Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A01P0203

STRUCTURAL FAILURE

HELIO COURIER C-FOMI
VALEMOUNT, BRITISH COLUMBIA, 37nm SE
20 AUGUST 2001

Canada

Aviation Investigation Report

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Summary

A Helio H-295 Super Courier, C-FOMI, with only the pilot on board, took off from Smithers, British Columbia, with full fuel tanks. The pilot landed at Fort St. James to pick up a passenger and took off for Calgary (Springbank), Alberta. A logger working in the Hugh Allan Creek area heard the aircraft passing overhead. He heard two loud cracks and looked up to see that the right wing had separated from the aircraft, which was spiralling downward, trailing debris. The aircraft crashed at approximately 1600 Pacific daylight time, 37 nautical miles southeast of Valemount. No fire occurred. Both occupants were fatally injured.

Ce rapport est également disponible en français.

Other Factual Information

Before the flight, the pilot received a full weather briefing from the Smithers Flight Service Station (FSS) at about 1115 Pacific daylight time (PDT).[1] Weather conditions were reported suitable for flight along the route in accordance with visual flight rules. Actual weather at 1600 at the Blue River airport, 36 nautical miles southwest of the accident site, was as follows: wind 190° true at 2 knots; visibility more than 15 statute miles; a few clouds at 300 feet and 2500 feet; broken clouds at 4500 feet, 12 000 feet, and 30 000 feet; temperature 13.6°C; and dew point 10.5°C.

A report was received from a pilot who took off from Valemount at 1443 (about 1¼ hours before the accident), intending to fly in the general area of the accident. He observed a large thunderstorm cell over the north end of McNaughton Lake and decided to return to Prince George. En route between Valemount and Prince George, visual meteorological conditions prevailed, numerous thunderstorm cells were present, and there were areas of light to moderate turbulence along certain areas of the Fraser River.

Visual and infrared satellite photographs for 2300 Coordinated Universal Time (1600 PDT) were examined but did not reveal any obvious thunderstorm activity. A lightning detection program was run but did not detect any strikes in that region for 24 hours before and after the time of the accident.

Wreckage was found in a steep, wooded area adjacent to a logging road at approximately 4500 feet above sea level. This site is 4630 m southeast of a 9080-foot peak in the Selwyn Range. Damage to trees near the wreckage indicates that the aircraft struck the ground in a vertical descent, consistent with the observation that it was spiralling out of control with one wing detached. Fuel was found in the left wing tanks. Fuel cell debris from the right wing was found by the side of a logging road, 175 m from the main wreckage. The right wing was found 575 m from the main wreckage, and the right aileron was found lodged in a tree above. The left aileron, trailing edge flaps, and leading edge slats were ripped off the wing structure and were not found. The wreckage was recovered from the accident site for a more detailed examination at the TSB regional wreckage examination facility.

Damage and contact markings indicated that the slats had deployed violently before being ripped off the wings. The flaps were torn away at their attachments while in the up position. Fretting corrosion marks were found on both lower wing attachment points. The right wing main spar was found to have failed in overload about one foot outboard of the carry-through structure. The wing structure showed torsional deformations consistent with failure occurring in an upward and aft direction.

The pilot held a valid private pilot licence. He had accumulated a total of 3585 hours of flying time as of 28 February 2001 and had been flying this particular aircraft since 1990.

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

Logbooks and maintenance records indicate that the aircraft had been certified, equipped, and maintained in accordance with existing regulations and approved procedures. The aircraft had no known deficiencies before the flight. The airframe had operated 2651.2 hours as of 09 July 2001. The engine had operated 994.2 hours since overhaul. The last recorded maintenance was to overhaul the propellor on 30 November 2000. The last annual inspection was accomplished on 11 August 2000. The aircraft was due for a 100 hour inspection or annual inspection, whichever came first, no later than 11 August 2001, nine days before the accident.

The aircraft was loaded with a considerable amount of gear, consisting of survival equipment, audiovisual equipment, and personal effects. When the wreckage was recovered, these articles weighed 340 pounds. The aircraft was operated close to its maximum allowable weight and was within its centre-of-gravity limits. At the time of the accident, the aircraft was airborne for about 2 hours 25 minutes, consumed about 130 L (approximately 220 pounds) of fuel, and weighed approximately 3600 pounds, 200 pounds below its maximum gross weight.

This Helio Courier H-295, serial number 1475, operated under a supplemental type certificate (STC), number SA1589CE, in the normal category. The STC was issued as part of a type design change to increase the maximum allowable gross weight from 3400 to 3800 pounds. The STC was issued 30 May 1980, amended 05 February 1981, and re-issued 31 May 1983. This STC did not require an inspection of the wing spar to carry-through structure for cracks or corrosion.

The aircraft was originally certificated by the Federal Aviation Administration (FAA) in the normal category, which calls for the aircraft to be designed to withstand a limit load factor of +3.8*g* and –1.52*g* and an ultimate load factor of +5.7*g* and –2.28*g*. In other words, a loading on the aircraft structure—either by pilot input through the flight controls or environmentally by means of a gust—of up to +3.8*g* would not cause permanent deformation or structural damage to the aircraft. Some structural damage could be expected if the limit load factor exceeds +3.8*g*, depending on the extent to which this limit is exceeded. Failure of a primary structural component would be expected if the ultimate load factor exceeds +5.7*g*. If the limit load factor was previously exceeded, the ultimate load factor would be compromised.

