

AVIATION OCCURRENCE REPORT

AIRFRAME FAILURE - WING

**MAGAL CUBY II (ULTRALIGHT) C-IEXR
LEGAL, ALBERTA 4 NM W
09 SEPTEMBER 1995**

REPORT NUMBER A95W0166

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 instructor and student departed the St. Albert Airport, Alberta, at about 1800 mountain daylight saving time (MDT), in the student's Magal Cuby II ultralight aircraft. The purpose of the flight was to conduct commercial ultralight student training exercises. At about 1830, witnesses near Legal heard a loud report emanating from an aircraft flying overhead. The aircraft was in level flight and heading in a northeast direction. They also observed pieces falling from the aircraft, which was about 500 feet above ground level (agl), and noticed that the outer section of the left wing was missing. Seconds later the aircraft entered a steep descent, and was destroyed when it struck the ground. Both pilots were fatally injured.

All times are MDT (Coordinated Universal Time minus six hours) unless otherwise noted.

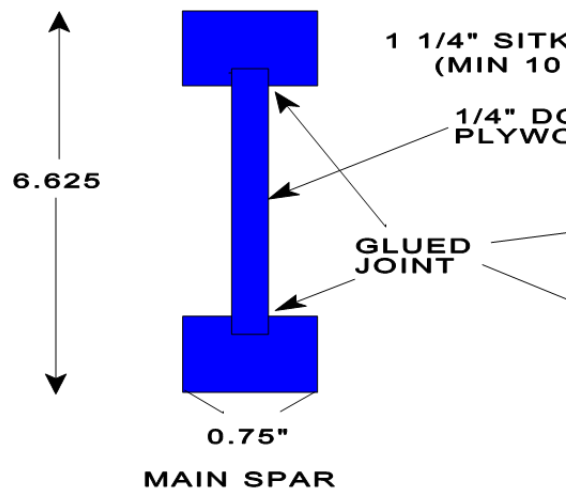
Other Factual Information

Witnesses at the accident site reported that, at the time of the accident, the sky was clear and there were light winds from the southwest.

The pilots were certified and qualified for the flight in accordance with the Transport Canada (TC) Ultralight Aeroplane Policy. The right seat position was occupied by the qualified ultralight instructor. The left seat position was occupied by the commercial ultralight student, who was also the owner. A witness reported that he was in attendance during the pre-flight briefing and that he overheard the pilots discussing their intention of practicing unusual attitudes and spins during the upcoming flight. The aircraft is not approved for spins.

The aircraft was manufactured in 1985, and the owner purchased it, ready to fly, in May 1995. No maintenance history of the aircraft was found; however, a sales receipt and TC registration form indicate that the aircraft was recently re-equipped from a 50 hp (Rotax model 502 GU) to a 65 hp (Rotax model 582) engine.

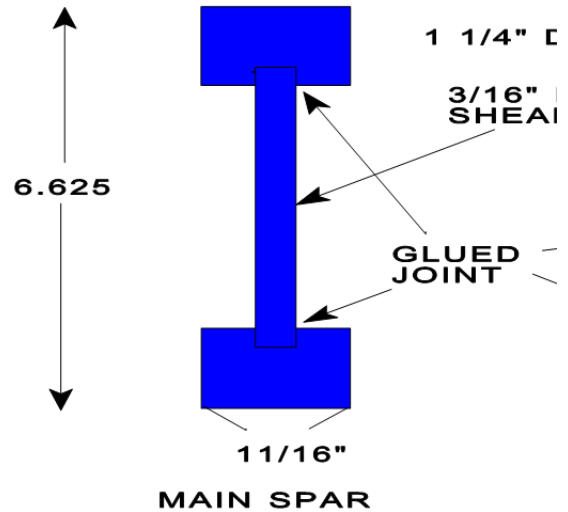
The Cuby II aircraft is a two-place, side-by-side, high-wing, conventional-gear monoplane. The designer's sketch specifies the cross-sectional dimensions of the spar caps as follows: the top main wing spar caps are to be constructed of 1 1/4 inch high by 3/4 inch wide Sitka spruce; the lower spar caps are to be 1 inch high by 3/4 inch wide, and also of Sitka spruce. The main spar caps are to be joined by 1/4 inch wide Douglas fir shear webbing.



NOTE: NOT DRAWN TO SCALE

The wreckage examination revealed that the outer section of the left wing was missing from the main wreckage, and was located in a field about 279 feet to the northeast. Other pieces of fabric and aluminum ribs from the left wing were strewn in a northeast direction up to a maximum distance of about 1,740 feet from the main point of impact. The left wing wooden front and rear spars were found with a vertical break near the lift strut attachment fittings. Examination of these surfaces by the TSB Engineering Branch determined that the fractures were a result of compression damage. There was no evidence to indicate that the left wing spars had been replaced since original manufacture in 1985.

Examination of the aircraft's failed left wing spars indicated that they were not constructed in accordance with the designer's sketch. The wood grain orientation of the failed spar caps was found to be at 90 degrees to the direction recommended and was unsatisfactory for straightness. The spar caps and webs were under-dimensioned; 3/16 inch mahogany had been substituted for the 1/4 inch fir plywood shear web called for in the sketch. In addition, the spar cap wood material was fir and not sitka spruce, as specified. Further examination reveals that the structural stability of the aircraft's wing design was questionable. Any sort of aerobatic manoeuvre, particularly ones requiring positive high angles of attack for entry, would be hazardous. There was also evidence of previous damage to the left wing in the form of a left wing tip spar and fabric repair. There were no wing inspection ports to allow for adequate periodic inspections of the internal wing structure.



NOTE: NOT DRAWN

The effect of the spar failure on the flight characteristics of the aircraft would be such that the left wing would experience a loss of lift, and that the aircraft would enter an uncommanded roll to the left.

