



AVIATION OCCURRENCE REPORT

LOSS OF CONTROL/SPIN

**DEPARTMENT OF NATIONAL DEFENCE
BELLANCA 8GCBC SCOUT C-GQIM
MOUNTAIN VIEW, ONTARIO
03 DECEMBER 1994**

REPORT NUMBER A94O0316

Canada

MANDATE OF THE TSB

The Canadian Transportation Accident Investigation and Safety Board Act provides the legal framework governing the TSB's activities. Basically, the TSB has a mandate to advance safety in the marine, pipeline, rail, and aviation modes of transportation by:

- conducting independent investigations and, if necessary, public inquiries into transportation occurrences in order to make findings as to their causes and contributing factors;
- reporting publicly on its investigations and public inquiries and on the related findings;
- identifying safety deficiencies as evidenced by transportation occurrences;
- making recommendations designed to eliminate or reduce any such safety deficiencies; and
- conducting special studies and special investigations on transportation safety matters.

It is not the function of the Board to assign fault or determine civil or criminal liability. However, the Board must not refrain from fully reporting on the causes and contributing factors merely because fault or liability might be inferred from the Board's findings.

INDEPENDENCE

To enable the public to have confidence in the transportation accident investigation process, it is essential that the investigating agency be, and be seen to be, independent and free from any conflicts of interest when it investigates accidents, identifies safety deficiencies, and makes safety recommendations. Independence is a key feature of the TSB. The Board reports to Parliament through the President of the Queen's Privy Council for Canada and is separate from other government agencies and departments. Its independence enables it to be fully objective in arriving at its conclusions and recommendations.



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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Synopsis

The pilot was conducting glider towing operations at Canadian Forces Detachment Mountain View, Ontario, and departed on the last launch of the day with a passenger occupying the rear seat of the aircraft. After releasing the glider and dropping the tow rope, the pilot commenced a demonstration flight. Shortly thereafter, the aircraft was observed to pass two gliders on their right side and then climb steeply in a left turn. During the climbing turn, the aircraft rolled abruptly to the right and entered a spin. The aircraft then descended steeply and struck the ground. Both occupants sustained fatal injuries.

The Board determined that the aircraft stalled during a steep, climbing left turn, which induced a spin at an altitude that precluded a successful recovery. Contributing to the accident were the increased longitudinal manoeuvrability because of the aft centre of gravity, and the increased stall speed caused by the pitching up of the aircraft and the bank angle.

Ce rapport est également disponible en français.

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1.0 *Factual Information*

1.1 *History of the Flight*

The pilot of a Bellanca 8GCBC Scout aircraft was conducting glider towing operations for the Quinte Glider Centre at Canadian Forces Detachment (CFD)¹ Mountain View, Ontario. The aircraft, registration C-GQIM, was being operated by the Central Region of the Department of National Defence (DND) in accordance with the Air Cadet Gliding Program (ACGP) for the Air Cadet League of Canada.

During the last glider launch of the day, the pilot departed from runway 24 with a Schweizer 2-33A glider in tow and with a passenger occupying the rear seat of the tow aircraft. The passenger was a glider pilot/cadet participating in the ACGP operations at the Quinte Glider Centre. After releasing the glider, the tow pilot returned to the aerodrome, made a low approach to runway 06 at a high power setting, and dropped the tow rope. The aircraft then entered a climbing right turn and proceeded to the southeast quadrant of the aerodrome, where it circled and completed steep turn and climbing turn manoeuvres at about 1,500 feet above ground level (agl).

Shortly thereafter, the aircraft was observed at approximately 1,200 feet agl, heading westbound north of the aerodrome, in the vicinity of the last two gliders that had been launched. The gliders were at the same altitude over the aerodrome in loose formation flight.

The tow pilot advised the glider pilots of his intent to pass them on their right side. After overtaking the gliders, the aircraft entered a steep, climbing turn to the left. During the climbing turn, the aircraft rolled abruptly to the right and entered a spin. The aircraft then descended steeply and struck the ground in a near-vertical attitude.

The accident occurred at 1630 eastern standard time (EST)² during the hours of daylight at latitude 44°04'N, and longitude 077°20'W³. The TSB and DND conducted a coordinated investigation.

1.2 *Injuries to Persons*

	Crew	Passengers	Others	Total
Fatal	1	1	-	2
Serious	-	-	-	-

¹ See Glossary at Appendix A for all abbreviations and acronyms.

² All times are EST (Coordinated Universal Time minus five hours) unless otherwise noted.

³ Units are consistent with official manuals, documents, and instructions used by or issued to the crew.

