



Accident to the Elixir Aircraft Elixir
registered **F-HKEC**
on Wednesday 14 February 2024
at La Rochelle - Île de Ré

Time	Around 15:30 ¹
Operator	Elixir Aircraft - CAO
Type of flight	Check flight
Persons on board	Pilot, additional pilot
Consequences and damage	Aeroplane substantially damaged
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.	

**In-flight disconnection of elevator control, difficulty
controlling aeroplane on short final, hard contact with
runway, during a maintenance check flight**

1 HISTORY OF THE FLIGHT

Note: the following information is principally based on on-board computers, statements, radio communication recordings and radar data.

The pilot, in the RH seat², accompanied by an additional pilot, took off from runway 09³ of La Rochelle - Île de Ré airport for a calibration flight of the AOA sensor⁴. During the climb, the pilot observed that the elevator control was free in movement. He controlled the pitch attitude using the elevator trim and the engine. The additional pilot transmitted an emergency message on the frequency and asked for clearance to return to the aerodrome. The controller read back the message and asked him to call back on final for runway 09 and then cleared him to land. During the approach, the average airspeed was 85 kt with a vertical speed of around -400 ft/min.

The pilot flared using power and the trim. The aeroplane bounced. The pilot initially decided to reject the landing and then tried to land again. He lost control of the flare and the aeroplane touched down hard on the runway. The nose gear broke. The aeroplane finished its run at the edge of the runway, around 250 m after the hard touchdown.

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

² All the flight and instrument controls are accessible from the RH and LH seats.

³ Paved runway measuring 2,213 m x 45 m. LDA 1,940 m.

⁴ The purpose of the flight was to carry out altitude stalls to check the calibration of the sensor.

