Serious incident to the BEECH - 1900 - D registered F-GLNH on 10 December 2021 in cruise

Time	Around 18:30[1]
Operator	Intairline
Type of flight	Commercial
Persons on board	Captain (PM), co-pilot (PF), 1 cabin crew member, 7 passengers
Consequences and damage	None

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.

Hardness in elevator control and jamming of elevator trim in cruise

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

1 HISTORY OF THE FLIGHT

Note: the following information is principally based on crew statements, radio communication recordings and radar data. The FDR and CVR data was not preserved.

The crew took off at 17:45 from Toulouse-Blagnac aeroport (Haute-Garonne) for a passenger commercial flight bound for Metz-Nancy-Lorraine aeroport (Moselle). The co-pilot was the PF for this leg. At 18:05, en route at FL 180, the crew were cleared to head directly towards Clermont-Ferrand. Before reaching Clermont-Ferrand, the aeroplane encountered turbulence associated with altocumulus cloud tops. At 18:21, in sector T of the Bordeaux south-west ACC, the crew asked the controller for clearance to climb in order to exit the turbulence. The latter initially cleared them to climb to FL 190 and then at their request, to FL 220.

After flying through FL 200 in climb, the A/P TRIM FAIL warning light (see paragraph 2.3.1 and paragraph 2.3.6) lit up. The co-pilot disconnected the autopilot. The aeroplane then adopted a steep nose-up attitude and climbed around 500 ft.

The co-pilot used the manual elevator trim control to return to a normal pitch attitude. He observed that the deflection of the elevator trim control was limited and that the elevator control was difficult to move. He managed to return the aeroplane to level flight by using a lot of force on the elevator control. The captain took back the controls. He observed that it was necessary to simultaneously act with an abnormal amount of force, on the elevator control and on the manual elevator trim control to modify the aeroplane's trajectory on the pitch axis. After finding the appropriate power and pitch values and an elevator trim position to keep the aeroplane in level flight, the captain transferred the controls to the co-pilot. The crew then complied with the "AP TRIM FAIL" procedure and after analysing the situation, decided to continue to destination.

At 18:29:30, the crew reported to the controller that they had a small problem with icing and asked to descend to FL 200. At 18:33, they indicated that they had a few small problems with the trim and asked to descend to FL 180. The controller transferred the aeroplane to sector LO of the Aix-en-Provence south-east ACC. After the transfer, at 18:36:47, the crew indicated that they had small icing and trim problems and asked to descend to FL 150. The rest of the flight was continued with the crew piloting manually.

The crew configured the aeroplane earlier than usual during the ILS approach for runway 22 at Metz-Nancy-Lorraine. The aeroplane remained controllable despite the more than normal force required to make inputs on the elevator control. During the flare, when power was reduced, the co-pilot observed the unjamming of the elevator control and the disappearance of the friction point. They landed at 19:45 and once at the gate, they observed that the elevator control could be fully deflected.

2 ADDITIONAL INFORMATION

2.1 Meteorological information

2.1.1 Forecasts and reports

The 17:30[2] automatic weather report from Toulouse airport indicated:

- wind from 330° of 26 kt, gusts 39 kt, varying in direction between 290° and 010° clockwise, becoming 300°, 15 kt, gusts 25 kt;
- visibility 9 km;
- rain;
- temperature 6°C and dew point temperature 4°C;
- broken clouds at 2,100 ft, 2,900 ft and at 4,200 ft with cumulonimbus;
- temporarily, visibility 4,000 m with showers (SHRA) and broken cumulus congestus at 1,200 ft.

The 15:00 UTC SIGWX chart mentioned clouds between Toulouse and Clermont-Ferrand, which could reach at least 15,000 ft, showers with local cumulonimbus clouds and a moderate risk of icing from 4,000 to 15,000 ft minimum (the 0°C isotherm was located at 4,000 ft).

The 18:30[3] automatic weather report from Metz aerodrome indicated:

- wind from 260° of 19 kt;
- visibility greater than 10 km;
- mist;
- broken clouds at 2,000 ft, overcast at 2,500 ft;
- temperature 4°C and dew point temperature 2°C;
- temporarily, wind from 270° of 22 kt, gusts 35 kt and broken clouds at 1,300 ft.

2.1.2 Weather conditions before and during the flight

The pilots of F-GLNH indicated that before the passengers boarded, there had been a heavy rain shower with gusts for about ten minutes. They then taxied to the runway in the rain and took off about fifteen minutes after the squall had passed over.

The French met office, Météo-France, estimated the weather conditions on the route followed by the aeroplane as being unstable cumuliform clouds giving rise to non-stormy rain or snow showers. Between Toulouse and Albi, the air mass was very humid from ground level to FL 180, particularly from FL 050 upwards.

According to Météo-France's AROME weather model, the aeroplane might have passed through an area of cloud from FL 030 to FL 080, with a risk of moderate icing from FL 040 to FL 200, and even severe icing around FL 050. However, the pilots indicated that they did not observe any icing conditions and did not have to use the de-ice systems during the flight.

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[2] LFBO 101630Z AUTO 33026G39KT 290V010 9000 2400 RA BKN021 BKN029 BKN042 ///CB 06/04 Q1012 TEMPO 4000 SHRA BKN012TCU BECMG 30015G25KT=

[3] LFJL 101830Z AUTO 26019KT 9999 -DZ BKN020 OVC025 04/02 Q0998 TEMPO 27022G35KT BKN013=

Based on the Météo-France analysis, from FL 180 upwards, the aeroplane seemed to have been flying above areas of precipitation and in temperatures reaching -35°C (ISA-6) at FL 220. According to the crew, when the A/P TRIM FAIL light illuminated, the aeroplane was flying in clear sky conditions.

2.2 Crew information

2.2.1 Experience and ratings

The 46-year-old captain (PM) held an aeroplane Commercial Pilot License (CPL (A)) issued in 2007. The day of the accident, he had logged around 5,310 flight hours including 753 h on type, and approximately 130 h in the previous three months, all on type. In the previous 24 h, he had flown 3 h 25 min on type.

He obtained the BE300/1900 initial type rating on 20 May 2019 after following theoretical and practical training with the ATO, Air Qualifications and was recruited by Twinjet on 21 May 2019 (see paragraph 2.4.1).

The 28-year-old co-pilot (PF) held a CPL (A) issued in 2017. The day of the accident, he had logged around 1,540 flight hours including 760 h on type, and 152 h in the previous three months, all on type. In the previous 24 h, he had flown 3 h 25 min on type. He obtained the BE300/1900 initial type rating on 3 June 2019 after following theoretical and practical training with the ATO, Air Qualifications and was recruited by Twinjet on the same day (see paragraph 2.4.1).

The two pilots had flown between 300 and 400 h together within the company. In April 2020, they had both followed the e-learning course regarding B1900 abnormal and emergency procedures (see paragraph 2.4.6).

2.2.2 Crew statements

The co-pilot indicated that he had not detected any anomaly with the elevator or elevator trim during the pre-flight check. After starting up the engines, he tested the deflection of the flight controls and did not detect any friction points.

When the AP TRIM FAIL warning light came on, he disconnected the autopilot and tried to operate the elevator trim manual control by hand to feel the loads. He felt the elevator control and the elevator trim manual control were very heavy and deduced that there was probably ice on the elevator. Not knowing where the problem came from, he tried to find a suitable trim position without forcing the system, while varying the engine power. The crew followed the "AP TRIM FAIL" procedure. The deflection of the elevator trim manual control was small. The co-pilot was not able to assess after the event, the extent of the loss of deflection of the elevator control and thought it more closely resembled a friction point.

The crew indicated that they then adjusted the power of the engines and the attitude of the aeroplane to reduce the loads on the controls and not apply tension to the flight control cables. The aeroplane remained controllable despite a lack of precision at the controls. Given that the weather conditions at Clermont-Ferrand were not suitable for a diversion and that the minimum safe altitude was high, the crew decided to continue to the planned destination. They started the descent by varying the power of the engines. During the descent, as a precaution, the crew increased the cabin temperature. During the last 6,000 ft, pitch control improved. The crew configured the aeroplane as early as possible before starting the approach at standard speed.

