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

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SAFETY INVESTIGATION REPORT

Serious incident to the DOUGLAS DC3 registered F-AZTE on Saturday 9 July 2022 at Meaux - Esbly aerodrome

Time	Around 17:55[1]
Operator	France DC3
Type of flight	Air show
Persons on board	Captain, co-pilot and two flight engineers
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.	

Stall in turn and in climb, recovery at low height, during airshow repetition flight

1 HISTORY OF THE FLIGHT

Note: the following information is principally based on the statements by the occupants of the aeroplane, data from an aeronautical application used by the co-pilot and a video taken by a witness on the ground.

The day before the planned airshow at Meaux - Esbly aerodrome, the crew were carrying out a repetition flight[2] in front of the flight director. This flight was composed of two parts:

- the first part consisted of a formation flight with the Douglas DC3 registered F-AZTE in the left-wing position, another DC3 in the right-wing position and a Dassault MD-315 in the leader position;
- the second part started with the separation of the formation at the northern edge of the aerodrome for solo passes. It was planned that F-AZTE would separate from the formation by turning left, while the other two aeroplanes turned right.

The co-pilot was to have the controls for the first part of the flight as she was sat in the right-hand seat and after the separation of the formation, she was to transfer the controls to the captain.

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

[2] Flight carried out to show the display programme to the flight director as part of the preparation of an air show subject to a prefectural authorization.

At 17:41, the co-pilot took off from runway 07L[3] and then turned right to join the other two aeroplanes. During the left-hand turn in formation, the co-pilot observed that the speed had decreased to below 100 mph[4], the minimum speed fixed by the crew. She then informed the formation of her temporary withdrawal due to the insufficient speed. Shortly afterwards, the co-pilot joined the formation again.

At 17:53, the formation separated when it reached the northern edge of the aerodrome in descent at a height of less than 500 ft. The co-pilot turned left at a height of around 340 ft (see **Figure 1**, point 1) and then asked the captain if he had sight of the aerodrome on his left-hand side and if he was ready to take the controls. The captain confirmed and took the controls. As he continued the turn in descent, the captain had difficulties in finding his visual references. He broke off the turn and the descent at a height of around 100 ft (point 2). He then turned left again in climb. He accentuated the bank and when the aeroplane reached a height of around 340 ft, the left wing stalled (point 3). The loss of control was recovered at a height of around 100 ft (point 4).

The flight director announced the end of the repetition flight over the radio. The captain turned right and directly joined the final for a landing on runway 07L.

The flight display planned for the next day was cancelled.

[3] Unpaved runway measuring 1,145 m x 100 m.

[4] The glossary of abbreviations and acronyms frequently used by the BEA can be found on its web site.

