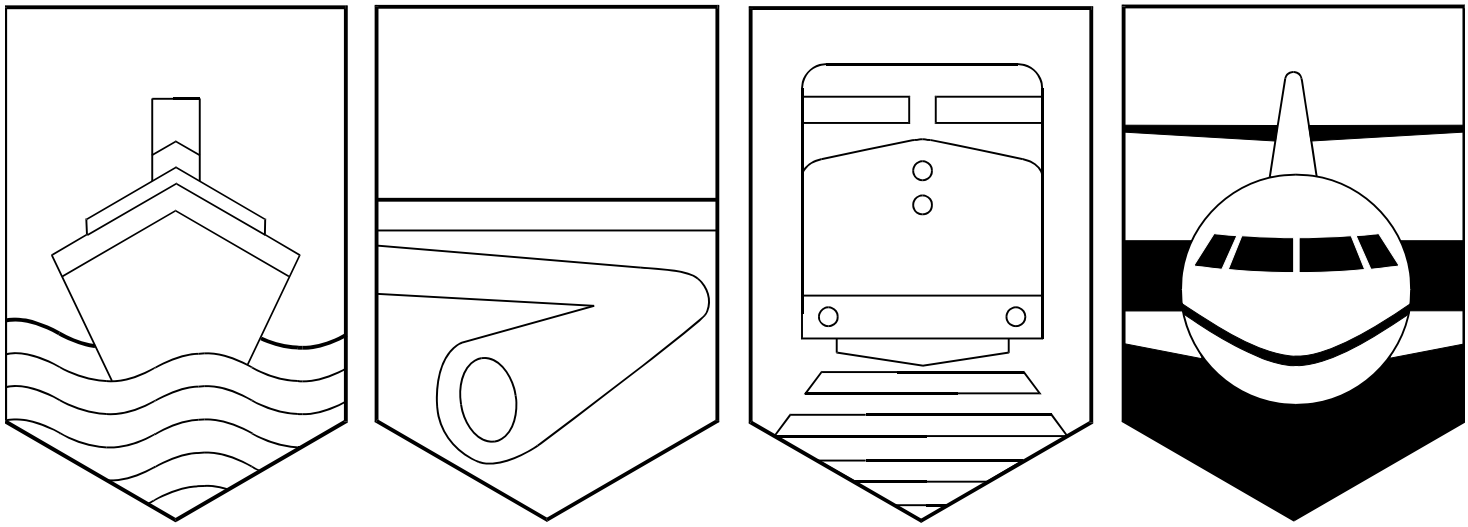
Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada



# AVIATION OCCURRENCE REPORT

## WING FAILURE

## TAYLORCRAFT BC12D-85 C-FXWA
## SYLVAN LAKE, ALBERTA 3 mi SW
## 27 JUNE 1994

## REPORT NUMBER A94W0107

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.

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# Aviation Occurrence Report

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# Sylvan Lake, Alberta 3 mi SW
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*Synopsis*

The pilot made a low pass over a neighbour's farm then pulled the aircraft into a climb. Suddenly the aircraft began rolling to the right, then descended vertically into the ground. Examination of the aircraft revealed that a structural failure of the right rear wooden wing spar had occurred. The pilot was fatally injured.

The Board determined that the wing failure may have been the result of a previous occurrence involving damage to the right wing that was inadequately inspected both at the time of repair and during subsequent annual inspections.

Ce rapport est également disponible en français.

# *Table of Contents*

# 1.0 Factual Information

## 1.1 History of the Flight

After working on his farm since early morning, the pilot decided to conduct a local pleasure flight from a nearby farm strip where the aircraft was stored. The pilot refuelled the aircraft and then departed on his flight. As he had done in the past, the pilot made several low passes over a neighbour's farm. The neighbours went into the yard to wave to the pilot. As the pilot pulled the aircraft into a climb, the aircraft suddenly began rolling to the right, then descended vertically into a field of alfalfa. The neighbours called the police, and proceeded to the wreckage site where they found that the pilot had sustained fatal injuries.

The accident occurred at about 2100 mountain daylight time[1] (MDT)[2], at latitude 52°18'N, longitude 114°02'W, in daylight conditions.

## 1.2 Injuries to Persons

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

1 All times are MDT (Coordinated Universal Time [UTC] minus six hours) unless otherwise stated.

2 See Glossary for all abbreviations and acronyms.

## 1.3 Damage to Aircraft

The aircraft was destroyed.