Ultralight aeroplanes are exempt from airworthiness certification requirements, and neither a Certificate of Airworthiness (C of A) nor a Flight Permit is required. At the time this aircraft was built, there were no TC-regulated design, construction, or assembly standards established for ultralight aircraft. There are now TC design standards for advanced ultralight aircraft. The current Cuby II is designated as an advanced ultralight and must meet these design standards.

The engine was examined, and no evidence of any pre-existing malfunction was found. The lack of propeller blade damage was consistent with reduced power being produced at the time of impact. An examination of the flight control system did not indicate any discontinuities, and all controls were capable of normal operation. Gap seals were not installed between the trailing edge of the wing and the leading edge of the ailerons. The manufacturer advises that tape gap seals reduce turbulence around the ailerons and improve the lateral stability of an aircraft. The magnetos and key were found in the OFF position. There were two fuel tanks installed: one in the

right wing and one behind the front seats. In addition, a plastic five-Imperial-gallon fuel container was located in the baggage compartment. All were ruptured and contained residual fuel. The ground, at the point of main impact, was saturated with fuel.

The centre of gravity (C of G) and wing loading could not be calculated because of the undetermined amount of fuel on board. However, considering the weight of both pilots, the additional weight of the newly installed engine, and the fuel-saturated ground, it is possible that the aircraft was at the maximum allowable weight and wing loading.

An autopsy of the deceased pilots by the Provincial Medical Examiner revealed that the cause of death has been attributed to multiple blunt injuries. The accident was not survivable because of the high deceleration forces and the destruction of the front of the cockpit. Postmortem toxicology of the instructor revealed the presence of tetrahydrocannabinol (Cannabis-containing substance) within the blood. During the field investigation, a marijuana cigarette was found in a cigarette package located in the cockpit.

Analysis

The analysis will focus on the structural failure of the left wing spars. The weather was not considered to be a factor in the occurrence.

The left wing structural failure may have been the result of a previous occurrence where the left wing tip had been damaged then inadequately inspected at the time of the repair. Given the leverage that existed during the wing tip strike, damage may have been done to the spar further inboard. Since ultralight aircraft are exempt from the requirement for a licensed engineer to reference a repair in an aircraft log-book, it was not possible to determine what had occurred. Normal load reversals on the spar while in service would include flight loads, landing loads, and the loads experienced while tied down. The questionable design and construction of the wing would typically result in a reduction in bending strength. Although wooden spars are susceptible to deterioration because of age and damage to a far greater degree than other spar materials, the means of actually examining these spars on the aircraft was very limited. Inspection of the wooden spar surfaces would be almost impossible without the installation of additional inspection ports.

A witness reported that, during the pre-flight briefing, the pilots had discussed practising unusual attitudes and spins. Manoeuvres such as these would place higher-than-normal aerodynamic flight loads on the aircraft. The combination of factors such as previous damage, orientation of the wood grain, wing loading, and the flight profile may have exceeded the strength of the already weakened and inadequately assembled wing spars. A sudden loss of lift following the left wing spar failure would have resulted in the aircraft entering an uncommanded left roll. Recovery would not have been possible. Examination of these surfaces determined that the

fracture was a result of compression damage, since the spars appeared to have been original to the aircraft, which was manufactured in 1985.

The postmortem toxicology report revealed the presence of a cannabis-containing substance within the blood of the instructor; however, it could not be determined what effect the amount specified would have had on his flight performance.

The following Engineering Branch report was completed:

LP 137-95 - Wing Analysis.

Findings

1. The pilots were certified and qualified for the flight in accordance with the TC Ultralight Aeroplane Policy.
2. The pilot lost control of the aircraft when the left wing spars failed in flight, and the aircraft entered an uncommanded left roll followed by a vertical descent into the ground.
3. The left wing spars were not constructed in accordance with the designer's specifications.
4. The aircraft's wing, as designed and constructed, had a questionable margin of safety in bending strength.
5. There was evidence of previous damage to the left wing tip, which had been inadequately inspected and repaired.
6. There were no wing inspection ports to allow for adequate periodic inspections of the internal wing structure.

Causes and Contributing Factors

The in-flight structural failure of the left wing was likely caused by pre-existing damage, and by questionable design, construction, and inadequate inspection procedures. Contributing to the occurrence may have been the aircraft's gross weight and the aerodynamic flight loads placed on the wing during the training flight.

Safety Action Taken

Wing Construction

Examination of the wreckage revealed that the aircraft had not been constructed in accordance with the manufacturer's suggestions. An article in issue 2/95 of Transport Canada's *Aviation Safety Ultralight and Balloon* discussed this aspect of the accident and indicated that the manufacturer was sending a related Air Safety Advisory to all known Cuby I and Cuby II owners.

Wing Design

In light of the identified wing design deficiencies, and the number of Magal Cuby II ultralights on the Canadian Civil Aircraft Register, a TSB Aviation Safety Advisory was sent to Transport Canada on the need to inform the ultralight community of the design shortcomings with at least some Cuby II aircraft.

Ultralight Placarding

The accident aircraft was not required to meet any design standards, nor was it required to be so placarded. It is not known if the student pilot was aware that the aircraft did not need to meet design standards.

The draft Canadian Aviation Regulations (expected to be promulgated in 1996), include a requirement for ultralights to have a placard affixed to a surface in plain view of any occupant seated at the flight controls that states, "THIS AIRCRAFT IS NOT REQUIRED TO MEET ANY AIRWORTHINESS STANDARDS/CET AÉRONEF N'EST PAS ASSUJETTI AUX NORMES DE NAVIGABILITÉ." This action should better enable occupants to manage their own risk.

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 16 April 1996.