Minor/None	-	-	-	-
Total	1	1	-	2

1.3 *Damage to Aircraft*

The aircraft was destroyed.

1.4 *Other Damage*

No other significant property damage occurred.

1.5 *Personnel Information*

	Pilot-in-Command	Passenger
Age	24	17
Pilot Licence	Private	Glider
Medical Expiry Date	01 Oct 96	01 Dec 97
Total Flying Hours	615	23
Hours on Type	87	N/A
Hours Last 90 Days	33	N/A
Hours on Type Last 90 Days	29	N/A
Hours on Duty Prior to Occurrence	9.5	N/A
Hours Off Duty Prior to Work Period	N/A	N/A

1.5.1 *Pilot*

The pilot was a Cadet Instructor Cadre (CIC) Officer employed by the Central Region of the DND at the Quinte Gliding Centre as a tow pilot and qualified glider instructor. He received his flight training as a member of the Royal Canadian Air Cadets, and acquired his private pilot licence through a powered flight scholarship in August 1988. The licence was valid for single-engine land aeroplanes and included night rating privileges. The pilot had completed a tow-pilot conversion course and started towing gliders in August 1993. He had no accident record and was regarded as a competent and conscientious pilot with an outgoing personality, and was well-liked and respected by his peers.

On the day of the occurrence, the pilot commenced duty at 0700 EST. Because of poor weather conditions, the scheduled cadet familiarization glider flights did not commence until late morning. At 1136 EST, the pilot flew the first of four consecutive glider flights; later in the afternoon, he started

towing gliders. He completed five uneventful glider launches with the tow aircraft before the last flight. At the time of the occurrence, the pilot had been on duty for nine and a half hours.

The pilot was certified and qualified for flight in accordance with existing civil regulations; however, to operate tow aircraft, he also required certification, qualifications, and authorization in accordance with ACGP air standards.

The ACGP Manual A-CR-CCP-242 (R93)/Chapter 1, Air Standards, Section 2, Article 115.1, Pilot Currency Standards and Currency Checks, states that a pilot shall not be authorized to fly as pilot-in-command (PIC) of a particular type of aircraft if the pilot has not flown as PIC in that aircraft for at least 60 and up to 180 days, depending on the type of aircraft, until the following requisites have been met: a) the pilot has completed at least one review mission with a qualified Glider or Tow Aircraft Check Pilot; b) the pilot has been flight-checked by a qualified Glider or Tow Aircraft Check Pilot and has achieved a level 5 proficiency rating (or level 4 for a Basic Glider Pilot); and c) the flight check includes a complete review of all critical emergencies.

The pilot flew the aircraft on 19 June 1994 and was current on that date, but he did not participate in ACGP towing operations for the next 118 days, until 15 October 1994. Following this date, the pilot participated in towing operations on five other occasions over the next 49 days, until 03 December 1994. Records indicated that the pilot did not complete a currency flight check throughout the period.

The ACGP Manual A-CR-CCP-242 (R93)/Chapter 1, Air Standards, Section 3, Air Cadet Familiarization Flying in Privately Owned Aircraft (Aeroplane or Glider), allows air cadets to participate in powered aircraft demonstration flights with restrictions and appropriate authorization. The section states in Article 133.1, Tow Aircraft Prohibitions, that air cadets shall not fly in tow aircraft engaged in towing operations. In addition, the ACGP Manual A-CR-CCP-242 (R93)/Chapter 2, Standard Operating Procedures (SOP), Section 8, Tow Aircraft Operations, Article 257.1, Passenger Flights During Towing Operations, states that the practice of air cadet familiarization flights in tow aircraft during tow operations is prohibited.

The aircraft was not engaged in towing operations at the time of the accident, but the passenger occupied the rear seat of the aircraft when a glider was in tow at the commencement of the flight. The passenger verbally requested and, at the discretion of the pilot, was permitted to board the aircraft. The powered aircraft demonstration flight was not authorized.

1.5.2 Passenger

The passenger was a Staff Cadet and participated in the gliding operations at Quinte Gliding Centre as a Glider (Front Seat) Familiarization Pilot. He also received his flight training as a member of the Royal Canadian Air Cadets, and acquired his glider pilot licence in September 1993. The licence was valid for all gliders, and he gained his ACGP passenger privileges in April 1994. He was regarded as a competent glider pilot, with an enthusiastic personality and a passion for flight.

