

AVIATION INVESTIGATION REPORT

A02P0136

AIRCRAFT STALL ON TAKE-OFF

REGENCY EXPRESS FLIGHT OPERATIONS

CESSNA 172N C-GRIL

BOUNDARY BAY AIRPORT, BRITISH COLUMBIA

01 JULY 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.

## Aviation Investigation Report

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### *Summary*

On 01 July 2002, a rented Cessna 172N, C-GRIL, serial number 17268072, was taking off from Boundary Bay Airport, British Columbia, at 1214 Pacific daylight time with the pilot and three passengers on board for a local pleasure flight. The pilot had rented the aircraft from Regency Express Flight Operations. The take-off on Runway 25 appeared to be normal until the main wheels left the ground, whereupon the nose rose to a very steep attitude. The aircraft climbed to an estimated height of 100 to 150 feet, the right wing dropped, then the left wing, then the right wing again, and the aircraft struck the runway nose down and right wing low. A fire broke out in the area of the left cowling, fed by a broken fuel line from the left fuel tank, but was quickly extinguished by bystanders with portable fire extinguishers. Two passengers were fatally injured, the pilot sustained serious injuries, and the third passenger died in hospital the next day. The aircraft was destroyed.

*Ce rapport est également disponible en français.*

## *Other Factual Information*

The pilot held a valid private pilot licence and medical certificate, both issued by Transport Canada. The licence was endorsed for single-engine land aeroplanes. The medical certificate, which had a restriction that glasses must be worn while flying, was issued on 13 September 2001. The last medical was conducted on 21 August 2001 and was valid for a period of 60 months.

The pilot had accumulated 57 flying hours on light aircraft: 30.7 hours dual and 17 hours solo on the Piper PA-38 Tomahawk, and 7.7 hours dual and 1.6 hours solo on the Cessna 172N. He had completed his private pilot training with Regency Express between 13 August 2001 and 31 March 2002, mainly on the Piper PA-38 Tomahawk aircraft. During his training, he flew six dual instructional flights on the Cessna 172 and, since receiving his licence, flew an additional three dual flights and two solo flights on this aircraft.

The pilot sustained serious injuries in the accident and has no memory of any events on the day of the accident.

Records indicate that the aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures, except for two discrepancies described in subsequent paragraphs. The aircraft was manufactured in 1976 and had flown a total of 5762.4 hours since new. A review of the journey and technical logbooks and engine logbooks showed nothing remarkable. The engine, a Lycoming O-320-H2AD, serial number L-3626-76T, had accumulated 1575.3 hours total since new. The only defect noted was that the right-hand fuel gauge was unserviceable and deferred, awaiting parts. Pilots were advised to dip the right fuel tank before flight.

The aircraft was fuelled to full tanks the previous day and did not fly again until the accident flight.

Nothing could be found to indicate the pilot had completed a weight and balance calculation prior to the flight. Post-accident weight and balance calculations, using reported occupant weights, full fuel tanks, and no baggage, showed the aircraft take-off weight to be 2589 pounds and the centre of gravity to be at 45.16 inches aft of the datum. The maximum allowable take-off weight is 2300 pounds, and the allowable centre of gravity range is 35 to 47.30 inches.

At the time of the accident the weather conditions were suitable for flight in accordance with visual flight rules. Boundary Bay airport does not record hourly weather observations.

The automatic terminal information service (ATIS) message "Bravo" that was made available to C-GRIL at start up, and valid from 1100 Pacific daylight time (PDT)<sup>1</sup>, was as follows: winds 260 degrees magnetic at 10 knots; visibility more than 15 statute miles; broken clouds at 2000 feet, broken above; altimeter setting 30.26 inches of mercury; instrument flight rules (IFR) approach in use was a very high-frequency omnidirectional range (VOR) approach for Runway 07, circling for Runway 30; landing runways 25 and 30; departure Runway 25. Weather is not considered to have been a factor in this accident.

The wreckage was initially examined at the accident site. The aircraft struck the runway nose down on its right side, damaging the right wing and right engine cowling, and forcing the nosewheel up between the pilot's seat and rudder pedals. Both propeller blades were twisted and showed leading edge damage. The twist and damage are consistent with considerable power being produced at the time of impact. The throttle and mixture controls were found in the full power (forward) position. The fuel selector was found positioned to the left fuel tank.

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<sup>1</sup> All times are PDT (Coordinated Universal Time minus seven hours) unless otherwise stated.

The fuel line from the left fuel tank fractured at impact and allowed fuel to escape, much of which was consumed by fire, and very little fuel remained in the left tank. The right fuel tank was examined and found to be full of fuel.

All control surfaces were accounted for and all damage to the aircraft was attributable to the severe impact forces and fire, except that substantial cuts were made to the fuselage in the cabin area by rescue crews extricating the occupants. The wreckage was recovered from the accident site for a more detailed examination at the TSB regional wreckage examination facility.

Damage and contact markings to both front seat tracks indicates both front seats were locked into the sixth hole from the front at impact.

The aircraft's stall warning horn did not sound when suction was applied to the stall warning hole in the left wing leading edge. The stall warning horn was removed and examined; the reed was intact and in place, but the reed assembly was heavily corroded and the horn did not sound when suction was repeatedly applied to it.

