



**Serious incident** to the CESSNA – 340A  
registered **N340YZ**  
on Sunday 6 February 2022  
in cruise between Lille-Lesquin and Aix-les-Milles

<b>Time</b>	Around 12:35 <sup>1</sup>
<b>Operator</b>	Private
<b>Type of flight</b>	Cross country
<b>Persons on board</b>	Pilot and three passengers
<b>Consequences and damage</b>	Aeroplane 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.	

**Pitch control difficulties in cruise in icing conditions,  
emergency descent and diversion**

**1 HISTORY OF THE FLIGHT**

*Note: the following information is principally based on statements, radio-communication recordings, radar data and Garmin TXI data.*

The pilot prepared a flight out of Lille-Lesquin airport, bound for Aix-les-Milles under an IFR<sup>2</sup> flight plan. He activated the elevator trim electrical control function (see paragraph 2.1.4) and switched on the anti-icing protections. He took off, accompanied by three passengers, at 12:02. The pilot initially climbed to FL 110. He engaged the autopilot at around FL 100. During the climb, the pilot observed a light deposit of white frost on the windshield. He continued to FL 180 which the aeroplane reached at 12:21. From time to time, the aeroplane flew in clouds. At FL 180, the planned flight level for cruising, the IAS was 150 kt and the recorded OAT approximately -15°C. The altitude was stable; the aeroplane's pitch attitude, controlled by the autopilot, fluctuated between 0 and 2°. The pilot then asked the controller for clearance to climb to FL 200 in order to fly on top.

At 12:28, the pilot started climbing to FL 200, which the aeroplane reached at 12:31. He was outside the cloud layer. The pilot observed that the leading edges of the wings were covered with "light" icing, which he estimated as being half a centimetre thick. He decided not to use the de-icing system. The IAS fluctuated around 150 kt (see **Figure 8**) and the OAT was around -19°C. The autopilot was no longer holding the altitude as accurately as previously. It fluctuated between + or -100 ft around FL 200, with a pitch attitude fluctuating between -2 and +4°.

<sup>1</sup> Except where otherwise indicated, the times in this report are in local time.

<sup>2</sup> The glossary of abbreviations and acronyms frequently used by the BEA can be found on its [web site](#).

At 12:34:43, the pitch attitude reached a minimum value of  $-3^{\circ}$  and the vertical speed  $-1,450$  ft/min. The pilot detected a loss of altitude of roughly 200 to 300 ft and reacted to this by making a slight nose-up input on the stick. The aeroplane returned to FL 200 and the pilot, feeling that the aeroplane was behaving abnormally, disconnected the autopilot. The pitch attitude then increased to reach  $5^{\circ}$  nose up.

At 12:35:09, the vertical speed reached  $+1,300$  ft/min. The pilot indicated that he pushed on the stick and used the elevator trim electrical control to apply nose-down trim. As this action had no effect, he disconnected the electrical trim. He then tried to use the elevator trim manual control, but it seemed to be jammed. He then pushed hard on the stick while reducing power. He explained that he suspected icing on the trim tabs or elevators and thought that he had to lose altitude as quickly as possible to return to positive temperatures.

At 12:35:50, the pilot declared an emergency situation and asked the controller for assistance to land at the nearest aerodrome. He decided to divert to Châlons-Vatry airport. The pilot asked the passenger in the front seat to help him push on the stick to descend, with the aim of maintaining a speed of 200 kt (VNO<sup>3</sup>). At 12:36:41, the pilot reported on the radio that the aeroplane was “vibrating too much”. At this point, the vertical speed was  $-3,000$  ft/min and the IAS 204 kt at FL 163. According to the pilot, despite the combined force that both he and the passenger exerted, the aeroplane was unable to reach VNE<sup>4</sup> (234 kt). The maximum IAS reached during the descent was 214 kt.

The pilot monitored the OAT during the descent; it seemed to him that as the temperature increased, the aeroplane started behaving normally again. The temperature became positive at a level below FL 50. The pilot reported that he regained full control of the aeroplane at an altitude of around 4,500 ft. At this point, the OAT was  $+1^{\circ}\text{C}$ . He was able to use the elevator trim again, first manually and then via the electrical control.