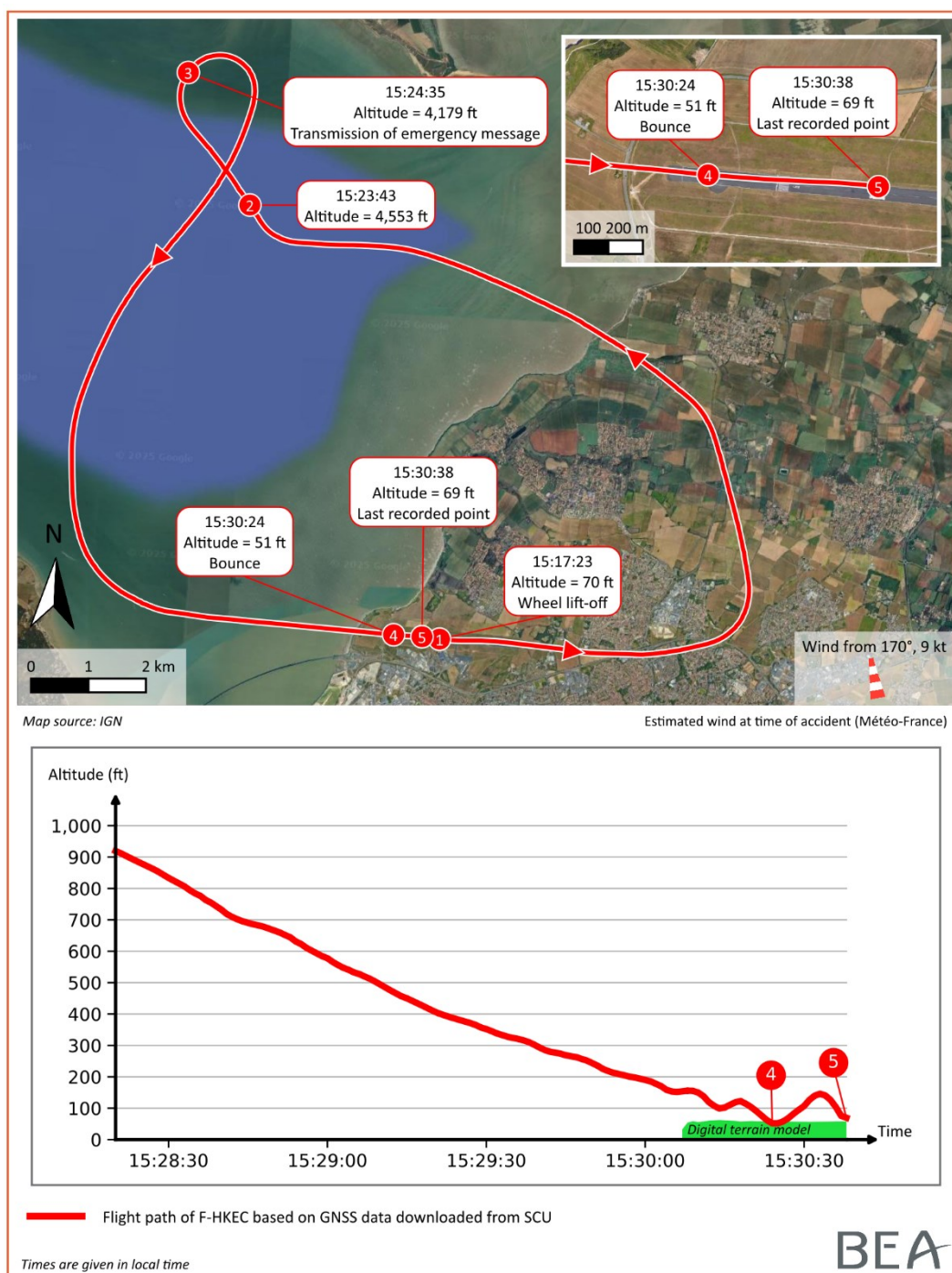


Figure 1: flight path

2 ADDITIONAL INFORMATION

2.1 Site and wreckage information

It was observed on the runway and in the area surrounding the runway (see **Figure 1**), that there were:

- marks made by the main landing gear coming into contact with the runway and a mark corresponding to the nose gear;
- debris from both the nose gear fairing and lower cowling;
- marks made by the propeller impacting the runway;
- pieces of propeller blade;
- the nose gear strut.

The aeroplane was found around 250 m after the first marks, immobilised at the edge of the runway with its nose in the grass.



Figure 2: position of marks and debris (source: BEA/IGN)

The aeroplane was moved to an Elixir Aircraft hangar in the evening so that the runway could be reopened. Care was taken to avoid any handling of the elevator and sticks when the aeroplane was moved.

The damage observed on the aeroplane was the result of the impact with the runway.

The elevator trim flap was found in a “nose-up” position.

A screw and washer were found in the keel located under the fin when the keel was removed. This screw and this washer were identified as being part of the assembly attaching the vertical rod of the elevator control to the bellcrank in the base of the fin. The associated nut⁵ was not found. The examinations carried out determined that the nut would have been found in the keel if it had been present when the assembly was installed. Furthermore, there was no damage on the screw thread. The screw showed no sign of a lock varnish used to visually identify the tightening of the screw-nut assembly⁶. The vertical rod was disconnected from the bellcrank (see **Figure 3**).

⁵ It was a Nylstop nut.

⁶ This marking is made in production. The varnish comes away very easily when the assembly is loosened and simply rubbing the varnish will remove it. This marking is not compulsory in maintenance. However, the mechanic was in the habit of applying it.

