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INVESTIGATION REPORT

Accident to the CESSNA - U206 SUPER SKYWAGON registered F-HIDZ

on 2 June 2020
at Gap-Tallard (Hautes-Alpes)

Time	Around 07:00[1]
Operator	ICARIUS AEROTECHNICS
Type of flight	Post-maintenance check flight
Persons on board	Pilot
Consequences and damage	Aeroplane substantially damaged

This is a courtesy translation by the BEA of the Final Report on the Safety Investigation published in December 2021. As accurate as the translation may be, the original text in French is the work of reference.

[1] Except where otherwise indicated, the times in this report are in local time.

Incorrect rigging of roll control cables during a maintenance operation, loss of roll control during the take-off rotation, during post-maintenance check flight

1 - HISTORY OF THE FLIGHT

Note: the following information is principally based on statements, radio communication recordings and images taken from the video recording of a witness.

The pilot carried out the first post-maintenance check flight after three years of restoration work on the aeroplane. After the preflight inspection and a ground run, he performed an acceleration-stop on paved runway 20R[2] with the flaps retracted, then backtracked on the runway and lined up again to take off.

After a run of around 200 m, at roughly 100 km/h with the control wheel slightly turned to the right[3], the aeroplane started banking to the left a little during the rotation. The pilot countered this by turning the control wheel fully to the right. The aeroplane continued to bank (up to around 30° to 40°) and the tip of the left wing touched the runway.

The plane veered to the left of the runway centreline at around one metre from the ground still with a high bank angle and still with the wing tip in contact with the ground. The pilot made a full right rudder input and reduced power by setting the propeller to "Beta"[4] mode. The aeroplane came to a halt on the left side of runway 20R and the pilot evacuated the aircraft after shutting down all the systems.

[2] 945 x 30 m.

[3] According to the pilot, there was a light, right crosswind component.

[4] Operating range exclusively used for ground manoeuvres. When taxiing at low speed, it is used to obtain low or even zero traction along with a reverse effect during the landing run.

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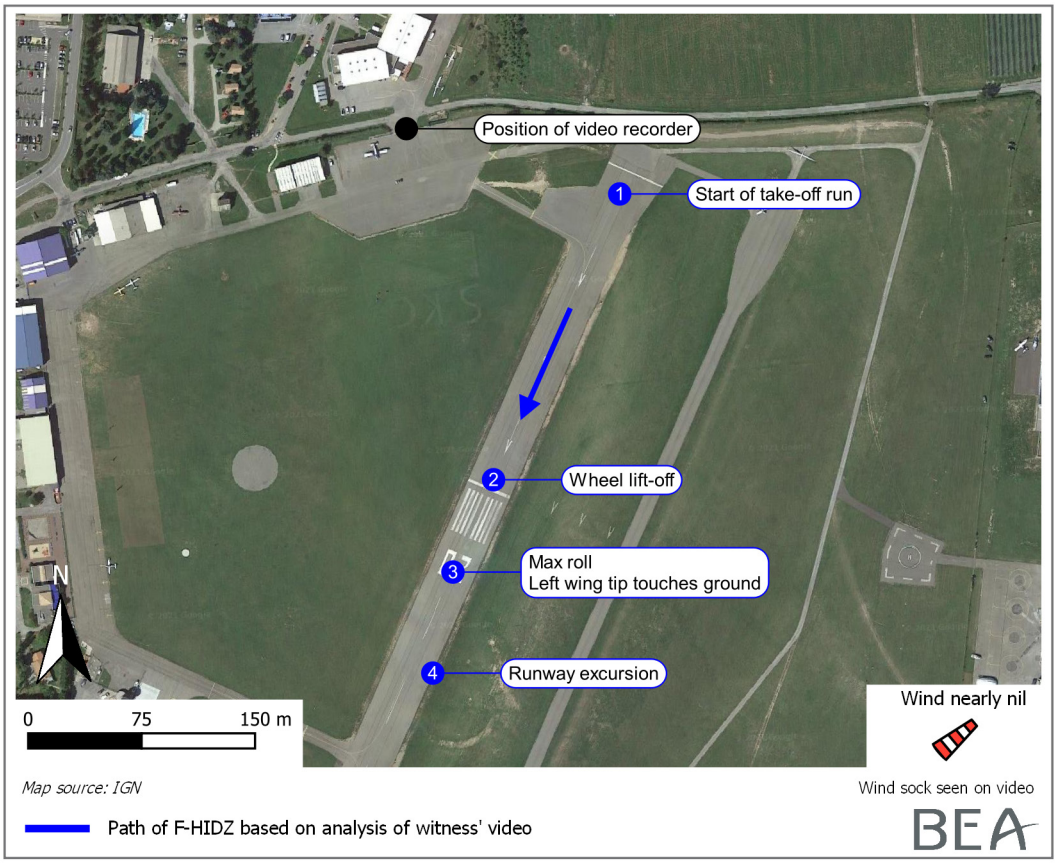

