AVIATION OCCURRENCE REPORT

LOSS OF DIRECTIONAL CONTROL

NAKINA OUTPOST CAMPS & AIR SERVICE LTD.
CESSNA 208B CARAVAN C-FTZF
NAKINA AIRPORT, ONTARIO
3 JANUARY 1997

REPORT NUMBER A97O0001

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 1110 eastern standard time (EST), the pilot commenced a scheduled cargo flight from Nakina, Ontario, to Fort Hope in a Cessna 208B Caravan, serial number 208B0389. The pilot reported that he selected the flaps to 20°, lined up on runway 09, and set the power at around 1,600 to 1,700 foot-pounds of torque. The torque redline is 1,865 foot-pounds. About 3/4 of the way through the take-off run, the aircraft began to yaw to the right, which the pilot initially compensated for by applying left rudder. As the airspeed increased and the nosewheel lifted off the runway, the right yaw became more pronounced, and the aircraft became more difficult to control. The aircraft became airborne at about 85 knots indicated airspeed (KIAS), with the pilot using left rudder and left aileron in his attempt to compensate for the yaw; however, he was not able to gain control of the aircraft. The aircraft touched down briefly on the runway, then became airborne again as the take-off continued. While flying at less than 20 feet above ground level over a small, frozen lake immediately off the end of the runway, the aircraft descended and struck the snow-covered surface of the lake. The aircraft was in a nose-high, right-wing-low attitude when it struck the ice. The aircraft flipped over and came to rest in an inverted position, approximately 1,000 feet past the end of the runway and 200 feet to the

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[1] All times are EST (Coordinated Universal Time minus five hours) unless otherwise noted.

right of the extended right edge of the runway. The pilot received only minor injuries. He exited the aircraft and walked back to the flight office.

Ce rapport est également disponible en français.

Other Factual Information

The weather at the time of the occurrence was good with scattered cloud, visibility greater than 15 miles, wind calm, and temperature -12° Celsius. Runway 09 is asphalt covered and 3,500 feet long by 100 feet wide. It had been plowed, and the surface condition was compacted snow.

The pilot was certified and qualified to conduct the flight in accordance with existing regulations. His total flying time was 3,200 hours, of which 1,300 hours were obtained on the Caravan aircraft.

The aircraft was loaded with a small quantity of foodstuff in the front cabin among the passenger seats, 71 pieces of three-eighths-inch plywood in the right side of the centre cabin, and another small quantity of foodstuff in the rear cabin. The cargo load was to be delivered to Fort Hope. The maximum allowable take-off weight of the aircraft was 8,710 pounds, and the actual take-off weight was calculated to be 8,582 pounds. The centre of gravity was calculated to have been within the approved limits. The calculated take-off speed for the weight and conditions was 70 to 75 KIAS.

Examination at the site showed that all three blades of the propeller were bent and twisted from contacting the snow and ice. Both wings were damaged but remained attached to the fuselage, and the wing flaps were partially extended. The rudder and vertical stabilizer were crushed and bent to the left. The internal rudder lock was not engaged. The rudder trim was indicating full right rudder trim; however, the rudder trim was positioned at nearly the full left trim position. The flaps were indicating 10° down, and the actual flap position corresponded with the indicator.

The aircraft flight control system consists of conventional aileron, elevator, and rudder controls, with wing spoilers interconnected with the ailerons. The controls are manually activated through conventional cable and pulley systems. All controls were continuous and functional at the accident site. The wing spoilers were found retracted, and they reacted normally to aileron control inputs.

The aileron and elevator are trimmed manually through typical cable and pulley systems to servo tabs on the control surfaces. Each of these trim systems was found to be continuous. The rudder trim system is different in that there is no servo tab on the rudder; it is the rudder that is moved, through the nosewheel steering bungee, to apply trim. The rudder trim system is actuated by manually rotating a trim wheel. The trim wheel is attached to a flexible shaft, which rotates as the wheel is turned, and the far end of the flexible shaft is attached to a rigid shaft. The rigid shaft has two sets of threads. The first set of threads goes through a rudder pedal actuator nut, and the second set of threads goes through a nosewheel steering slider. When the trim wheel is rotated, the rudder actuator nut and the steering slider are both moved along the shaft in one direction or the other. The rudder pedal actuator nut is connected directly to the right rudder pedal torque tube. Movement of the nut in an aft direction equates to left rudder pedal input, and movement in the forward direction equates to right rudder input. At the accident site, the rudder pedal actuator nut was found in the aft direction, with one thread on the shaft exposed; this equates to approximately full left rudder trim. This finding was confirmed by a Cessna representative who was working with the investigators at the site. With the trim in this position, the left rudder pedal would be down, and the rudder and nosewheel would be deflected to the left. The trim and rudder pedal relationship is such that full trim would displace the rudder pedal by ½ of its travel.

