# AVIATION OCCURRENCE REPORT

## STALL/SPIN

## TAIL WINDS LIGHT AIRCRAFT INC.
## ACES HIGH CUBY II (ADVANCED ULTRALIGHT) C-FQYD
## KENASTON, SASKATCHEWAN 8 nm W
## 15 MAY 1994

## REPORT NUMBER A94C0074

Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada



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*Synopsis*

The pilot of the Aces High Cuby II advanced ultralight departed Davidson, Saskatchewan, en route to a private airstrip near Kenaston. About two miles southeast of the private airstrip, the aircraft was seen to enter a spin and descend into the ground. The pilot and his passenger sustained fatal injuries.

The Board determined that the aircraft encountered gusty winds and wind shear which probably exceeded its capabilities, then stalled and entered a spin from which recovery was impossible in the altitude available. Contributing factors were the aft centre of gravity of the aircraft and incomplete aileron gap seals.

Ce rapport est également disponible en français.

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# 1.0 Factual Information

## 1.1 History of the Flight

The pilot and one passenger were on a flight from Disley, Saskatchewan, to a private airstrip near Kenaston, with a two-hour en route stop in Davidson. About two miles southeast of the private airstrip, witnesses observed the aircraft in straight and level flight approximately 300 to 500 feet above ground level (agl)[1]. The aircraft was then seen to bank steeply, pitch nose down, and rotate approximately three times before striking the ground.

The accident occurred at 1530 central standard time[2] (CST) during the hours of daylight at latitude 51°30'N and longitude 106°30'W.

## 1.2 Injuries to Persons

| | Crew | Passengers | Others | Total |
|---|---|---|---|---|
| Fatal | 1 | 1 | - | 2 |
| Serious | - | - | - | - |
| Minor/None | - | - | - | - |
| Total | 1 | 1 | - | 2 |

## 1.3 Damage to Aircraft

The aircraft was destroyed by impact forces.

## 1.4 Other Damage

There was no other damage.

## 1.5 Personnel Information

| | Pilot-in-Command |
|---|---|
| Age | 40 |
| Pilot Licence | PPL-UL |
| Medical Expiry Date | 01 Feb. 1995 |
| Total Flying Time | 204 hr |
| Total on Type | 14 hr |
| Total Last 90 Days | 14 hr |
| Total on Type Last 90 Days | 14 hr |
| Hours on Duty Prior to Occurrence | 7 hr |
| Hours off Duty Prior to Work Period | 12 hr |

The pilot was certified and qualified for the flight in accordance with the Transport Canada Ultralight Aeroplane Policy.

The right-seat passenger was the pilot's wife and a qualified ultralight pilot and instructor.

## 1.6 Aircraft Information

| Particulars | |
|---|---|
| Manufacturer | Aces High Light Aircraft Ltd. |
| Type | Cuby II |
| Year of Manufacture | Aircraft kit assembled 1993 |
| Serial Number | LC2F102111792 |
| Certificate of Airworthiness (Flight Permit) | Statement of Conformity dated 04 November 1993 |
| Total Airframe Time | 14.0 hours |
| Engine Type (number of) | Rotax 503UL (1) |
| Propeller/Rotor Type | |

1 See Glossary for all abbreviations and acronyms.

2 All times are central standard time (Coordinated Universal Time [UTC] minus six hours) unless otherwise stated.

| | |
|---|---|
| (number of) | Warp Drive Inc. (1) |
| Maximum Allowable Take-off Weight | 1,057 pounds |
| Recommended Fuel Type(s) | Premium Unleaded Auto Fuel |
| Fuel Type Used | Premium Unleaded Auto Fuel |

The aircraft is a two-place, side-by-side, high-wing, conventional-gear monoplane equipped with a 2-cycle, 50 hp engine (Rotax model 503UL). The fuselage, horizontal stabilizer, and landing gear are constructed of tubular steel. The wing spars and ribs are made of extruded aluminum and the complete aircraft is covered with Ceconite fabric. The aircraft cruises at approximately 55 to 60 knots. The operator's manual lists the stall speed as 30 knots and the never-exceed speed (Vne) as 95 knots.

