BEA
Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile
www.bea.aero
@BEA_Aero

SAFETY INVESTIGATION REPORT

Preliminary report

concerning the **Serious incident**
to the CESSNA Citation 525 CJ1
registered **F-HJAV**
on Friday 14 March 2025
en route

Time	18:42[1]
Operator	Valljet
Type of flight	Passenger commercial air transport
Persons on board	Captain (PF[2]), co-pilot (PM) and two passengers
Consequences and damage	None
This is a courtesy translation by the BEA of the Safety Investigation Preliminary Report. As accurate as the translation may be, the original text in French is the work of reference.	

Failure of an air data system, undetected altitude deviation, activation of a TAWS[3] warning during approach

[1] The times given in this report are in local time.
[2] The glossary of abbreviations and acronyms frequently used by the BEA can be found on its web site.
[3] Terrain Awareness Warning System.

RÉPUBLIQUE FRANÇAISE
Liberté
Égalité
Fraternité

June 2025 BEA2025-0084p

BEA

1 HISTORY OF THE FLIGHT

Note: the following information is principally based on statements, radio-communication recordings, radar data and the data recorded by the aeroplane's GNSS navigation system.

The crew took off from Limoges-Bellegarde airport at 17:55 bound for Paris - le Bourget airport.

At around 18:06, when flying through the transition altitude, the pilots detected an inconsistency between the altitude values indicated on their PFDs. They indicated that they then compared these altitudes with the standby altimeter altitude. However, as there was a significant difference between the three values, they decided to continue the climb and troubleshoot the failure once the aeroplane was established in cruise.

The crew reported that when flying through FL 100, the ALT indication (or "Amber ALT") appeared on their PFDs indicating an altitude inconsistency between the captain's PFD and the co-pilot's PFD (see **Figure 1**).

Figure 1: photo of PFD with ALT indication visible at the top of the altitude tape (Source: BEA)

The crew started cruise flight at 18:09 (see **Figure 2**, point 1).

At around 18:11, with the aeroplane established at FL 180 according to the information displayed on the captain's PFD[4], the crew informed ACC/south-west air traffic control that they had an on-board altimeter problem. The crew indicated to the controller that they were at FL 180 and asked him to confirm the flight level displayed on the radar screen. The controller informed the crew that they were displayed as being at FL 180.

Thereafter, the processing of the failure (see paragraph 4.2) led the crew to consider that the indicated altitude on the co-pilot's PFD was erroneous. The crew thus selected ADC 1[5] as the altimetric source for both PFDs.

At around 18:16, the aeroplane was transferred from the sectors controlled by ACC/south-west to the sectors controlled by ACC/north. During the radio exchanges, the crew reported in a standard manner, that they were at FL 180 heading towards Amboise (AMB) DME and did not mention that they had encountered an altimetric problem earlier on.

Between 18:09 (point 1) and 18:28 (point 2), although the autopilot was engaged and the information sent by ADC 1 indicated that the flight level was stable at FL 180, the GNSS altitude of the aeroplane progressively decreased from 15,300 ft to 12,600 ft.

[4] The GNSS altitude was at this time 15,650 ft.
[5] Air Data Computer.

At around 18:28, the controller asked the crew to descend to FL 120.

At around 18:31, on descending through FL 130 according to the information sent by ADC 1, the controller asked the crew to descend to FL 90. At this time, the aeroplane was in reality at a GNSS altitude of the order of 8,000 ft.

At around 18:34, the ACC/north controller asked the crew to contact the approach controller at Paris - Charles de Gaulle (CDG) airport. A few minutes later, the crew informed the ACC/north controller that they were unable to contact air traffic control on the 125.830 MHz CDG frequency (S INI[6] frequency).

At around 18:35 (point 3), when the crew thought they had started level flight at FL 90, the GNSS altitude was in reality of the order of 3,000 ft in descent with a vertical speed of around -270 ft/min.

At around 18:37, the crew were still experiencing difficulties with contacting the CDG controller. The ACC/north controller, after coordinating with the CDG INI COOR[7] controller, asked the crew to contact CDG on the 121.155 MHz (N INI[8]) frequency. Finally, at around 18:40, the crew managed to contact the CDG INI controller. The controller then thought that the crew had contacted him on the 125.830 MHz frequency (S INI frequency) as the two positions, N and S INI were combined.

At around 18:42, (point 4), although the information sent by ADC 1 still indicated that the aeroplane was in level flight at FL 90, the crew specified in their statement that a PULL UP TERRAIN TAWS warning was activated. At this point, the aeroplane was at a GNSS altitude of approximately 1,200 ft, i.e. a height of approximately 700 ft, in descent. The captain disconnected the autopilot, increased power and flew using external visual references. The GNSS altitude then increased to around 1,000 ft.

A few seconds later, the crew asked the controller to confirm that they were effectively detected on the radar and to inform them of the flight level that was indicated. The controller informed them that he saw them at FL 96. The crew replied that based on their visual references, they seemed to be lower. In response to this, the controller added that they should not use the altitude values indicated on his screen as they come from the aeroplane's transponder, and that it was not possible to know if the altitude provided was correct.

At around 18:44, the controller checked that the aeroplane was capable of acquiring the Le Bourget localizer. The crew replied in the affirmative. The controller then asked the crew if they required ground assistance from the ARFF service. The crew did not reply to this question.

The INI controller decided to split his sector into the N INI and S INI positions. He kept the N INI position and informed his colleague in the S INI position of the problems being encountered by the aeroplane.

At around 18: 46 (point 5), the GNSS altitude of the aeroplane stabilized at around 2,000 ft.

At around 18:49, the crew contacted the N INI controller again and informed him that the aeroplane was established on the localizer.

---

[6] Sector of south initial approach controller.

[7] Controller in initial approach coordinator position.

[8] Sector of north initial approach controller.

At around 18:53, the N INI controller asked the crew if they were capable of acquiring the descent path. The crew replied in the affirmative and that it would not be long before the glide was intercepted. Lastly, the controller asked the crew if they had sight of the ground to which the crew replied in the affirmative.

At around 18:54 (point 6), the N INI controller transferred the aeroplane to the Le Bourget airport tower controller. The crew landed four minutes later.

After landing, as the CDG N INI controller could still see the aeroplane at FL 130 on his radar screen, he asked the approach room supervisor to cut off the Mode C of the aeroplane's transponder.