The co-pilot indicated that he had already encountered this phenomenon in 2020 on another Twinjet Beech 1900 (see paragraph 2.3.5).

The captain explained that, during the cruise, the co-pilot (PF) had told him that he had to use abnormally high force to operate the elevator trim manual control and that, if he insisted, it reacted jerkily. He said that when he took the controls, the elevator deflection was normal, but stiff; he was able to override this stiffness with the application of the manual elevator trim. He added that he had never encountered this phenomenon and was unaware it existed. According to him, the aeroplane climbed slightly just after the unjamming of the control. The co-pilot landed without difficulty.

The crew reported that during the inspection of the aeroplane at the gate, after the passengers had disembarked, the co-pilot observed a light flow of water through the drains located under the wings, and at the elevator and the drain located under the vertical stabilizer. No icing was visible on the leading edges.

The captain indicated that he contacted the maintenance workshop by telephone, who explained that water could penetrate the fuselage and sometimes turn to ice despite the cables being greased. However, if full deflection was recovered, this meant that the controls were free.

The captain contacted the designated head of flight operations by telephone (see paragraph 2.4.2), who informed him that he had already encountered this phenomenon and confirmed that there was no contraindication to carrying out the return flight with the same aeroplane[4], provided that there was full deflection of the control surfaces on the ground and that there were no icing conditions on the route. After analysing the forecast weather conditions at Metz and on the return leg, the captain decided to carry out the next leg with the same aeroplane. The inspection of the aeroplane by the Part 145 maintenance workshop at the end of the return flight did not reveal any anomalies. However, the mechanics noticed the presence of water in the wing box structures and under the cabin floor.

Note: according to the designated head of flight operations, it was not clearly established that the flight controls had jammed during his telephone exchange with the captain. He added that he called the captain back to tell him not to hesitate cancelling the return flight if a serious problem was suspected.

2.3 Aircraft information

2.3.1 Activation conditions of AP TRIM/FAIL warning

According to the manufacturer's documentation, the AP TRIM/FAIL warning is activated in the event of an incorrect trim input or no trim input from the autopilot trim control.

According to the designated head of maintenance and airworthiness, the conditions leading to the illumination of the "AP TRIM FAIL" light are the following:

- icing conditions in flight: the presence of ice on the cables can interfere with the correct operation of the servocontrol;
- lack of lubrication of the elevator trim actuators;
- incorrect cable tension;

[4] The operator’s main base is at Toulouse airport.

- faulty servocontrol or clutch;
- electrical fault in one of the system's components.

2.3.2 Operation of the primary elevator control, the autopilot and the elevator trim

Elevator control

The wheel in the cockpit actuates the elevators by means of metal cables running first through various sets of pulleys under the cabin floor, then through the rear pressurised bulkhead (see **Figure 1**, detail B) up to the rear bellcrank at the top of the vertical stabilizer (see **Figure 2**).

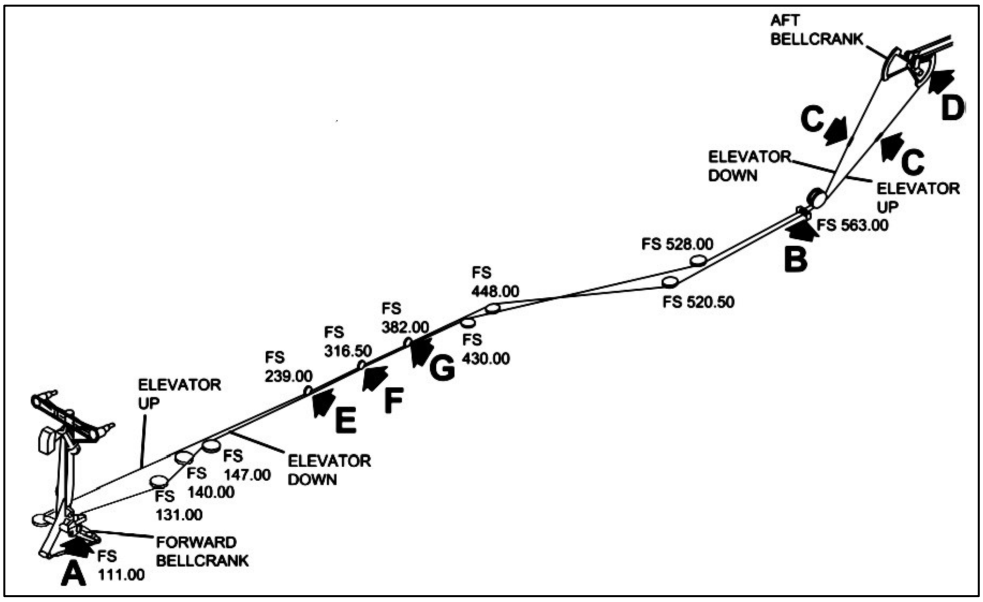
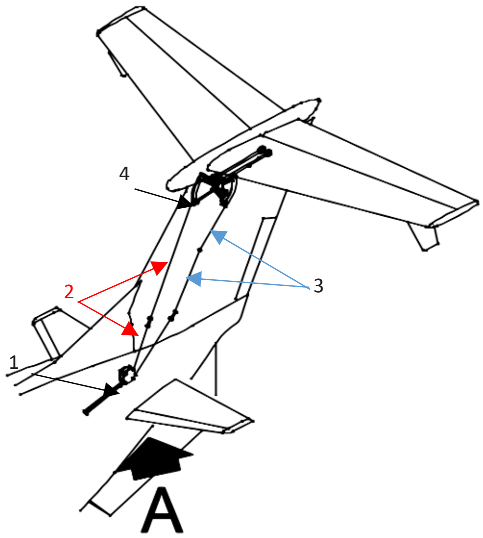


Figure 1: routing of elevator control cables through the pressurised bulkhead (source: Textron Aviation)



1- Lower pulley
2- Elevator down control cables
3- Elevator up control cables
4- Bellcrank

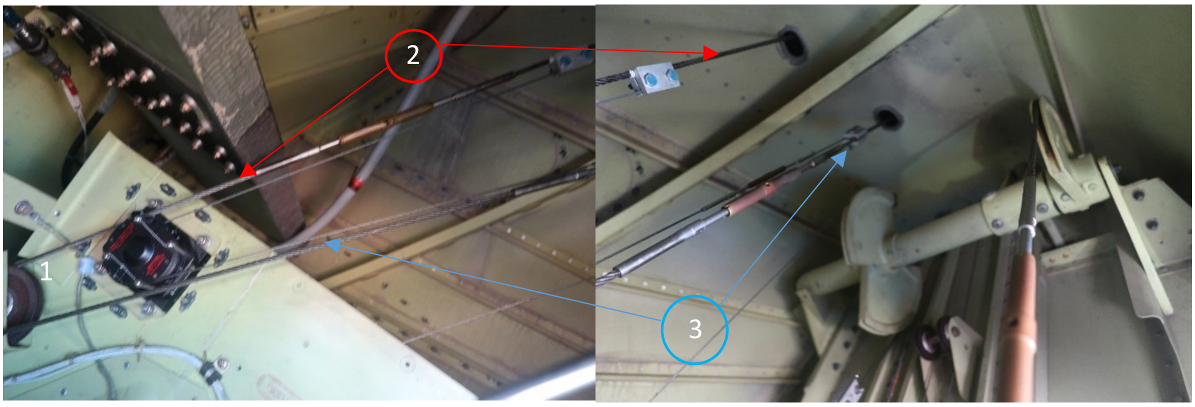


Figure 2: elevator control inside vertical stabilizer
(sources: BEA (photos), Textron aviation (diagram))

Autopilot servocontrol

Inside the bottom part of the vertical stabilizer, a servomotor acts on the elevator control when the autopilot is engaged. The servocontrol and the primary elevator control cables are connected by means of two other smaller cables (see **Figure 3**). According to the information from the autopilot, the servomotor starts rotating which makes the primary cables move towards the elevators.

