AVIATION INVESTIGATION REPORT
A00P0099

LOSS OF CONTROL

CESSNA 180E   C-FEGS
McIVOR LAKE, BRITISH COLUMBIA
13 JUNE 2000

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 privately registered Cessna 180E, registration C-FEGS, serial number 18051105, was flying to McIvor Lake, about five miles northwest of the Campbell River airport, British Columbia. The pilot and two passengers were on board. One passenger owned a float-equipped Bellanca Citabria (C-CGYN) that was being stored out of water, on private property at the southeast end of McIvor Lake; the other passenger was a prospective buyer for that aircraft. When the accident aircraft arrived at McIvor Lake, it overflew the storage yard then continued northwest across the lake, about 100 feet above ground level.

Observers noted that the aircraft was travelling very slowly as it flew overhead. The engine noise was reduced, and although the aircraft's height remained relatively level above the treetops, its pitch attitude created an impression that the aircraft was in a descent. As the aircraft passed over a recreational area at the northwest end of the lake, the engine noise increased, and the nose of the aircraft moved upward into a climbing attitude. The aircraft was then seen to enter a left-hand, steeply banked, climbing turn. During the turn, the aircraft's nose dropped abruptly, and the aircraft descended to strike the shoreline of the lake in a near-vertical, slightly left-wing-low attitude. The three occupants of the aircraft died on impact. A post-crash fire was restricted to the forward section of the cockpit. The aircraft sustained substantial damage. The accident occurred at 1053 Pacific daylight time.

Ce rapport est également disponible en français.

Other Factual Information

The weather observation at Campbell River, British Columbia, for the time of the accident shows the surface wind to be from 130 degrees at nine knots and visibility of six statute miles, with light rain and mist. There was a scattered cloud layer at 400 feet above ground level (agl), broken layers at 2500 feet and 3400 feet agl, and an overcast layer at 8000 feet agl. Conditions at McIvor Lake, about five miles to the northwest, were reported to be similar.

The pilot held a commercial licence and was qualified to fly single- and multi-engine land and sea aircraft. He had a total of 385 hours of flight experience, 102 hours of which was on the accident aircraft. His medical rating was valid at the time of the accident, and there was no record of any medical factors that would have adversely affected his performance. Transport Canada records indicate that the pilot's performance on his commercial, multi-engine, and instrument flight checks showed consistent weaknesses in airspeed and altitude control during in-flight manoeuvres. According to the aircraft journey logbook, this was the first time that the pilot had flown to McIvor Lake.

When the aircraft hit the ground, its left wing tip crushed backwards, causing the wing to twist and rotate and driving the trailing edge of the left flap downward and rearward into the side of the fuselage. The left flap appeared to be retracted when found. The right wing had rotated forward around the strut, stretching the right flap actuating cables, deforming the flap actuating pulleys, and causing the right flap to extend to approximately 30 degrees (°). The flap actuating handle was seized in place in the first notch position, relating to 10° of flap.

The propeller struck a large stump at the edge of the lake. Three deep blade strikes were evident in the stump, indicating engine rotation and power at impact. Both propeller blades separated at the hub.

The gascolator at the rear of the engine broke on impact, and a fuel-fed post-crash fire damaged the cockpit area, including the aircraft instrument panel. The fire was extinguished by initial responders to the accident scene.

An examination of the surrounding area by military search and rescue personnel and TSB staff found no indication that the aircraft had struck any trees during its flight over the recreational area.

The aircraft was a 1962 Cessna 180E equipped with EDO model 2870 floats. The aircraft had been modified in 1983, when a Crosswinds short take-off and landing (STOL) kit was installed. That installation involved the addition of leading edge cuffs, wing fences, and flap and aileron gap seals. The work was done under the authority of supplemental type certificate (STC) SA658AL and was inspected and signed off in the aircraft technical logs as having been conducted in accordance with the approved installation instructions.

Federal Aviation Administration flight tests, conducted during the evaluation and approval of the Crosswinds STC, showed that a properly modified aircraft would meet the flight conditions and characteristics required by the original aircraft type certificate. Although not published, these flight tests also showed that the modified aircraft exhibited a reduction in the aircraft's stalling speeds throughout a range of configurations and weights. No flight manual supplement is issued with the Crosswinds STOL kit installation, and pilots are expected to fly the modified aircraft in accordance with procedures and restrictions published in the original Cessna owner's manual.