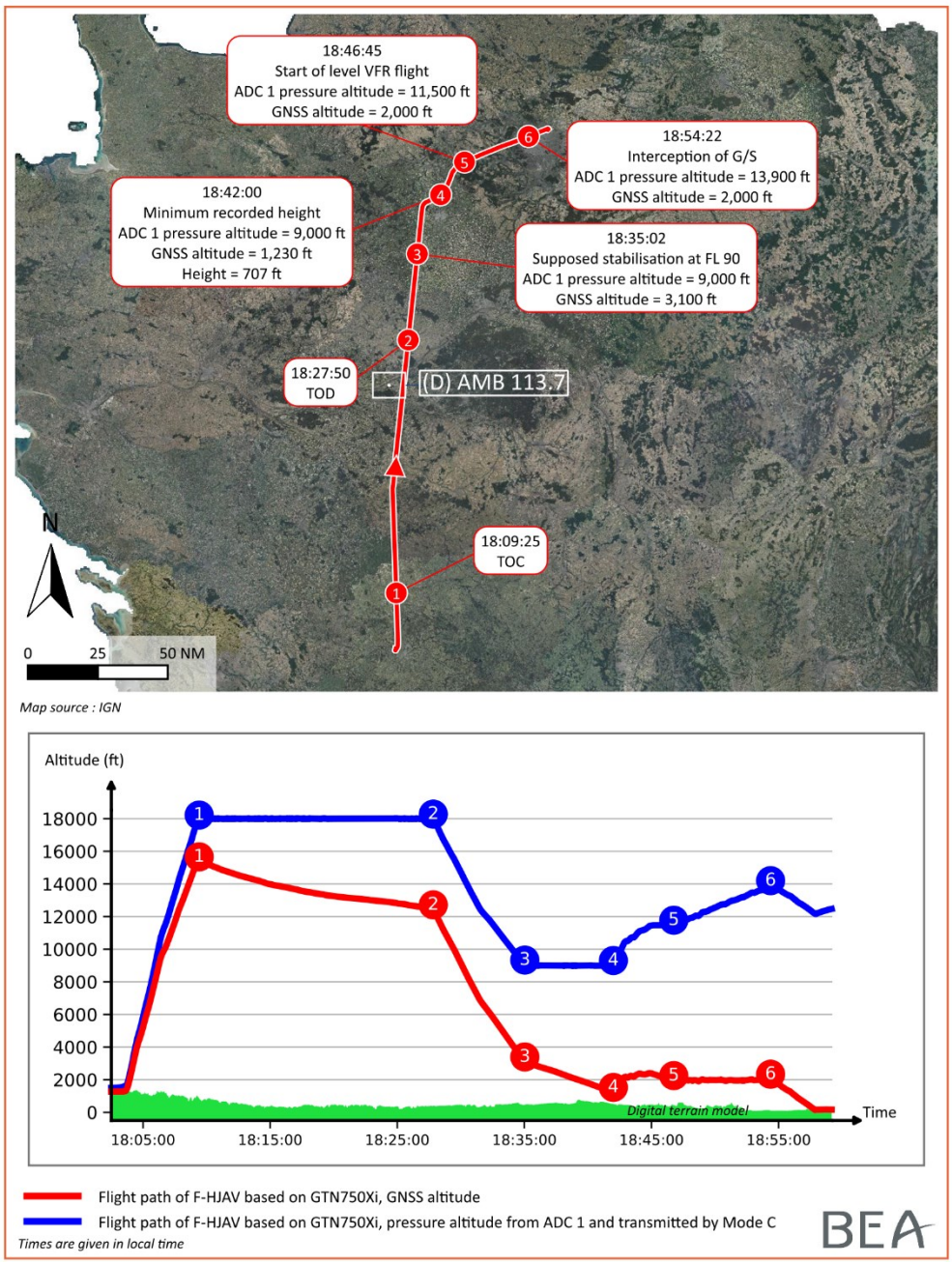


Figure 2: flight path of F-HJAV, based on GTN750x data[9]

*The flight path in blue in **Figure 2** and **Figure 5** represents the altitude with a 1,013 hPa setting (pressure altitude) sent by ADC 1 and visible on the captain's PFD and then on the co-pilot's PFD after processing the failure. Approximately 220 ft should be subtracted to obtain the QNH altitude of Paris - Le Bourget airport in the conditions of the day.*

2 METEOROLOGICAL INFORMATION

The SIGWX charts forecast no cloud cover or turbulence on the route above FL 100. A few cirrus were forecast between 15,000 and 20,000 ft east of the flight path. Below FL 100, there were stratocumulus between 2,500 and 4,500 ft. Moderate icing was possible for the whole of the flight between 2,500 ft and 10,000 ft.

[9] GNSS navigation system equipping F-HJAV.

The 18:00 METAR for Limoges - Bellegarde airport mentioned wind from 030° of 12 kt, visibility greater than 10 km with cloud cover of 1 to 3 octas at 4,900 ft and 8 octas at 5,800 ft. The QNH was 1,009 hPa which meant a difference of around -110 ft with respect to the pressure altitude.

The 19:00 METAR for Paris - Le Bourget airport mentioned wind from 360° of 7 kt and CAVOK conditions. The QNH was 1,005 hPa which meant a difference of around -220 ft with respect to the pressure altitude.

The captain indicated in his statement that during the flight, he had reduced sight of the ground due to the setting sun reflecting on a light layer of cloud.

3 AIRCRAFT INFORMATION

3.1 Cessna 525 CJ1 "Citation Jet" general information

The Cessna Citation 525 CJ1 is a light business jet certified for single-pilot operations according to certification specifications CS-23. Valljet operates it in multi-pilot operations for commercial air transport (CAT) flights, in accordance with requirement ORO.FC.200 c) (1) of consolidated European regulation (EU) No 965/2012, relating to air operations ("AIR OPS").

This aeroplane has a maximum take-off weight of 4,808 kg and can carry up to six passengers and two crew members. F-HJAV is not equipped with flight recorders (CVR or FDR), it is not a regulatory requirement.

F-HJAV was equipped with an integrated GNSS navigation system (GTN750xi) which provides the aeroplane's GNSS altitude. The GNSS altitude information was not directly shown on the page displayed by default.

3.2 F-HJAV's air data system

3.2.1 Description of air data system

F-HJAV has two independent air data systems, each including an ADC. The ADC calculates altitude and speed information based on outside temperature, static pressure and total pressure measurements. It also corrects altitude measurement errors due to the fuselage geometry around the static pressure ports.

System 1 (captain's side) is composed of a Pitot tube located on the LH side of the fuselage and a static pressure port on each side of the fuselage. The altimetric information displayed on the captain's PFD comes from ADC 1.

System 2 (co-pilot's side) is composed of a Pitot tube located on the RH side of the fuselage and a static pressure port on each side of the fuselage. The altimetric information displayed on the co-pilot's PFD comes from ADC 2. A standby altimeter and a standby airspeed indicator are also connected to system 2 without passing through ADC 2. F-HJAV is equipped with an option whereby the standby altimeter can be manually changed to another static port situated in a nose compartment (alternate static source) using a selector in the cockpit.

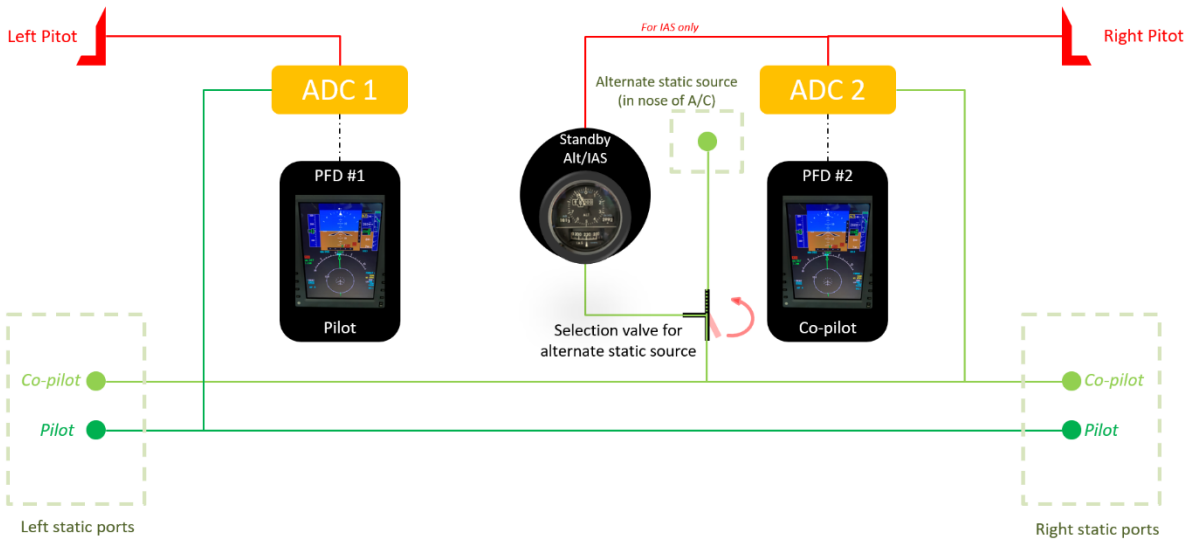


Figure 3: schematic diagram of F-HJAV air data system (Source: BEA)

Transponder 1 of the aeroplane (captain's side) receives altitude information from ADC 1 and transponder 2 (co-pilot's side) is connected to ADC 2. The transponder altimetric sources are not interchangeable. During the incident flight, the active transponder was transponder 1.