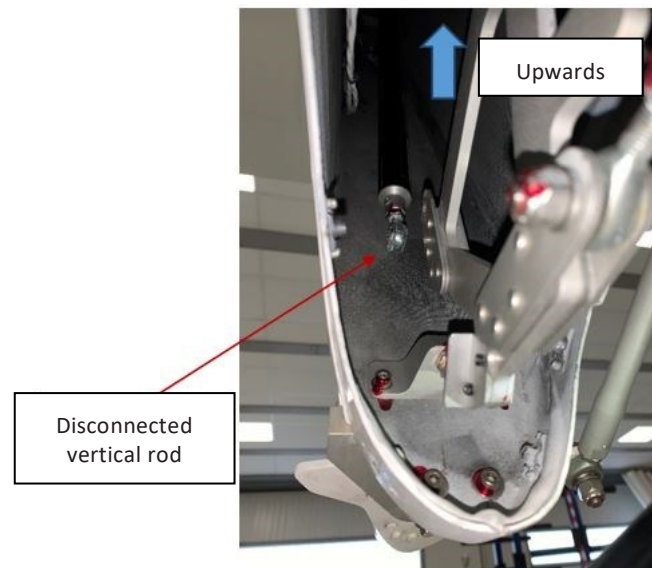


Figure 3: vertical rod disconnected from bellcrank (source: BEA)

2.2 Aircraft information

2.2.1 General

The Elixir is a two-seat aeroplane made of carbon. It is equipped with a Rotax 912isC3 engine and a three-blade propeller. It has a ballistic airframe parachute.

The aeroplane, MSN015, received its certificate of airworthiness on 25 October 2023 and was delivered to the owner at the end of October 2023. It had logged around 24 flight hours before being ferried to Elixir Aircraft on 19 January 2024 for work under the manufacturer's guarantee (see paragraph 2.2.4).

2.2.2 Description of elevator control

The elevator control is of entirely tubular design. At the bottom of the fin, a bellcrank operates a vertical rod which is attached to and moves the one-block elevator. The aeroplane has an elevator trim. It is solely operated by an electric system and sets the position of the trim on the horizontal stabilizer. The electric motor operating the trim is installed at the top of the fin.

2.2.3 Procedure in event of loss of elevator control

Chapter 3.10.1 of the flight manual contains an emergency procedure in the event of a loss of elevator control. The pilot is asked to control the pitch attitude and speed of the aeroplane using the elevator trim by anticipating the actions and planning for a certain latency. A standard approach and landing can be carried out, with preference given to the use of the take-off flap configuration⁷ for landing in the case of a forward C of G in order to increase the trim's authority. It is also recommended to avoid large bank angles, steep approaches and sudden power variations.

The approach speed recommended in the flight manual is 81 kt with the flaps in the take-off configuration.

⁷ Position of flaps: 15° for the take-off configuration and 37° for the landing configuration.

2.2.4 Maintenance

On 4 January 2024, the owner of the aeroplane made a request for the following work to be carried out:

- various paint touch-ups;
- identification of a smell of fuel with a suspected fuel tank leak;
- adjustment of elevator fairing;
- adjustment of RH landing gear fairing.

The aeroplane was ferried on 19 January 2024, and accepted by Elixir Aircraft Combined Airworthiness Organisation (CAO) on 22 January 2024.

The work started the next day. As no critical task had been identified by the technical manager and recorded in the work file on accepting the aeroplane, the latter carried out all the work on his own. The work was completed on 13 February 2024.

The Certificate of Release to Service (CRS) was signed on 13 February 2024 at 15:40. A first check flight of 40 min was carried out the same day without incident. An additional flight to calibrate the AOA sensor was to allow the aeroplane to be returned to service. For these flights, the CAO complied with the regulatory requirements for non-commercial operations (NCO).

2.3 Read-out of recorded data

The aeroplane's equipment includes two Garmin G3X computers and a RS Flight Systems SCU (System Control Unit).

The SD cards were recovered from the G3X computers after the accident. The occurrence flight data was read out and analysed. The SCU data was directly downloaded on the aeroplane by the Elixir Aircraft personnel for analysis by the BEA.

All of the recordings stop a few seconds before the impact probably due to the power to the computers being cut off when the position of the master switch changed on impact⁸.

2.4 Meteorological information

The meteorological conditions estimated by the French met office, Météo-France, on the site of the accident were the following: wind from 170°, 9 kt, visibility greater than 10 km, broken clouds based at 6,000 ft, temperature 17°C.