1.6 Aircraft Information

Manufacturer	Bellanca Aircraft Corporation
Type	8GCBC Scout
Year of Manufacture	1977
Serial Number	252-77
Certificate of Airworthiness (Flight Permit)	Valid
Total Airframe Time	5,747 hr
Engine Type (number of)	Avco Lycoming O-360-C2E (1)
Propeller/Rotor Type (number of)	McCauley 1A200/HFA8039 (1)
Maximum Allowable Take-off Weight	2,150 lb
Recommended Fuel Type(s)	100 LL Avgas
Fuel Type Used	100 LL Avgas

The aircraft was equipped and maintained in accordance with existing regulations and approved procedures as a civil aircraft. A calculated weight and balance of the aircraft, using an estimated fuel load, indicated a gross weight of 2,114 pounds and a centre of gravity (C of G) of 18.74 inches aft of the datum at the time of the occurrence. The maximum take-off weight is 2,150 pounds, and the aft C of G limit is 19.2 inches.

A review of the records indicated that the aircraft had an annual inspection on 29 September 1994, was last inspected on 29 October 1994, and had a daily inspection completed on 03 December 1994. The aircraft was owned by the Air Cadet League of Canada. Legal custody and control of the aircraft had been transferred to the DND through an agreement which constituted a lease for the purposes of then section 208(2) of the Air Regulations. Transport Canada issued a waiver to the provisions of that section of the Air Regulations on 07 February 1984, enabling the aircraft to remain registered in the name of the Air Cadet League of Canada.

On 01 October 1990, a new series of Air Regulations became effective respecting the marking and registration of aircraft and the leasing of aircraft. Under Air Regulations, Series II, No. 2, Aircraft Marking and Registration Regulations, section 32(1), where the legal custody and control of a Canadian aircraft changes, the registration of the aircraft expires; under section 46, where the registration of a Canadian aircraft expires or is cancelled, its certificate of registration is invalid.

During the investigation, it was determined that the terms of the agreement expired on 01 April 1984. There was no evidence on record with Transport Canada that the agreement had since been renewed and/or amended. The expired lease agreement between the operator and owner of the aircraft invalidated the certificate of registration of the aircraft.

Further investigation revealed that the operator and owner had renewed and amended the agreement accordingly for three-year periods in 1984, 1987, 1990, and 1993. The most recent 1993 agreement referenced the original waiver issued pursuant to Air Regulations revoked on 01 October 1990. There was no evidence that the waiver had been revised and/or amended in accordance with the new series of

Air Regulations. The expiration of the Air Regulation invalidated the waiver and also the certificate of registration of the aircraft.

1.7 Meteorological Information

The nearest meteorological reporting station was at Canadian Forces Base (CFB) Trenton, nine nautical miles (nm) northwest of CFD Mountain View. A special weather observation issued at 1630 EST reported an estimated sky condition of 5,000 feet broken, ceiling 8,000 feet overcast, visibility 12 miles, temperature five degrees Celsius, dew point four degrees Celsius, wind 100 degrees true at four knots, and an altimeter setting of 30.12 inches of mercury (in. Hg.). Similar weather conditions were reported at CFD Mountain View.

1.8 Communications

The aerodrome is located within the southeast quadrant of the CFB Trenton control zone. The designated air traffic control (ATC) frequency is 128.7 megahertz (MHz) for arriving and departing military or civilian aircraft with prior permission. The ACGP operations used two-way very high frequency (VHF) air-to-ground communications on a frequency of 123.3 MHz. There was no designated aerodrome traffic frequency (ATF) for ACGP operations in the *Canada Flight Supplement* (CFS).

1.9 Aerodrome Information

The facility at CFD Mountain View is operated solely by the DND and is situated on Crown land. The aerodrome has a triangular layout with three runways. Runway 06/24 is published as 5,007 feet long and 150 feet wide, and is the primary runway indicated in the CFS. Runway 16/34 is 3,040 feet long and 100 feet wide, and runway 10/28 is abandoned; neither of these runways is depicted for use in the CFS. The runway surfaces are asphalt with level grassed peripheral areas at an elevation of 362 feet above sea level. The ACGP operations were conducted on both the runways and grassed areas.

1.10 Flight Recorders

The aircraft was not equipped with a flight data recorder (FDR) or a cockpit voice recorder (CVR), nor was either required by regulation.

1.11 Wreckage and Impact Information

The aircraft came to rest on the grassed peripheral area of abandoned runway 10/28 approximately 70 feet from the threshold and 271 feet south of the runway centre line. The surface of the area was spongy and moist with trimmed grass/weed vegetation an average of 12 inches in height. Examination revealed that the wreckage remained relatively intact within the dimension of the aircraft. The impact resulted in extensive damage to the fuselage, cockpit, and wing sections of the aircraft. The damage and ground scars indicated that the aircraft struck the ground in a near-vertical, nose-down attitude, in a slow rotating spin to the right.