Figure 1: Aeroplane's take-off path

2 - ADDITIONAL INFORMATION

2.1 Site and wreckage

The aeroplane was quickly moved after the accident to free the runways and the marks made on the ground were not recorded. The left wing was slightly bent upwards. There was crushing deformation on the leading edge, around one metre along from its end, caused by the tip coming into contact with the ground. The propeller blades were all bent. The torque link assembly of the nose gear had broken at the hinge point of the two torque links. The workshop inspection of the plane, some time after the accident, showed that the aileron control cables had been incorrectly routed at the bellcranks in the wings.

2.2 Pilot information

The pilot, co-director of FLY HIGH ICARIUS which owned the aeroplane (see paragraph 2.4.1), held an aeroplane private pilot licence issued in 1992 and a CESSNA SET class rating obtained in November 2015. He had logged 3,439 flight hours of which 2,900 hours on turbine-powered aeroplanes including around 10 hours on the Cessna 206, and 2 hours 20 minutes in the last three months.

He held a Part-66 Aircraft Maintenance License associated with several category types, in particular categories A and B1 authorizing him to release to service turbine-powered aeroplanes and piston-powered aeroplanes.

He was the deputy maintenance manager in ICARIUS AEROTECHNICS which was a maintenance organization[5] specialised in the maintenance, repair, rebuild and management of the continuing airworthiness of turbo and piston drop aeroplanes.

According to the Maintenance Organization Exposition (MOE) of the company, in the absence of the maintenance manager, he was responsible for the execution of all the maintenance work and all the other work carried out by the technicians at the organisation's main base. As a qualified member of the personnel, he could also carry out work in all the maintenance phases of the aeroplanes. Lastly, for the past 25 years, he also carried out the post-maintenance check flights of all the aeroplanes coming out of maintenance.

[5] With EASA Part 145 FR303 approval since 1995 and CAMOplus FR.MG.256 approval since 2008.

2.3 Meteorological information

The conditions estimated by the French met office, Météo-France, at the time of the accident were the following: average wind from 200° of 4 kt, CAVOK. The video of the accident filmed by a witness (see paragraph 2.5) shows that the wind was calm at the time of the plane's take-off run.

2.4 Aircraft and maintenance organization information

2.4.1 Timeline of restoration work on F-HIDZ

The aeroplane, built in 1965, was involved in an accident in 2005 when it was registered with the United Kingdom. The previous owner started and then broke off the repair work and the aeroplane was stored in a hangar. In 2017, the aeroplane was purchased by FLY HIGH ICARIUS who wanted to restore it and replace the piston engine with a turbine engine. The restoration work started in March 2017. The accident pilot was in charge of this work and intervened in all the work phases. The work order[6] was issued by ICARIUS AEROTECHNICS based on a form dated January 2019.

[6] Document which identifies all the work to be carried out.

An inspection carried out by OSAC on 20 January 2020 found level 1 deviations [7] and ICARIUS AEROTECHNICS' Part 145 and Part MG approvals were suspended on 3 February 2020. OSAC indicated that these very approvals had already been withdrawn in the past due to level 1 deviations.

[7] Non-conformity affecting safety and justifying in the very short term, a suspension, or a limitation of all or part of the activity carried out under the approval.

The person in charge of the work (accident pilot) explained that he had started installing the new aileron cables on F-HIDZ a few days before OSAC's notification of the suspension of ICARIUS AEROTECNICS' approvals and that he had therefore not had time to finish the operation. On 18 February 2020, in light of the corrective actions implemented by ICARIUS AEROTECHNICS and considered acceptable, OSAC lifted the suspension of the approvals.

The pilot then gave priority to the work behind schedule on the other planes under a Continuing Airworthiness Management contract with ICARIUS AEROTECHNICS. He then resumed the work on F-HIDZ but the COVID-19 epidemic intensified and a lockdown came into force on 17 March 2020. He therefore stopped the work again, but indicated that he returned to work on the plane alone ten days later. He finished installing the cables on 15 May 2020.

