AVIATION INVESTIGATION REPORT
A02C0145

COLLISION WITH WATER

TRANSWEST AIR LIMITED
CESSNA A185F (SEAPLANE) C-GALM
ENGEMANN LAKE, SASKATCHEWAN
29 JUNE 2002

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

At approximately 1410 central standard time, a Cessna A185F seaplane, registration C-GALM, serial number 18503711, was taking off from Engemann Lake, Saskatchewan, on a visual flight rules (VFR) flight to Thomson Lake with the pilot and two passengers on board. The aircraft was about 10 to 15 feet above the water, established in a wings-level, nose-up climb attitude, when the pilot glanced to the left. Before the pilot was able to look back to the front, the aircraft struck the water, overturned, and began to sink. The pilot and front-seat passenger escaped from the sinking aircraft and survived. The second passenger, in the left rear seat directly behind the pilot, sustained serious injuries to the legs, chest, and head during the impact, did not escape from the aircraft, and drowned. The aircraft was substantially damaged. The accident occurred during daytime visual meteorological conditions.

Ce rapport est également disponible en français.

Other Factual Information

The Cessna A185F was equipped with EDO 3430 floats. The aircraft had accumulated 7478 hours since manufacture in 1977, the engine had accumulated 566 hours since overhaul, and the propeller had accumulated 1584 hours since overhaul. Records indicate that the aircraft was certified, equipped, and maintained in accordance with existing regulations. The aircraft had no known defects before the flight. The aircraft weight and balance were not computed before the accident flight; however, investigators calculated that the weight and the centre of gravity would have been within approved limits.

The pilot held a Canadian commercial pilot licence, issued 16 May 1997. His licence was valid for single-engine land aeroplanes and, as of 28 May 2002, sea aeroplanes. The licence was validated by a category 1 medical certificate, with no limitations, renewed on 10 May 2002. The pilot was trained and qualified to perform the tasks he had been assigned.

The pilot had accumulated 780 hours total flying time, with 179 hours on floats. In the 90-day period before the accident, the pilot flew 160 hours and, in the 30-day period before the accident, he flew about 143 hours. In the 48-hour period before the accident, he flew about
7.6 hours. On the day of the accident, he had flown about five hours. Canadian Aviation Regulation (CAR) 700.15(1)(c) limited a flight crew member to a maximum of 120 hours flight time in any 30 consecutive days. CAR 700.15(2) permitted this limit to be exceeded if the increase in flight time was authorized in the air operator certificate and the *Commercial Air Service Standards* (CASS) were complied with. The air operator certificate for Transwest Air included operations specification 92, which authorized an increase in the 30-day flight time limit to 150 hours as permitted by CASS 720.15(1)(c). The pilot's flight time was within the limits set by the CARs and the CASS. The *Canadian Aviation Regulations* (CARs) specify limits for flight time and time free from duty that differ depending on whether the pilot is on call or not. The accident pilot was not on call.

The Transwest Air operations manual required that the rest period for company pilots following a standard duty day must be a minimum of eight hours, plus a reasonable amount of time for transportation to and from a rest facility, meals and personal hygiene, as required by CAR 700.16. The manual also stated that, as a general rule of thumb, a minimum of one hour should be added to the required rest period to permit travel to and from a rest facility, meals and personal hygiene. CAR 101.01(1) defines the minimum rest period referred to in CAR 700.16(3) as "an opportunity to obtain not less than eight consecutive hours of sleep in suitable accommodation, time to travel to and from that accommodation and time for personal hygiene and meals." The day before the accident, the pilot completed his duty period at 2100 central standard time (CST).[1] On the day of the accident, he commenced his duty period at 0500.

The CARs also specified requirements for time free from duty, which differed from minimum rest period in that time free from duty pertained to the number of days off during a specified number of calendar days. CAR 700.19(1)(b) required that pilots be provided with one period of time free from duty, of at least 24 consecutive hours, three times within each 30 consecutive days. CAR 700.19(2) permitted exemptions from the 700.19(1)(b) requirement if the exemptions were authorized in the air operator certificate and the CASS were complied with. The air operator certificate for Transwest Air included operations specification 94, which authorized an exemption from the CAR 700.19(1)(b) requirements, within the limits specified by CASS 720.19(1). The limits permitted a flight crew member to be assigned duty for up to

[1] All times are CST (Coordinated Universal Time minus six hours).