The aircraft systems were examined and no evidence of any pre-impact malfunction or component failure was found. Continuity and integrity of the flight control systems were confirmed and the flaps were in a retracted position. The engine was operating before impact with no reported indications of malfunction. Damage to the propeller was consistent with an engine producing low power at impact.

The aircraft was forwarded to on-site facilities at CFD Mountain View for further examination and no faults were found. The standard flight control configuration of the aircraft included dual controls for pilot training. The rear control stick had been removed and properly stowed. The examination revealed no evidence to suggest that an uncommanded application and/or obstruction of any flight control contributed to this accident.

1.12 Medical Information

There was no evidence that physiological or psychological factors affected the pilot's performance, or that he was incapacitated. The pilot held a medical category one licence validation certificate with a limitation that glasses must be worn. The medical category assessment issued met Commercial Pilot Licence and/or higher licence requirements. The pilot's glasses were found in the aircraft.

There was no evidence that the pilot was suffering from fatigue, or that he was experiencing undue stress in any area of his life, and he was reported to have been in good spirits before the flight. There was no evidence that the pilot was under any pressure to operate the aircraft with a passenger on board or compromise safety.

1.13 Fire

There was no evidence of fire either before or after the occurrence.

1.14 Survival Aspects

The accident was not survivable as impact forces exceeded human tolerance limitations. The pilot seat of the aircraft was configured with a five-point, non-inertia seat-belt system. Examination revealed that the non-inertia shoulder harness attachment point to the airframe of the aircraft failed at the weld. The passenger seat of the aircraft was configured with a four-point non-inertia seat-belt system incorporating a single shoulder strap. The right lap-belt attachment point remained secured to its fitting but the retaining bolt pulled through the airframe of the aircraft. The two seat-belt attachment points failed from overload forces on impact.

1.15 Tests and Research

As part of the investigation, the American Champion Aircraft Company, formerly the Bellanca Aircraft Company, was consulted regarding the spin characteristics of the Model 8GCBC Scout aircraft. Flight test data indicated that the most dramatic spin occurred when the aircraft was stalled in the following configuration: aft C of G, maximum gross weight, flaps up, power-off, and turning left. These conditions also resulted in a pronounced right roll over the top during spin entry. When a recovery was initiated and opposite rudder applied, the roll and yaw rates momentarily increased before the rotation stopped. This was followed with a steepened nose-down attitude. Several spin recoveries within 3/4 of a rotation were demonstrated and the aircraft met certification requirements. The aircraft was not approved for acrobatic manoeuvres, including spins.

The investigation also indicated that when an aircraft is manoeuvred with an aft C of G, a pilot has more pitch-up authority than with a forward C of G, which increases longitudinal manoeuvrability of the aircraft. This permits a higher rate of pitch-up acceleration with the flight controls, which can force the aircraft into a deeper stall than would occur in an aircraft with a forward C of G position. When the aircraft stalls in a climbing turn, the high wing is at a greater angle of attack than the low wing and therefore stalls first, which results in a rolling motion toward the high wing, creating asymmetric lift and

drag. The down-going wing will stall further as a result of less lift and more drag than the up-going wing. A deeper stall, generated by aft C of G, will aggravate these asymmetries, increasing aircraft rolling and yawing moments into the down-going wing. In addition, the aft C of G reduces the distance from the C of G to the centre of pressure of the vertical fin, thus reducing directional control authority, making recovery more difficult.

2.0 *Analysis*

2.1 *Aircraft Control*

After the aircraft entered the steep climbing turn to the left, it rolled and entered a spin to the right, descended steeply, and struck the ground in a near-vertical attitude. The rolling entry and right spin were consistent with an aircraft that had stalled while in a climbing left turn. The slow rotation and low engine power on impact indicate that the pilot was attempting to regain control of the aircraft, but low altitude precluded successful recovery.

Although within prescribed limits, the weight of the aircraft was near the maximum allowable, and the C of G was near the aft limit. The aft C of G enhanced the longitudinal manoeuvrability of the aircraft, enabling the pilot more pitch-up authority. This would have allowed a higher pitch-up acceleration into a climbing turn, which would have resulted in a rapid loss of indicated airspeed. The high aircraft weight, the pitching up of the aircraft, and the bank angle would all have increased the aircraft's stall speed.