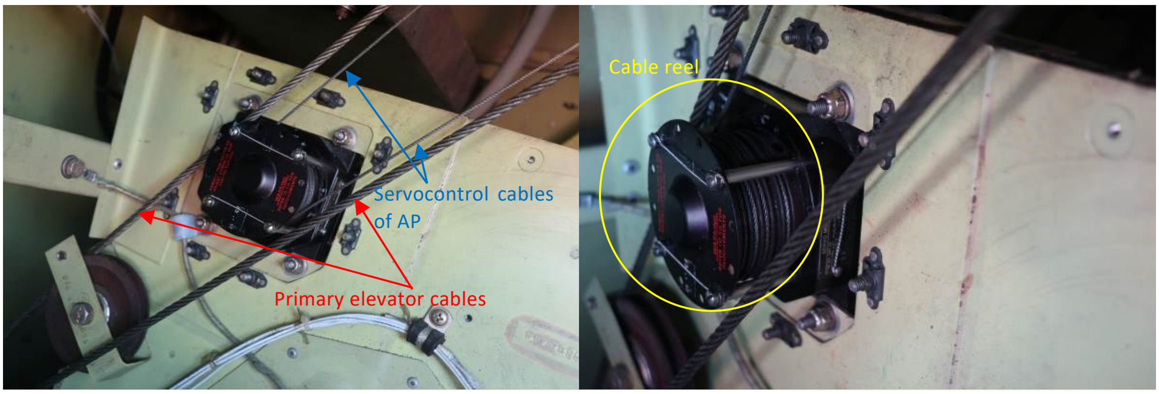


Figure 3: autopilot servocontrol (source: BEA)

Elevator trim manual control

The elevator trim manual control is actioned by a control wheel located on the left side of the pedestal in the cockpit, which moves a chain to which metal cables are attached. These cables then pass through a set of pulleys before passing through the pressurised bulkhead and climbing vertically to a set of pulleys directing the cables towards dual mechanical actuators operating each trim tab (see **Figure 4** and **Figure 5**).

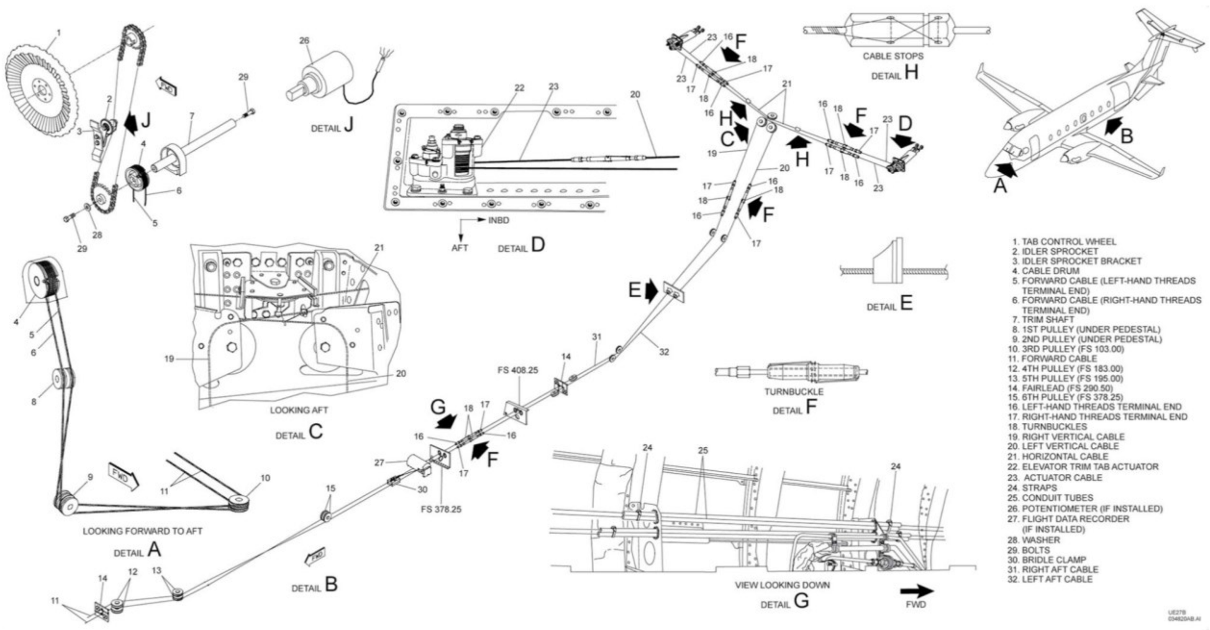


Figure 4: route of elevator manual control cables
(source: Textron Aviation)

Figure 5: exterior view of trim actuators (source: BEA)

Elevator trim electrical control

The double switch located on the left-hand side of each wheel actions the elevator trim electrical control via the electric servomotor located under the left floor of the passenger cabin aft of the spar. The motor drives two cables connected to those of the manual control (same principle as the elevator servocontrol) (see **Figure 6**, **Figure 7** and **Figure 8**).

Figure 6: double switch (source: BEA)

Figure 7: electric servomotor and electric trim cables (source: BEA)

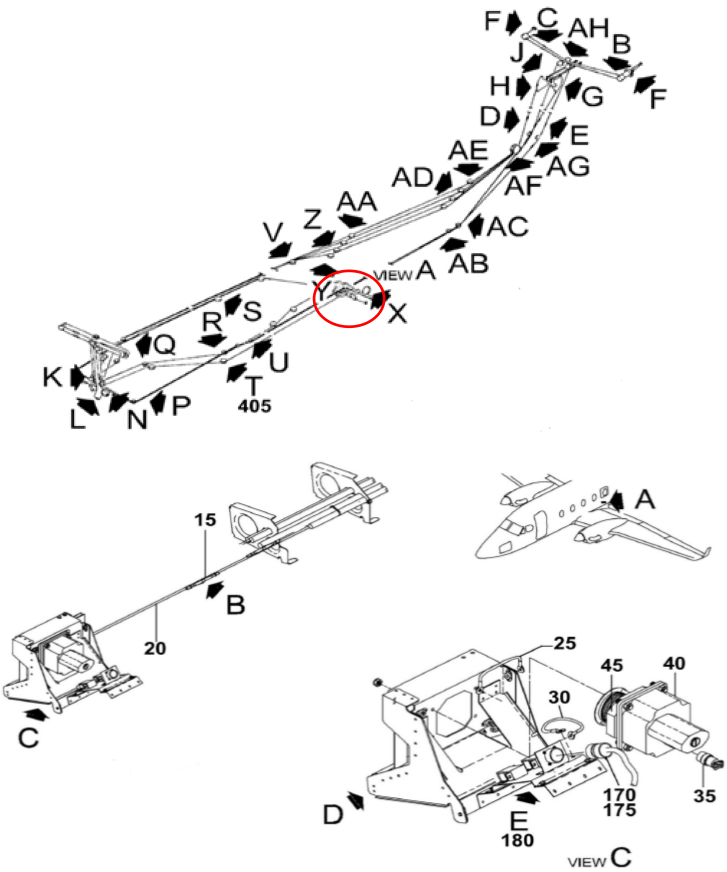


Figure 8: electric elevator trim servomotor (source: Textron Aviation)

2.3.3 Examination of cable routing and elevator trim actuators

The BEA was informed of the event on 24 January 2022 (almost two months after the occurrence) and began gathering information (crew report, maintenance report, information from the control services, exchanges with the aircraft manufacturer, etc.) to gain a better understanding of the circumstances of the event. A safety investigation was opened by the BEA on 9 February 2022.

The copy of the Technical LogBook (TLB)[5] provided by the company indicates "jamming of elevator trim by ice". This information was added at a later date. Initially, the crew had not recorded that they had encountered a fault during the incident flight and only the indication "*RAS*" (nothing to report) had been entered.