At 12:56, the pilot landed without further incident at Châlons-Vatry. A large dent in the fuselage level with the left engine was visible (see **Figure 6**).

## 2 ADDITIONAL INFORMATION

### 2.1 Aircraft information

#### 2.1.1 General

The Cessna 340A is a pressurized aeroplane which can carry six people. It is equipped with two Continental piston engines each providing 310 hp. N340YZ is not authorized to fly in known icing conditions<sup>5</sup>, as it is not equipped with an electrically-heated windshield. A placard situated in front of the power levers indicates: “FLIGHT IN KNOWN ICING IS PROHIBITED WITH THIS AIRPLANE” (see **Figure 1**).

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<sup>3</sup> Maximum structural cruising speed.

<sup>4</sup> Velocity Never Exceed.

<sup>5</sup> These conditions are defined by EASA as conditions where actual ice is observed visually to be on the aircraft by the pilot or identified by on-board sensors (GM1 NCO.OP.170(b)).



Figure 1: warning placard situated in cockpit of N340YZ (source: BEA)

Nevertheless, it is equipped with electrical anti-icing systems for the propellers, Pitot tubes and stall warning system, a windshield de-icing system using isopropyl alcohol and a pneumatic de-icing system for the leading edges of the wings and the horizontal stabilizer.

### 2.1.2 Elevator control mechanism

The aeroplane is equipped with two elevators linked together by a torque tube. They are controlled by cables which are guided under the floor and through the fuselage by a system of pulleys.

### 2.1.3 Elevator trim manual control mechanism

The elevator is trimmed (see **Figure 2**) by means of a trim tab attached to the right-hand elevator. It is operated manually by a thumbwheel on the left-hand side of the cockpit's pedestal (**Figure 2**, detail A), or by an electrical control on the pilot's stick (see **Figure 3**). The manual control thumbwheel moves a gear connected to a chain and cables which are guided via pulleys through the pedestal, then under the floor to the rear of the aeroplane. These cables operate a chain which in turn moves a jack screw (**Figure 2** see, detail B), connected to the trim tab.

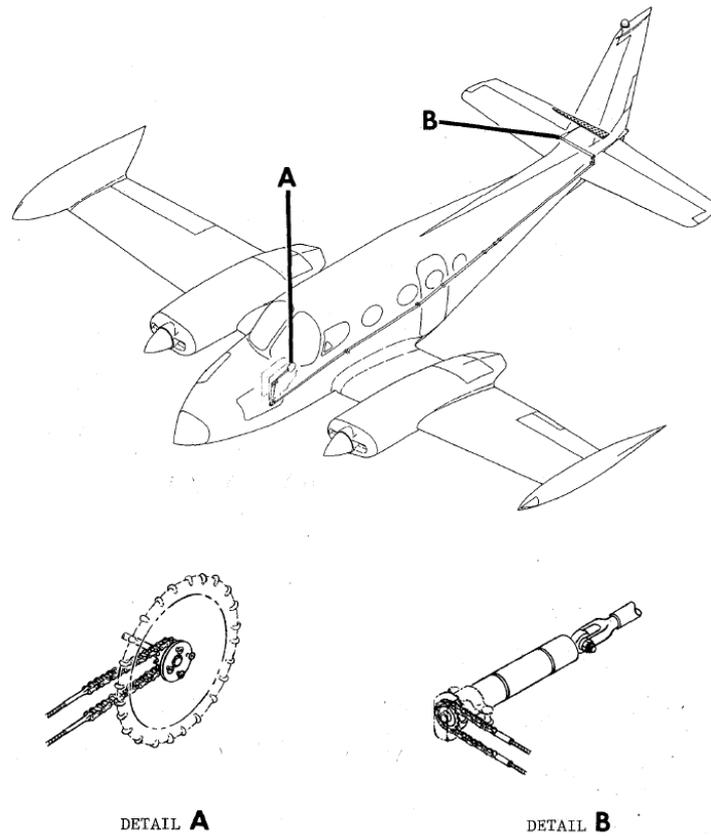


Figure 2: elevator trim (excerpt from flight manual)

#### 2.1.4 Trim electrical control mechanism

The pilot's wheel includes several controls (see **Figure 3**), namely:

- the elevator trim electrical control: when it is pushed forwards (DN position), the trim tab is deflected so as to cause a variation in the nose-down attitude; when it is pushed backwards (UP position), the tab causes a variation in the nose-up attitude;
- an electrical trim disengagement switch.