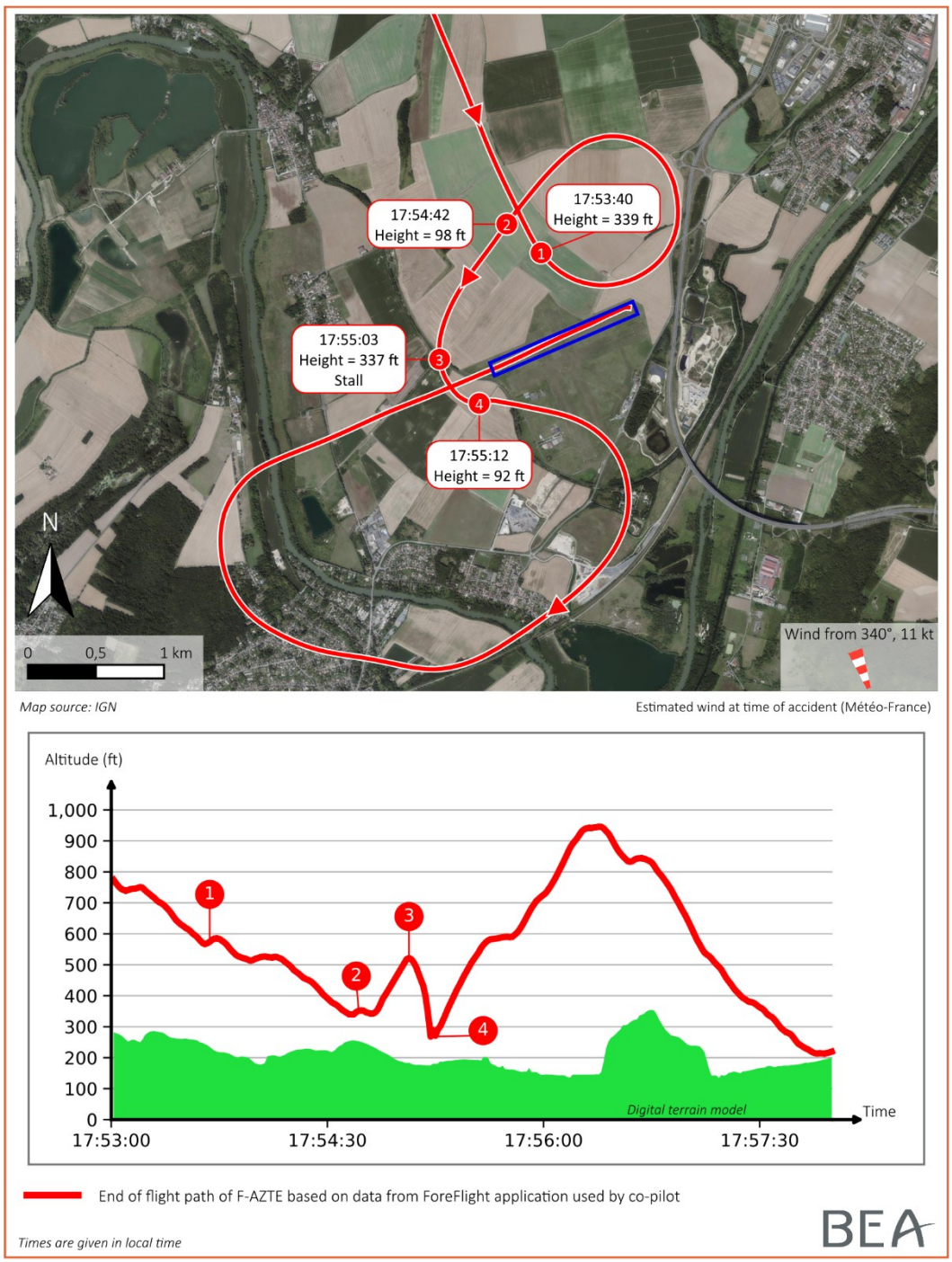

Figure 1: flight path based on data from the co-pilot's aeronautical application

2 ADDITIONAL INFORMATION

2.1 Analysis of aeronautical application data

Based on the data directly read out from the aeronautical application used by the co-pilot, the ground speed was:

- 113 mph when the aeroplane reached the maximum height of around 340 ft (see **Figure 1**, point 3) before losing height;
- 133 mph when the minimum height of 100 ft was reached (point 4).

2.2 Aircraft information

The Douglas DC3 is a multi-pilot[5], low-wing, twin-engine aeroplane with a conventional retractable landing gear. It had previously been operated within the armed forces and in commercial air transport.

The F-AZTE build was completed on 5 March 1943. It is equipped with two Pratt & Whitney R-1830-90-D piston engines, each producing 1,200 hp. The aeroplane holds a Restricted Certificate of Airworthiness for Vintage Aircraft, which allows it to be maintained and flown under rules adapted to the conservation of aeronautical heritage.

According to the statements collected, the aeroplane took off with a weight of approximately 10,600 kg for a maximum take-off weight of 11,880 kg. According to the flight manual, the stall speed was approximately 75 mph in straight and level flight with flaps retracted and engines at reduced power.

During a turn at constant altitude, the load factor increases with the bank angle, which increases the stall speed. For a 30° bank turn, the stall speed of F-AZTE was approximately 80 mph, and for a 60° bank, approximately 105 mph.

The minimum manoeuvring speed of 100 mph set by the crew allowed for maximum bank angles of approximately 50° in level flight at maximum authorized weight and with flaps retracted.

2.3 Meteorological information

The 18:00 METAR for Paris-Charles de Gaulle airport, located 10 NM north-west of Meaux aerodrome, indicated wind from 340°, varying between 250° and 040°, of 11 knots, with gusts up to 23 knots, a CAVOK situation and a temperature of 28°C. The 17:30 METAR did not report any gusts.

The co-pilot stated that the wind conditions were challenging and made holding the flight path difficult. The captain added that there was a wind gradient and that it was hot.

2.4 Captain information

2.4.1 Flight experience

The 85-year-old pilot held an ATPL(A), a valid IR rating for non-high-performance single-pilot multi-engine aircraft, and a valid CNRAC DC-3 type rating[6]. He had logged over 28,000 flight hours, including approximately 2,000 on the DC-3.