According to the annotations on the TLB sheet, a check of the elevator trim actuator system, cleaning and lubrication were carried out by the company's maintenance workshop in Toulouse after the return flight, followed by a "functional test" which proved satisfactory. There was no mention of any other inspections having been carried out on the manual or electric trim control, the main elevator control or the autopilot control. The approval for release to Service (APRS) was then granted on 14 December 2021 and the aeroplane resumed operations.

The mechanics who intervened reported that they had observed the presence of water in the wing box structures and under the cabin floor.

The statements made by the pilots, the tests carried out by the maintenance workshop and the absence of any similar event following the aircraft's return to service led the BEA to look for an environmental explanation for the jamming of the flight controls, and in particular an accumulation of frost or ice in certain areas of the aircraft.

An in-depth examination of another Beech identified several areas that could restrict the movement or even block the movement of the cables. In the presence of high humidity combined with negative temperatures, certain confined areas can accumulate water, which can turn to ice. These area are located:

- where the elevator control cables pass through a set of pulleys in the lower part of the vertical stabilizer (outside the pressurised and heated zone), at the junction of the skin of the tail cone and the pressurised bulkhead;
- where the cables wind in the barrel of the autopilot elevator servocontrol. However, the presence of a clutch inside the servocontrol allows it to be released in the event of a restriction or friction point detected during the rotation of the servocontrol;
- where the elevator control cables pass through the cable pressure seals (pressurised bulkhead feedthrough).

[5] It is used in particular, as a means of communication between crews and the staff of maintenance organisations in order to record all faults and malfunctions observed during the flight or on the ground during the operation of the aircraft.

In addition, a visual examination of the rod extension of the elevator trim actuators and a study of the documentation identified two other areas where the presence of water turning to ice could affect the operation of the elevator trim actuators (limited travel, jamming):

- the area where the rods slide in the actuator body (these are located at the trailing edge of the elevators) (see **Figure 9**);
- the area where the elevator trim control cables wind in the drum associated with these cables (located inside the horizontal stabilizer, on the left and right sides) (see **Figure 10**).

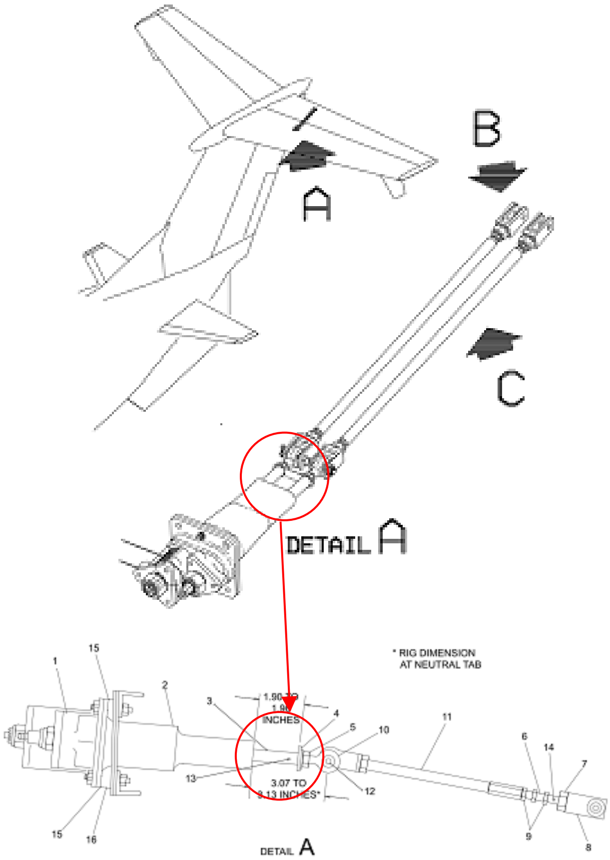


Figure 9: sliding area of elevator trim actuator rods
(source: Textron Aviation)

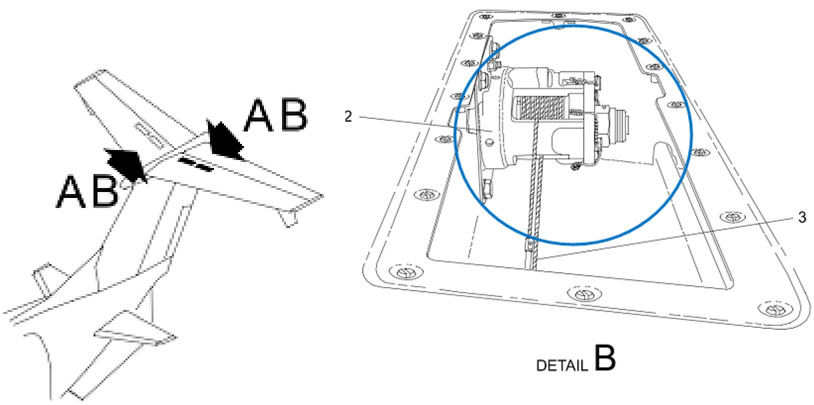


Figure 10: area where elevator trim control cables wind in drum
(source: Textron Aviation)

2.3.4 Inspections relating to flight controls

With regard to the elevator control, the manufacturer's programme stipulates greasing the following items:

- the elevator trim tab hinge (every 200 h);
- the elevator trim actuator grease fittings (every 200 h);
- the control cables and cable pressure seals (pressurised bulkhead) (every 1,200 h);
- the elevator trim tab chain every 1,200 h.

All the lubrication work scheduled at 200, 400, 600 and 1200 h had been carried out on the aeroplane in December 2019 at 24,541 h. At the time of the accident, the aircraft had logged 25,111 hours.

Routine inspections had been carried out at 24,744 h on 9 March 2020, then at 24,954 h on 23 July 2021, during which lubrication had also been performed.

2.3.5 Similar occurrences on the Beech 1900

2.3.5.1 FAA and type certificate holder TEXTRON Aviation[6] database

During the investigation, the FAA and the manufacturer, Textron Aviation (who currently hold the type certificate), indicated that they had recorded three events between 1995 and 1997 involving elevator trim or elevator jamming, encountered in cruise on US-registered Beech 1900D. Furthermore, Textron Aviation brought the existence of two publications about in-flight elevator trim icing to the attention of the BEA.

On 8 May 1981, the manufacturer distributed a first document called *Safety Communique 57* to all Beechcraft distributors, owners and operators (see APPENDIX: *Safety Communique* dated 8 May 1981 issued by Raytheon Aircraft). Following several occurrence reports relating to in-flight elevator trim icing, most of which occurred in clear skies, the manufacturer Raytheon (type certificate holder at the time) identified that high-pressure washing with a soap and water solution eliminates lubrication of the piano hinge pins, so that in the event of heavy or prolonged rain, water is free to enter the hinge line. It then freezes around the hinge line when the aeroplane is used at temperatures below the freezing point.

In this document, the manufacturer recommends the following steps in such a situation:

- do not try to free the jammed elevator trim using the electric elevator trim or the manual elevator trim control. The force required to break the ice will probably exceed the force that can be delivered to the hinge line by either the electric or manual controls. Overstressing the trim cable circuit or the electric drive unit could damage either or both;
- alter the power settings until the aeroplane is reasonably well in trim and can be manually flown without uncomfortable stick pressures;
- keep in mind that the control surfaces are not attached by piano hinges and will remain free and responsive to the normal commands of the pilot.

The manufacturer indicated that such a situation should not give rise to an emergency descent.

In July 2003, following reports from Beech 1900 operators of in-flight icing of elevator trim actuators due to moisture around or inside these actuators, Raytheon issued mandatory Service

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[6] Textron Aviation Inc. is the general aviation branch of Textron. It was created in March 2014 following the acquisition of Beech Holdings which included the Beechcraft and Hawker Aircraft activities.

Bulletin SB 27-3032. This SB indicates that ice build-up between the two spur gears[7] had been identified as the cause of the jamming of an elevator trim actuator. It required the actuators to be modified and the grease type to be changed. This SB was complied with on F-GLNH in 2005; at this time, the aeroplane had logged 10,527 h.

