BEA
Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile

www.bea.aero

SAFETY INVESTIGATION REPORT

Accident to the NICOLLIER HN700 registered F-PADB on Monday 2 May 2022 at Blois-Le Breuil aerodrome

Time	Around 15:00[1]
Operator	Private
Type of flight	Check flight
Persons on board	Pilot
Consequences and damage	Pilot fatally injured, aeroplane destroyed
This is a courtesy translation by the BEA of the Final Report on the Safety Investigation. As accurate as the translation may be, the original text in French is the work of reference.	

Incorrect installation of roll control cables, loss of control on take-off, tipping over, collision with the ground

1 HISTORY OF THE FLIGHT

Note: the following information is principally based on the statements taken during the investigation.

The pilot, a friend of the owner of the aeroplane, was carrying out several maintenance operations on F-PADB. After completing these operations, he decided to perform a check flight.

At the parking area, he contacted the AFIS officer to taxi towards runway 02[2] at Blois-Le Breuil aerodrome.

At approximately 15:00, he lined up on runway 02 and informed the AFIS officer that he was planning to run on the runway and then to take-off, if all was going well.

The aeroplane accelerated, took off, entered a left roll, tipped over and collided with the ground. It stopped 300 m after the threshold of runway 02, on the right side of the runway, about 5 m from the edge of the runway.

[1] The times in this report are in local time.
[2] Unpaved runway measuring 920 m x 70 m.

RÉPUBLIQUE FRANÇAISE
Liberté
Égalité
Fraternité

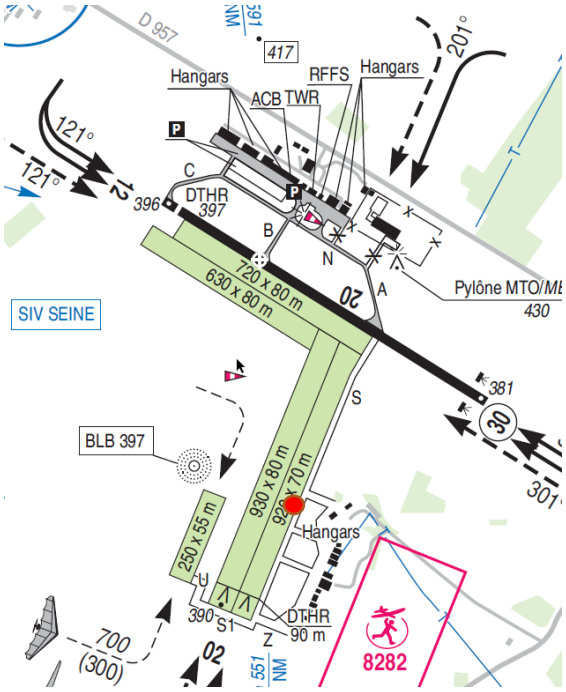

Figure 1: location of the wreckage (runway 02/20) shown in red

The AFIS officer activated the emergency siren and alerted the emergency services. The pilot was evacuated by helicopter and died as a result of his injuries.

2 ADDITIONAL INFORMATION

2.1 Pilot information

The 77-year-old pilot held a Private Pilot Licence - Aeroplanes (PPL(A)) issued in 2002 by converting a French TT licence issued in 1970. He also held a microlight pilot licence issued in 1989.

The investigation was unable to obtain any data relating to the pilot's experience after 2016. He had therefore logged 800 flight hours, at least 566 hours of which as a pilot-in-command.

2.2 Aircraft information

F-PADB is an amateur-built Nicollier HN700, built in 1998 by the owner with the help of the pilot of the accident flight. As the owner is paraplegic, F-PADB was originally equipped (see paragraph 2.5) with a rudder control system fitted with a hand-operated lever known as a "manual rudder control". It was operated under a restricted certificate of airworthiness (R-CoA).

2.3 Meteorological information

According to Météo-France, at the time of the event, the sky was cloudy, with the presence of stratocumulus clouds around 5,300 ft. The wind information available to the AFIS officer and transmitted to the pilot was a 030° wind of 7 kt, gusting up to 14 kt.

The METAR report at 15:00 for Tours-Val de Loire airport (Indre-et-Loire) gave the following information: 050° wind (varying from 360° to 80°) of 8 kt, visibility 8 km, no noticeable clouds, temperature 18°C, dew point temperature 5°C, QNH 1,016 hPa.

2.4 Site and wreckage

When the BEA arrived at the site, the wreckage had already been stored in a hangar close to the accident site.

Figure 2: wreckage of F-PADB after the accident (source: aerodrome manager)

The examination of the accident site allowed the following observations to be made:

- signs of fuel were visible on the ground;
- the area where the engine collided with the ground could be identified. Propeller parts were also found there;
- small trenches perpendicular to the path of the aeroplane were found a few metres before the wreckage. These marks are characteristic of a rotating propeller making contact with the ground.

