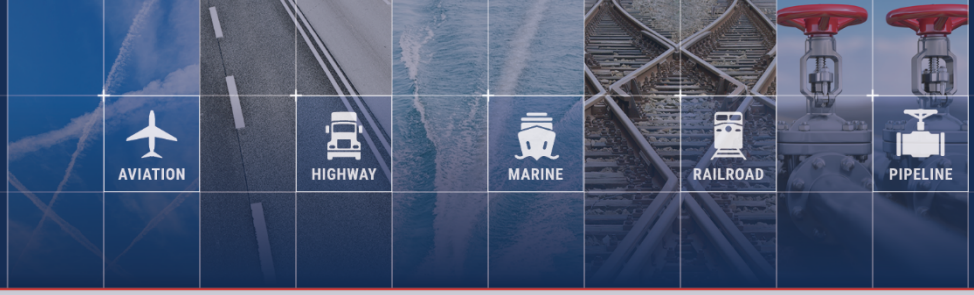

Aviation Investigation Final Report

Location:	Thonotosassa, Florida	**Accident Number:**	ERA21LA127
Date & Time:	February 9, 2021, 14:53 Local	**Registration:**	N611E
Aircraft:	Vans RV7	**Aircraft Damage:**	Substantial
Defining Event:	Fuel related	**Injuries:**	1 Minor
Flight Conducted Under:	Part 91: General aviation - Flight test		

Analysis

During the previous flight, the experimental, amateur-built airplane lost total engine power, and the pilot, who was the builder of the airplane, completed a successful forced landing with no damage to the airplane. He found that the fuel pressure adapter “t”-fitting, used to attach the fuel pressure line, had disconnected from the fuel pump elbow fitting. The automotive adapter fitting was adopted during the airplane’s construction for fitment in a confined space and did not allow for measured torque application. The pilot reattached the fitting with a modified and shortened 5/8” spanner wrench for the 11/16” b-nut. The pilot departed the forced landing site and landed successfully at his destination.

The accident flight was the airplane’s next flight. Minutes after takeoff, the airplane once again experienced a loss of fuel pressure and a total loss of engine power. During the subsequent forced landing, the pilot sustained minor injuries and the airplane was substantially damaged. Post-accident examination of the airplane revealed that the same fuel pump elbow fitting was disconnected from the adapter fitting.

Examination of the adapter revealed that its material was soft relative to materials used in Air Force-Navy (AN) standard fittings. As a result, the shoulder on the adapter body could have been deformed under the pressure of the retaining ring even when applying minimum torque values suggested for AN standard fittings made of aluminum alloys specified in military specification. This deformation may have inhibited the proper frictional resistance in the threads to prevent the nut from backing off in service. Additionally, the body of the adapter fitting tended to rotate when applying torque to the nut. If the body was not properly secured while torque was applied to the nut during field repairs, the twisting of the adapter fitting body could have produced stresses in the attached hoses in the assembly that may have worked to rotate the adapter fitting and nut in the loosening direction during operation.

Probable Cause and Findings

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

The pilot's failure to apply adequate torque on the fuel pressure line aluminum adaptor fitting, which resulted in the loosening of the adapter, a loss of fuel flow, and a total loss of engine power. Contributing to the accident was the pilot's choice of a soft aluminum automotive fitting, and the design, which required hand-tightening with a shortened, modified wrench that prevented a measured torque application.

Findings

Aircraft	Fuel - Related maintenance info
Personnel issues	Installation - Owner/builder

Factual Information

History of Flight

Enroute-cruise	Fuel related (Defining event)

On February 9, 2021, at 1453 eastern standard time, an experimental, amateur-built Vans RV7, N611E, was substantially damaged when it was involved in an accident near Thonotosassa, Florida. The private pilot sustained minor injuries. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 test flight.

The pilot, who was the builder of the airplane, was completing Phase 1 flight testing of the airplane. He stated that, two days before the accident, the airplane experienced a loss of fuel pressure and a total loss of engine power. He completed a successful forced landing uninjured, and during the subsequent inspection of the airplane, no damage was found. Examination of the engine revealed that the fuel pressure adapter “t”-fitting, used to attach the fuel pressure line, had disconnected from the fuel pump elbow fitting.