The wheel also includes an autopilot disengagement switch<sup>6</sup>.

<sup>6</sup> In normal operations, preference is to be given to this switch to disengage the autopilot. The autopilot is engaged using an ON/OFF switch situated on the pedestal, under the power levers.



Figure 3: wheel of N340YZ (source: BEA)

The electrical trim actuator (see **Figure 4**, detail D) is installed in the tail of the aeroplane. The trim cable is wrapped around a drum connected to the actuator clutch. When the electrical trim control is set to the up or down position, the actuator's electrical motor drives the clutch, which rotates the trim cable.

The electrical motor can be overridden by operating the manual control thumbwheel located on the left side of the pedestal. The electrical trim disengagement switch can also be used to deactivate the electrical actuator.

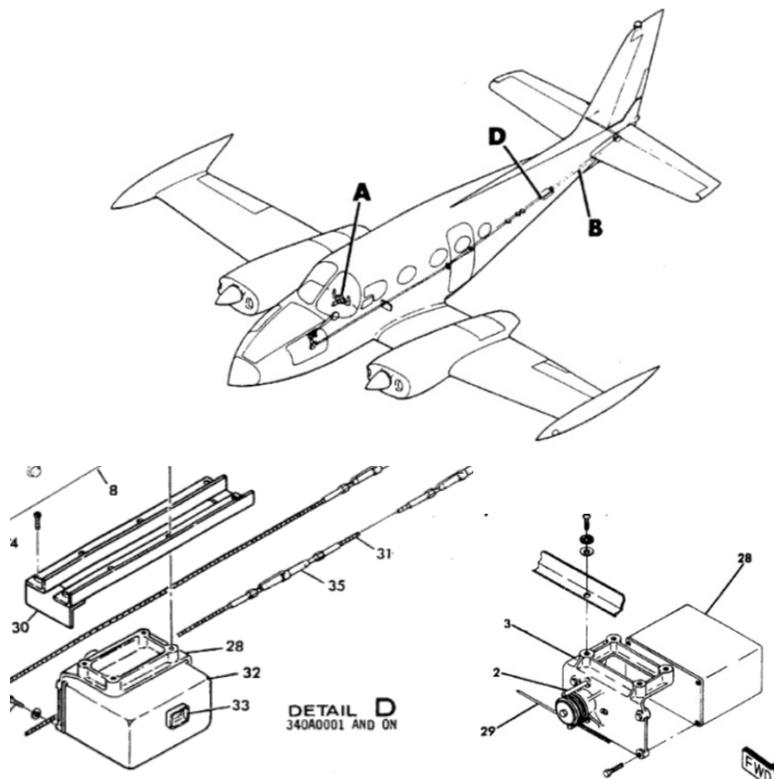


Figure 4: electrical trim actuator (source: maintenance manual)

### 2.1.5 Use of anti-icing systems

The flight manual recommends activating the Pitot probe and stall warning anti-icing systems at least five minutes before entering potential icing conditions (two minutes if the aircraft is on the ground), so that the elements are sufficiently warm to prevent ice formation.

The windshield de-icing system can be used as a continuously operating anti-icing system and should be used in this way during the approach to land. However, the maximum endurance with a 3-gallon tank is about one hour of continuous operation. The IAS should be 140 kt or less to obtain the best results.

### 2.1.6 Use of de-icing systems

The pneumatic de-icing system is based on inflation and deflation cycles to break up accumulated ice. The flight manual recommends activating it when a sufficiently thick layer of ice has accumulated, i.e. a thickness of between 0.6 and 1.3 cm (1/4 and 1/2 in). This operation can be repeated during the flight if necessary.