For the last few years, he had only flown F-ATZE. In 2022, he had flown around 1 h 15 min in June and around 40 min in July (ferry flight on aeroplane the day before the incident and runway circuits in the morning). The pilot had also carried out a flight of around one hour in the DC3 simulator (certified FNPT II) two months before the occurrence. In 2021, he had flown around 50 h.

[5] The presence of a flight engineer was not required on F-AZTE.

[6] A CRNAC type rating is a national rating associated with an EASA licence (PPL, CPL or ATPL).

He was the co-owner of F-AZTE which was operated by the association, France DC3[7]. He was the chief pilot in France DC3, an association which he had created and presided over until December 2021. He stopped piloting after the occurrence flight.

2.4.2 Medical information

2.4.2.1 Aero-medical fitness

For just over a decade prior to the incident, the pilot had consulted with Aero-Medical Examiners (AME) at two Aero-Medical Centres (AeMC). On several occasions, he had been declared unfit due to medical and sensory issues, particularly hearing problems:

- in 2015, he lost his Class 1 medical fitness certificate while retaining a Class 2 certificate with a validity limited to six months (TML);
- in 2016, two new fitness conditions were added: mandatory use of ANR[8] headphones during flight and monitoring in an AeMC. During this examination, the AeMC carried out a Mini-Mental State Examination (MMSE)[9] on the pilot where he scored 30/30;
- from 2016 to early 2021, the pilot kept his Class 2 fitness rating without any significant change in the limitations;
- in September 2021, the AeMC prescribed a cognitive assessment to determine his fitness. Following this assessment, the AeMC declared the pilot unfit on 16 February 2022, based on this evaluation, as well as ENT (ear, nose, and throat) issues and the results of heart examinations. This assessment, carried out in November 2021, included an MMSE test, the score of which was 29/30. The AeMC referred the case to the medical department of the DSAC/PN[10].

By decision of 29 March 2022, the CMAC awarded the pilot a Class 2 fitness rating for a period of six months with the following limitations:

- VML: valid only with correction for defective distant, intermediate and near vision;
- HAL: valid only when hearing aids are worn;
- OSL: valid only with a safety pilot and in aircraft with dual controls;
- 6 month TML: medical certificate's validity limited to 6 months;
- SSL (special restrictions as specified): mandatory use of an ANR headset in flight and monitoring in an AeMC;
- 12 month SIC: regular specific medical examinations for 12 months; mandatory contact with the authority (medical assessor).

2.4.2.2 Neuropsychological aspects of aeromedical fitness

An assessment conducted by a specialized cognitive neurology service in November 2021 revealed a high-performing neuropsychological profile but identified difficulties in both visual analysis, particularly in recognizing images presented from a non-prototypical angle (i.e. different from the usual or typical angle) and in complex visuospatial processing along with effective but disorganized visual search strategies. Furthermore, "weaknesses" in memory were noted.

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[7] The association only operated F-AZTE.

[8] Active Noise Reduction.

[9] The MMSE is a test for assessing overall cognitive functions and has become a screening tool for cognitive impairment.

[10] If there is any doubt about a pilot's fitness, the file may be referred to the DSAC/PN medical department, which can then declare fitness with or without limitations, or even unfitness. In the latter case, the pilot may appeal, and the decision will be reviewed by the civil aviation medical board (CMAC).

This apparent contradiction between a high-performing profile and visual analysis and memory difficulties is due to the use made of the assessment. This assessment is designed to measure overall cognitive performance in the general population in order to obtain an objective appraisal of a potential cognitive impairment. The anomalies observed in the pilot are, in this context, considered minor, even negligible, relative to his chronological age.

However, the performance levels required for piloting an aircraft are far higher and of a different order than for everyday tasks. Specifically, difficulties in mentally representing and manipulating complex three-dimensional visual and spatial information can be a disqualifying factor for piloting an aircraft, while still allowing the person to lead a normal daily life for his age.

In other words, the conclusion of the assessment, implicitly associated with the chronological age, is not appropriate for the level of cognitive demands required at any age for an aircraft pilot.

