Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A06A0092

COLLISION WITH TERRAIN

VARIVIGGEN (AMATEUR-BUILT/EXPERIMENTAL) N106VV
PLASTER ROCK, NEW BRUNSWICK, 8 nm E
17 SEPTEMBER 2006

Canada

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

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Summary

The amateur-built VariViggen aircraft departed Bangor Airport, Maine, United States, on 17 September 2006, at 1711 Atlantic daylight time, on a non-stop, visual flight rules (VFR) flight to Goose Bay, Labrador. The aircraft wreckage was located on 22 September 2006 in a heavily wooded area about nine nautical miles east of Plaster Rock, New Brunswick. The pilot had been fatally injured in the crash, and the aircraft was destroyed.

Ce rapport est également disponible en français.

Other Factual Information

N106VV, a VariViggen two-seat (tandem arrangement), wood and fibreglass aircraft, was registered 06 December 1993 as an amateur-built aircraft in the experimental category. The original owner was also the aircraft's builder and was certified to maintain the aircraft. It was powered by a Lycoming O-360-A1A 180 HP piston engine, serial number L-18063-36A. From the time it was built and registered in 1993 until it was sold in the summer of 2006, the original owner operated N106VV from Lawrence Municipal Airport (KLWM) in Lawrence, Massachusetts, United States. The aircraft total flight time was about 140 hours.

The fuel system on the VariViggen consists of three tanks, a seven-gallon tank installed in each outboard wing leading edge and an aft fuselage-mounted, 25-gallon main tank. Fuel is transferred from the wing tanks via two transfer pumps, to a T-fitting, and a single fuel line then feeds the fuel into the main tank. The engine receives fuel from the main tank only. Maintenance records for the aircraft show that the wing tanks were serviced on 11 September 2006. During this servicing, the wing tanks were filled with fuel, a leak check was carried out, and the wing tanks were then drained.

The accident pilot was appropriately licensed and held a valid pilot's medical. He had about 3000 hours of flight time and had experience ferrying a variety of aircraft across the Atlantic Ocean. He had recently purchased N106VV and intended to fly it back to Germany, his home country. From 14 to 16 September 2006, he flew familiarization flights at KLWM and prepared the aircraft for the ferry flight. A 33-gallon ferry fuel tank was installed and secured in the rear seat of the aircraft. Fuel from this tank was fed via a fuel line and transfer pump to the existing fuel T-fitting and from there into the main tank.

On 16 September 2006, the aircraft was fully fuelled. The ferry tank was filled first, and the remainder of the fuel was then added to the main tank and two wing tanks. On September 17, at 1110 Atlantic daylight time,[1] the aircraft departed KLWM under visual flight rules (VFR) and proceeded directly to Bangor Airport (KBGR), arriving at 1243. At KBGR, the aircraft was refuelled with 18.3 US gallons. Fuel was added to the ferry tank and the main tank but not to the wing tanks, as these were still full. The pilot filed a VFR flight plan for a non-stop flight to Goose Bay, Labrador (CYYR), and the aircraft departed KBGR at 1711. The pilot did not contact Bangor flight service station after take-off to activate the VFR flight plan to Goose Bay.

The last air traffic control (ATC) communication with N106VV was near Millinocket, Maine, when the pilot was advised by Boston Area Control Center (ACC) that he was approaching the edge of Boston's radar coverage, and to contact Moncton Area Control Centre (ACC) in another 20 miles. He switched to the Moncton frequency (134.25); however, he did not establish communications with Moncton ACC. Data from an on-board, portable global positioning system (GPS) receiver indicates that the aircraft continued en route at about 2500 feet above sea level (asl) at an average groundspeed of 115 knots. Near Plaster Rock, New Brunswick, flying at 2500 feet asl placed the aircraft at approximately 1600 feet above ground level (agl). The flight remained uneventful and the aircraft performance was unchanged until just abeam Plaster Rock.

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[1] All times are Atlantic daylight time (Coordinated Universal Time minus three hours).

A digital camera was found at the wreckage site, and images were recovered from the camera for analysis. Near Plaster Rock, four minutes before the accident, the pilot took a series of photographs. Images of the instrument panel captured the aircraft's GPS position and aircraft operating parameters. The images show the aircraft operating normally and in good weather. There were about 18 gallons of fuel in the main tank, and fuel was not being transferred from the wing tanks. The engine was operating at a cruise setting of 2500 rpm. The final image, taken three minutes before impact, was a self-portrait in which the pilot appears to be unperturbed.