### 2.1.7 Refuelling conditions at Lille before departure

The pilot indicated that while preparing for the flight's departure, a very heavy rain shower forced him to interrupt refuelling. During this interval, the aeroplane was parked in such a way that the tail surfaces were exposed to continuous rain. He indicated that the rudder remained deflected to the left-hand side for a long moment, with the elevators in the down, rest position, i.e. nose down.

### 2.1.8 Examination of aeroplane after serious incident

#### Examination of airframe

Damage to the fuselage was visible in line with the left engine (see **Figure 5** and **Figure 6**). The damage measured about six centimetres in diameter and one centimetre in depth. This type of damage can be caused by the projection of a piece of ice which has built up on one or more propeller blades when the aeroplane passes through an area of icing conditions.

The propeller anti-icing system was tested by the workshop before and after the serious incident flight and was found to be operating normally. The maintenance workshop indicated that this damage was not present the last time the aeroplane was in the workshop, the day before the accident flight.

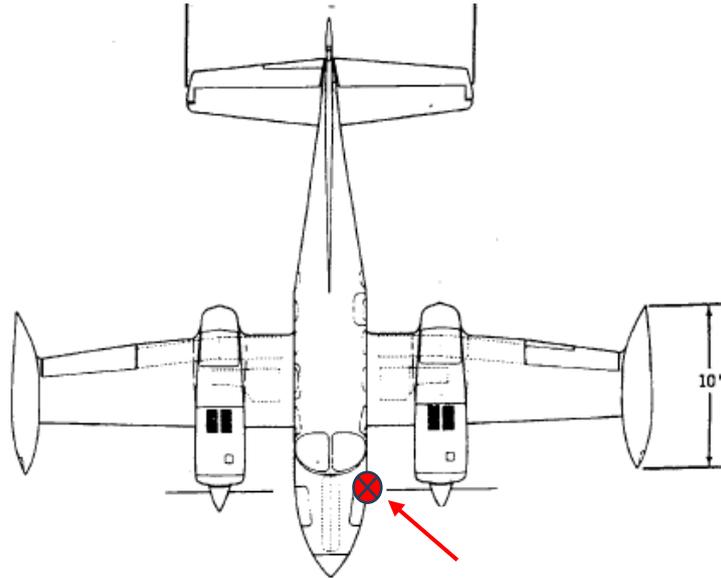


Figure 5: position of dent on fuselage (source: Cessna 340A maintenance manual)



Figure 6: photos of dent made by ice in fuselage level with left engine (source: BEA)

### Examinations of flight controls

The examinations of the elevator and elevator trim control mechanisms revealed no anomalies likely to lead to a malfunction.

The BEA took grease samples from the elevator trim actuator, as well as from the new grease used by the workshop. These samples were analysed by a laboratory. It was determined that:

- the used grease had the same characteristics as the new grease;
- its characteristics corresponded to those indicated in the Cessna documentation;
- the water content of the used grease was very low, and most probably rules out the jamming of an elevator trim actuator in icing conditions.

In conclusion, the various examinations did not reveal any factors likely to explain an in-flight jamming of the elevators or the elevator trim.

## 2.2 Pilot and front-seat passenger information and statements

### 2.2.1 Pilot

The 72-year-old pilot held an Airline Transport Pilot Licence (ATPL(A)) obtained in 1969 and a PPL(A) with valid SEP, IRSE(PBN) and IRI(A)<sup>7</sup> ratings. He had logged around 23,000 flight hours. He had not renewed his IRME rating<sup>8</sup> since 2013. He held a valid class 2 medical certificate.

The pilot reported that the weather conditions on the previous day's outbound flight had been "excellent" and that the entire flight had been conducted in VMC conditions. He stated that the weather forecasts he had collected in the morning of the return flight indicated "not very encouraging" conditions on departure, due in particular to rain, but that they posed no particular problem thereafter, with a very favourable situation on arrival at Aix-en-Provence.

The pilot believes that he would not have been able to put the aeroplane into descent on his own.

### 2.2.2 Front-seat passenger

The 74-year-old front-seat passenger held a Private Pilot Licence (PPL(A)) obtained in 2010 along with an up-to-date MEP rating. He regularly flew under VFR on N340YZ. He was the owner of N340YZ.