2.5 Co-pilot information

The 41-year-old co-pilot held a CPL(A) license along with numerous valid ratings at the time of the incident, including an IR rating for non-high-performance single-pilot multi-engine aircraft and a CNRAC DC-3 type rating (obtained in October 2018) and aerobatics, mountain and instructor ratings. In November 2021, following a flight test by an examiner pilot external to the association, the co-pilot's OPL restriction on the DC3 was lifted, allowing her to act as captain. She had also been designated a DC3 instructor by the authorities.

She had logged approximately 6,500 flight hours, including about 80 hours on the DC3, and 117 hours in the previous three months, including 1 hour on the DC3. Two months before the occurrence, she had also carried out 13 flight hours in a DC3 simulator (certified FNPT II).

She joined France DC3 as a co-pilot four years before the occurrence. In 2021, she flew several times as captain with the pilot involved in the incident. The day after the occurrence, she flew the aeroplane back to Orly, accompanied by a co-pilot from the association.

2.6 Statements

2.6.1 Members of France DC3

Several witnesses (current and former members of the association) had raised concerns about the captain, pointing in particular to his small number of recent flight hours, a decline in his cognitive abilities which they attributed to his age, and hearing problems. Several pilots who had flown with the captain stated that he had periods of absentmindedness, was sometimes disoriented, and became angry when there was a disagreement. The captain, however, had never agreed to finding a successor and appointing them as captain. They left the association, deeming the situation dangerous.

The two passengers on the flight were standing[11] in the cockpit, behind the pilots. They indicated that their role was to retract/extend the landing gear and flaps as requested by the crew, as well as to monitor hydraulic pressures. One was a flight engineer instructor, the other a student flight engineer. The two passengers explained that they did not perceive the loss of control and noticed nothing unusual. One of the witnesses stated, however, that after the captain took the controls, he felt the aeroplane bank steeply.

[11] F-AZTE has only one observer seat in the cockpit.

One of the two witnesses filmed part of the flight. The transfer of controls and the loss of control do not appear in the videos submitted to the BEA.

2.6.2 Captain

The pilot believed his hearing impairment was compensated for by his hearing aid and that the ANR headset he used in flight was a supplementary aid. He explained that during his last Class 2 medical examination, he was asked to undergo further cognitive assessments in a hospital neuropsychology service. According to him, the results of these tests were positive as he was considered to perform well. He specified, however, that he did not intend to renew his medical certificate, as he planned to permanently stop flying after the Meaux airshow.

The pilot indicated that the association's activities had been suspended during the restrictions related to the COVID-19 pandemic and were struggling to resume, particularly due to high fuel and insurance costs. In this context, he was apprehensive about the Meaux airshow due to their lack of recent experience flying the DC-3. He added that the co-pilot had managed the participation in the show and, in particular, conducted the before flight briefing. He stated that the atmosphere was stressful within the association and that, although he disagreed with the co-pilot on certain points of the before flight briefing, he did not intervene.

The captain explained that during the flight, the co-pilot left the formation; he felt the situation was dangerous and stated that this had annoyed him. He indicated that when the controls were transferred to him, he could not see the runway. He then wanted to gain distance and altitude. During this manoeuvre, the aeroplane stalled at low height. He then immediately pushed on the stick and applied full power.

The captain believed that the more important contributing factor to the occurrence was a problem of crew resource management, citing recurring tensions with the co-pilot over the past six months, particularly regarding compliance with procedures, as he considered the co-pilot too "rigid." He specifically mentioned disagreements while ferrying the aeroplane from Orly the day before the event, during which the co-pilot allegedly challenged his authority as captain.

2.6.3 Co-pilot

The co-pilot explained that approximately two weeks before the occurrence, she had contacted the association's president to express her doubts about the captain's fitness to fly, given his lack of recent experience, age-related cognitive decline, and hearing problems. She specified that he had a tendency to forget items on checklists, to make minor errors, to have lapses in concentration, or to pretend to have heard when he had not. She added that while overall experience can partially compensate for limited recent experience, it can only do so to a certain extent and cannot replace it. All the pilots in the association were also lacking in training. She had expressed doubts to the captain and other members of the association about their ability to perform the flight display safely.

The co-pilot explained that the ferry flight from Orly to Meaux-Esbly, flown with the captain the day before the occurrence, took place in a strained atmosphere. After landing, there was a disagreement between the two pilots regarding their participation in the airshow. That evening,

she suggested to the captain that they use their flight slot the following morning, not for a rehearsal, but to carry out runway circuits, and then decide whether or not they would do the afternoon rehearsal flight. The runway circuits went very well, and this eased the tension. She and the captain then decided to carry out the rehearsal flight.