2.3.5.2 BEA database and European database

A search in the BEA database and in the European ECCAIRS database identified ten occurrences involving the Beech 1900 between 1994 and 2020, during which either the elevator control or the elevator trim had hardened or jammed.

- Incidents involving the Beech 1900C registered F-GJTP in April and May 1994: on both occasions, the inspection of the aeroplane revealed heavy condensation in the elevator control system.
- Incident involving the Beech 1900C registered F-GLPL in 1995: the jamming was caused by the freezing of moisture which had penetrated into the elevator control bearings after the aeroplane had been parked in the rain for four days.
- Incident involving the Beech 1900D registered F-GUME in 2011 (operated by Twinjet): the cause of the failure was not determined. The following commercial flight was cancelled and the aeroplane took off without passengers in MEL conditions, in manual flight, with the trim in neutral and the "ELEVATOR TRIM" breaker pulled. SB 27-3032 had been complied with for this aeroplane in 2005. As a precaution, the trim actuators were replaced.
- Incidents involving the Beech 1900D registered F-HBCG in 2014: SB 27-3032 had been complied with. The elevator control system was inspected and no anomalies were found. This same phenomenon was subsequently reported on several occasions. The grease used for the trim actuators was replaced and there were no further reports of trim jamming after this.
- Incident involving the Beech 1900D registered C-GZVJ in 2018: after landing, a thorough inspection of the elevator trim system was carried out followed by two flight tests during which the problem occurred again. Both elevator trim actuators were replaced and a flight test showed that the problem had been solved.
- Incident involving the Beech 1900D registered F-GLNK on 27 November 2020 (operated by Twinjet): the elevator control system was inspected and the cables were greased (see paragraph 2.4.3).

The BEA does not have any information about any possible exchanges between Twinjet and the manufacturer following the above events.

2.3.5.3 Beech 1900D pilots of another air operator

In August 2023, the BEA carried out a survey of pilots employed by another French operator of Beech 1900Ds to assess their level of knowledge of the "STUCK ELEVATOR TRIM" procedure. Eight captains replied to this survey (the majority). Half of them had never heard of this procedure and had never been confronted with the jamming of an elevator trim.

According to the flight safety officer working for this operator which operates five Beech 1900D, the “Inoperative elevator control” simulator exercise was in the three-year recurrent training programme. He added that the “STUCK ELEVATOR TRIM” procedure was not in the QRH and that it has since been added in an update.

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[7] Situated in the area where the rods slide in the actuator body (see **Figure 7**).

2.3.6 Textron and Intairline procedures in event of elevator trim or elevator jamming

On 23 October 1998, Raytheon issued supplement 120-590000-41 "French registered aeroplanes" to the aeroplane flight manual, at the request of the French classification authorities[8]. In particular, the supplement contained the "STUCK ELEVATOR TRIM" procedure (see **Figure 11**), which was to be attached to the FAA-approved aeroplane flight manual for French-registered aeroplanes.

The procedure indicates that when the elevator trim control becomes stuck at high airspeeds, abnormal elevator control forces appear which can approach 75 lb (34 kg) of pull during the approach phase (see **Figure 11**).

ABNORMAL PROCEDURES

FLIGHT CONTROLS

STUCK ELEVATOR TRIM

A stuck elevator trim control will produce abnormal elevator control forces If the trim control becomes stuck at high airspeeds elevator control forces can approach 75 pounds of pull during normal approaches with the elevator trim control at 5 units nose down and at a forward C G Forces will be less with less nose down trim and/or a more aft C G If possible simulate a normal approach configuration at a safe altitude and determine the magnitude of the resulting elevator forces If forces are high use the following procedure

1 Airspeed	If practical maintain a speed close to the speed at which the trim became stuck to maintain normal pitch forces until ready for the approach
2 Approach and Landing	Plan for a straight in approach to the longest available runway using full flaps and normal approach speed Fly a shallow approach at approximately 500 feet per minute rate of descent Fly the airplane onto the runway without reducing power and using a minimum amount of flare Retard the power to idle after touchdown and use brakes and reverse as required to decelerate Landing distances will exceed published values

Figure 11: STUCK ELEVATOR TRIM procedure contained in supplement 120-590000-41

The DSAC explained that with the creation of the European Aviation Safety Agency (EASA) in 2003, the configuration requirements introduced by France for imported aircraft classified as French, were no longer enforceable[9]. However, the specific French configuration remained approved, subject to having a flight manual adapted to the aeroplane's configuration. This was confirmed by EASA[10]. The DSAC indicated that it had not specifically communicated to operators on this subject.

F-GLNH had been Frenchified and the French classification inspection had been carried out on 15 May 1996 at 960 h, before the creation of EASA. According to Intairline's designated head of maintenance and airworthiness, F-GLNH subsequently remained in the same configuration. The designated head of maintenance and airworthiness explained that Intairline used the France-specific flight manual (approved by the FAA with supplement 129-590000-41) for all its aeroplanes. The copy of the flight manual (AFM) provided by Intairline during the investigation included the supplement in its entirety (English version) in part VII with the procedure "STUCK ELEVATOR TRIM". This procedure refers to basic airmanship.

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[8] The investigation was unable to find the reasons for this French requirement. However, it does not appear to be linked to any particular configuration specific to the Beech 1900Ds registered in France, but rather to an assessment by the French authorities, during the flight tests carried out with a view to the Frenchification of this model, of its flight qualities and, in particular, the forces appearing on the elevator control when the elevator trim is left in a position used in cruise.

[9] Until 2003, the French requirements for the certification of the Beech 1900D were detailed in Airworthiness Directive F-1995-038 of 25 February 1995 concerning the conditions for “F” classification and in the DGAC airworthiness sheet drawn up in December 2003 associated with the type certificate of airworthiness No IM89.

[10] EASA specified that these aeroplanes must have embodied modifications specific to France, in particular kit 129-005002, which required, among other things, that supplement 129-590000-41 be inserted in the AFM.

The “STUCK ELEVATOR TRIM” procedure was not present in Intairline’s OM in force at the time of the occurrence nor in the on-board abnormal and emergency procedures in paper format available to the crew. Intairline indicated to the BEA that it did not wish to insert the “STUCK ELEVATOR TRIM” procedure in the QRH.

Note: the crew specified to the BEA that they managed to move the elevator trim control which was not therefore totally jammed. This “STUCK ELEVATOR TRIM” procedure was therefore not directly applicable in the situation encountered.

Documentation in electronic format of parts A, B and C was included in the Electronic Flight Bag (EFB) given to each pilot. The "STUCK ELEVATOR TRIM" procedure was present in the version of the EFB used by the crew of F-GLNH, under the heading Flight manuals and supplements. However, the title of each of the supplements was not indicated in the summary menu, which meant that they had to be opened one by one to find out what they contained. Part B "Abnormal and Emergency Procedures" in Intairline’s Operating Manual (OM) contained other procedures, including in particular: "A/P TRIM FAIL" and "LANDING WITH INOPERATIVE ELEVATOR CONTROL" (see **Figure 12**).

The “A/P TRIM FAIL” and “LANDING WITH INOPERATIVE ELEVATOR CONTROL” check-lists were present in the paper format of the abnormal and emergency procedures on board the aeroplane. The crew followed the "A/P TRIM FAIL" procedure.

Note: the “LANDING WITH INOPERATIVE ELEVATOR CONTROL” procedure only applies to situations where the elevator control no longer controls the associated control surface. It was therefore not directly applicable in the situation encountered.

4.7.2. A/P TRIM FAIL

❑ 2 ❑ ELEV TRIM.................................... OFF
❑ 2 ❑ ELEV TRIM.................................... ON

➔ **Si le voyant A/P TRIM FAIL s'éteint**
POURSUIVRE LE VOL EN SURVEILLANT L'AFFICHAGE TRIM dans l'EADI.

Si le voyant A/P TRIM FAIL ne s'éteint pas ou s'il se rallume une deuxième fois :
❑ 1 ❑ TENIR LE MANCHE FERMEMENT
❑ 1 ❑ AP .... OFF
❑ 2 ❑ ELEV TRIM.................................... OFF
❑ 1 ❑ AP ....NE PAS REENGAGER

POURSUIVRE LE VOL EN PILOTAGE MANUEL (TRIM MANUEL).