3.2.2 Examination of air data systems

The air data systems were examined. Both Pitot tubes and the static pressure ports were subjected to simulated pressures reproducing those encountered during a flight.

A first test was carried out with the ADCs in their normal position[10], and a second test was carried out after swapping the positions of ADC 1 and ADC 2. In both tests, the information sent by ADC 2 and by the standby altimeter was within the tolerances specified in the manufacturer's documentation. However, the information sent by ADC 1 was erroneous. ADC 1 will be further examined as part of the BEA's safety investigation.

The erroneous indications of the standby altimeter mentioned by the crew (see paragraph 4.2) could not be reproduced during these tests. At this stage of the investigation, the BEA has not been able to rule out the possibility of an intermittent failure on air data system 2.

3.3 Analysis of radar data and GNSS data

The analysis of the radar and GNSS data revealed a significant difference between:

- the radar altitude data, based on the barometric information from ADC 1, transmitted by the aeroplane's transponder (Mode C);
  and
- the GNSS altitude data recorded by the aeroplane's navigation system.

This difference in altitude was 2,500 ft at the start of cruise flight, 7,800 ft when the TAWS warning was activated, and reached 13,500 ft after landing (see **Figure 2**).

[10] The BEA did not attend this test.

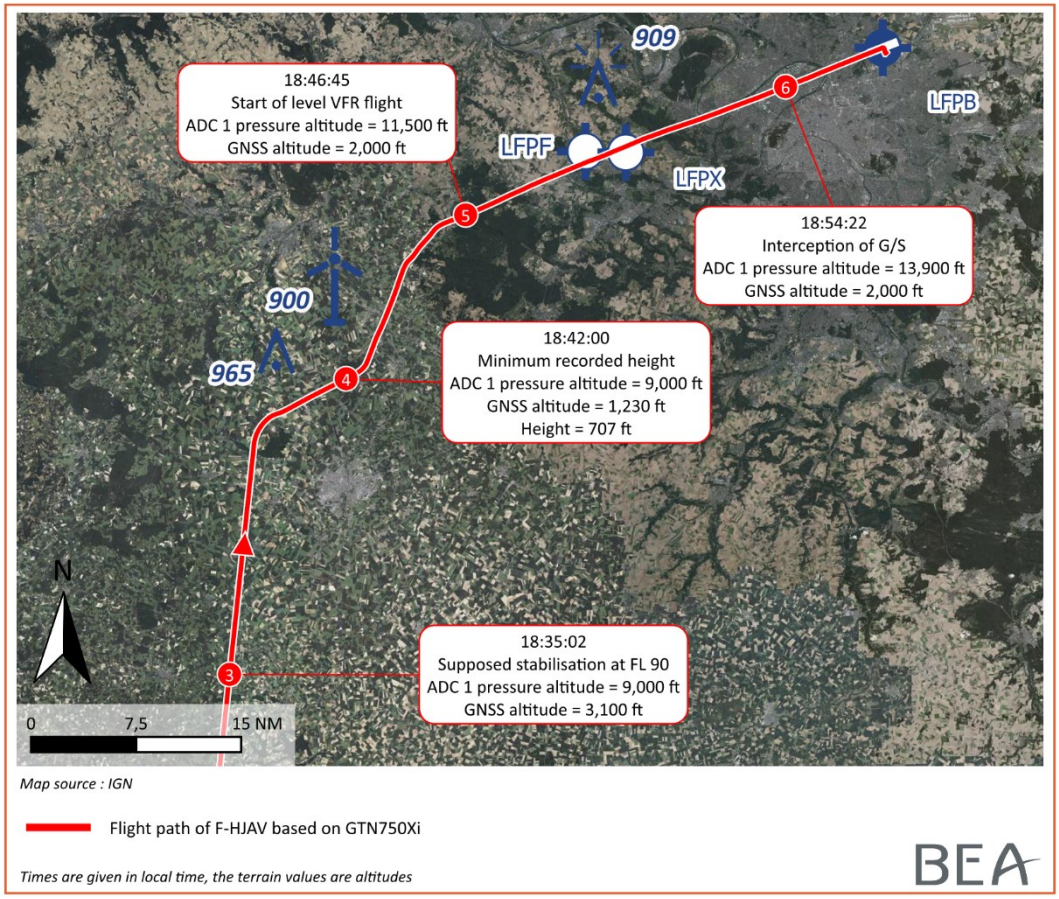


Figure 4: horizontal flight path of F-HJAV in the last 30 flight minutes

During the flight, F-HJAV crossed the following airspaces: Limoges (ANS/south), ACC/south-west, ACC/north, CDG approach and then Le Bourget approach, as well as the Orléans and Paris-Orly airspaces, Seine FIS, Paris FIS and Chevreuse FIS. The Orléans zones were not active at the time of the serious incident, and were managed by the Seine FIS. Likewise, the Chevreuse zones were not active and were managed by ACC/North for the IFR flights and by Paris FIS for the VFR flights.

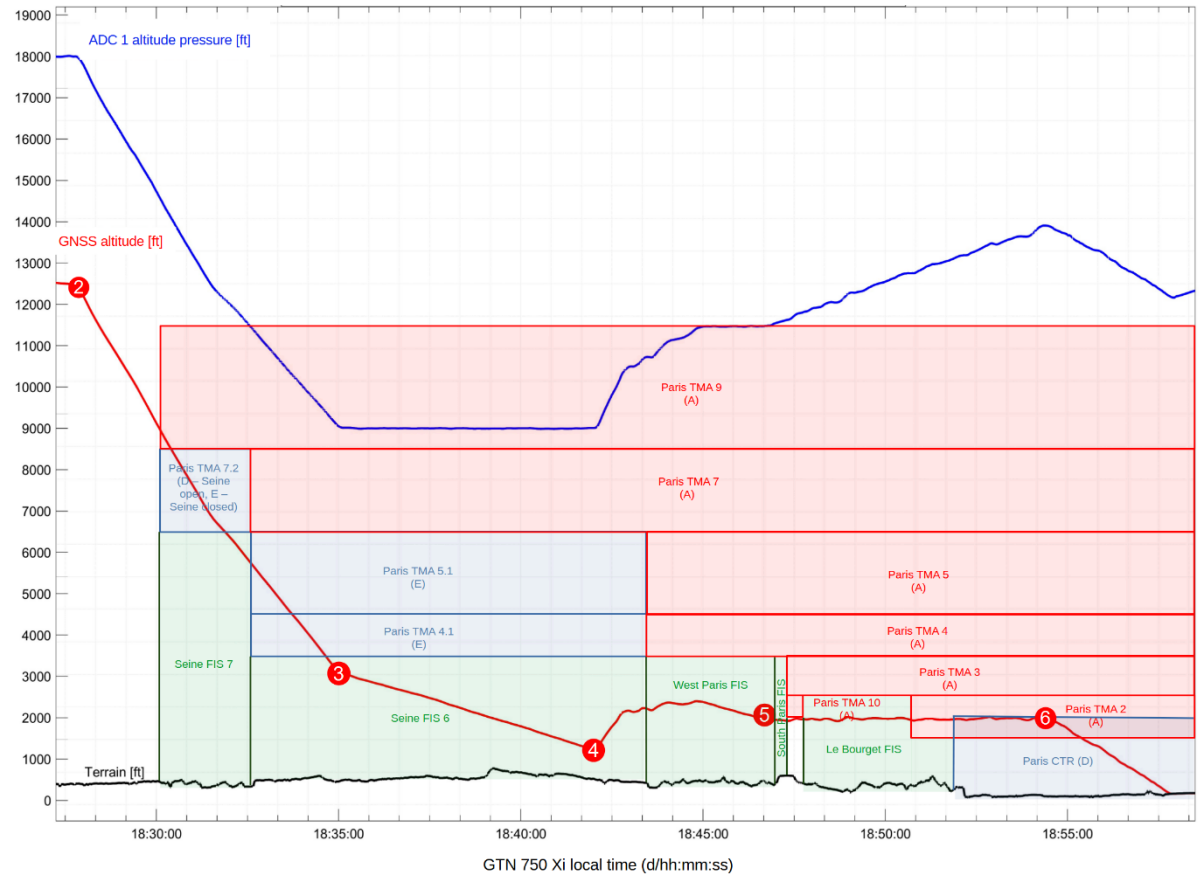


Figure 5: vertical flight path and airspaces crossed by F-HJAV in the last 30 flight minutes (Source: BEA)

At 18:50, the aeroplane flew over Beynes - Thiverval (LFPF) aerodrome[11], then a few seconds later, over Chavenay - Villepreux aerodrome (LFPX)[12]. The aeroplane was then flying at an altitude of 2,000 ft and a speed of 250 kt. Both these aerodromes are below Paris TMA 3 (Class A) whose floor is situated at 2,500 ft.