At the time of the accident, the aircraft was not configured entirely in accordance with the Crosswinds STC. The installation instructions for STC SA658AL require that a specific stall warning indicator be used in conjunction with the Crosswinds STOL kit. The instructions state that the use of any stall warning indicator not listed in the instructions must receive separate Federal Aviation Administration approval. Aircraft records indicate that the stall warning indicator was changed about one year after the STOL kit installation. The type of unit installed at that time is not indicated in the aircraft technical logs. The stall warning indicator in the aircraft at the time of the crash was not the type required by the installation instructions for STC SA658AL.

The installation instructions for STC SA658AL also state that body filler is to be applied sparingly to the upper and lower trailing edges of the leading edge cuffs. The filler is to be sanded to give an aerodynamically smooth surface, with particular attention to smoothly blending the cuff's upper trailing edge with the wing. The post-accident inspection of the aircraft revealed that no body filler was in place to smooth the transition from the leading edge cuff to the original wing surface. The effect of this alteration from the original installation instructions is not known. However, discontinuities near the leading edge of an aerofoil surface will increase the drag of the aerofoil and will adversely affect its laminar flow and lifting capability.

These two discrepancies were not identified or corrected during the aircraft's routine inspection cycles. General aviation aircraft are normally maintained in accordance with a maintenance manual set out by the aircraft manufacturer. The maintenance manual contains inspection checksheets for each level of inspection. Aircraft maintenance engineers (AMEs) will inspect an aircraft using the items identified on these checksheets.

In some instances, an aircraft manufacturer may be aware of an approved modification for one of its aircraft types and may choose to integrate any supplemental inspection requirements brought on by that modification into its own inspection checksheets. This is often done in the form of notes to the AME indicating that if a certain STC has been embodied into the aircraft, then the following additional inspection requirements exist. These notes will alert the AME to the additional inspection requirements. However, in other instances, an aircraft manufacturer may not be aware of an approved STC for its aircraft type, or may not even approve of the modification from a manufacturer's standpoint. In such instances, any supplemental inspection requirements brought about by the installation of the STC would not be incorporated into the manufacturer's maintenance and inspection program, and it would be unlikely that an AME would be aware of the inspection requirement, unless the AME was personally familiar with the specifics of the STC. In this occurrence, the items related to the type of stall warning and to the requirement for body filler to smooth the transition between the leading edge cuff and the original wing were not integrated into the aircraft manufacturer's maintenance checksheets.

The accident aircraft was equipped with a stall warning system designed to aurally warn the pilot of an impending stall. In straight-ahead and turning flight, the warning horn should sound 5 to 10 miles per hour ahead of the stall. The aircraft flight manual indicates that the second item a pilot must check on every pre-flight exterior inspection is the proper operation of the stall warning system. An examination and test of the individual components of the stall warning system, conducted shortly after this accident, revealed that neither the stall warning sensor (lift detector) nor the stall warning horn would operate. A laboratory examination was later conducted after storing the components in a warm, dry environment for several weeks. That second examination found that the warning sensor operated properly. The warning horn, however, again failed to operate until electrical power had been applied and then re-applied a number of times. The reason these components did not operate during initial testing was not determined. It is not known if the stall warning operated during the flight.

Aircraft weight and balance calculations and adherence to the published limits are prerequisite to safe flight. Transport Canada's *Aeronautical Information Publication* (AIP) states that, when loading, it is essential that the maximum gross weight not be exceeded and that the centre of gravity of the loaded aircraft be within the permissible range and remain so during the flight. AIP also states that actual passenger weights should be used in weight and balance computations, but where these are not available, the following average passenger weights (which were determined by an airline / Transport Canada survey) may be used:

Summer		Winter
182 lb	Males (12 years and over)	188 lb
135 lb	Females (12 years and over)	141 lb
75 lb	Children (2–11 years)	75 lb
30 lb	Infants (less than 2 years)	30 lb

The aircraft's maximum certificated weight with the installed EDO 2870 float system is 2820 pounds. The aircraft weight at the time of the accident was estimated. That estimate was based on recorded weights of the aircraft at its last weighing, a computed fuel weight based on aircraft journey log entries and the invoice record for fuel that was uploaded before the aircraft's departure from Vancouver International Airport, and standard weights allowed for in AIP for the pilot and the passengers. The weight and balance computation using the above figures shows that the aircraft weighed 2766 pounds at the time of the accident and that the weight and the distribution of that load were within the certificated range. When the weight and balance calculation was recomputed using the actual weights of the three occupants, the aircraft's weight at the time of the accident was calculated to be 2826 pounds, about 6 pounds more than the maximum certificated limit.