ATTENTION :
L'avion n'étant pas ou mal compensé en profondeur, s'attendre à un mouvement brusque à cabrer ou à piquer lors de la déconnexion du pilote automatique.

4.4.2. ATTERRISSAGE AVEC COMMANDE DE PROFONDEUR HORS SERVICE

❑ ■ VOLETS....................................ZERO
■ ❑ APPROCHE DIRECTE ....SOUS ANGLE REDUIT
■ ❑ ASSIETTE .... AVEC LE COMPENSATEUR
■ ❑ VITESSE .... AVEC LA PUISSANCE
■ ❑ ARRONDI .... AU COMPENSATEUR
■ ❑ REDUCTION DE LA PUISSANCE ....EN DOUCEUR

➔ **En cas de remise des gaz**
■ ❑ REAJUSTER LA PUISSANCE ....EN DOUCEUR

Figure 12: excerpts from operating manual (source: Intairline)

The analysis of the actions carried out by the crew found that they were in fact close to the manufacturer's recommendations detailed in *Safety Communique 57* mentioned in paragraph 2.3.5.1.

2.4 Operational information

2.4.1 Internal organisation of Intairline

The organisation and managers of Intairline and Twinjet[11] are the same. The two operators can charter each other. The various managers and their deputies are appointed under a detachment agreement. The tasks and responsibilities assigned to them for supervising and carrying out Intairline operations are identical to those they have at Twinjet and are described in the OM part A1 Organisation and Responsibilities.

The OM is applicable to both operators. The Safety Management System (SMS) manager is the same person for both operators and this position is held by the Flight Safety Officer (FSO). According to the OM, the internal oversight programme, common to both operators, ensures that they comply with regulatory requirements and internal procedures. An Intairline audit of Twinjet is scheduled every two years as part of Twinjet's service provision. The two operators have separate Air Operator Certificates (AOCs). Intairline's AOC was issued on 19 August 2019.

[11] Intairline and Twinjet are French airlines which are subsidiaries of the FMA (Fleet Management Airways) group.

2.4.2 Completion of TLB by crew and decision to make return flight

The flight during which the incident occurred was flight No 1 on the TLB sheet. The captain entered the wording “RAS” (nothing to report) followed by his signature at the end of flights No 1 and No 2.

The OM recommends describing anomalies as precisely as possible as this makes for a more effective and faster corrective action.

No tolerance for commercial flights was specified in MEL ATA.27 with respect to the elevator trim or the elevator control. As a consequence, flight 2 could only be carried out if a maintenance operation had been carried out and an APRS had been recorded in the TLB before take-off. However, the crew's decision to continue the flight was fortified by the exchange that the captain had directly had with the maintenance workshop and then the designated head of flight operations (see paragraph 2.2). This exchange and the associated decision were not documented in the TLB and not formalised by an APRS.

According to the crew, another aeroplane was available at the Metz stop. It could have replaced F-GLNH for the return flight.

2.4.3 Safety management system and notification of events

According to the operator's OM, the limitation of movement, stiffness or ineffective or delayed response in the operation of primary flight controls or their associated systems is one of the events to be reported by crews.

The OM stipulates that the captain must send an air safety report to the operator's operations office within 72 hours of an incident. This is then forwarded to the internal and external parties concerned, including the authorities, within the next 72 hours.

The OM provides for a series of regular meetings to improve the flow of information between the company's managers. In particular, it specifies that an "AIROPS" meeting is to be held each time the main operations managers have to be consulted about a case in order to analyse the events of the month (incident, accident, ASR), the technical situation of the fleet, etc. In practice, a management review led by the head of conformity serves as the operator's safety meeting. It meets every six months to take stock of incidents and the implementation of corrective and preventive actions.

The management review for the second half of 2020 was held on 25 January 2021. The FSO explained that he received the air safety report for the event concerning F-GLNK (operated by Twinjet) on 27 November 2020, the day after the management review. This event was therefore not presented at the review and was not analysed by the operator. Nor was it presented at subsequent management reviews. No Flight Safety Bulletin was issued internally following this event and no measures relating to this first event were taken by the operator in 2021. As a consequence, crews were not aware in 2021 that this phenomenon had already been encountered in 2020.

The event of 10 December 2021, which is the subject of this report, was reported to the designated head of flight operations on 13 December 2021 when the crew sent an air safety report. The designated head of flight operations notified DSAC Nord of the event on 13 December 2021, but not the BEA. The BEA did not learn of it until almost two months later and was only able to open a safety investigation on 9 February 2022. In June 2022, the operator issued a Flight Safety Bulletin addressed to its crews in which the two occurrences were presented and the "STUCK ELEVATOR TRIM" procedure was mentioned.

In the past, the operator had issued a Flight Safety Bulletin in the second half of 2010. This Flight Safety Bulletin included a report (ASR) relating to the seizure of the elevator trim and the illumination of the "A/P TRIM FAIL" light that occurred on 10 November 2010 to F-GUME at the start of cruise. A second Flight Safety Bulletin issued in 2011 included the ASR relating to the incident to F-GUME mentioned in 2.3.5.2. In addition, Flight Safety Bulletins issued in 2009 and 2014 made the company's pilots aware of the dangers of icing, and another, issued in 2017, dealt with the dangers of the winter period.

2.4.4 DSAC (French civil aviation safety directorate) oversight of operator

DSAC Nord is responsible for the oversight of Intairline.

During an audit carried out in February 2020 on pilot training, DSAC Nord noted the absence of training in the prevention and recovery of loss of control during pilot recurrent training and checking. The operator was notified of this point, as well as the need to revise training session scenarios annually to incorporate new exercises based on events that had occurred in the company or in other similar companies. In its reply, the operator indicated that it had added the flight control failure to a simulator training session and had filed a temporary revision with DSAC Nord (see paragraph 2.4.6).

During an audit carried out in November 2020 covering the organisation and flight safety, it was noted that several events had only been reported internally by the captain, and had not been notified to DSAC Nord, which specified that these anomalies had already been noted in 2019. During the next audit carried out in June 2021, it was observed that the operator's SMS did not provide any framework for collegial reflection on the safety measures taken following an event.

2.4.5 Air Qualifications (ATO) training programme for the initial Beech 1900 TR

The captain had attended the practical training course from 2 to 14 May 2019 to obtain the TR. The co-pilot had completed the same practical training from 1 to 13 April 2019. The Air Qualifications training programme that was in force at the time was Amendment No 5 of December 2018. The programme included the following exercises to be carried out during a two-hour practical simulator session:

- Pitch trim jammed;
- Full stop landing with pitch trim jammed;
- Pitch trim jammed or INOPERATIVE ELEVATOR CONTROL.

However, the initial TR programme provided by Air Qualifications to the two pilots was based on a previous version (Amendment No 4 of May 2018) which did not include the exercises mentioned above.

According to the OM, when the type rating is completed less than three months before the start of the Operator Conversion Course (OCC[12]), it is considered to be part of the OCC. In this case, the pilots do not have to follow the course on the aeroplane systems, the training relating to normal,

[12] It corresponds to a pilot's integration into the company, consisting of a theoretical part, practical training sessions, a simulator check, line flying under supervision (LIFUS) with passengers, finalised by a line check.

abnormal and emergency procedures, and the base checks again. The TR test is the equivalent of the OCC base check. This was the case for both pilots.

2.4.6 Recurrent training programme at Intairline/Twinjet

The three-year recurrent training programme provided for all aeroplane system families to be reviewed in theory and practice in the simulator, including compliance with the associated procedures.

Part D of the OM listed the systems that had to be reviewed in theory each year. However, the "flight controls" item was not mentioned in any of the theory programmes. Furthermore, the e-learning module, abnormal and emergency procedures B1900 did not mention the procedures "STUCK ELEVATOR TRIM" and "LANDING WITH INOPERATIVE ELEVATOR CONTROL".