## 2.3 Meteorological information

### 2.3.1 Flight preparation

The pilot indicated that he had only used the "Gramet" site, which provides indications such as the thickness of the cloud layer and possible icing altitudes, to prepare the flight.

The 12:00 UTC SIGWX chart (see **Figure 7**) forecast, for the north of France:

- moderate icing above FL 40 to FL 60;
- rain and drizzle;
- overcast with a cloud layer above FL 10;
- 0°C isotherm at FL 50.

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<sup>7</sup> Aeroplane instrument rating instructor

<sup>8</sup> This rating is necessary to carry out a flight under IFR on N340YZ as pilot-in-command.

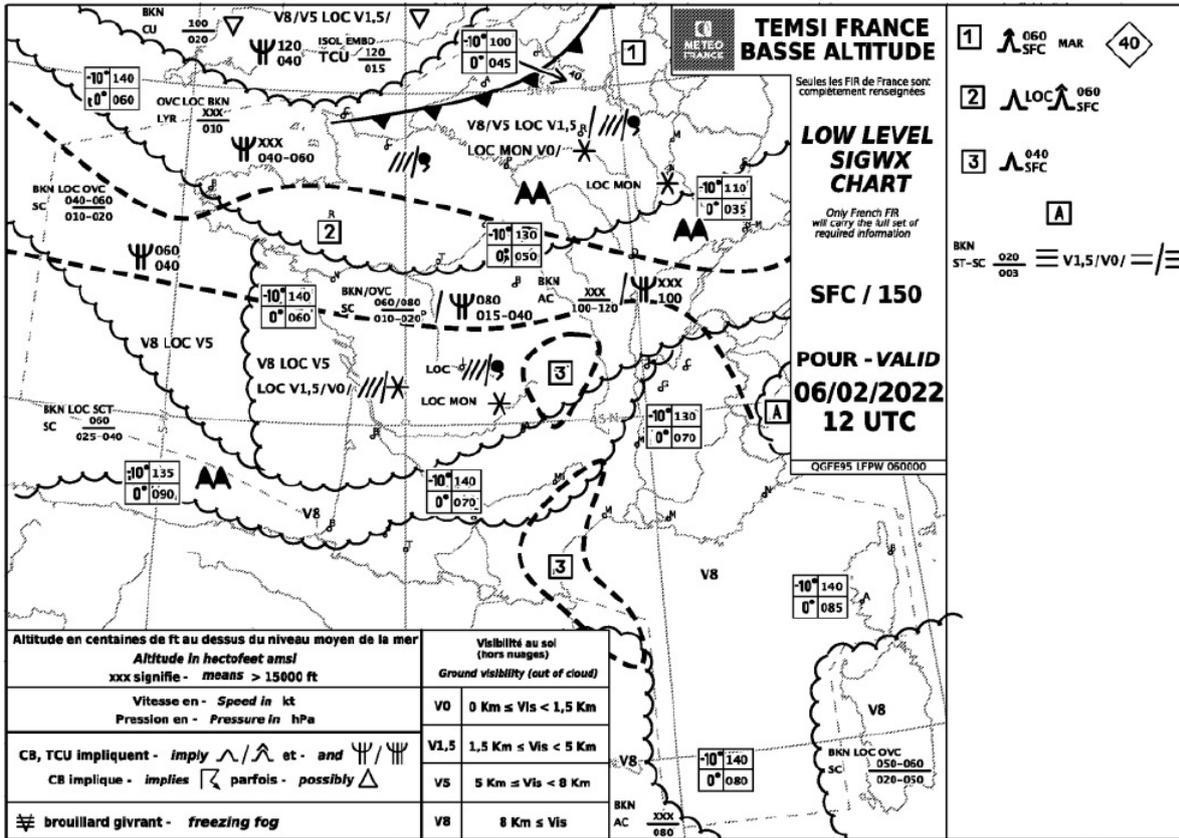


Figure 7: SIGWX chart at 12:00 UT

**2.3.2 Meteorological conditions encountered**

During the initial climb and descent, according to the vertical profiles calculated by Météo-France's AROME model, there was a low probability that the aeroplane could have encountered a band of severe icing approximately 3,000 ft thick located around FL 80.