Aces High Light Aircraft Ltd. manufacture Cuby II aircraft kits. The Cuby II in this occurrence was assembled by Tail Winds Light Aircraft Inc., a company which assembles various aircraft kits, sells aircraft, and provides instruction on their aircraft. The pilot and his wife were the owners of Tail Winds Light Aircraft Inc.

## *1.7 Meteorological Information*

The flight path extended between a front lying to the northeast and an upper ridge to the southwest, through a convectively unstable air mass.

The area forecast was for overcast cloud based at 6,000 to 8,000 feet, isolated embedded cumulonimbus cloud and thundershowers, and winds increasing in strength after 1400 CST to 20 knots, with gusts up to 35 knots.

At Saskatoon, about 40 nm north of the accident site, at 0900 CST and 1000 CST, the wind was from the east at six knots. The weather observation at 1500 CST was scattered cloud based at 5,000 feet, temperature 20 degrees Celsius, winds from the southeast at 9 gusting to 17 knots. At 1600 CST the winds were from the southeast at 11 gusting to 18 knots.

Witnesses reported that the sky was overcast at the time of the accident, the winds had increased in strength during the early afternoon, and were gusting from 15 to about 25 knots, and visibility was about 10 nm in blowing dust. One witness noted that the wind direction was variable and the buffeting made it difficult to drive his truck.

Several witnesses observed numerous "dust devils" occurring in rows along the flight path of the accident aircraft at the time of the accident. Dust devils are atmospheric vortices caused by strong surface heating, frontal systems, thunderstorms and other phenomena. Research has shown that dust devils resulting from frontal systems often occur in rows. Researchers have measured wind gusts of 37 knots above ambient wind in dust devils[3]. The observed dust devils

were rotating fast enough to lift soil into the air, and remained in contact with the ground for more than 1/4 mile.

## *1.8 Centre of Gravity*

The initial centre of gravity (C of G) for this aircraft was calculated by the builder using a weight and balance form provided by the kit manufacturer. The position of the fuel as stated on the weight and balance form (in inches from the main spar) differs from the position as stated in the operator's manual: the form lists the fuel at a position further forward of the main spar than does the operator's manual. The builder calculated the C of G using the figures on the form.

During the assembly of the aircraft, the builder encountered problems with the paint and, therefore, repainted part of the aircraft. An examination of the aircraft's fabric after the accident revealed that the paint covering on the fuselage and part of the tail was thicker than that on the wings. Most of the area covered by the thicker paint is aft of the C of G.

The builder modified the design of the aircraft to relocate the battery from its position behind the pilot's seat to a position forward of the aircraft's firewall, and temporarily added a 10-pound ballast weight to the lower engine-mount structure. A C of G calculation record was found with the aircraft documents after the occurrence. The calculation showed that when the aircraft was fully fuelled and a pilot and passenger occupied the aircraft, the C of G was beyond the aft limit. It could not be

3 G.D. Hess and K.T. Spillane, "Characteristics of Dust Devils in Australia," *Journal of Applied Meteorology* June 1990: 498-507.

determined whether the calculation was prepared before or after the modifications to the aircraft were made.

The C of G was re-calculated, using the record found with the aircraft documents, to determine the effects of the aircraft modifications. The resulting C of G, however, was still not within the required range. Shortly before the accident, the pilot was reported to have discussed the installation of a heavier engine and gearbox, which would have had the effect of moving the C of G forward.

Aircraft flown with a C of G aft of limits exhibit reduced pitch stability and increased susceptibility to aerodynamic stall. As well, such aircraft have reduced elevator effectiveness available for aircraft control.

## *1.9 Flight Controls*

The flight controls were of standard design and operation. The ailerons ran the full length of the wing trailing edge. In the construction manual supplied with the aircraft kit, the manufacturer specified that gap seals be installed between the trailing edge of the wing and the leading edge of the ailerons.