Floatplane pilots must contend with hazards such as floating debris, submerged obstructions, mooring buoys, and boats during the landing phase of flight. For that reason, a potential landing area should be inspected carefully before every landing. Additionally, because there is normally no windsock at a water landing site, pilots will use the inspection pass to assess the water conditions and the direction of the wind along the taxi routes they plan to use from the landing area to the dock.

Transport Canada's *Flight Training Manual* (TP1102) indicates that a preliminary inspection pass should normally be conducted between 500 and 1000 feet agl. This may be followed by a final inspection pass, which may be conducted at a height low enough to inspect the surface but not so low that the pilot must manoeuvre to avoid obstacles. An inspection pass is made parallel to and slightly to the right of the intended landing area. Making the pass into wind helps to keep ground speed as low as possible.

Normally, the speed for an inspection pass is not less than the aircraft's published approach speed. Where special conditions require a lower speed, the flight configuration, speed, and altitude selected should be such as to require minimum attention from the pilot, thus allowing more time to effectively inspect the intended approach and landing path.

TP1102 describes a number of illusions that can be created by the drift of an aircraft (pp. 118–120). That manual indicates that when a pilot is flying downwind, as in this occurrence, the increased ground speed is very noticeable, sometimes to the extent that there is a temptation to reduce airspeed. Airspeed reductions, if carried to extremes, could lead to a stalled condition.

The term aerodynamic "stall" refers to a situation where an aircraft has been allowed to reach a condition of flight in which the wings can no longer provide the lift necessary to sustain flight. The aircraft flight manual lists the stalling speeds for various flight configurations, but these speeds will vary, depending on a number of factors, as follows:

Aircraft Condition: A clean, well-maintained, properly rigged aircraft will have better stalling characteristics and lower stalling speeds than a similar aircraft in poor general condition.

Aircraft Weight: A heavily loaded aircraft will have a higher stalling speed than a lightly loaded aircraft.

Power: The addition of power near the point of the stall can lower the stalling speed. However, as an aircraft's speed slows and approaches the stalling speed with power on, the aircraft's general stability is reduced, due to a decreased velocity of the airflow over the aerofoil surfaces and an increase in aileron drag. If a stall occurs with full power applied, the nose of the aircraft may tend to pitch down abruptly, and a rapid decrease in altitude will result. TP1102 states: "The slow flight speed range does not automatically imply serious control difficulties or hazardous conditions. However, it does amplify any errors of basic flying technique. Hence, proper technique and precise control of the aircraft are essential in this speed range."

Angle of bank: The greater the bank angle in coordinated, level flight, the higher the stall speed. Specifically, the wings-level stall speeds that are published in aircraft flight manuals will increase by about 40 per cent when an aircraft is established in a level, 60° banked turn, and by about 100 per cent if the aircraft bank is increased to 75°. Attempts to climb while conducting a turn will require further increases in g-forces, resulting in proportionally higher stalling speeds.

Flaps: When flaps are extended, the camber of the wing is effectively increased, allowing the aircraft to be flown at a lower speed before the stall occurs. However, TP1102 indicates "extreme care must be taken when retracting the flaps in flight, especially near the ground, because flap retraction will result in a sudden loss of lift, and changes in the aircraft's balance."

Analysis

According to the aircraft journey logbook, this was the first time the pilot had flown to McIvor Lake. It is normal for a floatplane pilot to make one or more inspection passes before landing and to land into wind in the vicinity of the intended destination. The requirement for an inspection pass is even more compelling if the pilot is unfamiliar with the landing area. In this occurrence, the pilot overflew the intended destination at the southeast end of the McIvor Lake. He proceeded downwind across the lake at low altitude and low speed, with a tailwind component of approximately 10 knots. The aircraft's flight path was biased toward the north shore of the lake, affording the pilot a clear view of the available landing area and any obstructions. This overflight of McIvor Lake was likely an inspection pass to assess the conditions on the lake and to identify an appropriate landing area.

