolts 7 and 8 and the bolts were fractured through the cotter pin hole in the shank. The threads around the cotter pin hole were also stripped. The self-locking nut remained installed on bolt 9 with 1-2 threads visible. Removal of the nut showed the hole in the shank of the bolt was just visible beyond the material stack up and the nut was engaged in the area of the hole as installed. Examination of several other AN3HX bolts installed on the left and right spar caps showed a similar arrangement. The hole 9 bolt was deformed and measured 1.670 inches long.

The aft spar carry-through was found intact in the main wreckage and consisted of a 0.125-inch-thick L-angle with an additional 0.125-inch-thick bar riveted to the vertical flange. The right-wing aft spar

attachment point consisted of a 0.125-inch-thick lug and a 0.125-inch-thick reinforcement plate. The right side of the aft spar carry-through remained attached to the right-wing lug, and the entire carry-through was bent aft. An AN4-6A bolt with no washers and a low-profile nut were in place in the right attachment point. The bolt in the left side of the aft spar carry through was fractured with a portion of the shank remaining in the carry through. The head was fractured from the bolt, and the nut was pulled off the threads. The hole in the left side of the aft spar carry through was elongated in an outboard direction. The left-wing aft spar attachment point was fractured from the wing and was not recovered.

Impact damage was noted throughout the engine, however, all four cylinders remained attached to the engine crankcase. A large hole was noted to the forward section of the crankcase. The hole was about 4 inches in diameter and was consistent with ground impact. The left magneto, starter, carburetor, oil cooler, and alternator separated from the engine and were found within the main wreckage. The engine case was cracked between the push rods on the No. 4 cylinder forward of the cylinder upward toward the case half. The oil sump displayed extensive ground impact damage. Postaccident examination of the engine revealed no evidence of any preimpact mechanical malfunctions or failures that would have prohibited normal operation.

Additional Information

After a series of accidents involving RV-3 in-flight wing separations, Vans conducted extensive testing. The testing showed that the initiating failure of the RV-3 wing was the buckling of the upper spar cap and that bonding the spar caps together as a unit during assembly, which was optional, provided better resistance to buckling. The first modification to the RV-3 wing (CN-1) involved strengthening the rear spar attachment points and carry through and modifying the wing root rib. The second modification to the RV-3 wing (CN-2-I or CN-2-II) involved adding stiffening angles to the main spar.

The RV-3 wing has a NACA 23012 airfoil. The original wing spar (referred to as Type I, circa 1973 to 1983) was mathematically stress analyzed to design and ultimate load limits of 6.0 and 9.0 Gs, respectively, at an aerobatic gross weight of 1,050 lbs (the nonaerobatic gross weight is 1,100 lbs). A test in 1982 verified that it met the 9 G ultimate load criteria. The spar consisted of .040-inch aluminum channel web with a buildup of seven 1/8-inch thick by 1-1/4 inch wide bars held together with 1/8-inch AN470 rivets to form the upper and lower caps. As an assembly option, an epoxy adhesive could be used to bond the seven aluminum bars together to form a single unit to facilitate drilling and riveting the unit to the spar web. (It was later discovered that the adhesive provided some interbar shear and column strength, but the bonding process can deteriorate, so it was not considered in the design as contributing to spar strength.)

On March 16, 1981, the FAA issued General Notice TWA 1/40 SVCB, which prohibited aerobatics in the RV-3. The action was permanent and could not be rescinded. Following this action, Vans issued Change Notice 1 (CN-1) to RV-3 owners and builders. Briefly, CN-1 modified the wing by reinforcing the rear spar attachment point and strengthening the wing root rib. FAA and Canadian Ministry of Transport reports on the RV-3 accidents suggested that these areas could have been the primary failure points. When CN-1 was drafted, it appeared that the only means of regaining aerobatic operating authorization would be for individual RV-3 owners to change the airplane's designation to RV-3A. Soon thereafter, the FAA issued another letter stating that RV-3 owners showing compliance with CN-1 could reapply for aerobatic operating limitations. Thus, the RV-3A designation was adopted by some builders

but does not signify any definite main spar structural distinction.

In 1984, Vans redesigned the wing spar (referred to as Type II). It incorporated five 3/16-inch thick by 1 1/4-inch wide aluminum bars held together with 3/16-inch diameter AN470 rivets. Although the primary purpose was to simplify assembly and minimize the possibility of assembly errors, the calculated bending strength was slightly increased. Further, two additional ribs were added in the root rib area to increase torsional stiffness, and the rear spar attachment was strengthened.

Despite the changes, the suggested airspeed limitations remained relatively unchanged. Vne (never exceed speed) is 210 mph. Va (maneuvering speed) is 127 mph (down from 132 mph). Vs (stall speed, clean) is 54 mph. According to Vans, because of the high ratio between Vne and Vs, the RV-3 is more susceptible to pilot-induced overstress than most contemporary light airplanes.

In 1996, an RV-3 wing with a Type I spar was again static load tested. During the tests, the wing failed below the 9.0 G load level. A review of test data revealed that the 1982 test had been performed on a wing whose spar had been assembled with the optional epoxy bonding. The 1996 test had been performed on a wing whose spar had been assembled without the epoxy adhesive. Although the epoxy adhesive had not been calculated to add any spar bending strength, it appeared to have added compression buckling strength. As a result of further static load testing on both Type I and Type II wing spars, Vans issued Change Notice 2 (CN-2-I for Type I spars and CN-2-II for Type II spars), which recommended main spar modifications which it deemed necessary for aerobatic strength. CN-2 included a detailed history, explanation, and recommendations, and was sent to all known RV-3 and RV-3A owners and builders. Vans maintained that both CN-1 and CN-2 (I or II) were necessary to achieve the aerobatic strength of the wing.

Medical and Pathological Information

No autopsy was performed.

The FAA Forensic Sciences Laboratory performed toxicological testing on specimens from the pilot. The tests were negative for ethanol and all tested drugs and their metabolites. Tests for carbon monoxide and cyanide were not performed.

Administrative Information

Investigator In Charge (IIC):	Hogenson, Dennis
Additional Participating Persons:	Dan Frandson; FAA; Boise, ID
Original Publish Date:	November 6, 2019
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=95386