The Cuby II aircraft is normally constructed with both aluminum and tape aileron gap seals. A diagram in the construction manual entitled "Aileron Section" contains a cross-sectional and plan diagram of the aluminum gap seals. A note at the bottom of the diagram says: "Seal gap with tape after final assembly. See instr. book." The aircraft's construction manual is the only book accompanying the kit, and in it only the aluminum gap seals are mentioned. The manufacturer reports that the builder was shown the tape gap seals and was verbally advised to install them on the aircraft.

Aluminum gap seals were installed on the accident aircraft. The manufacturer reports that tape gap seals are required to reduce turbulence around the ailerons and improve the lateral stability of the aircraft. No tape gap seals were installed on the accident aircraft.

An examination of the complete flight control system indicated no discrepancies.

## *1.10 Wreckage and Impact Information*

The aircraft was located approximately 8 1/2 miles west of Kenaston and approximately 1/2 mile north of provincial highway 15. There was no wreckage trail and all components were contained within the immediate area of the wreckage. The aft fuselage was compressed and the tail section twisted to the right. The passenger compartment was compressed and crushed. The right wing was swept back slightly and sustained more damage than the left wing. The damage to the aircraft indicates that it struck the ground in a right-wing-low, nose-down attitude. The aircraft was removed from the site and examined. All internal failures were overload in nature and attributed to the high impact forces.

## *1.11 Engine and Propeller Examination*

The engine was removed from the site for test and evaluation. The engine was examined and there was no evidence of any pre-existing failure or malfunction. The engine was run and was found to be capable of producing power.

The propeller blades were constructed of composite material and their pitch was ground adjustable. Both blades of the propeller were attached to the hub, and damage was limited to a single blade which was embedded in the ground and bent rearward in the propeller hub.

## *1.12 Certification*

The manufacturer issued a Declaration of Compliance certifying that the aircraft meets Transport Canada's TP 10141, *Design Standards for Advanced Ultra-Light Aeroplanes*. Based on this declaration, Transport Canada approved the design as No. 1991-03-21.

The builder that assembled the aircraft was the kit manufacturer's designated Industry Representative (IR). Industry Representatives are responsible for assessing the condition and assembly of Advanced Ultralight Aircraft (AULA), in the context of manufacturer's fitness inspections, mandatory actions, modifications, and the quality and currency of maintenance.

The builder, acting in the capacity of an IR, completed a Statement of Conformity for the accident aircraft certifying that "...the aeroplane referred to herein has been assembled in accordance with the manufacturer's assembly instructions." No other qualified IR is known to have inspected the accident aircraft.

The aircraft was still in the test flight stage and the builder had not yet installed all the required operating and limitation placards.

## *1.13 Survival Aspects and Medical Information*

The aircraft was equipped with a four-point harness restraint system. The occupants' shoulder straps were secured to structural members of the airframe, several of which failed when the aircraft struck the ground. The occupant compartment was crushed by the impact forces and the occupants sustained multiple non-survivable injuries. There was no evidence that incapacitation or physiological factors affected the pilot's performance.

# 2.0 Analysis

## 2.1 Certification

The builder of the accident aircraft was also the manufacturer's designated Industry Representative for the Cuby II aircraft. There was, therefore, no requirement for independent supervision of the aircraft's construction, or for an independent final check of the aircraft before it was certified for flight.

## 2.2 Centre of Gravity

There is no record of the aircraft's C of G before the aircraft was painted, and it could not be determined how much paint was applied in the second coat. However, because the fuselage and part of the tail were found to have thicker paint than the rest of the aircraft, and the repainted part of the aircraft is mostly aft of the C of G, repainting the aircraft had the effect of moving the C of G aft.

The C of G calculation found with the aircraft documents was not dated and so it is not possible to determine whether it was prepared before or after the repainting, the relocation of the battery, or the addition of the ballast weight to the engine. However, because those changes would not have been sufficient to move the C of G within the required range, the C of G of the aircraft was probably beyond the aft limit at the time of the accident.