2.5 Personnel information

The 34-year-old pilot who had the controls held a Commercial Pilot Licence - Aeroplanes (CPL(A)) obtained on 18 May 2021 along with MEP, SEP, IR ME, IR SE and instructor ratings. He had logged 382 flight hours, including 15 hours on the Elixir and 7 hours in the previous three months, all on the Elixir. He had also followed a Multi Crew Coordination (MCC) course.

The 23-year-old additional pilot held a Commercial Pilot Licence - Aeroplanes (CPL(A)) obtained on 13 August 2021 along with MEP, SEP, IR ME, IR SE and instructor ratings. He had logged approximately 750 flight hours including 400 hours on the Elixir. He had also followed a MCC course.

⁸ This position change is confirmed in the statement of one of the pilots.

The 53-year-old mechanic had been working as a mechanic since 1993 and held a Part-66 aircraft maintenance licence for the A2, B1.2 and C categories for aircraft other than complex motor-powered aircraft categories. He was recruited by Elixir Aircraft around 18 months before the accident. He was technical manager, mechanic and CRS signatory in the CAO, and mechanic in the production organization. In this respect, he participated in the production line tasks and due to his experience, carried out the final inspection of the manufactured aeroplanes.

2.6 Organisational and management information

2.6.1 Regulatory requirements

2.6.1.1 Part-CAO

A CAO is an organisation approved to carry out maintenance and continuing airworthiness management activities of aircraft where such aircraft are not classified as complex motor-powered aircraft and are not listed in the air operator certificate of an air carrier licensed in accordance with regulation (EC) No 1008/2008⁹, according to Part-CAO of regulation (EU) No 1321/2014¹⁰.

The regulation defines a critical task as being a task involving the assembly or any disturbance of a system or any part of an aircraft, engine or propeller that, if an error occurred during its performance, could directly endanger the flight safety. Examples of tasks which can be considered as critical are given in Acceptable Means of Compliance (AMC) of Part-CAO.

Paragraph CAO.A.060(h) requires that an error-capturing method is implemented after the performance of any critical maintenance task. An independent inspection is described as one of the possible methods for complying with this requirement. However, it is possible to set up another method, which the organisation must describe in its Combined Airworthiness Exposition (CAE)¹¹; deferred inspection is another example of this method.

The independent inspection is carried out by a person who must have been trained and gained experience in the specific control systems to be inspected - a Part-66 license is not required - while the task is performed by an authorised person who assumes the full responsibility for the completion of the task. If only one person is available, a re-inspection can be carried out under the same conditions as an independent inspection, with the same person performing both roles. The regulations specify that this remains an exceptional case for critical tasks, to be used only in unforeseen circumstances.

⁹ Regulation (EC) of 24 September 2008 on common rules for the operation of air services ([Version in force on the day of the accident](#)).

¹⁰ Commission regulation of 26 November on the continuing airworthiness of aircraft and aeronautical products, parts and appliances, and on the approval of organisations and personnel involved in these tasks ([Version in force the day of the accident](#)).

¹¹ A CAE framework is proposed in the AMC of Part-CAO.

2.6.1.2 Maintenance Check Flight (MCF)

The Guidance Material GM1 of paragraph ML.A.301(f)¹² indicates that the definition of and operational requirements for MCFs are laid down in regulation (EU) No 965/2012¹³, known as the AIR OPS, and are carried out under the control and responsibility of the operator, without, however, clearly identifying the latter. The DSAC specifies that when a CAO has completed maintenance work, the latter can either call on a pilot from the usual operator, who, in this case, will then be the MCF operator, or carry out the MCF using a CAO pilot, in which case the CAO is the MCF operator.

The operation of an aircraft for activities such as MCFs is considered to be a specialized operation (SPO) within the meaning of this regulation. Moreover, when an MCF is part of a paid service, it is considered a commercial operation under the same regulation.

Specialized non-commercial operations of aircraft other than complex motorized aircraft must comply with part NCO of the AIR OPS regulation. For other specialized operations, the SPO operator must declare its operations to the DSAC and meet the requirements of part SPO and those applicable to parts ORO and SPA of the AIR OPS regulation.