Despite the presence of a tailwind, which would have increased the aircraft's speed over the ground, the observers on the lake had a clear impression that the aircraft was travelling very slowly and with a nose-down attitude as it passed overhead. These circumstances are consistent with the pilot being adversely affected by "drift illusion" and may explain the reason for the low airspeed during the inspection pass. Additionally, the aircraft was modified with a STOL kit that should decrease the risk of a stall and thus increase the level of safety. That will be true, provided the aircraft is flown in accordance with the published aircraft flight manual procedures. However, if the pilot attempted to fly at speeds that were slower than those published in the flight manual, the risk of encountering a stall would have increased.

As the aircraft reached the northwest end of the lake, power was added, and the pitch of the aircraft was seen to increase from a nose-down to nose-up attitude. A pitch change that was large enough to be observed from the ground was likely caused by an aggressive application of back pressure on the control column to initiate a climb, a retraction of the flaps at low flying speed, or a combination of the two. Either of these conditions would increase the risk of an aircraft stall. The pitch change of the aircraft was followed by a steeply banked turn to the left. The increased back pressure required to execute a steeply banked, climbing turn would have effectively raised the stalling speed by a factor depending on the angle of bank. The aircraft's heavy weight would have adversely affected the stall speed and further degraded the aircraft's ability to maintain flight in the climbing turn.

Almost immediately after the bank was established, the aircraft's nose dropped abruptly, and the aircraft descended to strike the ground. The flight dynamics described by observers were consistent with the aircraft entering an aerodynamic stall. At the height the stall occurred, the pilot had insufficient time to recover before the aircraft struck the ground.

A post-crash inspection found no mechanical faults that would have caused the aircraft to stall. The absence of body filler, to smooth the transition from the leading edge cuff to the original wing surface, would have changed the aerodynamic characteristics of the wing to some extent; however, the amount of that change is not known. The right flap cables and pulleys were damaged by overload during the crash, and the damage was consistent with the crash dynamics. Had such damage occurred in the air, as a precipitating event, the aircraft should have rolled opposite to the direction described. It is not known if the stall warning system was operational at the time of the accident. Without such a system, the pilot would have to rely on more subtle aerodynamic characteristics to warn of an impending stall.

Findings as to Causes and Contributing Factors

1. The pilot, while manoeuvring the aircraft, induced an aerodynamic stall.

2. The heavy weight of the aircraft increased the risk of a stall.

3. The initiation of a low-speed, climbing turn increased the risk of a stall.

4. It is not known if the aircraft's stall warning system was operational. An inoperational stall warning system would have adversely affected the pilot's ability to recognize the aircraft's approach to the stall.

Other Findings

1. The pilot was likely conducting an inspection flight of a potential water landing area at low altitude and low speed.

2. The use of a stall warning indicator that was not approved by the Crosswinds supplemental type certificate likely was not a factor in the occurrence.

3. The absence of body filler, to smooth the transition from the leading edge cuff to the original wing surface, may have changed the aerodynamic characteristics of the wing to some extent; the amount of that change is not known.

Safety Action Taken

In 1999, Transport Canada conducted "An Evaluation of Stall/Spin Accidents in Canada" and, based on that study, made changes to its pilot training plans. These changes were aimed at increasing a pilot's ability to recognize a stall situation and at increasing the knowledge and skills required to prevent the stall from occurring. An underlying rationale for these changes was that accident statistics showed that a large percentage of stall-type accidents occurred during take-off and landing and at an altitude from which recovery was not possible. This shift in training emphasis is expected to improve pilots' awareness of impending stalls and should aid in reducing the accident rate through stall prevention rather than through stall recovery skills.

The change to the Transport Canada training program was initiated before this accident occurred; however, the accident pilot would not have been exposed to the new syllabus because he completed his training to the commercial pilot standard in 1998.

The TSB forwarded an occurrence bulletin to Transport Canada highlighting the discrepancies found between the condition of the aircraft modification at the time of the accident and the original supplemental type certificate installation requirements.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 10 April 2001.