## 2.3 Aileron Gap Seals

In the construction manual, the tape aileron gap seals are mentioned in the "Aileron Section" diagram by the reference: "Seal gap with tape after final assembly. See instr. book." The manufacturer reportedly advised the builder to install

the tape gap seals. The seals are not described in the text of the construction manual.

The manufacturer advises that tape gap seals are required to reduce turbulence around the ailerons and improve lateral stability. Because the accident aircraft lacked tape gap seals, its lateral stability was reduced.

## 2.4 Effect of the Weather

The wind speed increased during the stopover in Davidson and by 1600 CST the wind was 11 knots gusting to 18 knots. Witnesses noted variable and buffeting winds and observed numerous dust devils along the aircraft's flight path. Since wind gusts as high as 37 knots above ambient wind have been observed in dust devils, and the accident aircraft's cruise speed was about 25 to 30 knots higher than its stalling speed, wind shear in a dust devil could have reduced the airspeed of the accident aircraft below its stalling speed.

## 2.5 Aerodynamic Stall and Spin

Because the aft C of G reduced the aircraft's pitch stability, reduced its elevator effectiveness, and increased the aircraft's susceptibility to aerodynamic stall, the pilot was probably unable to avoid stalling the aircraft when it encountered gusty winds and possibly dust-devil-related wind shear. Because of the effects of the aircraft's lack of tape aileron gap seals and its aft C of G, the pilot was probably unable to maintain control of the aircraft in the stall. Once the aircraft stalled, it entered a spin from which recovery was not possible in the altitude available.

## 2.6 Engine and Propeller

The damage to the propeller indicates that the engine was operating at low power at impact. However, because there was no evidence of a malfunction, it is unlikely that either the engine or propeller was a factor in this occurrence.

## 2.7 Survivability

Despite the failure of the occupant restraint system, the accident was not survivable because of the high deceleration forces and crushing of the occupant compartment.

# 3.0 Conclusions

## 3.1 Findings

1. The aircraft records indicate that it was certified and equipped in accordance with existing regulations and approved procedures.

2. There was no requirement for independent supervision of the aircraft's construction, or for an independent final check of the aircraft before it was certified for flight.

3. The pilot was certified and qualified for the flight in accordance with the Transport Canada Ultralight Aeroplane Policy.

4. The C of G of the aircraft was probably beyond the aft limit at the time of the accident.

5. There was no evidence that incapacitation or physiological factors affected the pilot's performance.

6. The lack of tape gap seals probably reduced the effectiveness of the ailerons, thereby reducing the lateral stability of the aircraft.

7. The aircraft encountered gusty winds and wind shear which probably exceeded the capabilities of the aircraft.

8. The aircraft stalled and entered a spin from which recovery was impossible in the altitude available.

9. The accident was non-survivable because of the high deceleration forces and crushing of the occupant compartment.

## 3.2 Causes

The aircraft encountered gusty winds and wind shear which probably exceeded its capabilities, then stalled and entered a spin from which recovery was impossible in the altitude available. Contributing factors were the aft centre of gravity of the aircraft and incomplete aileron gap seals.

# 4.0 Safety Action

## 4.1 Action Taken

The manufacturer has amended the text of the aircraft's construction manual to describe the installation of the tape gap seal, and has added a diagram illustrating both types of gap seals in detail.

*This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson, John W. Stants, and members Gerald E. Bennett, Zita Brunet, the Hon. Wilfred R. DuPont and Hugh MacNeil, authorized the release of this report on 22 December 1994.*

# *Appendix A - Glossary*

| | |
|---|---|
| AULA | Advanced Ultralight Aircraft |
| agl | above ground level |
| C of G | centre of gravity |
| CST | central standard time |
| hr | hour(s) |
| hp | horsepower |
| IR | Industry Representative |
| nm | nautical miles |
| PPL-UL | private pilot licence - ultralight aircraft |
| TSB | Transportation Safety Board of Canada |
| UTC | Coordinated Universal Time |
| Vne | never-exceed speed |