42 consecutive days following at least five consecutive periods of 24 consecutive hours free from duty. They also required the flight crew member to receive at least five consecutive periods of 24 consecutive hours free from duty following any assignment that exceeded 27 consecutive days. In the 30 consecutive days before and including the day of the accident, the pilot had two periods of 24 consecutive hours free from duty. During the period from 16 to 23 May inclusive, he had six consecutive periods of 24 consecutive hours free from duty. This met the requirement of CASS 720.19(1), and permitted him to be assigned duty for up to 42 consecutive days commencing 24 May. The accident occurred on the pilot's 38th day of the CASS 720.19(1) period of 42 days. The pilot's time free from duty was within the limits set by the CARs and the CASS.

Including the day of the accident, the pilot had flown for the operator on 27 consecutive days. The regulations permitted the pilot to work for another four days before the operator would have been required to provide five consecutive periods of 24 consecutive hours free from duty.

The pilot, by himself, departed from La Ronge, Saskatchewan for Engemann Lake at 0530 under day visual flight rules (VFR). The aircraft was refuelled at Engemann Lake and two passengers and their fishing equipment were emplaned and flown to Thomson Lake, Saskatchewan, about 30 miles to the northeast. The passengers deplaned at Thomson Lake, and the pilot arrived back at Engemann Lake at about 1330. The remaining two passengers and their fishing equipment were emplaned, along with an outboard motor and a half-full container of fuel for the outboard motor. The passengers were given a safety briefing, as required by the CARs. The motor was secured to the floor by the right rear seat belt and then further secured by a cargo net that also secured the fuel container. All three occupants were wearing seat belts and, although the front seats were equipped with shoulder harnesses, the pilot and front seat passenger did not wear them. The shoulder harnesses were not equipped with inertial reels and prevented the pilot from reaching controls for some aircraft systems. The aircraft taxied out from the dock at about 1400.

Before take-off, the pilot extended the flaps to 20 degrees. In this configuration, the power-off stall speed of the Cessna A185F with wings level is 50 knots indicated airspeed (KIAS). At 60 degrees of bank, in level or near level flight, the aircraft is affected by an acceleration of twice the force of gravity (G), causing an increase in the power-off stall speed to 71 KIAS.

Near the centre of the lake, well clear of the trees on the shore, the pilot commenced the take-off run to the northeast, into the wind. During the take-off, he adjusted the horizontal stabilizer trim to a nose-down setting to help get the aircraft on the step. He lifted the right float out of the water at about 65 to 70 KIAS, and the left float at about 75 KIAS. A normal nose-up climb attitude was established as the aircraft accelerated after liftoff. Because of the nose-down stabilizer trim setting, the pilot was maintaining back pressure on the control column to hold the aircraft in the climb attitude. He glanced to the left through the side window and assessed the altitude at about 10 to 15 feet above the water. Immediately after he glanced to the left, but before he could look forward, the pilot heard a bang and the aircraft was in the water and sinking. The pilot could not recall whether the bang occurred before or at impact. It was reported that the engine was producing full power before impact and that there had been no indication of any problems with the aircraft during the take-off.

At 1400, the weather at Stony Rapids, Saskatchewan, 85 nautical miles northeast of the accident site, was observed to be as follows: winds calm, visibility 15 statute miles, scattered clouds at 3000 feet, broken clouds at 7000 feet, broken clouds at 26 000 feet, temperature 21°C, dew point 14°C, altimeter setting 29.60 inches. Similar conditions existed at the accident site, with the exception that the wind was from the northeast at about five knots. The lake surface at Engemann Lake was rippled, with small, glassy-smooth areas near the shore line where the lake was sheltered from the wind. The take-off was in an area of rippled water.

The aircraft sank immediately after it struck the water. The seat belt release latches were located between the two front seats. Both the pilot and the front seat passenger experienced disorientation and difficulty releasing their seat belts. Following their ascent to the surface, the pilot and front-seat passenger initially clung to the forward section of one float that had torn away, then donned and inflated two life jackets which floated to the surface. After some time had passed without the second passenger surfacing, they began swimming to the shore of the lake, about one mile away. Both the pilot and passenger were suffering from hypothermia when they reached the shore. They dried their clothing, attempted unsuccessfully to start a fire, used pine boughs to build a makeshift shelter, and prepared the bright yellow life jackets to be used as signalling devices.