GPS data also showed that, at 1829:16, two minutes before impact, the aircraft slowed and began an uninterrupted descent. The rate of descent increased to about 800 feet per minute. The last GPS track point, captured at 1831:20, was for a position just short of the crash site. Two hunters found the aircraft wreckage on the evening of September 22, 8.5 nm east of Plaster Rock. The pilot was wearing the four-point harness; however, the accident was not survivable, and the pilot was fatally injured during the crash.

Wreckage Examination

The aircraft descended into the trees on a northeasterly heading, and the wreckage trail was about 200 feet long. The aircraft wings tore away during the final portion of the impact sequence. The fuselage then struck the ground in a nose-low attitude, flipped over, and came to rest inverted. The propeller showed no indication that it was turning at impact. The wing fuel transfer switch was found in the ON position.

The engine was removed and transported to the TSB wreckage examination facility in Dartmouth, Nova Scotia. No mechanical faults were found with the engine; however, the fuel system at the engine was contaminated with water. Approximately one ounce of fluid was drained from the gascolator[2] bowl. The fluid was about 90 per cent water and 10 per cent fuel. When the carburetor drain plug was removed, approximately one ounce of water drained out of the bowl and no fuel was observed. Water was also found in the engine-driven fuel pump. The amount and concentration of water was sufficient to have stopped the engine.

According to Federal Aviation Administration (FAA) Advisory Circular 20-105B, Section C (1), Fuel Contamination:

> Water contamination continues to be a major cause of fuel related accidents… In an aircraft, condensation can happen inside a less than full fuel tank. When a temperature difference occurs between the walls of the fuel tank and the air in the tank, water droplets will form on the inside top part of the fuel tank walls and drain down into the fuel. The effects of condensation can be reduced by keeping the fuel tanks full while the aircraft is parked.

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[2] A gascolator is a fuel filter and water strainer. It should be installed at a low point in the fuel system, usually on the firewall or on the wing roots below the fuel tank to trap any water that may accumulate so that it can be drained.

Normally, fuel tank drains are installed on each tank. Water is heavier than aviation gasoline and settles below the fuel to the bottom of the tank. By draining a small amount of liquid from each tank into a clear fuel sample cup, a pilot can visually inspect the fuel for water contamination before flight. This fuel can then be tested with water-finding paste, or another type of chemical detector. Fuel should be considered unfit for use in aircraft if a visual examination shows more than a trace of sediment, globules of water, cloudiness, or a positive reaction to chemical water-testing methods. There was no fuel sampling or chemical testing equipment found at the accident site.

N106VV did not have wing-tank fuel inspection drains. The VariViggen fuel system design calls for only one fuel drain, located at the gascolator on the engine firewall. Homebuilt experimental aircraft are fabricated and assembled by their owners for educational and recreational purposes. The designs of these aircraft do not have to meet the same FAA standards that apply to certificated aircraft.

In 2005, after an accident involving an amateur-built Kolb, model Mark III (National Transportation Safety Board NYC05LA017), the FAA issued a Special Aviation Maintenance Alert. The alert recommended the inspection of all Kolb or other experimental amateur-built aircraft without fuel tank drains installed for contamination and water. Owners were further encouraged to consider installing fuel pickup inlet screens and proper low-point fuel sump drains in the fuel tanks, if not installed. Pilots were advised to be mindful of what goes into their fuel tanks, how long it has been there, and under what circumstances.

Search and Rescue Notification

The VFR flight plan had been filed, but was not activated upon departure from KBGR. The aircraft was between control agencies when the accident occurred. Canadian air traffic controllers were not aware that N106VV had crossed into Canadian airspace, and N106VV was not expected at CYYR. Because the flight plan had not been activated, the Halifax Joint Rescue Coordination Centre (JRCC) search and rescue (SAR) did not receive a notification of an overdue aircraft when N106VV did not arrive at CYYR.

It was not until the evening of 19 September 2006 that a concerned acquaintance of the pilot contacted Canadian authorities, indicating that the pilot had not made contact since departing KBGR. Shortly thereafter, the JRCC initiated a communications search, declared N106VV missing, and on September 20, began air and ground searches for the aircraft. The aircraft wreckage was found by two hunters on the evening of September 22.

From January 2005 to July 2006, 201 VFR aircraft arrived in Canada from the United States without an active flight plan and without the afforded SAR notification. Of these, 66 had filed a flight plan that had not been activated upon departure. The others apparently conducted trans-border flights without filing a flight plan. Of those 66 that filed without activating, about equal numbers were Canadian and foreign-registered aircraft.