These observations showed that the engine was most likely torn off from the airframe during the collision with the ground, that the airframe continued its course until it came to a stop a few metres further on, and that the propeller was rotating when it made contact with the ground.

2.4.1 Examination of the wreckage

The wreckage was examined by the BEA in the hangar where it was stored, at Blois - Le Breuil aerodrome.

The elevator, elevator trim and yaw trim control linkages, as well as the flaps, were found continuous and unrestricted.

Figure 3[3] below shows the entire roll control linkage as nominally assembled in an HN700. The idler pulleys installed in the wings are numbered 1 to 4, and the ailerons are shown in blue. The top cable is called “H” (actually, there are two cables connected together at the bottom of the stick) and the bottom cable is called “B”. This cable is commonly referred to as the “coordination cable” on aeroplanes with this architecture.

[3] The diagrams in **Figure 3** and **Figure 4** were produced by the BEA, the numbering is arbitrary.

Figure 3 represents the direction in which the cables move when a left input is made on the stick:

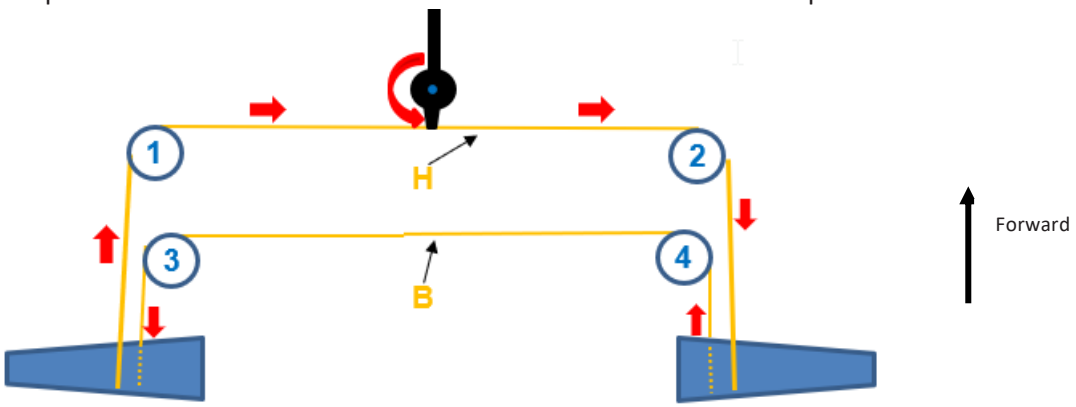

Figure 3: conceptual diagram of the aileron control.

When a left roll input is made on the stick, the left aileron raises and the right aileron lowers.

Figure 4 below now shows the aileron control linkage as installed and observed on F-PADB on the day of the accident:

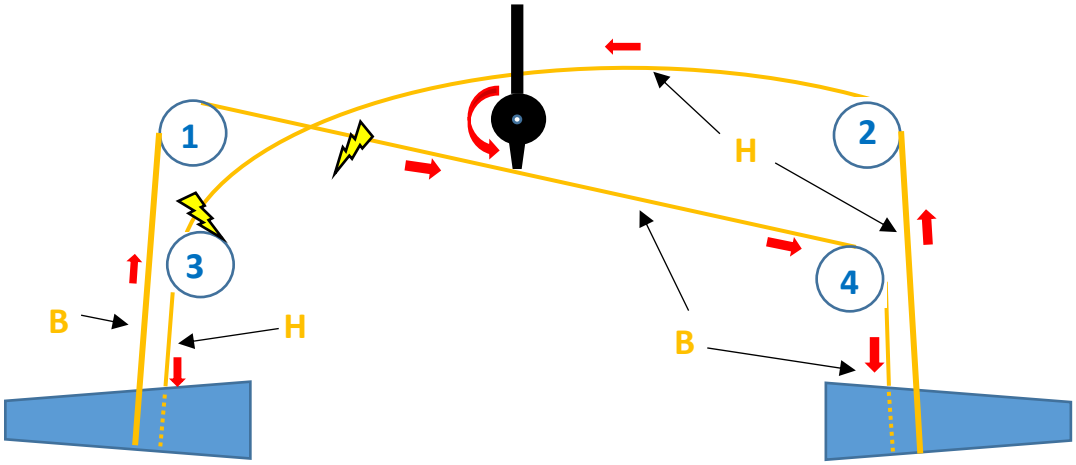

Figure 4: aileron control as installed on F-PADB, on the day of the accident.

The yellow symbols ( ) show the discontinuities observed. The examinations carried out at the BEA's laboratory determined that these cables were severed, probably when the wreckage was recovered. Examination of the rupture faces indicated that the cables were most likely installed as in **Figure 4**.

In contrast to the cables' nominal assembly, two errors were observed: the stick actuated cable B instead of cable H, and cable B and cable H were inverted on the left side. As a consequence:

- when a left roll input was made on the stick, the left aileron raised, and the right aileron raised too;
- when a right roll input was made on the stick, the left aileron lowered, and the right aileron lowered too.