It is indicated in the OM, in response to the deviations noted in February 2020 by the DSAC, that the missing items had been added, in particular the flight control (elevator) failure). An UPRT H1 cabin door then flight control (elevator) failure exercise was indeed added in May 2020 to the EHL CT2 2021 simulator training session and approved by DSAC Nord on 19 August 2020. The co-pilot followed the UPRT H1 in November 2020 and the captain in March 2021. However, although the exercise scenario does specify that the instructor should activate the illumination of the CABIN DOOR light, it only indicates that the consequence would be a deterioration of the elevator, without specifying what this deterioration is, and indicating that it cannot be simulated. This programme does not include any other exercises related to the jamming of flight controls.

The crew were confronted with an event which did not appear to be the result of a straight failure or a total malfunction of the elevator or elevator trim. The two procedures mentioned above would therefore not have been directly applicable, as the control surfaces were not completely jammed. Nevertheless, training for these two situations enables crews to better deal with the different situations that may be encountered.

2.5 Measures taken by operator

In the spring of 2022, a Flight Safety Bulletin concerning the icing of control surfaces was issued. The occurrence of 27 November 2020 to F-GLNK and the occurrence of 10 December 2021 to F-GLNH, the subject of this report, were described in this bulletin and the “STUCK ELEVATOR TRIM” procedure was recalled. In June 2022, the operator also issued a Flight Safety Bulletin addressed to crews containing an extract from the document *Givrage aéronefs – Guide de bonnes pratiques* (Aircraft icing - good practices guide) published by the DSAC in 2010.

On 10 June 2022, Intairline notified DSAC Nord of a revision, amending section B3 "Abnormal and emergency procedures" of the OM, and integrating the "STUCK ELEVATOR TRIM" procedure. DSAC Nord stated that this revision had also been included in the EFBs.

3 CONCLUSIONS

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

Scenario

Before taking off, the aeroplane had been in a heavy rain shower for several dozen minutes, during which water might have seeped inside the fuselage of the aeroplane. The ambient humidity in the non-pressurised and unheated areas was very likely to have been high. During the climb to cruise level, the aeroplane flew through a very humid and very cold air mass. The combination of negative temperatures and the probable presence of water at the various feedthroughs of the elevator control and/or elevator trim cables could have led to the creation of ice. This ice could have interfered with the correct operation of the elevator control and/or elevator trim by causing substantial friction and even jamming. This phenomenon could also have occurred at the elevator trim actuator rods.

Once in cruise, the AP TRIM/FAIL warning was activated. The crew then disconnected the autopilot and observed that it was necessary to simultaneously act with an abnormal amount of force on the elevator control and the elevator trim wheel to modify the aeroplane's path on the pitch axis. They then complied with the procedure to deal with the failure relating to the AP TRIM/FAIL warning. After adjusting the engine power and pitch using reference values and choosing an elevator trim position to maintain level flight, they continued the flight in manual mode, overriding the control surface forces and optimising the combined use of the trim, elevator control and engines in order not to force the system.

During the descent, as the temperature rose, the ice very probably began to melt. During the flare, when power was reduced, the co-pilot observed normal operation of the elevator control with no friction point, and landed without difficulty.

Safety lessons

Management of ice jamming elevator trim

In the 1980s, Raytheon Aircraft had widely distributed a *Safety Communique* (see APPENDIX: *Safety Communique* dated 8 May 1981 issued by Raytheon Aircraft) containing recommendations to deal with the freezing of an elevator trim. Similar occurrences in the 1990s led this manufacturer to carry out design modifications and replacements of the elevator trim actuators. However, the investigation revealed occurrences that seem to show that these technical modifications had not completely resolved the problem.

The crew of F-GLNH did not have knowledge of this document, which was an old document, and furthermore, were not trained to detect and manage the partial jamming of the elevator trim by ice. They had to rely on basic airmanship to continue the flight.

Without knowledge of this document and without specific training, there is a risk that crews will incorrectly manage this unusual situation.

It would be beneficial for operators to ensure that this information is disseminated to all crews and continues to exist over time, and to develop training and procedures to make it easier for them to deal with this type of situation.

Decision to take off again after the jamming of flight controls

After being confronted with a flight control malfunction that did not fall within the accepted tolerances for a commercial flight, the crew took the decision, after consultation by telephone with the operator's maintenance workshop and designated head of flight operations, to take off with passengers for the return flight. This informal exchange between the pilots and the maintenance workshop and designated head of flight operations was not recorded in the TLB.

The crew took this decision because they had not been confronted with a straight failure and had been able to check the control surface deflections using the associated controls after the landing. Based on discussions with maintenance staff and the designated head of flight operations, and given that they had observed water coming out of the drains, the crew assumed that the malfunction problem encountered during the previous flight had been resolved. The examinations carried out after the return to base and the absence of any recurrence of the malfunction on subsequent flights suggest a posteriori that this assumption was correct. However, the information available to the crew at the time they formulated this hypothesis and took the decision to return remained uncertain.

Discussions with professionals that the BEA were able to consult found that there are differing opinions as to whether this type of fault (absence of a straight failure) should be reported in the TLB, which implies at least, a mechanic signing an APRS before the aeroplane is returned to service. Furthermore, when pilots are not at their main base, there may be some reluctance to fill in the TLB because of the consequences for maintenance and operations.

In this case, even though there was an informal dialogue by telephone between the crew and maintenance, this exchange was not as robust as a physical check of the aircraft by a mechanic. It remains important to record these exchanges, by making an entry in the TLB, so that maintenance can intervene at a later date.

Sharing safety events with crews

The organisation and managers of the two operators (Intairline and Twinjet) were identical; the FSO responsible for the SMS and their OMs was the same person.

On several occasions in the past, Twinjet and Intairline had been confronted with in-service events linked to the jamming of or stiffness in the elevator control or elevator trim, and published several flight safety bulletins to inform their crews of the recurrence of these events on the Beech 1900s of the two operators. However, the management of the similar serious incident in 2020 by Intairline’s SMS did not lead to a flight analysis and information being shared with the crews.

Safety promotion is the mechanism by which lessons learned from investigations into safety-related occurrences and other safety-related activities are made available to all concerned.

A guide concerning the operator management system entitled *Système de Gestion de l’Exploitant* has been published by the DSAC. This document specifies that in order to keep its staff aware of the risk, with the aim of continuously improving safety, the operator shall set up a system for communicating and sharing safety-related information. The operator shall communicate the lessons it has learned from its SMS to all the staff concerned and, where appropriate, to the rest of the industry (manufacturers, other operators). This communication may, for example, take the form of information bulletins, flight safety reviews, regular meetings with staff or a forum.

4 RECOMMENDATIONS

Note: in accordance with the provisions of Article 17.3 of Regulation No 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation, a safety recommendation in no case creates a presumption of fault or liability in an accident, serious incident or incident. The recipients of safety recommendations shall report to the safety investigation authority which issued them, on the measures taken or being studied for their implementation, as provided for in Article 18 of the aforementioned regulation.

4.1 Updating crew recurrent training programme

The crew of F-GLNH identified the partial jamming of the elevator trim following the illumination of the A/P TRIM FAIL light and complied with the "A/P TRIM FAIL" procedure. They did not use any other procedures when they identified hardness in the elevator control. The crew relied on basic airmanship to continue the flight, and carried out actions which proved to be, in retrospect, broadly those detailed in the manufacturer's Safety Communique issued in 1981.

This basic airmanship for managing this type of in-flight fault requires an analysis based on experience and training. It is all the easier to mobilise these skills when the crew has been trained and informed of the different scenarios they could encounter, and of the means available to maintain control of the aircraft (flaps, engine, trim, elevator).