During the search for N106VV, aircraft repeatedly overflew the accident site without detecting the aircraft's emergency locator transmitter (ELT) signal. When the aircraft wreckage was located, rescuers turned the fuselage upright to gain access to the pilot. A weak signal was then detected by overflying SAR aircraft. The ELT was in the armed position, but the antenna had been torn away during the crash.

Analysis

The GPS data and images retrieved from the pilot's camera indicated that the flight was normal until minutes before impact. The technical examination of the aircraft engine showed that it had stopped due to water contamination of the fuel. The analysis therefore will focus on the source of the contamination, the reason it was not detected, and the delay in SAR notification after the accident.

Fuel from the ferry and main tanks was used to fly from KLWM to KBGR and beyond. Because the ferry and main tanks were used successfully on the flight from KLWM to KBGR, it is not possible that the water contamination came from the fuel source at KLWM. Likewise, fuel from the main tank was used from KBGR until near Plaster Rock. Had the aircraft fuel system been contaminated with water from the fuel source at KBGR, the effects of water contamination would have been apparent shortly after engine start. Therefore, the only remaining sources of water contamination were the wing tanks.

Water contamination in the wing tanks should have been removed when the wing tanks were filled and then drained on 11 September 2006. It is possible therefore that the contamination occurred between the time of this servicing and the pilot's departure from Lawrence Airport. However, the investigation was not able to determine how the wing tanks came to be contaminated with water.

The only fuel drain was near the engine, and this single drain was far removed from the wing tanks. Sampling fuel from this single source could not have provided the pilot with an indication of pre-existing water contamination of the wing tanks. There is no indication that the pilot attempted to ascertain that the wing fuel tanks were free of contamination, or that he had transferred fuel from the wings at any time before his departure from KBGR.

As the only source of water contamination was the wing tanks, and the fuel transfer switch was found in the ON position after the accident, it is likely that a transfer from the wings to the main tanks had been initiated. Water would have been transferred from the wing tanks to the main tank, where it settled and was delivered to the engine, causing the engine to stop.

The flight was conducted at a relatively low altitude of about 1600 feet agl. Following the engine stoppage, the pilot had little time to attempt a restart of the engine, and the selection of forced landing areas was limited in the rugged terrain.

The delay in SAR notification occurred because the VFR flight plan had not been activated by the pilot upon his departure from KBGR. The pilot may not have been aware of the requirement to activate his flight plan, or he may have forgotten to do so because this was not a part of his flying routine. Because he did not survive the impact, the delayed search did not affect his chances of survival; otherwise, it would have significantly reduced them.

Findings as to Causes and Contributing Factors

1. The wing tanks had become contaminated with water; however, the source of the water contamination could not be determined.

2. The aircraft did not have fuel tank drains to allow for easy pre-flight inspection of the entire fuel system.

3. The engine stopped when water, transferred from the wing tanks to the main tank, settled in the main fuel tank and was subsequently delivered to the engine.

4. The flight was conducted at a relatively low altitude, limiting the pilot's opportunity to cope successfully with the engine stoppage.

Findings as to Risk

1. Because the flight plan had not been activated, Canadian air traffic control and search and rescue authorities were not aware of the flight, and the initiation of the search was delayed for three days.

2. The emergency locator transmitter signal was not detected, primarily because the antenna had been broken during the accident.

Safety Action Taken

This report shows that there are visual flight rules (VFR) aircraft proceeding from the United States to Canada without the protection of search and rescue notification that an activated flight plan affords. On 27 November 2006, the TSB sent an Aviation Safety Advisory (A060042) to Transport Canada. In the advisory, it was suggested that, in conjunction with NAV CANADA and the Federal Aviation Administration, Transport Canada take steps to ensure that pilots comply with the requirement to file VFR flight plans for trans-border flights and ensure that filed trans-border VFR flight plans are automatically identified and activated.

Transport Canada published an article titled "Transborder Flights Without a Flight Plan—Revisited" in the *Aviation Safety Letter*, Issue 1/2007. A copy of this article may be obtained at http://www.tc.gc.ca/CivilAviation/publications/tp185/1-07/menu.htm.

Scaled Composites has advised VariViggen owners to install low-point fuel tank inspection drains in the wing tanks before the next flight. Scaled Composites has produced and provided owners with plans for the drain installation, modifications to the aircraft flight manual

requiring fuel checks before every flight, and the method to be used when checking the fuel tanks for contamination. Scaled Composites has also sent a safety bulletin to the publishers of the *Central States Newsletter*, and the Experimental Aircraft Association *Sport Aviation* magazine with a request to publish it in the next available edition of both publications.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 02 April 2007.

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