## 1.4 Other Damage

There was minor crop damage.

## 1.5 Personnel Information

| | Pilot-in-Command |
|---|---|
| Age | 47 |
| Pilot Licence | PPL |
| Medical Expiry Date | 01 Dec 1994 |
| Total Flying Time | 1,000 hr |
| Total on Type | 200 hr |
| Total Last 90 Days | 4 hr |
| Total on Type Last 90 Days | 4 hr |
| Hours on Duty Prior to Occurrence | 9 hr |
| Hours off Duty Prior to Work Period | 15 hr |

### 1.5.1 Pilot Background

The pilot had obtained his private pilot licence (PPL) in 1972 and had owned several light aircraft prior to the purchase of the accident aircraft in 1986. The family was unable to locate the pilot's log-book.

## 1.6 Aircraft Information

| Particulars | |
|---|---|
| Manufacturer | Taylorcraft Inc. |
| Type | BC12D-85 |
| Year of Manufacture | 1948 |
| Serial Number | 12028 |
| Certificate of Airworthiness (Flight Permit) | Valid |
| Total Airframe Time | 1,668 hr |
| Engine Type (number of) | Continental C-85-8 (1) |
| Propeller/Rotor Type (number of) | McCauley 1B90/CM7146 (1) |
| Maximum Allowable Take-off Weight | 1,280 lb |
| Recommended Fuel Type(s) | 80\87 Avgas |

| | |
|---|---|
| Fuel Type Used | Mogas |

### *1.6.1 Maintenance History*

The aircraft had last been certified airworthy during a Certificate of Airworthiness (C of A) Renewal/100-Hour Inspection on 28 December 1993 at 1,652.4 airframe hours. The aircraft had been inactive for some time, and had been ferried to a maintenance facility for servicing.

The aircraft technical logs indicate that in July 1985, at 1,571.2 airframe hours (96.8 hours prior to the accident), the aircraft had been damaged in an unreported occurrence while registered to a previous owner. The airframe log repair entry does not indicate the nature of the occurrence, but describes the replacement of a damaged right main landing gear leg, and repairs to the right wing tip bow and wing tip fabric. The engine log indicates that the crankshaft was inspected for

run-out, and the propeller log entry indicates that blade straightening was carried out at an overhaul facility. The maintenance facility involved is no longer in business.

A second technical log entry, in March 1989, at 1,624.3 airframe hours (43.7 hours prior to the accident), describes repairs including straightening the fuselage tail-post, the rudder and vertical stabilizer, and the horizontal stabilizer support. The crankshaft hub was magnaflux inspected and the propeller was repaired. A propeller entry in the Record of Installations and Modifications log indicates "damaged by wind tip over - removed for repair and straightening." The aircraft repair facility indicated the owner had reported that the aircraft had been blown over on its back.

## *1.7 Meteorological Information*

There was no evidence found to indicate that the pilot had obtained a formal weather briefing prior to departure. Local weather conditions were reported as a partially cloudy sky and calm wind conditions. The nearest Environment Canada station at Red Deer, Alberta, reported scattered cloud at 9,000 feet, visibility 15 miles, temperature 16.2 degrees Celsius, dew point 7.3 degrees Celsius, and wind from 060°T at 3 knots at 2100 MDT. Weather was not considered a factor in the occurrence.

## *1.8 Wreckage and Impact Information*

### *1.8.1 Accident Site*

The aircraft struck the ground in a steep, nose-down attitude. The engine and propeller were pushed back and under the forward fuselage. One propeller blade was heavily twisted, and the leading edge was nicked in a manner typical of ground contact at a high power setting. The aft fuselage was buckled downwards just behind the wing trailing edge. Both wing leading edges were heavily impact damaged. Prior to the arrival of TSB investigators, the wreckage had been displaced, and the cabin area steel tubing had been cut apart with a "jaws of life" tool to remove the pilot.

### *1.8.2 Instrument Examination*

The following instruments were found with their pointers indicating the following readings:

| | |
|---|---|
| Tachometer | 2100 rpm |
| Oil Pressure | 26 psi |
| Oil Temperature | 125°F |
| Cylinder Head Temperature | 350°F |

3 For additional information see TSB Engineering Branch Report, LP 96/94 - Instrument Analysis.

4 For additional information see TSB Engineering Branch Report LP 95/94 - Wing Failure Analysis.

The airspeed indicator and the vertical speed indicator dials were examined by the TSB Engineering Branch Laboratory to determine their pointer locations at impact, but no information was found[3].