The analysis of the radar and GNSS data found that F-HJAV flew close to several VFR traffic during the last twenty minutes of flight, while flying at an altitude below 2,500 ft. The precise separations between F-HJAV and these other flights are currently being determined.

3.4 Aeroplane's on-board radios

The crew reported radio problems during the serious incident (see paragraph 4.2). The analysis of the radio communications found that the crew had encountered difficulties contacting CDG approach. At this stage of the investigation, no failure of the on-board radio system has been identified.

This subject will be further analysed as part of the BEA's safety investigation.

[11] The Beynes aerodrome circuit is at an altitude of 900 ft.

[12] The Chavenay aerodrome circuit is at an altitude of 1,300 ft.

3.5 Examination of F-HJAV technical documentation

An entry in the technical logbook for the penultimate flight before the serious incident mentions the appearance of the "Amber ALT" indication on final approach, with a difference in altitude of 150 ft between the two PFDs according to the information entered by the crew. The problem subsequently disappeared, and no maintenance action was taken.

The technical logbook entries for the flight preceding the serious incident do not mention an "Amber ALT" indication.

3.6 ACAS[13] and TAWS on-board systems

F-HJAV was equipped with an Airborne Collision Avoidance System (ACAS) and a Terrain Awareness Warning System (TAWS) although AIR OPS regulations do not require them for an aircraft weight of less than 5,700 kg and carrying less than nineteen passengers.

More precisely, it was equipped with:

- a TCAS[14] ACAS which only provides the pilot with Traffic Advisories (TA), and not Resolution Advisories (RA), unlike TCAS II. This system uses the altimetric values transmitted by the transponders of other aircraft, as well as the altimetric values of the aircraft on which the system is installed. Thus if the altimetric value transmitted by the aircraft's transponder is incorrect, the safety barrier provided by the ACAS system is no longer guaranteed;
- an EGPWS[15] TAWS. This system uses height information from the aeroplane's radio altimeter and a terrain database to estimate the risk of collision with the ground. It activated at the time of the incident.

4 OPERATOR INFORMATION

4.1 Procedures to be complied with in event of air data system fault

4.1.1 *COMPARATOR MONITOR ALERTS* procedure

The procedure, described in the operator's QRH, to be complied with in the event of the ALT indication appearing on the PFD, is identical to that in the C525 CJ1 AFM. This procedure requires the crew to compare the information sent by the captain's and co-pilot's altimeters with that of the standby altimeter. Once the erroneous information has been identified[16], the crew is asked to disengage the ADC on the unreliable side and switch the autopilot source to the system not affected by the fault, using the AP XFR button.

[13] Airborne Collision Avoidance System.
[14] Traffic Collision Avoidance System.
[15] Enhanced Ground Proximity Warning Systems.
[16] The procedure does not specify how the troubleshooting is to be carried out.

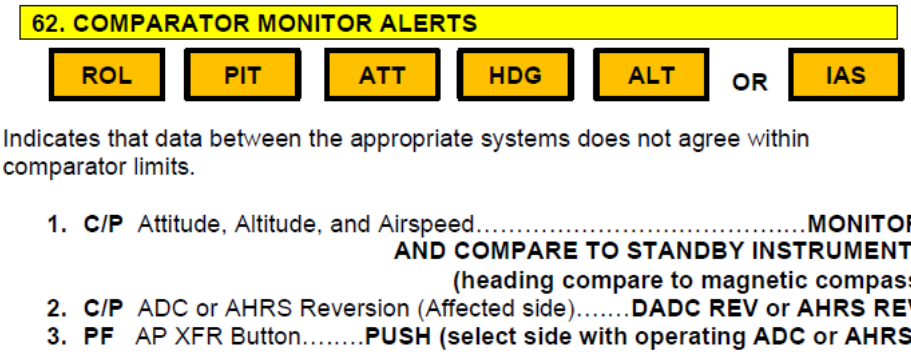


Figure 6: COMPARATOR MONITOR ALERTS procedure (Source: Valljet)

This QRH procedure does not contain a reference to the "*Unreliable ALT indications / Altimeters Failed*" QRH procedure described below.

4.1.2 UNRELIABLE ALT INDICATIONS / ALTIMETERS FAILED procedure

Following the serious incident involving a Cessna 525 CJ registered F-HGPG operated by the same operator on 12 January 2022 (see paragraph 6.1.3), Valljet added a specific procedure, "UNRELIABLE ALT INDICATION / ALTIMETERS FAILED" to the QRH of the Cessna 525s in its fleet. Points 1, 2, 3, 6 and 7 of this procedure are memory items and must therefore be complied with by pilots from memory (see **Figure *7***).

In the event of an unreliable altimetric indication, this procedure requires the crew to:

- disconnect the autopilot;
- inform air traffic control of unreliable altimetric indications;
- ask for lateral separation;
- compare the barometric altitudes of systems 1 and 2 with the standby instrument altitude and the GNSS system altitude (GSL).

81. UNRELIABLE ALT INDICATIONS/ ALTIMETERS FAILED

1. **PF AP/FD.....DISCONNECT**
2. **PM ATC..... .....INFORM & REQUEST LATERAL SEPARATION**
3. **PM COMPARE/VALIDATE/MONITOR ALT1/2 to S/B ALT AND GSL ALT**

IF BELOW MSA

4. **PF CLIMB TO MSA**

IF AT OR ABOVE MSA

5. **PF LEVEL OFF**

6. **PM ATC..... .....INFORM & REQUEST LATERAL SEPARATION**
7. **PM COMPARE/VALIDATE/MONITOR ALT1/2 to S/B ALT AND GSL ALT**

In order to compare ALT1/2/S/B ALT to GSL ALT (which is a geometric altitude), apply QNH correction and temperature correction as follows:

- To ALT1/2 indication apply QNH correction (+27,5ft/mb if QNH>1013 or -27,5 ft/mb if QNH<1013) and
- Temperature correction (+4ft/1000ft/°C if outside average temperature if > STD, or -4ft/1000ft/°C if outside average temperature is below STD.

Altitude may be considered valid if difference is less than 200ft.

- Divert to the nearest suitable airport

8. **PM** Inform CTL of possibly unreliable ALT indications & request to CTL lateral separation with other traffic during situation assessment.

" UNRELIABLE ALT INDICATIONS/ ALTIMETERS FAILED Checklist Complete."

Figure 7: UNRELIABLE ALT INDICATION / ALTIMETERS FAILED procedure (Source: Valljet)

4.2 Flight crew information and statements

The 37-year-old captain had logged around 3,450 flight hours. He held a CPL(A) along with valid Cessna 525, IR-ME, IR-SE, FI-A and SEP land ratings. He joined the operator in the autumn of 2024. The 25-year-old co-pilot had logged around 650 flight hours. He held a CPL(A) licence along with valid Cessna 525 and IR-ME ratings. He joined the operator in the summer of 2023.

The two pilots indicated that they performed all the pre-flight checks on F-HJAV without detecting any particularities on the aircraft. The captain stated that the QNH of 1,005 hPa on departure had been entered into the three on-board altimeters, and that these indicated an altitude of 1,290 ft, consistent with Limoges airport's altitude of 1,300 ft.