The aircraft was found to have a post-production, metal, flap-position indicator cover installed, which physically limited maximum flap selection to 30 degrees instead of the normal 40 degrees. According to information provided by the manufacturer, starting with the 1978 model year, a similar metal cover was used for the flap control lever and indicator, but not until the 1981 model year was the maximum flap extension reduced from 40 to 30 degrees. Examination of the aircraft records confirmed that the aircraft had never been the subject of any supplemental type certificate (STC).

Efforts were made to determine the flap position on impact. The right flap inboard aft end was found extending into the cabin area by the rear side window. The flap trailing edge in that area was bent upwards locally by contact with the window lower edge. This indicates the right flap position was greater than 10 degrees on impact.

On the right wing, the total flap travel was measured and determined to be 40 degrees. With the right flap positioned so that its outboard aft roller sat in the largest of three dents in the outboard flap track, aft slot, upper surface, the flap was measured at 19.4 degrees down. With the right flap positioned so that its outboard forward roller sat in the beginning of a smear/dent in the outboard flap track, forward slot, lower surface, the flap was measured at 21.7 degrees down. When the right flap was positioned to where it would be if the flap actuator push-pull rod, which was bent, was straightened, the right flap was found to be at 20.2 degrees down. Using figures supplied by the aircraft manufacturer of flap position versus exposed flap actuator jack screw, the 4.2 inches of exposed jack screw measured on the wreckage corresponded to a flap position of 23 degrees down.

When the left flap was positioned with its outboard aft roller in the wing's outboard flap track, aft slot, at the point where the slot had been bent open to its widest point and the paint chipped off the side of the slot due to impact deformation, the left flap was measured at 19 degrees down.

The elevator trim tab actuator position was measured and, using figures supplied by the aircraft manufacturer, found to correspond to a spot halfway between the neutral (take-off) position and full nose up on the cockpit indicator.

The checklist provided to Cessna 172 pilots by Regency Express, a copy of which was carried in the pouch of aircraft documents, was examined. No challenge to verify the elevator trim tab position can be found on any of the lists of vital actions to be completed before take-off. The pilot confirmed this to be the checklist he used when flying the Cessna 172. By contrast, the before take-off checklist found in the manufacturer's pilot operating handbook, also carried in the aircraft, shows *elevator trim set to the take-off position* as an item on the before take-off checklist.

The pilot and the passenger seated in the right rear seat survived the relatively severe impact, but that passenger died in hospital the next day. All occupants were wearing seat belts; a diagonal shoulder strap was also available for and worn by the front seat occupants.

The armed emergency locator transmitter (ELT) was activated by impact forces and was turned off by first responders.

## *Analysis*

The major element in this accident appears to be the incorrect position of the elevator trim tab at halfway between neutral (take-off) and full nose up, for take-off. The very strong nose-up pitching moment that occurred at lift-off clearly took the pilot by surprise and resulted in the aircraft stalling aerodynamically at a height from which recovery was not possible. A test flight flown by the manufacturer, replicating the accident aircraft's configuration, indicated the stick force should have been within the pilot's physical ability to counteract. But when unexpected, it is unlikely the pilot would have been able to react and counteract this considerable force in time to prevent the pitch-up and stall.

It could not be determined why the elevator trim tab was not properly set for take-off. It may have been left in the "as found" position at the conclusion of the last flight the previous day, or the pilot might have been distracted in the process of operating the trim tab to check for full travel during pre-flight checks. Had there been a requirement in the checklist to confirm the correct positioning of the elevator trim for take-off, the chance of taking off with it incorrectly set would be minimized.

Why the flaps were set to at least 19 degrees and possibly as much as 23 degrees for take-off could also not be determined. The pilot operating handbook limited the aircraft to no more than 10 degrees of flap for take-off, and that only for take-offs on soft or rough fields, or where a minimum ground run is required, neither of which is the case at Boundary Bay Airport. Information provided by the aircraft manufacturer indicates this flap setting would have slightly exacerbated the already strong nose-up pitching moment induced by the elevator trim setting.

A formal weight and balance calculation prior to flight would have revealed that, with four occupants and full fuel tanks, the aircraft's weight would be in excess of the maximum allowable take-off weight. As no indication

could be found that such a calculation was completed, yet a take-off was attempted, it must be concluded that it probably was not done.

### *Findings as to Causes and Contributing Factors*

1. The elevator trim tab was set halfway between the neutral (take-off) position and full nose-up on the cockpit indicator, which resulted in a very strong nose-up pitching moment at lift-off, causing the aircraft to stall aerodynamically at a height from which recovery was not possible.
2. The checklist used by the pilot contained no challenge to verify the position of the elevator trim tab before take-off.
3. The flaps were set inappropriately for the attempted take-off, adding to the instability.
4. The aircraft was overweight at take-off; it is unlikely a weight and balance calculation was completed prior to flight.
5. The aural stall warning mechanism was defective and probably did not activate when the aircraft stalled during the accident sequence.
6. The wrong flap selector plate for the particular Cessna 172 model was installed around the cockpit flap lever, which limited flap extension to a maximum of 30 degrees.

*This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 24 February 2003.*

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