*1.8.3 Spar Failure*

The right rear wooden wing spar was found with a vertical break inboard of the rear lift strut attachment fitting. The break exhibited an unusual, smooth, flat fracture surface over 75 per cent of the spar cross-section, with a splintered appearance on the remainder. The fracture surfaces appeared to have been rubbing against one another. The fracture coincided with the inboard edges of a pair of plywood spar doublers. Examination of these surfaces by the TSB Engineering Branch Laboratory[4] and a wood products specialty facility determined that the fracture was a result of compression damage to the wooden wing spar prior to the accident. Compression damage is characterized by a buckling of the wood fibres, and will appear as streaks on the surface, substantially at right angles to the grain. Compression damage to wood can occur during the felling of trees, if they are roughly handled, or while a wooden component is in service on the aircraft. A typical example of in-service compression damage to wooden wing spars would be an occurrence where the lower surface of a wing tip contacts the ground heavily while the aircraft is in motion.

There was no evidence found to indicate that the right rear spar had been replaced since original manufacture in 1948.

A finite element computer simulation of the effect of this spar failure on the flight characteristics of the aircraft was prepared by the TSB Engineering Branch Laboratory facility. It indicated that the right wing would experience a loss of lift, and that the aircraft would enter an uncommanded roll to the right.

*1.8.4 Engine and Fuel System Examination*

The engine was examined and found capable of normal operation. Fuel samples indicated that mogas was being used, although no evidence was found of the Supplementary Type Certificate (STC) approval which is required by Transport Canada (TC) regulation for use of this fuel.

*1.8.5 Flight Controls*

Examination of the flight control systems did not indicate any discontinuities, and all controls were capable of normal operation.

## *1.9 Medical Information*

An autopsy and toxicological examination of the deceased pilot by the Provincial Medical Examiner indicated evidence of atherosclerotic coronary artery disease; however, it was not believed to have been the cause of or a contributing factor in the pilot's death.

## *1.10 Fire*

There was no fire.

## *1.11 Survival Aspects*

The aircraft was not fitted with a shoulder harness; however, the accident was considered non-survivable due to the magnitude of the deceleration forces. The lap-belts found installed in the aircraft were of the obsolete fabric-to-metal type.

The aircraft was not equipped with an emergency locator transmitter (ELT); however, it was operating within a 25-mile radius of its home base, and, therefore, an ELT was not required.

## *1.12 Additional Information*

*1.12.1 Regulatory Requirements for Inspection of Wooden Spars*

TC has historically recognized the requirement for thorough, repetitive inspections of wooden components to ensure continuing structural soundness. An early TC Wooden Component Airworthiness Directive (AD), AD 63-3, was cancelled by AD CF-63-03R1, which indicated that, with the introduction of Chapter 571 of the *Airworthiness Manual* (AWM) and *Airworthiness Manual Advisory* (AMA) 571.101/5, all the necessary requirements were provided for the inspection of wooden components.

A review of these documents indicates that Chapter 571, item G, page 18 in Appendix A of the *Inspection Program for Small Aircraft* requires inspection for poor condition of all components of the wing at 100-hour intervals. AMA 571.101/5, however, does not provide the Aircraft Maintenance Engineer (AME) with any inspection criteria for detection of compression failures in wooden spars. The AMA appears devoted to aircraft with wood skin rather than the more common combination of internal wooden structural members with metal ribs and fabric cover.

There was no evidence found to indicate that the owner/pilot had selected and identified an inspection program in the aircraft journey log or provided the maintenance facility with a copy of an Inspection Check List as required by the AWM, Chapter 571. The inspection forms used by the maintenance facility during the last annual/100-hour inspection did not include a specific reference to visual inspection of the wing spar for condition as required by the AWM, Chapter 571.

### *1.12.2 Inadequate Inspection of Wooden Spars*

Although wooden spars are susceptible to deterioration due to age and damage to a far greater degree than other spar materials, the means of actually examining the wooden spars on the average light aircraft are very limited. The accident aircraft had only two inspection panels on the lower surface of each wing, and they were provided for control system access. Inspection of the wooden spar surfaces, especially to try to detect the evidence of compression damage, would be almost impossible without the installation of additional inspection panels.