With the agreement of EASA, the DGAC issues derogations, deferring compliance with certain requirements until 31 May 2026, for organisations which do not have a management system under the AIR OPS or AIR CREW regulations¹⁴, and which carry out MCFs with aircraft whose usual operations come under the rules applicable to aircraft other than complex motorized aircraft. In particular, the derogation means that MCF activities need not be declared, and that the aircraft's continuing airworthiness can be managed in accordance with the provisions applicable to the person normally responsible for it. The derogation must be formally requested from the DSAC.

2.6.2 Elixir Aircraft - CAO

Elixir Aircraft holds a CAO approval obtained on 2 June 2023. Elixir Aircraft is considered as being a small CAO, only having privileges for aircraft complying with part-ML, and employing less than ten people to carry out the maintenance and less than five people for continuing airworthiness management. The CAE describes the organisation set up by Elixir Aircraft. A few points of the CAE are indicated below.

2.6.2.1 Description of installations

According to the CAE, the premises rented by Elixir Aircraft were designed and fitted out for the maintenance and the continuing airworthiness management of aircraft and its surface area (around 310 m²) was adapted to the workforce and activity of Elixir Aircraft.

The investigation found that the premises dedicated to the CAO were permeable to the other activities of Elixir Aircraft and that the CAO did not have dedicated supplies.

¹² Part-ML of regulation [1321/2014](#) establishes the requirements for the continuing airworthiness of aeroplanes, other than complex motor-powered aeroplanes with a maximum take-off mass of less than 2,730 kg, not listed in the air operator certificate of an air carrier licensed in accordance with regulation [1008/2008](#).

¹³ Commission Regulation of 5 October 2012 laying down technical requirements and administrative procedures related to air operations ([Version in force on the day of the accident](#)).

¹⁴ Commission regulation No 1178/2011 of 3 November 2011 laying down technical requirements and administrative procedures related to civil aviation aircrew ([Version in force the day of the accident](#)).

2.6.2.2 Human resources

According to the CAE, since 15 December 2022, the CAO's workforce was comprised of nine people with only one person, the technical manager, in charge of the maintenance and the continuing airworthiness management.

The CAE specifies that the technical manager, responsible for the organisation's conformity with the regulations in force and compliance with procedures, makes sure that there is a sufficient number of appropriately qualified personnel.

The technical manager had not informed management that he did not have a sufficient number of appropriately qualified personnel. In practice, he called on POA¹⁵ personnel to help him with tasks that could not be carried out by one person. In theory, he could have called on the accountable manager, who also held a Part-66 aircraft maintenance licence for the L1C¹⁶ and L2C¹⁷ categories, to help him carry out certain tasks.

2.6.2.3 Carrying out critical tasks

Based on the definition of critical tasks in the CAE manual¹⁸, removing the elevator and removing the wings are critical tasks.

The CAE specifies that the critical tasks require an independent inspection by a qualified person who was not involved in the performance of the said task, who also signs the documents and that cross-checks are possible. It does not explain how this independent inspection or these cross-checks can be carried out when only one person was dedicated to the maintenance within the CAO.

2.6.2.4 Maintenance check flights

Elixir Aircraft indicated that it was not aware that MCFs must be considered as being part-SPO flights. As a consequence, there were no specific indications for carrying out this type of flight in the CAE. OSAC had not identified this deviation when issuing the CAO approval.

2.7 Statements

2.7.1 Pilot¹⁹

The pilot specified that this was the first time that he had carried out a calibration flight for the AOA sensor and that he was accompanied by an additional pilot. He indicated that he carried out the pre-flight actions and then took off from runway 09. The control surface tests had not revealed anything abnormal and the controls responded normally during the take-off and initial climb. During the climb, the aeroplane, correctly trimmed and stable, had a speed of 86 kt. From time to time, the pilot made small corrections to the pitch attitude.