2.4.2 Installation of aileron cables on F-HIDZ

It is indicated in the manufacturer's reference document, the Service Manual, that,

"To ease rerouting of cables, a length of wire may be attached to the end of the cable before it is withdrawn from the airplane. Leave the wire in place, routed through the structure; then attach it to the cable being installed and use it to pull the cable into position."

According to the pilot, the cables had been removed before the purchase of the aeroplane and the wires were not present. Consequently, this easy reinstallation method was no longer possible. He explained that he had been uncertain about the correct routing when rigging the new cables.

He had checked this point in the Service Manual but according to him, the diagram was not clear and he had difficulties in interpreting it (see Figure 2). He finally routed the cables mistakenly reversing the outboard carry-thru cable and the outboard direct cable at the bellcrank situated in the wings.

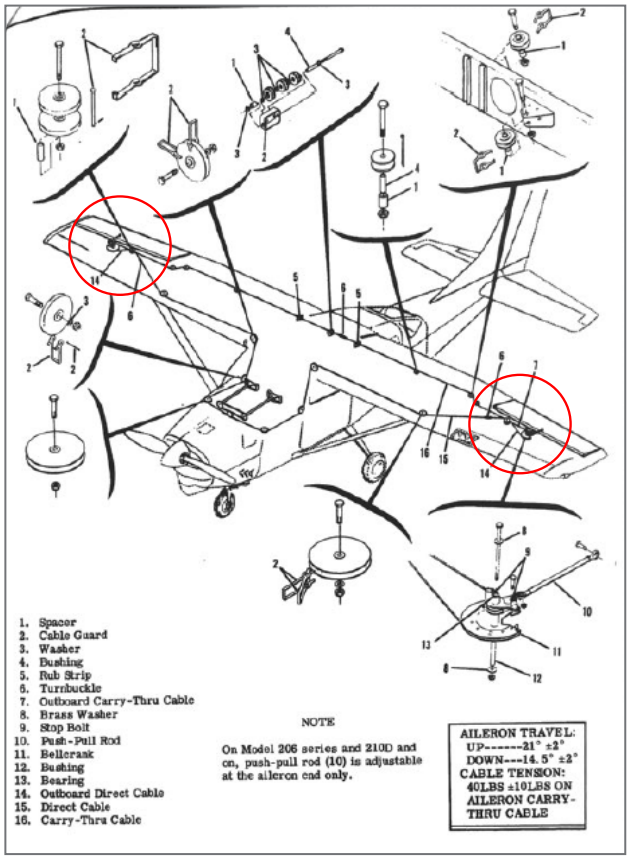

Figure 2: Excerpt from section 6 of MODEL 200 SERIES (1960- 1965) DEPT. HEADS MANUAL

The Service Manual indicates that particular attention must be paid to the reinstallation, checking and rigging of the aileron control. It also specifies, "*Be sure ailerons move in the correct direction when operated by the control wheel.*"

The investigation found that the sheet recording the movement and tension of the flight control cables written by ICARIUS AEROTECHNICS and used on 18 May 2020 by the technician (accident pilot), did not specify that the direction of movement of the control surfaces and in particular the ailerons was to be checked.

More generally and in order to minimise the risk of errors, the company had set up an inspection procedure when a critical task was carried out that could have an impact on flight safety, such as: tasks which could affect the control of the flight path and the attitude of the aeroplane, for example **the installation, rigging and adjustment of the flight controls.**

According to the MOE, different types of inspection were indeed specified:

- An independent inspection by an inspector of a task carried out by a qualified person,

or

- A re-inspection by an inspector who had himself carried out the task. This is a check carried out in the same conditions as an independent inspection except that the inspector and the qualified person are one and the same. This operation could be carried out after a period of time to give the inspector sufficient distance with respect to the task previously carried out.

Note: It was specified that the second type of inspection could only be used if and only if, only one person was available to carry out and inspect a task. This procedure was to remain an exception however: one-off repair, line operation, temporary base.

The pilot declared that given that there was no technician with an "inspector" approval available at that time to carry out an independent inspection, only four of the thirty-nine employees having returned to work, he carried out the re-inspection himself on 18 May 2020 (three days after the installation of the cables). He added that he was under enormous stress due to time and financial pressures, and the workload that the exceptional situation linked to the COVID-19 pandemic had generated in the company. During the re-inspection as approved company inspector, he did not detect that the cables had been incorrectly routed and signed the Approval for Release to Service (APRS) on 18 May 2020 with the indication that it was subject to a satisfactory post-maintenance check flight being carried out.