> A search of the TSB database revealed two similar occurrences of in-flight wing structural failure (reports A93P0013 and A78P0084) and another instance of structural damage caused by severe turbulence (report A94W0174) to Helio Courier H-295 aircraft in Canada. A search of the US National Transportation Safety Board (NTSB) database revealed one occurrence of in-flight wing structural failure to a Helio Courier H-295 aircraft in the US since 1983.

Limit load is a product of limit load factor and gross weight and is constant for all weights above design gross weight. Since the limit load is constant, if the gross weight is increased (example, 3400 to 3800 pounds), the limit load factor is reduced, in this case from 3.8*g*, to 3.4*g*.

A warning in the *Airplane Flight Manual* carried in the aircraft states:

> WARNING:
> 1. Use controls with caution above 125 mph (109 [knots]) CAS [calibrated airspeed].
> 2. In gusty air, it is advisable to reduce cruising speed below normal, and in severe turbulence reduce speed below 94 mph (flaps up) and below 65 mph (flaps down).

Airspeed indicators in the aircraft are marked with colour-coded radials and arcs to facilitate pilot recognition of important airspeeds:

- A radial red line marks the never-exceed speed, which is the maximum safe airspeed.
- A yellow arc on the outside of the instrument denotes a range of speeds in which operations should be conducted with caution and only in smooth air.
- A green arc denotes the normal operating speed range.
- A white arc denotes the speed range in which flaps may be safely lowered.

When this aircraft's gross weight was increased under the STC, several of the limiting airspeeds (in mph CAS) were changed to reflect the new maximum weight:

- The never-exceed speed (red radial) was reduced from 200 to 167.
- The caution range (yellow arc) was reduced from 160–200 to 133–167.
- The design cruising speed was reduced from 160 to 133.
- The normal operating range (green arc) was changed from 60–160 to 60–133.
- The maximum design manoeuvring speed was increased from 103 to 107.

The airspeed indicator was not changed, nor were any modifications made to reflect these changes in limiting airspeeds and airspeed ranges. The STC had no requirement to change or modify the airspeed indicator. The airspeed indicator incorporated a dual layout, presenting airspeed information in knots on the outside of the dial and in mph on a smaller scale on the inside of the dial.

A comparison between the right aileron and its factory drawing shows a number of discrepancies. These discrepancies were apparently perpetuated in field maintenance because, until recently, the factory drawing was proprietary and unavailable. Maintenance reference information on aileron balance and aileron free play is also not readily available.

Analysis

The pilot may have been aware of the new operating airspeeds in effect after the gross weight was increased. However, the layout of the airspeed indicator would have made it difficult to interpret airspeed readings in mph on the smaller inner scale, since it would have been easier and more natural to refer to the larger outer scale. The incorrect coloured arcs would also have been misleading.

The fretting corrosion on the lower wing attachment points indicates that heavy aircraft *g* loads had been applied over time. Since the limit load factor of 3.8*g* was established at the gross weight of the original design, the limit load factor would be reduced to 3.4*g* when the aircraft was flown at a higher weight.

Although the presence of convective clouds in the area of the accident cannot be verified, a pilot report of such activity in the area 1¼ hours before the accident makes it highly probable. Turbulence is normally associated with convective clouds; the larger the cloud, the more turbulence. Flight through or near convective clouds can be very rough.

At the time of the accident, the aircraft was approximately 200 pounds below its maximum allowable gross weight. Weight affects the limit load factor . The limit load factor decreases faster than the gust-imposed load factor when weight is increased; therefore, heavily loaded aircraft can be damaged without particularly high *g* loadings.

The aircraft may have been flown above its maximum design manoeuvring speed of 107 mph, the maximum speed at which flight controls could be safely moved through their full operating range. A large movement of the flight controls at the maximum design cruising speed could, in itself, cause structural damage, especially if the structure had been weakened by previously exceeding the aircraft limit load factor.

The aircraft likely encountered a strong gust, causing the slats to deploy asymmetrically and then to be torn off the wing structure. This likely caused wing torsional oscillations which may have resulted in the flaps separating. The gust, which may have exceeded the aircraft's limit load factor, might also have exceeded the aircraft's ultimate load factor, causing the right wing main spar to fail in overload. The gust encountered would not have had to actually exceed the aircraft's ultimate load factor. If the gust rolled the aircraft significantly from level flight and the pilot tried to correct the roll with a large aileron control input, the average *g* loading might not have been critical, but the downgoing wing would have had a higher angle of attack and therefore sustained a higher load factor. In addition to the wing lift loads possibly not being equal, deflecting the ailerons to try to roll level exerts torsional forces on the wing. If a wing is close to its limit load factor when torsional forces are introduced, the forces may be sufficient to cause structural failure.

Findings as to Causes and Contributing Factors

1. As indicated by the fretting corrosion on the lower wing attachment points, the aircraft had previously exceeded its limit load factor, compromising the ultimate load factor.

2. A strong gust likely exceeded the aircraft's ultimate load factor in cruise, causing the right wing main spar to fail in overload.

Findings as to Risk

1. The airspeed indicator displayed ranges that were no longer valid once the aircraft's gross weight was increased, and its layout might have been misleading.

2. The ailerons were not properly maintained, balanced or rigged due to a lack of readily available reference information, thus possibly compromising the aircraft's airworthiness.

Safety Action

Transport Canada, Aircraft Certification, Pacific Region has been made aware of potential inadequate maintenance of Helio H-295 Courier ailerons and will conduct an examination to determine if any action is required on their part.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on27 August 2002.