The operator used a pilot self-dispatch operational control system, under which the pilot-in-command was solely responsible for preparing an operational flight plan and providing flight following information. The pilot had informed the operator's duty officer at La Ronge of the first flight from La Ronge to Engemann Lake, and had updated the company flight itinerary when he landed en route to wait for better weather. The operator was not informed of the subsequent flights from Engemann Lake to Thomson Lake and return; the pilot did not file an operational flight plan as required by the company operations manual. The pilot discussed his flight itinerary with the passengers left at each location and asked them to use their satellite phones to call for assistance in the event that the aircraft became overdue.

The passengers who deplaned at Thomson Lake on the first flight became concerned when the aircraft did not return with the rest of the fishing party. They made two calls to the camp organizer's home in Lloydminster, leaving voice mail messages at 1624 and 1708 to report their concern about the overdue aircraft. The organizer retrieved the messages at 1710 and began investigating. The operator's base manager at Stony Rapids received a call from the organizer at about 1740, investigated briefly, declared the aircraft overdue, and initiated search and rescue procedures. The operator sent an aircraft from Stony Rapids to Thomson Lake, where the two passengers from the first flight from Engemann Lake were picked up. The aircraft then flew to Engemann Lake, where the crew found the pilot and front-seat passenger at about 1950. The pilot and passenger were then flown to La Ronge, the nearest location with a hospital.

A team of Royal Canadian Mounted Police (RCMP) divers and TSB investigators arrived at the crash site five days after the accident. The divers located the aircraft wreckage at a depth of about 70 feet; the body of the second passenger was found in the wreckage, secured to the seat by the seat belt. The rear seat was not equipped with a shoulder harness. The passenger's body was recovered and the aircraft wreckage was lifted to the surface of the lake using air bags. The propeller and engine had separated from the aircraft and were not found by the divers. The wreckage was towed to shallow water and a helicopter was later used to lift the wreckage onto the lakeshore.

Examination of the wreckage by investigators revealed compressive damage to the top wing skins, flaps, fuselage and empennage, indicating that the aircraft had pitched nose-down and overturned during the impact with the water. The horizontal stabilizer trim indicator was found to be at a setting about ⅓ of the travel forward from the take-off position toward the nose-down placard; the flaps were found set at 20 degrees. The propeller and engine were missing. The engine crankcase legs /mounts had failed in overload; the engine mount deformation was consistent with an impact with the water in a nose-down attitude. The vertical adjustment of the pilot's seat was about mid-range. The eye bolt from the upper left forward float strut attachment had failed at the second thread; the remainder of the threaded portion of the eye bolt and the nut could not be found. The upper end of the left forward float strut was flared outward at the leading edge, indicating that the eye bolt was in the correct position at impact. The eye bolt was sent to the TSB Engineering Branch Laboratory for analysis, which revealed that fatigue cracking had occurred over greater than 75 per cent of the cross section of the eye

bolt at the plane of the second thread. The remaining portion of the eye bolt cross section had failed in overload. Investigators could not determine whether the overload failure of the eye bolt occurred before or at impact. There were no pre-impact anomalies found with the aircraft wreckage other than the eye bolt fatigue cracking.

Investigators conducted a static test on another similarly configured Cessna A185F aircraft to assess the possible effect of the failure of the upper left forward float strut eye bolt while the aircraft was airborne. Failure of the eye bolt was simulated by removing the nut from the eye bolt while the aircraft was suspended in a hangar. The eye bolt pulled out about ⅛ inch, but otherwise remained in position. The floats did not move in the vertical plane, and pivoted no more than ¼ inch to the right in the horizontal plane as measured at the front of the floats.

Investigators also examined the eye-head-body relationship in the cockpit of the Cessna A185F. They determined that the occupant of the pilot's seat could look down and to the left past the float strut without moving the upper body or head. To permit the occupant to look horizontally through the left window with the pilot's seat in the mid-to-upper vertical adjustment range, it was necessary to move either the head down or the upper body forward and down. During the examination, the upper body movement resulted in a relaxation of back pressure and a forward movement of the control column.