The two pilots took off and when switching to the standard setting at around 6,000 ft according to the captain[17], they noted an inconsistency of approximately 1,000 ft between the two altitudes displayed by their PFDs. They then compared these altitudes with the standby altimeter altitude. According to the pilots, the three altitude values were significantly different, preventing them from

[17] The transition altitude when departing from Limoges-Bellegarde is 5,000 ft.

identifying the erroneous altitude value. They then decided to continue their climb to FL 180. Flying through FL 100, the ALT alert appeared on the PFDs. The co-pilot carried out the *COMPARATOR MONITOR ALERT* procedure. This procedure asks the crew to compare the altitudes of the three altimeters. According to the pilots, these were inconsistent. The standby altimeter reportedly indicated values of between 600 and 1,200 ft more than the copilot's altimeter during the flight. Once established in cruise, the captain's altimeter indicated 18,000 ft, while the copilot's altimeter reportedly indicated 12,600 ft. The pilots then asked air traffic control for the altitude at which they were seen. The captain also attempted to obtain altitude information using the GNSS navigation system. However, in doing so, he confused the pressure altitude information sent by the navigation system with a GNSS altitude. He added that he had not thought about checking the information on his EFB. Finally, the pilots compared their estimated time of arrival at FL 180 with their actual time of arrival at cruising level. The difference was one minute. They concluded that the altitude indication displayed on the co-pilot's PFD was incorrect. They then switched the altitude information source for both PFDs to ADC 1.

During the approach, while changing control sectors, the co-pilot was unable to contact CDG approach. The workload was high for the co-pilot. The CDB, for his part, was focused on preparing the arrival. At this moment, the captain was surprised to see the radio-altimeter activate, and a few seconds later, the TAWS TERRAIN PULLUP warning activate. The co-pilot indicated that he did not hear the TAWS warning. Following the activation of the warning, the pilots referred to the altimetric information sent by ADC 2.

Both pilots stated that they were not aware of the *UNRELIABLE ALT INDICATIONS / ALTIMETERS FAILED* procedure in the QRH. They added that the associated memory items had not been taught to them during their training with the operator. The pilots added that they were not aware of the serious incident that occurred to F-HGPG in 2022[18] (see paragraph 6.1.3), which had similar characteristics and following which this procedure had been included in the QRH.

5 AIR NAVIGATION SERVICE PROVIDER INFORMATION

5.1 Air traffic control procedure in case of unreliable altitude

The operational documentation of ANS/south (in charge of the Limoges control unit), ACC/south-west, ACC/north, ANS/CDG and ANS/LBG, in contact with the crew of the serious incident flight, includes operational directive 17-58/24 (see paragraph 6.1.3) on what to do in the event of an unreliable flight altitude. This directive, issued by DSNA's Operations Division (OD), details the working method to be applied by all control units under its responsibility. The associated procedure sets out the following actions:

- obtain lateral separation from other aircraft when separation is due, or possibly vertical separation from the moment the pilot affirms that he knows the altitude range in which he is located;
- ask the pilot to stop transmitting Mode C or ADS-B altitude data, using the appropriate phraseology from the current phraseology manual;
- inform the crew that the control service cannot resolve any uncertainty by a cross-check;
- inform the control sector(s) or air traffic control units potentially concerned by the aircraft of the action taken;
- inform the CMCC[19] concerned.

[18] BEA report published in the summer of 2023.

[19] Military control and coordination centre.

In addition, depending on the perceived seriousness of the situation, one or more of the following actions can be taken:

- ask the pilot to select code 5677[20] to indicate to other DSNA units and the armed forces the particularity of this flight;
- provide flight assistance to the crew, either immediately if they consider themselves to be in a state of distress, or at their request if they consider themselves to be in a state of emergency. Flight assistance may be conducted, if necessary, with the help of the military in the case of assistance to a person in danger. As such, it may in certain cases lead to an interception [...];
- ask the pilot to land at the closest appropriate aerodrome by looking for or maintaining VMC conditions.

In addition, the ANS/CDG documentation contains a quick reference card for the approach room supervisor which includes the main points of this procedure (see **Figure 8**). This card is also accessible for the controllers on the radio in the control positions. The ACC/north documentation also includes a quick reference card in the controller's position concerning an altimeter failure (see **Figure 9**).

The ANS/south, ACC/south-west and ANS/LBG operational documentation does not contain a quick reference card for the specific case of a crew expressing doubts about the altitude.

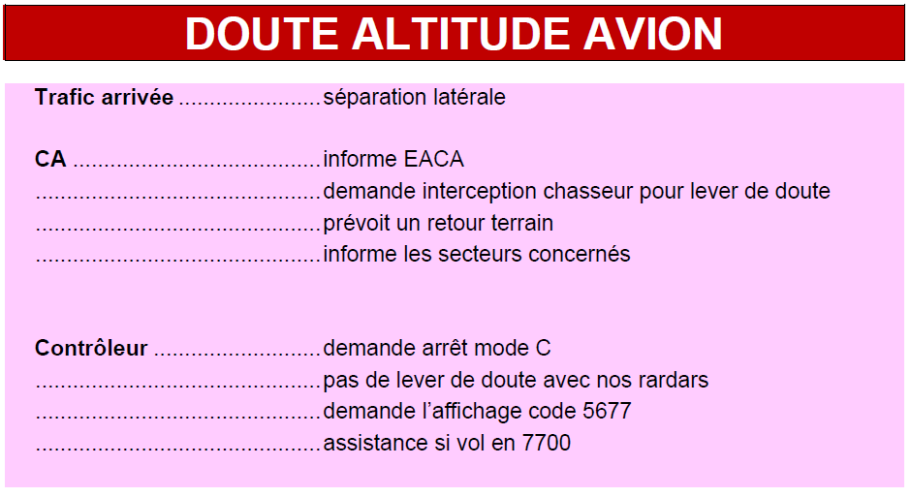
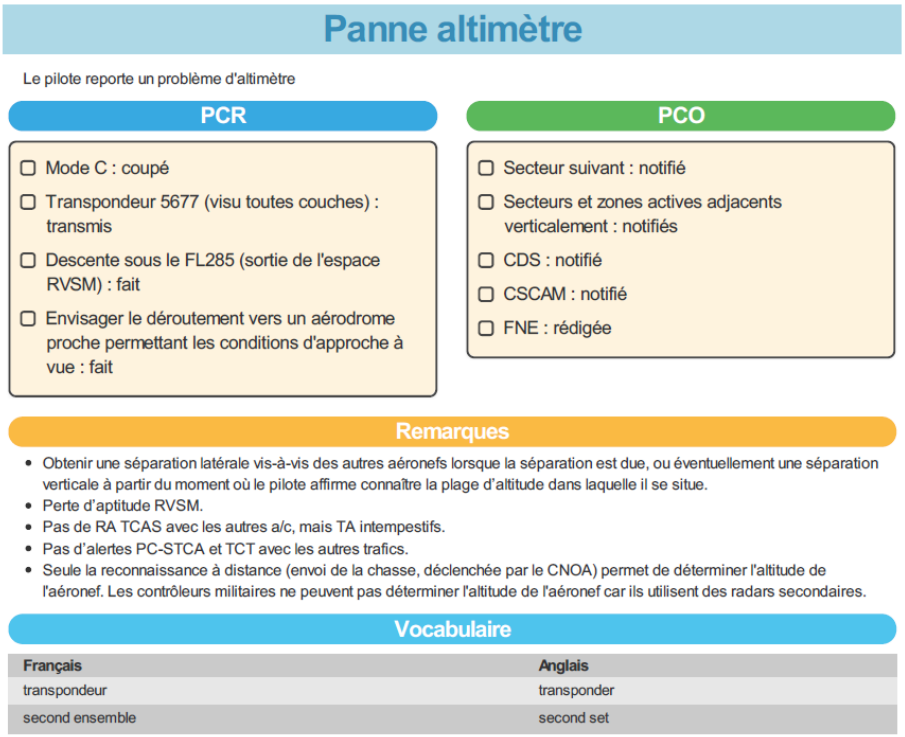


Figure 8: quick reference card regarding unreliable altimetric information (Source: ANS/CDG)

[20] This transponder code is displayed on all the layers with the indication "ATTN" (for caution) on the radar label. This particular code is only used as such in France and is known by the military organisations.