When the aeroplane was at an altitude of between 3,000 and 3,500 ft, the pilot, on making a pitch attitude correction, felt that the stick was "limp". He tried to put the aeroplane into level flight but the stick fell against the forward limit. He specified that he had not felt anything abnormal beforehand and that he had not encountered turbulence. He then checked that the

¹⁵ Production Organization Approval.

¹⁶ Composite sailplanes.

¹⁷ Composite powered sailplanes and composite aeroplanes with a maximum take-off mass of 1,200 kg.

¹⁸ The definition of a critical task in the manual is similar to that of regulation [1321/2014](#).

¹⁹ The statement made by the supplementary pilot did not provide any additional information and is therefore not given in this report.

trim was functioning correctly. He warned the additional pilot of the situation. The latter declared an emergency situation (PAN PAN) and asked for clearance to return to the aerodrome.

After conferring with the additional pilot, the pilot decided to land without flaps instead of in the take-off configuration recommended in the flight manual²⁰ so as not to change the configuration and not modify the aeroplane's attitude. He had not identified the exact cause of the malfunction and was concerned that they might have lost a control surface. The airframe parachute would have been used in this case.

The pilot indicated that during the final approach, the aeroplane was stable, the flight path a little low and the speed a little high, between 80 and 85 kt. When the aeroplane passed over the runway threshold, the pilot felt some turbulence and the aeroplane was less stable. He specified that this turbulence was usual due to the presence of a cliff in this area.

On touching down, the aeroplane made a hard bounce. The trim was in the nose-up position since the flare. The pilot believed that he could not act quickly enough on the aeroplane's attitude using the trim because of the latter's lag and initiated a go-around.

The additional pilot suggested that he tried to land again as the runway length was sufficient. The pilot put the aeroplane into descent using the trim and reducing power. The aeroplane pitched down more than the pilot wanted and he tried to regain control by increasing power while pitching up with the trim. To his surprise, the aeroplane pitched down even further before the flight path righted itself. The aeroplane then touched down hard on the runway with a flat attitude.

The pilot added that he had already had training in the loss of the elevator control, during training, on his instructor's initiative, in a Diamond DA40 simulator equipped with an electric elevator trim. He specified that he knew the procedure for the loss of elevator control on the Elixir as he had recently studied the flight manual when familiarising himself with the aeroplane.

2.7.2 Mechanic

The mechanic indicated that he accepted the aeroplane on 19 January 2024 and started work on it the next day. He first checked for the presence of the smell of fuel in the cabin and assessed that he would have to remove the wings to check the condition of the fuel tank. Given the estimated time for carrying out these actions, he postponed this and carried out the other tasks starting with the adjustment of the elevator fairing.

To do this, he disassembled the fairing, removed the elevator, carried out the adjustments and reassembled the elevator and then the fairing. He remembered that he was interrupted in this task to carry out inspections of the aeroplanes in production. He specified that when returning an assembly to its position, he always fitted all the parts (screw, washer, nut) in one operation. He did not always immediately tighten the assembly, particularly when a specific tool was required. He specified that it is difficult to get to this particular assembly with the tools to tighten it. He added that at the end of a task, he checks that there is nothing left in the boxes used to store the various disassembled parts. He remembered that there were no parts left in the boxes when he had finished the task. He specified that he reused the original attaching hardware. He stamped

²⁰ See paragraph 2.2.3.

the inspection file to certify that this task had been carried out. He specified he was the only person who had carried out this task.

He added that the fuel tank task had lasted more than a week and required the removal of the wings. He specified that a person from the production line came to help him to remove and reassemble the wings. He remembered that he was also interrupted in this task to carry out other inspections tasks of the aeroplanes in production along with maintenance and administrative tasks.

He checked all the tasks listed in the maintenance file in one go, at the end of all the work.

He specified that the workshop's work space was disrupted by the company's other activities. In particular, it sometimes happened that a lay-up would be moved to accommodate marketing activities.

Lastly, the mechanic explained that in the previous few months, there had been a particular context due to the temporary suspension of the certificate of airworthiness which obliged Elixir Aircraft to inspect all the aeroplanes in service. In particular, this had led to an increased workload for him and numerous interruptions in his tasks. He had felt under time pressure.