This means that the left aileron travel direction was consistent with the movements of the stick, while the right aileron travel direction was inverted. The aeroplane was therefore uncontrollable in roll.

2.5 Aeroplane's maintenance and continuing airworthiness

In 1998, due to his disability, the owner and builder of the aircraft submitted a modification request to the French civil aviation safety group (GSAC) to install of a manual rudder control. He described this modification as a system consisting of a flywheel coupled to a transfer box that actuated two cables from the rudder pedals.

Maintenance of aeroplanes flying under an R-CoA is based on a declaration system. These aircraft are therefore maintained and flown under the responsibility of their owners.

The owner declared himself responsible for ensuring continuing airworthiness and maintenance operations based on a maintenance programme submitted to OSAC[4]. According to this[5], the airworthiness certificate renewal complied with the normal three-year cycle. The RSA-Nav[6] carried out two airworthiness reviews on F-PADB in May 2016 and June 2019, during which the certificate could be renewed. During these two examinations, the manual rudder control system was installed. However, when the wreckage was examined after the accident, the manual rudder control system was not present.

2.6 Owner statement

The owner explained that the pilot helped him build F-PADB and that they used to perform the aeroplane maintenance together, checking each other's work. He added that he had not flown F-PADB for several years. For this reason, the pilot who suffered the accident had informed him of his plan to remove the manual rudder control system. However, he did not inform him of the actual removal.

2.7 Other statements

Several members of the association that owns the hangar in which F-PADB was parked reported that the pilot had worked on the aeroplane for a long time, in particular on the roll control linkage. The pilot told them that he was removing the manual rudder control system. They specified that they offered to help the pilot, but that the latter declined and worked alone.

2.8 Similar occurrences

On 2 June 2020, a Cessna-U206 registered F-HIDZ lost roll control during the take-off rotation following incorrect installation of the roll control cables.

[4] The French civil aviation safety organisation is empowered by ministerial decree to carry out appraisal, instruction, control and inspection tasks and to issue documents relating to airworthiness.

[5] For an aircraft covered by Annex I of Regulation (EU) 2018/1139, the owner of which is also the manufacturer, the normal renewal cycle for the airworthiness certificate is three years.

[6] The RSA-NAV is an organisation also empowered to carry out airworthiness reviews as part of an R-CoA.

3 CONCLUSIONS

The conclusions are solely based on the information which came to the knowledge of the BEA during the investigation.

Scenario

As part of the removal of the manual rudder control installed on F-PADB and of several maintenance operations, the pilot carried out a number of critical tasks alone. On reassembling the roll control linkage, he incorrectly assembled the control linkage cables, making the aeroplane uncontrollable in roll.

During the take-off, the aeroplane tipped over and collided with the ground.

Contributing factors

The following factors may have contributed to the incorrect installation of the roll control cables and the installation error not being detected:

- the absence of an independent inspection of the control linkage, and more generally of the various tasks carried out, by a third party competent in aeronautical mechanics (such as a member of the association with which the aircraft was based or a mechanic);
- insufficient checking of the flight controls' travel direction during the pre-flight inspection and before take-off.

Safety lessons

Sharing best practice, monitoring work:
As a member of a federation, such as the RSA, amateur builders can benefit from support in their actions. In particular for certain critical tasks, such as operations on control linkages, it would seem appropriate to have the completed operations reviewed by a third party.

Checking the flight controls' travel direction before take-off
Pre-take-off checklists generally include verifying that the flight controls are unrestricted, but less commonly ask for checking the travel direction, which could help detect potential inversions following a maintenance operation.

In 2015, the US National Transportation Safety Board (NSTB) issued a Safety Alert following several accidents related to inverted or incorrectly installed flight controls during maintenance operations. In particular, it recommended that pilots familiarise themselves with the flight controls' travel direction before carrying out maintenance operations. It also referred to a document from the US Federal Aviation Administration (FAA) which recommended:

- carrying out a complete review of the maintenance operations conducted;
- drawing up an additional checklist detailing the additional items to be checked during the pre-flight inspection and before take-off after a maintenance operation.

Rejected take-off

The accident to the Cessna 206 registered F-HIDZ and the accident to the DR400 registered F-GYKC showed that, in the event of a flight control problem, the pilot's rejection of the take-off when the aeroplane is at low height means that the aeroplane may touch down with a relatively small amount of energy, thus reducing the consequences of the accident.

The French Aeronautical Federation (FFA) published a practical information sheet on rejected take-offs. This sheet provides information to help pilots make the decision to reject take-off, in particular in the event of a loss of longitudinal control of the aeroplane following a flight control problem.

The BEA investigations are conducted with the sole objective of improving aviation safety and are not intended to apportion blame or liabilities.