Panne altimètre

Le pilote reporte un problème d'altimètre

PCR

- ☐ Mode C : coupé
- ☐ Transpondeur 5677 (visu toutes couches) : transmis
- ☐ Descente sous le FL285 (sortie de l'espace RVSM) : fait
- ☐ Envisager le déroutement vers un aérodrome proche permettant les conditions d'approche à vue : fait

PCO

- ☐ Secteur suivant : notifié
- ☐ Secteurs et zones actives adjacents verticalement : notifiés
- ☐ CDS : notifié
- ☐ CSCAM : notifié
- ☐ FNE : rédigée

Remarques

- Obtenir une séparation latérale vis-à-vis des autres aéronefs lorsque la séparation est due, ou éventuellement une séparation verticale à partir du moment où le pilote affirme connaître la plage d'altitude dans laquelle il se situe.
- Perte d'aptitude RVSM.
- Pas de RA TCAS avec les autres a/c, mais TA intempestifs.
- Pas d'alertes PC-STCA et TCT avec les autres trafics.
- Seule la reconnaissance à distance (envoi de la chasse, déclenchée par le CNOA) permet de déterminer l'altitude de l'aéronef. Les contrôleurs militaires ne peuvent pas déterminer l'altitude de l'aéronef car ils utilisent des radars secondaires.

Vocabulaire

Français	Anglais
transpondeur	transponder
second ensemble	second set

Figure 9: quick reference card regarding altimeter failure (Source: ACC/north)

5.2 MSAW and STCA systems in air navigation services

The MSAW (Minimum Safe Altitude Warning) system warns an air traffic controller when an aircraft is getting dangerously close to the ground and obstacles. ANS/CDG is equipped with this system. The MSAW system uses the altitude value sent by Mode C of the aircraft's transponder. Thus, if this information is not correct, the system is no longer effective.

The STCA (Short Term Conflict Alert) is a ground system which warns an air traffic controller of a short term loss of minimum radar separation. ANS/CDG is equipped with this system. The STCA system uses the altitude value sent by Mode C of the aircraft's transponder. Thus, if this information is not correct, the system is no longer effective.

5.3 Ground personnel information and statements

5.3.1 ACC/south-west air traffic controller information

The control position in contact with the aeroplane was manned by two controllers:

- the tactical controller, responsible for ground-aircraft radio exchanges, radar vectoring aircraft and the tactical resolution of conflicts. The controller in position had been qualified for ACC/south-west since 2011;
- the planning controller, responsible for the coordination with the other sectors or units. The controller in position had been qualified for ACC/south-west since 1997.

Both controllers indicated that they did not perceive the pilot's request as being related to unreliable altimetric indications. The pilot's tone of voice did not inspire any concern from their point of view. Moreover, they had no information on their control screens to suggest that the situation was unusual.

Both controllers indicated that they were not aware of the serious incident between a Cessna 525 CJ operated by Valljet and an Embraer ERJ170 operated by HOP! in January 2022 (see paragraph 6.1.3). They stated that they had received and read directive DO 17-58/24 and the feedback information regarding unreliable altimetric indications published by the DO in February 2025 (see paragraphs 6.1.2 and 6.1.3), but could not remember the content of the documents. They added that the large number of documents that are shared with them makes it difficult to identify and absorb all the information. However, they remembered that a few years previously, in training regarding abnormal and emergency situations[21], they had had a theoretical lesson on the serious incident between an Airbus A318 operated by Air France and a Pilatus PC12 in June 2010 (see paragraph 6.1.1).

5.3.2 ANS/CDG air traffic controller information

The approach room at ANS/CDG is organized into two corridors: the inbound corridor and the outbound corridor. The inbound corridor was manned by four controllers at the time of the event:

- the controller in the INI position, who handles aircraft transferred from adjacent units and brings them to the approach axes. This position can be split into two zones: north and south. The controller in position (combined positions) had been qualified since 2018 at ANS/CDG;
- a controller in on-job-training in the INI COOR position and his instructor, responsible for coordination with other sectors or units. The instructor in position had been qualified for ANS/CDG since 2005. The controller in on-job-training had started his training at ANS/CDG in December 2022;
- an ITM controller, who is responsible for the interception of the approach paths and managing aircraft on final until handover to the tower controller. This position can be split into three: a position for the CDG north set of parallel runways, a position for the CDG south set of parallel runways and a position for Le Bourget airport. As the ITM controller never had F-HJAV on the frequency at the time of the incident, the BEA did not interview him.

In addition to the controllers on the frequency, the approach room supervisor supervises operations and organises the work. The controller in position had been qualified at ANS/CDG since 2001 and qualified as approach room supervisor since 2011.

The controllers specified that the traffic was quiet at the time of the incident.

The INI controller indicated that on first contact, he had directly checked the frequency on which the crew were transmitting, INI/north on 121.155 MHz or INI/south on 125.830 MHz using the squelch[22]. According to him, they were on the INI S frequency. Once the radio problems had been resolved, the situation became normal again until the crew informed the INI controller of an onboard altimeter problem. On his radar screen, the aeroplane was shown at FL 96 with a vertical speed of +200 ft/min whereas it should have been in level flight at FL 90. The INI controller informed the crew that he could not cross-check the aircraft's altitude information. He had remembered his last abnormal and emergency situations training in July 2024 in which a similar situation had been presented (see paragraph 6.1.2). He therefore no longer gave an altitude and organised a lateral separation with the other aeroplanes in his sector.

[21] Training received every three years.

[22] Indication on radio channel which allows controller to know what frequency is effectively being used.

He added that the crew seemed untroubled and he also knew that the weather conditions were good. The INI COOR controller informed the controller in the CDG S TWR position[23], ACC/north, ANS/ORLY and ANS/LBG of the problem, their sectors being adjacent to the CDG sectors. With his instructor, he specified that he had not thought about contacting the FIS.

When the crew did not reply to the INI controller's proposal for ground assistance, the latter thought that they still had radio problems. He therefore chose to split the INI position. A controller took up the S INI position and he kept the N INI position. The Mode C altitude continued to increase on the radar screens. The INI COOR controller indicated that the S INI controller tried to contact the crew several times, in vain.

When the crew re-contacted the N INI controller on his frequency, the latter kept the crew on the frequency and did not transfer it to the ITM sector. He explained that he did not want to ask the crew to carry out other actions nor interfere with the crew's work.

After landing, the N INI controller asked the control room supervisor to cut off the aeroplane's Mode C as he could still see it on his screen at FL 130 and that this interfered with the traffic he was handling.

The control room supervisor did not intervene in the management of the incident. He considered that his colleagues had taken the right decisions to ensure the safety of both this flight and the other flights in their sectors. He did not therefore use the quick reference card corresponding to the situation. He also added that there was some ignorance with respect to the transponder code 5677, a view shared by the INI COOR instructor. The latter explained that he considered that the crew were in good conditions with sight of the ground and obstacles and with a controllable aeroplane. The crew had not transmitted a distress or emergency message. He added that given the proximity of the aeroplane to its destination, the activation of an interception mission by the military duty office was not useful.

During the incident, the controllers in the INI and INI COOR position stated that they had not thought above asking for the aeroplane's Mode C to be switched off nor of asking for the selection of transponder code 5677. They considered that all the sectors concerned were informed of the situation and that the lateral separation with the other traffic was ensured.