Consequently, the BEA recommends that:

- ***whereas the flight manual does not contain a specific procedure or information regarding ice jamming the longitudinal control system;***
- ***whereas useful information existed in Safety Communique 57 issued by the manufacturer in 1981;***
- ***whereas today, operators and pilots probably do not know of the existence of this old document;***
- ***whereas there have been new occurrences in connection with a fault on the elevator control channel on the Beech 1900, subsequent to the introduction of mandatory service bulletin SB 27-3032;***
- ***whereas the possible risks associated with such jamming;***
- ***whereas some pilots are not aware of this phenomenon of ice jamming the longitudinal control system;***

the DSAC ensure that the risk of icing jamming the longitudinal control system is suitably taken into account in the safety management systems of Beech 1900 French operators and that, based on the analysis carried out, the corresponding appropriate measures are implemented with the crews. [Recommendation FRAN-2024-001].

4.2 Occurrences in connection with ice jamming the elevator control system on Beech 1900Ds

The BEA's inspection of a Beech 1900D in the scope of this investigation confirmed the existence of areas inside the aeroplane's fuselage where water can accumulate. These areas are located in both the pressurised and non-pressurised parts of the aeroplane.

The investigation revealed that this problem is not well known by some of the profession.

The manufacturer's past implementation of specific technical measures shows that it had clearly identified the need to evacuate water.

Several statements or reports made by crews seem to show that there have been other similar occurrences to the one encountered by the crew of F-GLNH, which the manufacturer told the BEA that it had no knowledge of.

Consequently, the BEA recommends that:

- ***whereas the manufacturer's solution of greasing and replacing the elevator trim actuators, imposed by mandatory Service Bulletin SB 27-3032 appears to be a risk mitigation solution that has reduced the frequency of these events without making them disappear;***
- ***whereas there have been new occurrences in connection with a fault on the elevator control system on the Beech 1900, subsequent to the introduction of mandatory Service Bulletin SB 27-3032;***

the FAA review the analysis of in-service events related to in-flight cases of ice totally or partially jamming controls on the Beech 1900 and ensure that Textron Aviation propose appropriate corrective measures. [Recommendation FRAN-2024-002].

EASA ensure that the manufacturer and the FAA are well informed of the occurrences in Europe involving European operators, including the occurrences identified in this report, that it is informed of the analysis made of these occurrences, of the actions taken by the manufacturer and the FAA, and that it draw the consequences in the event of no measures or insufficient measures being taken. [Recommendation FRAN-2024-003].

APPENDIX: *SAFETY COMMUNIQUE* DATED 8 MAY 1981 ISSUED BY RAYTHEON AIRCRAFT

Raytheon Aircraft

Safety Communique

Beech
Hawker

May 8, 1981

TO: ALL BEECHCRAFT WHOLESALERS, AVIATION CENTERS, AERO CENTERS, INTERNATIONAL DISTRIBUTORS AND DEALERS AND BEECHCRAFT OWNERS OF RECORD FOR ALL BEECHCRAFT AIRPLANES

SUBJECT: ELEVATOR TRIM TAB FREEZING - EXPOSURE OF AIRCRAFT TO HIGH-PRESSURE SOAP-AND-WATER WASHING AND INTENSE RAIN

The engineering investigation described in this communique was undertaken following reports of elevator trim tab freezing. In none of these instances was there any injury to persons or damage to the aircraft; and in every case, although the trim tab became inoperable, the elevator remained free at all times and responsive to pilots' manual input to the control wheel. The airplane always remained controllable although higher than normal pilot input forces were required.

Beech assigned an engineer, reporting directly to the Manager of Technical Engineering, with instructions to conduct an investigation which systematically eliminated various components in the trim tab system until the point or points of freezing interference with the free movement of the trim tab was located. That investigation established that the piano hinge by which the tab is connected to the elevator and the tab push rod end fittings were the only points involved.

Interviews with pilots who reported incidents of trim tab freezing provided Beech with the following profile for the occurrences:

1. In each reported incident, the aircraft had been washed with a soap-and-water solution and high-pressure washing equipment within a few days or weeks preceding the incident.

2. In every reported case, the aircraft had been exposed to prolonged or intense rain while parked on a ramp shortly before the flight.

3. The trim tab became inoperative (frozen) during flight in clear air or in IFR conditions which usually did not involve airframe icing sufficient to require the use of deicing boots. Trim tab freezing was not related to flight in airframe icing conditions. Most often it occurred in clear air.

4. The trim tab became inoperative after the aircraft climbed through the freezing level, during climb-out or cruise in a sustained low temperature environment.

5. All reported incidents occurred in an environment of subfreezing temperatures, usually at medium to high altitude.

SAFETY COMMUNIQUE

ALL-57

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6. Upon descent to an altitude where the temperature was above freezing the trim tab immediately became operative without any residual effects.

7. Although the trim tab became frozen, the elevator (which is <u>not</u> connected to the stabilizer by a piano hinge) remained entirely free. The aircraft is controllable with the elevator and can be adjusted to straight and level flight or descent by retarding power until the desired attitude and flight profile is obtained.

Piano hinges are utilized at various points in Beech airplanes including the elevator, rudder and aileron trim tabs on most models. It is the opinion of Beech engineers that high-pressure washing with soap-and-water solution removes the lubrication from these hinge-lines with the result that when exposed to heavy or prolonged rain, the water is free to invade the hinge-line. It then freezes along the entire hinge-line when the aircraft is operated in temperatures below freezing.

This analysis was confirmed by a series of ground and flight tests during which, without lubrication and after exposure on the ground to free water, freezing was encountered. After being dried and lubricated (LPS-I applied by aerosol spray can), the exposure to free water and low temperature conditions was duplicated with the same airplane, but the trim tab remained entirely free.

Actual incidents of trim tab freezing have been reported and confirmed for Baron and King Air Models. Although trim tab freezing could occur on any of the models listed above, experience to date indicates that it occurs with multi-engine models which customarily fly at higher altitudes and lower temperature environments.

To avoid trim tab freezing, Beech instructs the following procedure:

1. Do not expose aileron, rudder and elevator trim tab hinge-lines or their push rod systems to the direct stream or spray of high-pressure soap-and-water washing equipment.

2. After high-pressure or hand washing, and at each periodic inspection, lubricate the hinge-lines and push rod end fittings with a water displacement lubricant (either CRC 3-36, LPS-1 or WD-40).

   Note: Maintenance Manuals will be revised accordingly.
   Please make a note in your manual until revised.

If trim tab freezing is encountered during flight, Beech recommends the following procedure:

1. Do not attempt to free a frozen trim tab by activating either the electric trim or manual trim controls. The force required to break the ice will probably exceed the force that can be delivered to the hinge-line by either electric or manual controls. Overstressing the trim tab cable circuit or the electric drive unit could damage either or both.

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2. Alter power settings until the aircraft is reasonably well in trim and can be manually flown in the desired flight path without uncomfortable stick pressures. Keep in mind that the control surfaces (elevators, ailerons and rudders) are not attached by piano hinges and will remain free and responsive to the normal commands of the pilot.

3. Trim tab freezing should not be an occasion for an emergency descent and landing.

4. Please report any incident of trim tab freezing to Commercial Service, Beech Aircraft Corporation, Wichita, Kansas 67201, so that we may investigate the background and particulars of the flight in order to confirm that the analysis of these occurrences and the methods for avoidance presented in this communique are correct in every respect.

Finally, it is appropriate to comment upon some of the other possible effects of washing your airplane with soap-and-water solutions dispensed at high pressure: high-pressure washing can carry the required lubrication away from wheel bearings, uplock rollers and propeller hub bearings if directed on or into these components. It can also damage avionics equipment if the stream is directed into overboard cooling ducts. In power plant areas there are garlock type seals which could be unseated by a high-pressure stream which, in turn, will allow contaminants to enter the sealed system. High-pressure sprays should not be directed upon the wings, fuselage or tail assembly from the rear where the structure is exposed to invasion by moisture and chemicals which can result in corrosion damage to structural members as well as moving parts.

Make certain that those responsible for servicing of your airplane are advised of these conditions and use proper caution when washing the airplane so as not to direct the high-pressure stream or spray into areas that might be damaged or adversely affected. Be certain that they are also instructed to lubricate the appropriate places after washing.