In the cruise flight area, the model detected a band of unstable air with cumuliform clouds based at around FL 160 with the cloud tops reaching around FL 260, which could have been the site of moderate to severe icing.

**2.4 Analysis of recorded data**

The following information is based on data recorded by the GARMIN TXI EFIS computer. The engine parameters, the elevator and trim positions, the engagement of the autopilot and the associated modes were not recorded.

From the moment the aeroplane reached FL 200, there were quite marked fluctuations in altitude, speed and pitch attitude. The autopilot's servo system no longer seemed to be effectively carrying out its damping function. However, the aeroplane manufacturer indicated that it is not possible to affirm with certainty, based on the available data, that this behaviour was indicative of a jammed elevator trim.

Such fluctuations were not observed during cruise flight at FL 180 a few minutes earlier. More generally, prior to the onset of these fluctuations at FL 200, the recorded data did not reveal any abnormal variations in flight parameters, such as a gradual diminution in speed or an increase in pitch attitude in level flight, for example.

The IAS during cruise at FL 180 and FL 200 averaged approximately 150 kt. Based on the flight manual, this speed appears consistent with the engine parameters the pilot indicated he displayed.

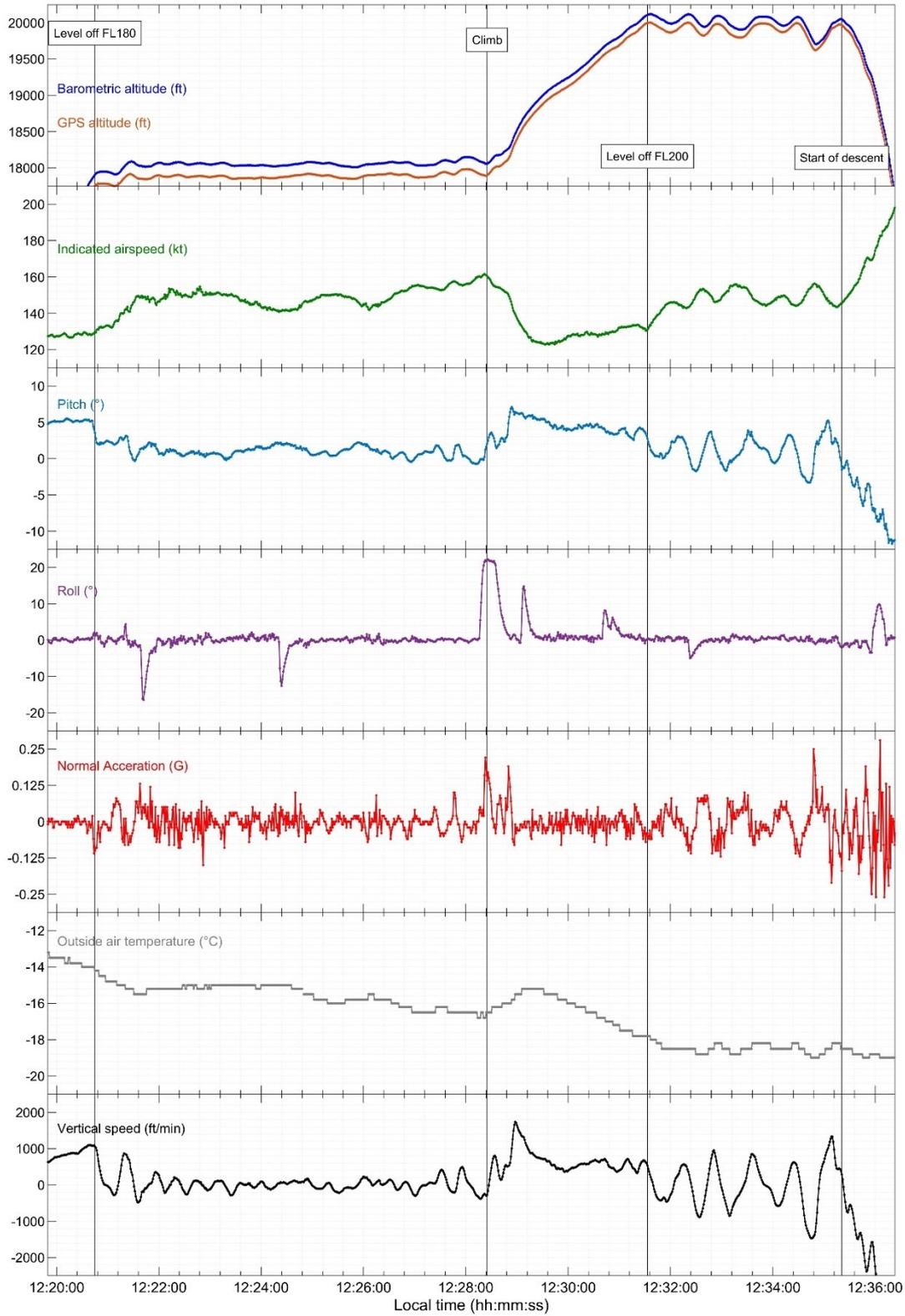


Figure 8: flight data recorded by Garmin TXI

## 2.5 Associated procedures to manage jamming of elevator trim and elevators

The manufacturer has not published any documents concerning the jamming of the elevator trim or elevators for the Cessna 340A. It stated that it was not aware of occurrences of this type with this model of aeroplane. It added that should the elevator trim become inoperable, the pilot could control the aeroplane's pitch by using the elevators.

Lastly, the aeroplane manufacturer recommends that the fuselage drains and tail unit drain tubes be inspected annually to ensure that they are unobstructed and allow the evacuation of any water that may have accumulated after heavy rain. The drains were not inspected following the occurrence.

## 2.6 Similar event

The BEA has published a report concerning a similar serious incident involving the Beech 1900 D registered [F-GLNH](#) on 10 December 2021. In cruise, the crew were confronted with a jammed elevator trim and felt hardness in the elevator control. Before taking off, a heavy rain shower probably led to water infiltrating the fuselage, increasing the humidity in the non-pressurised and unheated areas. During the climb, the aeroplane flew through a very cold and humid air mass, conducive to the formation of ice. This ice may have formed along the route of the cables or control rods of the trim and elevator, resulting in substantial friction or jamming affecting the correct operation of the controls.