2.2 *Standards and Procedures*

Although the pilot was certified and qualified for flight in accordance with existing civil regulations, under the ACGP he was required to maintain additional certification and qualifications to operate tow aircraft. The pilot currency standards and currency checks depicted in the ACGP Manual A-CR-CCP-242 (R93)/Chapter 1, Section 2, required that a pilot not operate tow aircraft as PIC without first completing a check flight if the pilot had not flown for 60 days in the aircraft type. Records indicated that the pilot had not flown the aircraft for 118 days, and then participated in towing operations on five occasions in the 49 days before the occurrence. There was no evidence that a flight check had been completed throughout the period.

The ACGP Manual A-CR-CCP-242 (R93)/Chapter 1, Section 3, Air Cadet Familiarization Flying in Privately Owned Aircraft, and Chapter 2, Standard Operating Procedures, Section 8, allows air cadets to participate in powered aircraft demonstration flights with restrictions and authorization, but prohibits flight with air cadets in tow aircraft during towing operations. The pilot verbally authorized and conducted a flight with a passenger on board the aircraft with a glider in tow.

2.3 *Aircraft Certification*

The aircraft was operated under the legal custody and control of the DND through an official lease agreement with a waiver enabling the owner of the aircraft to be named on the certificate of registration. Since the terms of the agreement and the legislation enabling the waiver had expired, and there was no evidence on record with Transport Canada of renewal and/or amendment, the certificate of registration was invalid.

3.0 *Conclusions*

3.1 *Findings*

1. The aircraft stalled during a steep, climbing turn and entered a spin at an altitude which precluded a successful recovery.
2. The aircraft weight and centre of gravity were within, but near, the prescribed limits.
3. The aft centre of gravity enhanced the longitudinal manoeuvrability of the aircraft, enabling higher pitch-up acceleration.
4. The aft centre of gravity reduced directional control authority of the aircraft on recovery.
5. The pilot was certified and qualified for flight in accordance with existing civilian regulations.
6. The pilot's currency on the aircraft had lapsed with regard to the air standards and requirements of the Air Cadet Gliding Program.
7. The aircraft was operated with a passenger on board during towing operations, in contravention of air standards and standard operating procedures of the Air Cadet Gliding Program.
8. Neither the carrying of the passenger nor the demonstration flight was authorized.
9. There was no evidence found of any pre-occurrence airframe failure or system malfunction.
10. The lease agreement and waiver on record pertaining to the legal custody and control of the aircraft had expired, which rendered the aircraft's certificate of registration invalid.

3.2 *Causes*

The aircraft stalled during a steep, climbing left turn, which induced a spin at an altitude that precluded a successful recovery. Contributing to the accident were the increased longitudinal manoeuvrability because of the aft centre of gravity, and the increased stall speed caused by the pitching up of the aircraft and the bank angle.

4.0 *Safety Action*

4.1 *Action Taken*

4.1.1 *Pilot Training*

Subsequent to this occurrence, the DND has revised Air Cadet pilot training courses and annual examinations to place greater emphasis on weight and balance calculations and the effects of weight and balance on aircraft flying characteristics.

Training videos on stall/spin entries and recoveries have been incorporated into initial and recurrent training programs.

The instruction of slow flight, stalls, and incipient spins has been reinforced on the tow-pilot conversion course.

4.1.2 *Air Standards*

The Central Region of the DND has assigned a full-time Regular Force pilot to carry out standardization duties. No-notice standardization and staff assistance visits have been implemented as part of a more formal system of standardization and evaluation.

Prior to the Air Cadet Gliding Program commencing 1995 operations in the Central Region, all supervisor qualifications and suitability were reviewed. The annual currency requirements of all personnel were met, site inspections were completed, flight safety surveys were scheduled, and staff training files and other documentation were completed.

Personnel schedules for the gliding centres have been adjusted to ensure that glider and tow-plane check personnel are available to ensure staff currency. Records of tow-plane conversion training and all completed examinations are being retained on personnel files. The results of training are then entered and retained in a database located at the headquarters of the Central Region.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson John W. Stants, and members Zita Brunet and Maurice Harquail, authorized the release of this report on 22 November 1995.

Appendix A - Glossary

ACGP	Air Cadet Gliding Program
agl	above ground level
ATC	air traffic control
ATF	aerodrome traffic frequency
C of G	centre of gravity
CFB	Canadian Forces Base
CFD	Canadian Forces Detachment
CFS	Canada Flight Supplement
CIC	Cadet Instructor Cadre
CVR	cockpit voice recorder
DND	Department of National Defence
EST	eastern standard time
FDR	flight data recorder
hr	hour(s)
in. Hg.	inches of mercury
lb	pound(s)
MHz	megahertz
N/A	not available
nm	nautical miles
PIC	pilot-in-command
SOP	standard operating procedures
TSB	Transportation Safety Board of Canada
UTC	Coordinated Universal Time
VHF	very high frequency

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