The rudder trim indicator system consists of a pointer arm (trim indicator) on top of the trim wheel and a follower arm beneath it. There is a single, helical groove on the bottom of the trim wheel. The follower arm

(bottom arm) has a protrusion which rides in the groove in the trim wheel. As the trim wheel is rotated, the protrusion is dragged either inwards or outwards, moving the top arm, which indicates the trim position.

When examined at the site, the rudder trim indicator was showing full right rudder trim. It was found that, with the aircraft inverted, the rudder trim indicator could be moved easily to indicate any setting simply by pushing it to the trim wheel and then sliding the indicator to any position. The trim wheel was slightly out of place, and the protrusion on the follower arm was not properly in its groove. With the aircraft upright, the indicator could be moved by pressing on it, which caused the protrusion on the follower arm to come out of the groove in the trim wheel; the trim indicator could then be moved through about 3/4 of its travel, from full right indication to ½ left indication. When the trim wheel was lifted to the full extent that the flexible cable would allow (approximately 1/16 inch), the protrusion was not in its groove, and it was possible to move the indicator through its full travel.

The Cessna representative stated that it is difficult to move the trim indicator on new aircraft at the factory. There have been no service bulletins issued by Cessna regarding this trim system. Records indicate that there had not been any recent work done on the rudder trim system.

In preparation for departure, the pilot had conducted the aircraft walk-around inspection and actioned the normal check-lists. In checking the rudder trim, the pilot turned the trim wheel in both directions and then set the trim so that the trim indicator showed slightly to the right of centre. During the trim check, he did not turn the trim wheel through its full left and right travel, as required in the checklist. The pilot taxied the aircraft for departure, making three left turns to position the aircraft on the runway centre line for take-off.

Analysis

The only anomaly found on examination of the aircraft and crash site was that the rudder trim was close to its full left rudder trim position, while the indicator showed full right trim. Because the trim is manual, and the time from when the pilot first experienced difficulty controlling the aircraft until it crashed was very short, it is unlikely that the pilot made any rudder trim adjustment after initially setting the trim for take-off. Therefore, barring any tampering with the aircraft after the crash, it is probable that the rudder trim was set to the left before the pilot started his take-off. During taxi, the three left turns to position the aircraft on the runway centre line may have hidden the fact that the rudder trim was not in the neutral position as the pilot expected. With the rudder trim deflected, the rudder pedals and nosewheel would also be deflected to about ½ their travel in the same direction as the trim. The pilot did not comment on rudder pedal position, so it could be that he interpreted some deflection as a result of the left turns. With the trim set to nearly full left, full rudder authority would still be available; however, pressure on the opposite rudder pedal would be required to maintain the rudder and nosewheel in their neutral positions.

Under normal circumstances, the rudder trim would be approximately neutral for take-off. The pilot indicated that he exercised the rudder trim and set it for take-off, and it is inconceivable that he would intentionally set the trim to the nearly full left position. It is likely that when the pilot entered the aircraft, the rudder trim indicator was indicating right rudder although the trim was actually neutral or near neutral. When the pilot exercised the rudder trim, he would have brought the indicator to neutral but, in so doing, moved the rudder trim to almost full left. It was demonstrated that the trim indicator could be moved without moving the trim wheel and without affecting rudder position. This could have been done by some inadvertent action, such as dragging a coat over the trim indicator while a pilot was exiting the aircraft.

With the rudder deflected to the left, as it would be with the trim set to nearly full left, the aircraft should have yawed and rolled to the left during the take-off. However, the pilot stated that he applied left rudder and left aileron in his attempt to control the yaw to the right. No satisfactory explanation was found to account for this inconsistency.

Findings

1. During the take-off, the aircraft reportedly yawed to the right, and the yawing became more pronounced as the airspeed increased.

2. The pilot reportedly applied left rudder and left aileron in his attempts to maintain control of the aircraft, but he was unsuccessful and it crashed.

3. Prior to the take-off, the pilot verified rudder trim operation but did not turn the trim wheel through its full left and right travel, as required by the checklist.

4. The pilot set the rudder trim indicator pointer to the slightly right-of-centre position for take-off.

5. The rudder pedal actuator nut was found in the aft direction with one thread on the shaft exposed, which equates to the rudder being positioned at approximately the full left trim position.

6. The rudder trim indicator could easily be moved, without moving the trim wheel or affecting the actual rudder trim position, to indicate any trim setting.

7. The aircraft take-off weight and centre of gravity were within approved limits.

Causes and Contributing Factors

The pilot experienced directional control difficulties during the take-off run, probably because the rudder trim was set at the near full left position. Because the rudder trim indicator could be moved without affecting the actual rudder trim, it is probable that it did not reflect the actual position of the rudder trim.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson Benoît Bouchard, and members Maurice Harquail, Charles Simpson and W.A. Tadros, authorized the release of this report on 23 September 1997.