3 CONCLUSIONS

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

Scenario

While re-assembling the elevator during a maintenance action, the mechanic very probably forgot to position the nut on the screw fitted through the ball joint connecting the vertical rod of the elevator control with the bellcrank in the base of the fin. In the absence of the nut, the screw was not held in place and came out of position during the second flight after this work. The stick became free in pitch due to the rod disconnecting from the bellcrank.

This disconnection occurred during the initial climb, between 3,000 and 3,500 ft with the aeroplane correctly trimmed. The aeroplane thus remained stable. The pilot noticed the abnormal situation when making a correction to the pitch attitude. He then checked that he could control the pitch attitude using the trim as recommended in the loss of elevator control procedure. The additional pilot transmitted an emergency message and asked to return to the aerodrome.

The pilot carried out the approach and landing without flaps at a speed of around 85 kt. On touching down, the aeroplane bounced. As the trim was in the nose-up position, the pilot believed that that he could not act quickly enough on the aeroplane's attitude because of the trim's lag, and initiated a go-around. Seeing that the remaining runway length was sufficient, he tried to land again. When he put the aeroplane into descent, the nose down angle was too high and the pilot tried to regain control by increasing power while pitching up with the trim. To his surprise, the aeroplane pitched down even further before the flight path righted itself. The aeroplane touched down hard on the runway with a flat attitude. The nose gear broke. The aeroplane finished its run at the edge of the runway, around 250 m after the hard touchdown.

Contributing factors

The following factors may have contributed to forgetting the nut:

- interruptions in the work to reassemble the elevator due to the mechanic being called upon by the production line technicians to carry out inspections because he was an experienced mechanic;
- the particular high workload and time pressure context due to the mandatory inspection of all the aeroplanes in service in the previous few months;
- no independent inspection as the task was not considered a critical task by the technical manager.

Safety lessons

Raising awareness about piloting in the event of a primary flight control failure

The situation encountered is outside the scope of the practical knowledge usually taught to pilots. Moreover, flight manuals do not always contain a procedure for dealing with a primary flight control failure. Immediate adaptation, when emotions are running high, can make it difficult to diagnose the problem and choose appropriate actions.

The Elixir flight manual includes a procedure for the loss of elevator control. The pilot was familiar with this procedure and had practised this type of failure in the past. These two factors very probably helped him in his diagnosis and choice of appropriate actions.

The BEA report on the accident to the APM30 registered [F-HHOP](#) on 2 August 2020 at Arras-Roclincourt expands on this safety lesson, while also pointing out that practical training could, in certain respects, have counter-productive consequences (*“negative training”*). However, pilots could probably benefit from being made aware of this possibility by their instructors during their initial and recurrent training. The DSAC or the federations could propose summaries for instructors to support and provide a scope for this awareness-raising.

Distress message

The level of emergency response at an airport depends on the nature of the signal transmitted by the crew. The loss of a primary flight control could, in certain respects, justify the transmission of a MAYDAY message.

Reusing Nylstop nuts

Although this was not a contributory factor in this accident, the reuse of Nylstop nuts is not recommended. In fact, their locking capability diminishes after several reassemblies and, as it is impossible to determine this number, the systematic replacement of these nuts at each maintenance is the only guarantee of safety.

SAFETY MEASURES TAKEN BY THE OPERATOR

Since the accident, Elixir Aircraft has taken the following measures:

- segregation between the production and maintenance workshops;
- introduction of means to avoid interruptions to tasks;
- recruitment of new mechanics, dedicated to CAO activities;
- identification of critical tasks on service requests;

- introduction of an extended pre-flight inspection in the presence of a mechanic before a flight following completion of a critical task;
- modification of the pilot training program to include training in potentially risky situations during post-maintenance flights;
- systematic replacement of Nylstop nuts with new ones after disassembly;
- taking into account requirements relating to maintenance check flights.

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