6 SIMILAR EVENTS

6.1.1 Serious incident to the Airbus A318 registered F-GUGJ operated by Air France and to the Pilatus PC 12 registered EC-ISH[24] in 2010

6.1.1.1 Description and conclusion of BEA investigation

The A318 was flying at FL 290 while the PC 12, cleared for FL 270, was in reality at FL 290 due to an altimetric problem. The Airbus crew made an emergency evasive manoeuvre. The minimum separation between the two aeroplanes could not be determined on the radar recording, it was estimated by the crews as being between 15 and 30 m horizontally and around 100 ft vertically.

[23] Tower frequency, south tower.

[24] Serious incident to the Airbus A318 registered F-GUGJ operated by Air France and to the Pilatus PC 12 registered EC-ISH on 2 June 2010 en route.

In the conclusion, the report indicates that, *"This incident was due to a leak at level of the static pressure line supplying the left side barometric and speed unit. This leak caused erroneous altitude and speed information to be supplied and led the PC 12 to fly at a level that was in conflict with flight AF 850 NE, without the risk of collision between the 2 airplanes being detected either by the ATC, or by the anti-collision systems such as the STCA or the TCAS.*

The flight level displayed on the ground systems did not make it possible to dispel the doubt and thus led all of those involved (crew and controllers) to believe a flight level for the airplane that was erroneous. Due to this, the crew did not search any further for the causes of the inconsistency in the speed observed on the left side unit."

6.1.1.2 Safety recommendations following this serious incident

Recommendation regarding manufacturer's procedures relating to doubtful or erroneous altitude situations

The BEA recommended to EASA:

- *"that procedures in the flight manual relating to situations of doubtful or erroneous altitude be completed or developed by manufacturers;*
- *that these cases be considered as emergency situations that must be declared without delay by crews to the ATC services."*

In response to the first recommendation, EASA replied that Pilatus had updated the procedures in its flight manual and it considered that this recommendation could be closed. In 2021, EASA told the BEA that no other specific action had been carried out since this occurrence, in particular with respect to other manufacturers.

Recommendation regarding procedures for ATC services relating to doubtful or erroneous altitude situations

The BEA recommended to the DSNA that it *"...implement, in the shortest possible time, an emergency procedure so that ATC ensures that there is a safety space around an aircraft as soon as the crew casts doubt on its vertical position, without waiting for the latter to declare a distress or emergency situation."*

The DSNA produced and circulated an operational directive 11-158/1025 applicable when a pilot of an IFR flight expresses doubts about the altitude of his flight. All the control units (ACCs and ANSs) implemented this directive on 21 July 2010.

In compliance with this directive, when there is a doubt about the altitude of an IFR flight, the controller must apply a lateral separation with other flights as soon as possible, ask the pilot to stop transmitting in Mode C and tell him that the control services cannot carry out a cross-check.

[25] This directive was subsequently updated to become directive 17-58/24 (see paragraph 6.1.3.2).

6.1.2 Serious incident to the Cessna 525A CJ2 registered N222NF[26] in 2020

6.1.2.1 Description and conclusions of investigation

The pilot of the Cessna[27] was confronted with inconsistent altitude and speed information displayed on his instruments when taking off from Le Bourget. The pilot did not comply with the dedicated procedure and tried to troubleshoot with the help of the CDG controller with whom he was in contact. This led the actors to rely on the air data system associated with the transponder, resulting in a confirmation bias situation - it was in fact this system that was providing the erroneous information. In consequence, during the occurrence, the controller asked the pilot flying in the cloud layer to descend to 1,500 ft. The radar altitude at this time was close to 3,000 ft whereas the actual altitude of the aeroplane was around 1,300 ft. A TAWS warning was activated on board the aeroplane. After the flight, an insect and sand were found in a static port.

6.1.2.2 Safety recommendations following this serious incident

Recommendation regarding Textron Aviation's procedures[28] relating to doubtful or erroneous altitude situations

The BEA recommended that, "*the FAA ensure that the procedure in the Cessna Citation 525 flight manual is updated to provide pilots with a specific procedure for processing inconsistent air data information, adapted to the configuration of the aeroplane concerned".*

In April 2025, the FAA replied to the recommendation. It assessed that procedures could be improved to provide clarification to crews on how to detect an air data system failure and select the valid air data source for the transponder. It indicated, however, that the crew workload should be taken into account on a case-by-case basis for any new flight manual procedure. It also stated that it had not identified any unsafe situation requiring mandatory corrective action.

Recommendation regarding manufacturer's procedures relating to doubtful or erroneous altitude situations

In its report, the BEA recalled that the safety recommendation issued in 2010 regarding incomplete procedures on what to do in the event of inconsistent altitude information had not been applied to aircraft other than the Pilatus PC 12 (see paragraph 6.1.1).

Consequently, the BEA recommended again that, "*EASA, in liaison with the primary airworthiness authorities of the aeroplanes, implement the recommendation by not limiting itself to the particular case of the Pilatus PC 12.*"

At the end of January 2023, EASA informed the BEA, in response to this recommendation, that it had sent a CARI[29] to the various Type Certificate Holders (TCH) of aircraft covered by the CS-23, CS-27 and CS-29 certifications, as well as to Supplemental Type Certificate Holders (STCH) relating to avionics and/or "air data" systems for these aircraft. This CARI asks Design Organisation Approval (DOA) holders to review operational procedures with regard to inconsistencies or deviations in "air data".

[26] Serious incident to the Cessna 525A registered N222NF on 14 August 2020 close to Le Bourget.
[27] Aeroplane complying with certification specifications CS-23.
[28] Aeroplane manufacturer.
[29] Continuing Airworthiness Review Item.

Recommendation relating to emergency procedures for air navigation services linked to doubtful or erroneous altitude situations

The BEA recommended that, "*the DSNA ensure, in addition to the teaching of the emergency procedure to be applied when the pilot announces a doubt about the altitude of his flight, that all active controllers have correct knowledge of how the air data information, available to them on their screens, is obtained. [Recommendation FRAN-2022-016]".*

In June 2023, the DSNA replied that it had instructed the Operations Division to create feedback material on how altimetric information is obtained. Material in the form of Computer Aided Instruction (CAI) or a video was being studied and a review would be carried out in July 2023.

Once completed, this feedback would be consolidated, based on the chosen material, with a view to being widely distributed to all active air traffic controllers. Preference would be given to the organisation of briefings, and the material created would be distributed via QR code on posters, as well as in a forthcoming edition of the DSNA Safety Bulletin. The aim was to deploy this feedback by the spring of 2024 at the latest.

The Operations Division finally published feedback material in February 2025, addressed to ANSs and ACCs, containing:

- a summary of the serious incident between a Cessna 525 CJ operated by Valljet and an Embraer ERJ170 operated by HOP! in 2022 (see paragraph 6.1.3);
- a link to directive 17-58/24 (see paragraph 6.1.3);
- a reminder of how a secondary radar operates.

The ACC/south-west forwarded this feedback to the safety contacts of each controller team, who were then responsible for discussing it within their teams. The ANS/CDG had planned to present this feedback to the representatives of each control team at a meeting scheduled for May 2025, leaving it to them to discuss it within their teams.

Furthermore, ANS/CDG had included feedback on this serious incident in its Abnormal and Emergency Situations (AES) training program, from the summer of 2023, including a theoretical part with a reminder on altimetry and the procedure to be applied in the event of a pilot reporting a doubt about the altitude of his flight, and a practical part in a simulator.

6.1.3 Serious incident to the Cessna 525 CJ registered F-HGPG operated by Valljet and to the Embraer ERJ170 registered F-HBXG operated by HOP![30] in 2022

6.1.3.1 Description and conclusion of BEA investigation

On 12 January 2022, there was a near collision between two aeroplanes when the ERJ was at FL 280 and the Cessna 525 cleared for FL 270, was slightly below FL 280 because of an altimetric problem that the crew had detected at the end of the climb. The aeroplane's documentation did not include a procedure for processing this failure. The controller, belatedly informed about the unreliable altimetric information on board the Cessna 525, was unable to ensure the minimum separation. This was calculated as being 1.5 NM horizontally and 665 ft vertically. The controller, remembering the procedure when a crew expresses doubt about the altitude of their flight, asked the crew to cut off Mode C of the transponder and proposed an interception mission. He then used the quick

[30] Serious incident to the Cessna 525 registered F-HGPG operated by Valljet and to the Embraer ERJ170 registered F-HBXG operated by HOP! on 12 January 2022 in cruise.

reference card for a transponder failure available in his position in the absence of the quick reference card for when a pilot reports having a doubt about the altitude of his flight.