Regarding the occurrence flight, she stated that before handing over the controls, she asked the captain if he had the runway in sight, and he replied in the affirmative. Then, after handing over the controls, she did not understand the flight path taken by the captain, voiced her confusion, but received no response. She stated that she called out "we're low" twice, without the captain responding. The captain then stabilized the flight path and turned left while climbing. She pointed out that the airspeed was low, but the captain's eyes were fixed on the left-hand side, and he did not respond. The aeroplane's bank angle increased, she saw the airspeed decrease below 80 mph, and she felt buffeting. She then shouted "airspeed!" and pushed the stick forward with both hands, banking to the right. She added that she also used the right rudder pedal. She specified that it was the captain who increased power.

She explained that after landing and shutting down the engines, she was surprised by the captain's reaction, who commented on the formation flight without any mention of the loss of control.

3 CONCLUSIONS

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

Scenario

For several years prior to this serious incident, the captain's declining medical fitness had made it urgent for him to ensure his replacement within the association, France DC3. While he had shown himself determined to overcome the increasing difficulties in obtaining a medical fitness certificate, he had put off several association pilots with the DC3 rating who could have succeeded him as captain.

A neuropsychological examination had revealed impaired visual analysis capabilities. However, the significance of this finding had been obscured by the captain having demonstrated high cognitive abilities. Undertaking the flight of the serious incident with limited recent experience and in an atmosphere he perceived as stressful, with, in particular, significant disagreements with the co-pilot, the captain's behaviour was dominated by his emotions. These high emotions impaired his reasoning and decision-making, and hindered his ability to compensate for his cognitive weaknesses. It was therefore difficult for him to compensate for his visuospatial impairments and fully exercise his prerogatives as captain within the crew.

In accordance with the program, the captain took the controls upon separation from the formation while in a heightened emotional state due to frustrations accumulated before and during the flight. The aeroplane was at this point in a left-hand turn and at a low height, so the captain's mental workload immediately became high, a stark contrast to his previous cognitive activity. In this context, he was unable to identify the runway on his left-hand side, probably due to the combination of his emotional state and the visual analysis deficit highlighted during the neuropsychological assessment in November 2021. After stabilizing the flight path, he banked left while climbing to orient himself. The airspeed decreased as the aeroplane climbed and the bank angle increased. The co-pilot, aware of the decreasing airspeed, informed the captain of this, but he did not react. The bank angle increased, and the aeroplane entered a stall. The co-pilot then pushed forward on the stick with both hands to counteract the roll. The captain also made a nose-down input and applied power. The crew regained control of the aeroplane, and the captain carried out the landing.

Contributing factors

The following factors may have contributed to the loss of control:

- a decline in the captain's psychosensory performance, related to normal ageing, exacerbated by his emotional state;
- the captain's failure to perceive the co-pilot's warnings due to his hearing problems;
- deficient crew collaboration due to disagreements with the co-pilot, who was aware of the captain's decline in performance;
- an interpretation of the neuropsychological assessments that was insufficiently adapted to the aeronautical context, the conclusions of which were implicitly related to the pilot's chronological age and everyday life, rather than to the specific demands of piloting, which may have led to an underestimation of the operational impact of the captain's cognitive impairments.

Safety lessons

Ageing in aviation

Faced with the obvious decline in performance of an ageing pilot who persists in their desire to fly, an AME may be tempted to order numerous paraclinical somatic examinations until a reason is found to declare the pilot unfit. However, the main functions specific to piloting are generally not thoroughly explored, such as spatial awareness and divided attention such as the ability to perform a task while simultaneously managing communications. Cognitive decline in ageing pilots manifests itself in particular through the impairment of these functions, which can lead to insidious disabilities that compromise flight safety.

More generally, ageing general aviation pilots who are experienced and available may be encouraged to continue their activity despite their doubts or even difficulties[12]. Indeed, they may feel under pressure from various stakeholders for the services they provide (glider towing, introductory flights, piloting vintage aircraft, etc.), They also generally enjoy a prestigious social status, even a genuine aura stemming from their distinguished aeronautical careers. This may push them to continue their activity although their experience is no longer sufficient for compensating their deficiencies.

Paradoxically, social pressure as well as the goodwill of aeronautical actors are likely to impair the judgement of these pilots and prevent them from deciding for themselves to end their activities.

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

[12] 03AEN, F-GSEV