According to the pilot, the adapter fitting was adopted during the airplane’s construction for fitment in a confined space. Reattachment of the fitting was accomplished with a modified and shortened 5/8” spanner wrench for the 11/16” b-nut. The pilot departed the forced landing site and landed successfully at his destination.

Minutes after departing on the accident flight, the airplane once again experienced a loss of fuel pressure and a total loss of engine power. During the subsequent forced landing, the pilot sustained minor injuries and the airplane was substantially damaged. Post-accident examination of the airplane revealed that the same fuel pump elbow fitting was disconnected from the adapter fitting.

The airplane’s airworthiness certificate was issued January 21, 2021. According to the pilot, the first loss of engine power occurred about 3.5 total aircraft hours. The second total power loss occurred about 4.1 total aircraft hours.

A Federal Aviation Administration aviation safety inspector recovered the adapter fitting and performed some rudimentary, comparative, hand-tightened torque applications with the shortened, modified wrench, and a standard 11/16” spanner and recorded those tests.

According to the pilot, the aluminum adapter fitting attached to the steel fuel pump elbow fitting was purchased at an automotive “speed shop.”

In the pilot's NTSB Form 6120.1 Pilot/Operator Accident Report Form, the pilot stated, "Fuel line 'T' fitting disconnected from engine fuel pump fitting elbow most likely due to improper torquing."

The fitting and associated parts were examined at the NTSB Materials Laboratory. Examination and research revealed material hardness below an Air Force Navy (AN) military specification for the aluminum adapter fitting. The manufacturer of this automotive fitting stated that there was no specified torque value, but that the fitting should be tightened to a "snug" condition. Multiple sources cited a 150 to 195-inch-pound torque value for the fitting or the "flats" method (1 to 1.5 flats past finger tight). When the flats method was attempted in the lab, two to three times the torque value specified was required to rotate one flat and, once the nut was removed, the shoulder of the adaptor body displayed damage. Further, the body of the adaptor fitting rotated when torque was applied to the nut. The movement of the adapter fitting created the potential for stresses in the fuel lines to apply force in the loosening direction.

Pilot Information

Certificate:	Private	**Age:**	54,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	5-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	
Instructor Rating(s):	None	**Toxicology Performed:**	
Medical Certification:	Class 3 With waivers/limitations	**Last FAA Medical Exam:**	July 1, 2020
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	
Flight Time:	(Estimated) 882 hours (Total, all aircraft), 20 hours (Total, this make and model), 830 hours (Pilot In Command, all aircraft), 59 hours (Last 90 days, all aircraft), 10 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Vans	**Registration:**	N611E
Model/Series:	RV7	**Aircraft Category:**	Airplane
Year of Manufacture:	2021	**Amateur Built:**	Yes
Airworthiness Certificate:	Experimental (Special)	**Serial Number:**	70816
Landing Gear Type:	Tailwheel	**Seats:**	2
Date/Type of Last Inspection:	January 21, 2021 Condition	**Certified Max Gross Wt.:**	1800 lbs
Time Since Last Inspection:	4.4 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	4.4 Hrs at time of accident	**Engine Manufacturer:**	Titan
ELT:	C126 installed, activated, did not aid in locating accident	**Engine Model/Series:**	IOX-370-J4B3T8
Registered Owner:	RV770816 LLC	**Rated Power:**	185
Operator:	On file	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KVDF,22 ft msl	**Distance from Accident Site:**	
Observation Time:	14:55 Local	**Direction from Accident Site:**	
Lowest Cloud Condition:		**Visibility**	10 miles
Lowest Ceiling:	Broken / 3400 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	9 knots / 14 knots	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	230°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.13 inches Hg	**Temperature/Dew Point:**	28°C / 20°C
Precipitation and Obscuration:			
Departure Point:	Tampa, FL (KVDF)	**Type of Flight Plan Filed:**	None
Destination:	Zephyr Hills, FL (KZPH)	**Type of Clearance:**	None
Departure Time:	14:30 Local	**Type of Airspace:**	Class G

Wreckage and Impact Information

Crew Injuries:	1 Minor	**Aircraft Damage:**	Substantial
Passenger Injuries:	N/A	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Minor	**Latitude, Longitude:**	28.0833,-82.2666(est)

Administrative Information

Investigator In Charge (IIC):	Rayner, Brian
Additional Participating Persons:	Mark Keefer; FAA; Tampa, FL
Original Publish Date:	January 19, 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=102615