The crew then checked the GNSS altitude of the aeroplane to determine the faulty altimetric source.

The examinations were not able to identify with certitude, the cause of the fault, however, the freezing of water that had possibility accumulated at a low point of a hose connected to a Pitot tube could explain it.

6.1.3.2 Safety recommendations following the serious incident

Recommendations relating to the quick reference card for controllers

The BEA recommended that, "*the DSNA ensure that the emergency procedure relating to a pilot's doubt about the altitude of his flight is the subject of a quick reference card, made available to controllers at their control position and is accompanied by recurrent training on a simulator".*

The DSNA replied to the BEA in November 2023 that it had taken into account the recommendation and had already taken the following measures:

- the Operations Division (OD) was asked to identify the centres where this quick reference card did not exist in the controller position, and to coordinate with these centres, the creation of this quick reference card as well as its direct accessibility to position controllers;
- the Strategy and Resources Division was asked to identify what was already being done in terms of centre training, and to consider the possibility of integrating this parameter into training.

In August 2024, the OD published directive 17-58/24, which repealed directive 11-158/10. The new directive reiterates the principles of the previous one. It mentions the addition of an item to the procedure consisting in displaying the transponder code 5677, to inform the other DSNA and Armed Forces centres of the particularity of the flight. The directive also specifies that the phraseology to be used in such circumstances should be in plain language.

The various DSNA organisations (ANSs and ACCs) implemented this directive directly in their Operations Manuals, or by means of an operational directive pending an update of the Operations Manual.

The OD also identified the ANSs and ACCs that have a quick reference card for a position controller. At the time of publication of this report, three of the five ACCs and eight of the twenty-three ANSs surveyed had such a quick reference card.

As for training in the management of unreliable altimetric information, at the time of publication of this report, the DSNA was unable to provide the BEA with any progress report on this subject.

Recommendation regarding the analysis of the risk posed by an air data system fault

The BEA recommended that, "*EASA continue and complete the analysis of the risk posed by a fault on the air data system, taking into account the system as a whole, and draw, as applicable, any conclusions regarding safety actions."*

EASA replied in October 2023 that it was working to address the recommendation in the scope of the Safety Issue SI-2002 Deconfliction with aircraft operating with a malfunctioning or non-operative transponder. EASA indicated that it was currently conducting a Safety Issue

Assessment (SIA) on the subject, and that the analysis would be documented in a Best Intervention Strategy (BIS) report. This BIS is the prerequisite for setting up a working group to initiate regulatory tasks.

In April 2025, EASA indicated that the BIS on the subject was planned for the 2 to 4 quarters of 2025.

7 CONTINUATION OF SAFETY INVESTIGATION

7.1 Measures taken following serious incident

7.1.1 By the operator

A safety note reminding pilots of the use of the "UNRELIABLE ALT INDICATION / ALTIMETERS FAILED" procedure and its memory item status was shared with all the operator's pilots.

In addition to this publication, the operator indicated that it would provide pilots with procedures explaining the method of accessing the geometric altitude given by the various GNSS navigation systems.

7.1.2 By air navigation services

The ACC/south-west service quality subdivision presented initial information on the incident during a briefing to controllers. In addition, an "urgent safety" e-mail setting out the actions to be taken if a pilot expresses doubt about the altimetric information, in addition to directive DO 17-58/24, was sent to the safety contacts at the beginning of April.

The ANS-CDG service quality subdivision presented initial information on the incident during a monthly meeting with controllers. In the meeting, those present were also reminded of directive DO 17-58/24, the actions to be taken by the position controllers and the quick reference card for approach supervisors. All the controllers were also reminded of how to access the quick reference cards.

7.2 Initial findings

- The crew detected that the three altimeters were showing different altitudes during the climb. The climb was continued to the cruise level.
- The *COMPARATOR MONITOR ALERTS* procedure in the operator's QRH, identical to that given in the aeroplane flight manual, did not mention the use of the alternate static source equipping this aeroplane.
- The *UNRELIABLE ALT INDICATION / ALTIMETERS FAILED* procedure in the QRH was introduced by the operator following a similar incident in 2022. This procedure asks the crew to compare the barometric altitudes with the altitude based on the aeroplane's GNSS system. The crew were not aware of this procedure. This procedure is not referred to in the *COMPARATOR MONITOR ALERTS* procedure in the QRH.
- At the beginning of the cruise flight, the crew contacted the ACC/south-west controller about an on-board altimeter problem. The latter indicated that the aeroplane was displayed as being at FL 180.
- The two position controllers did not perceive that the crew's request was linked to a doubt about the on-board altimetric information and therefore did not comply with the associated procedure.

- The crew, after troubleshooting the failure, selected ADC 1 as the altimetric source for both PFDs. ADC 1 was providing erroneous altitude values.
- At the time of the incident, the meteorological conditions were compatible with visual flight (VMC). The captain indicated that he had reduced sight of the ground due to the setting sun reflecting on a light layer of cloud.
- During the flight (in cruise at FL 180, and then in level flight at FL 90), the GNSS altitude continuously decreased from 15,650 ft until it reached an altitude of 1,200 ft, i.e. a height of 700 ft, at which point, according to the captain's statement, a TAWS *TERRAIN PULL UP* warning was activated in the cockpit.
- The co-pilot did not perceive this TAWS warning, he was dealing with a radio problem as he was unable to contact the CDG controller.
- The captain processed this warning, stopped his descent and continued visual flight, at an altitude of 2,000 ft based on the information provided by ADC 2.
- Following the TAWS warning, the crew asked the CDG controller what altitude they were at. The controller replied that the aeroplane was displayed at FL 96. The crew replied that it seemed to them that they were at a lower altitude.
- The CDG controllers partially complied with the procedure for when a pilot reports a doubt about his flight altitude.
- Part of the flight took place in uncontrolled airspace. The aeroplane flew at high speed close to several VFR traffic during the last twenty minutes of the flight.
- Given that the transponder was sending data from ADC 1 during the flight, the controllers' MSAW and STCA systems were ineffective as were the aeroplane's ACAS systems and those on the aeroplane's flying nearby.

7.3 BEA's concerns regarding risks associated with air data system faults

The first elements of the investigation confirm once again that an altimetric problem is a singular and real threat for flight safety, particularly for aeroplanes only equipped with two independent air data systems.

This type of in-flight malfunction is likely to, simultaneously:

- generate a flight path deviation in the vertical profile which could cause a dangerous loss of separation between aircraft or between an aircraft and the ground;
- deprive pilots and air traffic controllers of elements permitting them to have full situational awareness;
- compromise the effectiveness of the ACAS (aircraft) and STCA or MSAW (air traffic control) barriers.

Three similar serious incidents have already been the subject of BEA safety investigations and led to several safety recommendations being issued (see paragraph 6). At the date of publication of this report, certain recommendations had given rise to actions (several of these are still in progress), other recommendations were not acted upon. Valljet, Textron, the DSNA, the DSAC, the FAA and EASA have already been associated with some of these investigations.

This serious incident shows that the means available to crews and air traffic controllers can be insufficient to allow them to suitably manage a situation where there is a doubt about an aircraft's altimetric information.

The initial information collected during the investigation regarding F-HJAV along with this report, have been shared with the organisations mentioned above in order that they may re-assess, in the light of this new serious incident, the appropriateness of the decisions or measures already taken.

7.4 Next steps in investigation

The safety investigation will pay particular attention to the following points:

- the fault on the air data system of F-HJAV;
- crew and air traffic controller training and procedures;
- the actions by the different parties concerned by the previous safety occurrences and corresponding safety recommendations.

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