### 3 CONCLUSIONS

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

#### Scenario

While preparing the flight, a very heavy rain shower meant that the pilot had to interrupt refuelling. The tail unit was then exposed to sustained rain. After take-off from Lille-Lesquin in the rain, the pilot reported that he identified the presence of ice deposits on the windshield during the climb, and on the leading edge of the wings when he was in level flight at FL 200. However, the thickness of these deposits was still not sufficient, according to the pilot, to activate the pneumatic de-icing devices on the leading edges.

Flight parameters revealed fluctuations in altitude and speed during level flight at FL 200. The pilot reported that the elevator trim electrical control was no longer effective and that the manual control was jammed. The examinations carried out did not reveal any element likely to explain this jamming. It is probable that the elevator trim was jammed by water that solidified during the climb to FL 200, performed at an average indicated airspeed of 130 kt.

This probably impaired the autopilot's altitude hold function and caused abnormal pitch fluctuations that led the pilot to disengage the autopilot and perform a rapid descent to an altitude band where positive temperatures prevailed. The indicated airspeed was approximately 200 kt during the descent. The pilot, aided by his passenger, had to exert a considerable nose-down force on the stick until the aeroplane descended to an altitude of around 4,500 ft where there were positive temperatures. The elevator trim manual, then electrical control became operational again.

#### Safety lessons

##### **Management of descent in event of icing of a flight control**

If icing affecting a control surface or its command mechanism is suspected, if the safety altitude permits, descending to altitudes where there are positive temperatures is essential to recover the ability to move the control surface again. In the event of the elevator trim jamming, speed management during descent must take into account both the force that the pilot is capable of sustaining on the stick and the maximum (VNO, VNE) and minimum speeds in icing conditions.

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