Analysis

Investigators were not able to definitively determine the reason the aircraft struck the water; therefore, several hypotheses were examined to determine which was most likely. These hypotheses included a mechanical failure of the airframe, failure of the float strut attachment eye bolt, failure of the propeller or engine, aerodynamic stall, wind shear, and the actions of the pilot.

Examination of the aircraft wreckage determined that, other than the eye bolt fatigue cracking, there were no pre-impact anomalies. Therefore, airframe failure did not contribute to the water impact.

The leading edge at the upper end of the left forward float strut sustained damage, which indicated that the eye bolt was in the correct position at impact. The eye bolt had fatigue cracking across greater than 75 per cent of its cross section. It could not be determined whether the overload failure of the eye bolt occurred before or at impact. Static testing revealed that, even with the eye bolt nut missing, the eye bolt likely would have stayed in position and the floats likely would not have moved any significant amount from their normal position. Therefore, even if the eye bolt had failed before impact, such a failure should not have resulted in the aircraft pitching nose-down and striking the water.
The engine and propeller were not recovered and, therefore, could not be examined. However, they were reported to be operating normally throughout the take-off, there were no unusual sounds or vibrations before the bang heard by the pilot, and the pilot could not recall whether the bang occurred before or at impact. Damage to the engine mounts was consistent with the attitude of the aircraft at impact with the water. Therefore, a pre-impact failure of the engine or propeller was considered to be unlikely.

The aircraft became airborne with an airspeed of about 75 KIAS and was climbing in a wings-level attitude with increasing airspeed before the impact. The stall speed of the
Cessna A185F with 20 degrees of flap, at 60 degrees of bank, and an acceleration of 2G, is
71 KIAS. It is unlikely that such an acceleration could be achieved without an extreme increase in control column back pressure. Therefore, even if the pilot had increased the control column back pressure, the airspeed was greater than the stall speed and the aircraft would not have stalled.

The take-off was made into wind near the centre of the lake, well clear of the trees on the shore. Winds were reported to be from the northeast at about five knots. Under these conditions, it is very unlikely that the aircraft encountered wind shear.

The pilot set the horizontal stabilizer trim to a nose-down setting during the step portion of the take-off run. This resulted in a need to maintain back pressure on the control column to hold the required nose-up attitude during the final portion of the take-off and the initial climb. When the pilot glanced to the left, it is possible that he unintentionally relaxed the back pressure on the control column, resulting in the aircraft pitching nose down and striking the water. This was considered the most likely reason for the aircraft pitching nose down and striking the water.

The pilot completed his duty period at 2100 on the day before the accident and started his duty period at 0500 on the day of the accident. This off-duty period was only eight hours and, given his additional need for transportation to and from a rest facility, meals and personal hygiene, the pilot's opportunity for sleep was less than that required by regulation. It could not be determined whether the shorter-than-required sleep opportunity contributed to the accident.

The passenger in the left rear seat was restrained by only a lap seat belt and sustained serious injuries to his legs, chest, and head. The risk of injury was increased because the seat was not equipped with a shoulder harness. He was likely incapacitated by the injuries and not able to undo his seatbelt and escape from the sinking aircraft.

The following TSB Engineering Branch Laboratory Report was completed:

LP 081/02 — *Aircraft Components Examination*

Findings as to Causes and Contributing Factors

1. The horizontal stabilizer trim was set to a nose-down setting, resulting in a need for the pilot to maintain back pressure on the control column to hold a nose-up climb attitude.

2. The pilot most likely unintentionally relaxed the control column back pressure after take-off, causing the aircraft to pitch nose down and strike the water.

Findings as to Risk

1. The eye bolt from the upper left forward float strut attachment had a pre-impact fatigue crack greater than 75 per cent of the cross section of the eye bolt.

2. Injuries sustained by the rear seat passenger likely prevented his escape from the sinking aircraft. The risk of injury was increased because the seat was not equipped with a shoulder harness.

3. The pilot's rest period the night before the accident was less than the minimum required by either the *Canadian Aviation Regulations* or the company operations manual.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 05 May 2003.

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