# 2.0 Analysis

The analysis will concentrate on the structural failure of the right wing spar. Weather and the pilot's medical condition were not considered to be factors in the occurrence.

## 2.1 Spar Failure

The compression damage found in the spar could have occurred either before the wood was processed for aircraft use or, later, while the spar was installed on the aircraft. Since the spar appears to have been original equipment on an aircraft manufactured in 1948, and it would be considered unusual for damage prior to fabrication to take 46 years to fail, it appears more probable that the spar failure was the result of the recent damage to the aircraft.

Of the two occurrences involving damage which were documented in the aircraft logs, the event in 1985 had the most potential to cause compression damage to the right rear spar. The repair description indicates a probable loss of control resulting in a ground loop or landing gear collapse. Since the repair facility involved has gone out of business, it was not possible to determine what had occurred.

Normal load reversals on the spar while in service, which would include flight loads, landing loads, and loads experienced while tied down, would result in a progressive failure at the compression damaged area. When the aircraft was on its back during the second occurrence, the spar would have been subjected to unusual bending loads that may have exacerbated the progressive nature of the fracture.

The low pass and pull up conducted by the pilot finally stressed the weakened right rear spar to its limit, and it failed. The sudden loss of lift on the right wing would have resulted in the aircraft entering an uncommanded right roll from which recovery would not likely have been possible.

## 2.2 Inspection

The aircraft had been inspected for damage following the two occurrences found in the logs and annually during the normal 100-hour inspection, but the compression damage to the spar was not detected. In order to properly inspect the spar, it would be necessary to either install additional wing inspection panels or remove the fabric cover.

TC AMA 571.101/5 is deficient because it does not contain guidance for inspection requirements to detect compression failures in wooden spars.

# 3.0 Conclusions

## 3.1 Findings

1. The pilot was certified and qualified for the flight in accordance with existing regulations.

2. The aircraft entered an uncommanded right roll and descended vertically into the ground.

3. The right rear wooden wing spar failed in flight due to compression damage which may have been the result of previous damage to the aircraft.

4. The wing spar damage was not detected during initial repair or subsequent annual inspections.

5. The pilot/owner had not selected or identified an inspection program in the journey log as required by regulation.

6. The inspection form used by the maintenance facility during the last annual inspection did not include visual inspection of the wing spar for condition as required by AWM, Chapter 571.

7. The inspection panels installed on the wing would not allow for adequate examination of the spars for damage.

8. The aircraft was equipped with obsolete fabric-to-metal type seat-belts.

9. Mogas fuel was being used without the STC approval required by regulation.

10. The aircraft was not equipped with an ELT.

11. AMA 571.101/5 does not contain guidelines on how to detect compression damage in wooden spars.

## 3.2 Causes

The wing failure may have been the result of a previous occurrence involving damage to the right wing that was inadequately inspected both at the time of repair and during subsequent annual inspections.

# *4.0 Safety Action*

The Board has no aviation safety recommendations to issue at this time.

*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 28 March 1995.*

# *Appendix A - List of Supporting Reports*

The following TSB Engineering Branch Laboratory Reports were completed:

LP 95/94 - Wing Failure Analysis; and
LP 96/94 - Instrument Analysis.

These reports are available upon request from the Transportation Safety Board of Canada.

# *Appendix B - Glossary*

| | |
|---|---|
| AME | aircraft maintenance engineer |
| AMA | Airworthiness Manual Advisory |
| AD | Airworthiness Directive |
| AWM | Airworthiness Manual |
| C of A | Certificate of Airworthiness |
| ELT | emergency locator transmitter |
| hr | hour(s) |
| lb | pound(s) |
| MDT | mountain daylight time |
| mi | mile(s) |
| N | north |
| PPL | Private Pilot Licence |
| psi | pounds per square inch |
| rpm | revolutions per minute |
| STC | Supplemental Type Certificate |
| TC | Transport Canada |
| TSB | Transportation Safety Board of Canada |
| UTC | Coordinated Universal Time |
| W | west |
| ' | minute(s) |
| " | second(s) |
| ° | degree(s) |
| °F | degrees Fahrenheit |
| °M | degrees of the magnetic compass |
| °T | degrees true |

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