2.5 Pre-flight checks

The F-HIDZ flight manual indicates in the pre-take-off check section, "*flight controls – check free and correct*" but in the pre-take-off check-list present in the aeroplane and used by the pilot, it is just indicated "*controls – free*".

The pilot indicated that at the holding point before lining up on the runway, he followed the pre-take-off check-list and checked for the free movement of the flight controls without looking outside the plane to check for the correct direction of movement of the ailerons.

3 - CONCLUSIONS

The conclusions are solely based on the information which came to the knowledge of the BEA during the investigation. They are not intended to apportion blame or liability.

Scenario

As part of the restoration work on the aeroplane started three years previously, the pilot, who was both co-director of FLY HIGH ICARIUS and deputy maintenance manager for ICARIUS AEROTECHNICS, carried out various tasks, including the installation of the new flight control cables. While carrying out this task - considered as critical - he had been uncertain about the correct routing of the cables and consulted the TEXTRON documentation, in particular the Service Manual. However, he wrongly interpreted the diagram containing illustrations which did not seem clear to him and incorrectly installed the aileron cables. He carried out the re-inspection himself without waiting for another approved inspector to be available. During this operation, he followed the flight control inspection sheet which did not stipulate to check the direction of movement of the controls, and he did not detect his error.

The technician then carried out the post-maintenance check flight himself. During the pre-flight check on the apron and when carrying out the pre-take-off checks at the holding point, he did not visually check for the correct direction of movement of the control surfaces, and in particular the ailerons. He thus did not realise that the roll control was reversed. During the take-off, he tried to counter a slight roll movement to the left by turning the control wheel to the right which amplified the bank angle of the aeroplane. Being close to the ground in a dynamic situation, he was unable to analyse that the control may be reversed.

Contributing factors

The following factors may have contributed to the reversal of the roll control cables when they were rigged, and this error not being detected:

- The fact that the roll control cables had been removed before the company purchased the aeroplane and that no "routing" wire had been positioned during this disassembly operation.
- The workload in the context of the company's activity rapidly picking up again with a small number of personnel.
- The technician's choice not to ask another inspector to carry out an independent inspection although he had had some doubts during the installation of the cable and had had difficulties in interpreting the installation diagram.

Safety lessons

Checking direction of movement of control surfaces before take-off

On carrying out the pre-flight and pre-take-off check-lists, it is generally specified that the pilot-in-command checks for the free movement of the flight controls and that there is no sticking. However, it is rarely requested that the direction of movement is checked in order to detect a possible reversal after a maintenance operation.

Following several accidents in the United States of America in connection with reversed or incorrectly rigged flight controls during maintenance operations, the American safety investigation authority (NTSB) issued a Safety Alert in March 2015 entitled: "*Pilots: Perform advanced preflight after maintenance*"[8]. In particular, it specifies that the Federal Aviation Administration (FAA) has produced a guide to help pilots develop the knowledge and techniques required to reduce the risk of undetected maintenance problems, including how to:

- *"Conduct a complete review of maintenance-related records and data*
- *Develop an "additional items check-list" to be used in conjunction with the aircraft's preflight check-list."*

[8] https://www.ntsb.gov/Advocacy/safety-alerts/Documents/SA-041.pdf

Corrective measures set up by ICARIUS AEROTECHNICS

Following the accident, ICARIUS AEROTECHNICS raised the awareness of its personnel with respect to the risk of confusion when re-rigging flight controls. A list of critical tasks was drawn up for each type of aeroplane in order to clarify the tasks requiring an independent inspection. The sheet recording the movement of each flight control system was modified with the addition of the instruction to check the direction of movement. The company also modified the aeroplane's check-list with the addition of the check for the correct direction of movement of the flight controls during the pre-take-off checks.

Rejected take-off

The pilot's rejection of the take-off when the plane was still at a low height meant that the aeroplane touched down with a relatively small amount of energy, thus reducing the consequences of the accident.

The *Fédération Française Aéronautique* issued an information sheet[9] on 26 March 2021 concerning rejected take-offs. This sheet sets out the various points to help pilots take the decision to reject the take-off, in particular in the case of a loss of pitch control of the aeroplane following a flight control problem.

[9] https://www.ffa-aero.fr/FR/frm_Lic_RP.awp?A1&A3=1