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Air, Maritime and Railway Traffic Accident Investigation Agency

Air Traffic Accident Investigation Department

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FINAL REPORT

ON ACCIDENT OF THE AIRCRAFT Cessna 182, D-EGLF

Bročanac near Slunj, 29 May 2022



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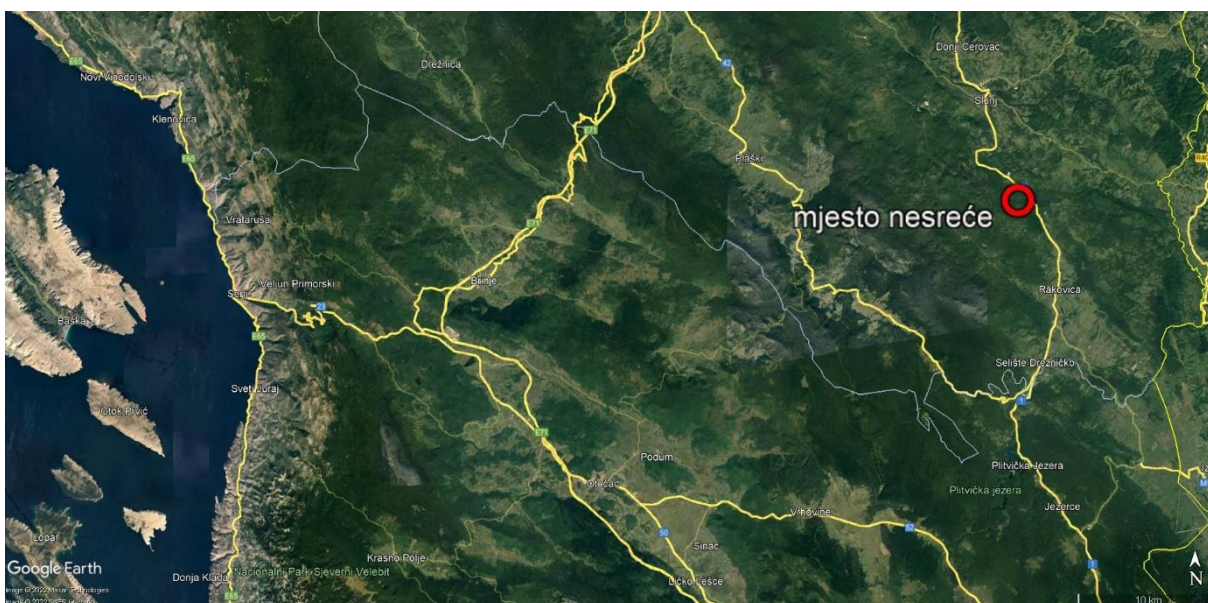
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OCCURENCE INFORMATION

Type of the occurrence:	Accident
Date:	29 May 2022
Local time:	11:24
Place:	Bročanac, near Slunj
Type of the aircraft:	Aeroplane
Manufacturer / model:	Cessna 182
Country of registration:	Germany
Registration:	D-EGLF
Owner:	LSC Bayer Leverkusen
Operator:	LSC Bayer Leverkusen
Number of persons on board:	4
Injuries:	4 fatalities
Damage to the aircraft:	Completely destroyed



Picture 1 – the accident site is located about 10 km south of Slunj

INVESTIGATION

The Air, Maritime and Railway Traffic Accident Investigation Agency (hereinafter referred to as AIA) received the first information about the disappearance of the aircraft from the Croatia Control shortly after the disappearance of the aircraft of the radar. Immediately after that came a report from OKK of the Ministry of the Interior.

From that moment on, AIA was in constant contact with the services that participated in the search and rescue.

AIA investigators were dispatched to the area of the aircraft's disappearance. The same was found the next day in the morning hours.



AIA issued a notification about the accident and opening of an investigation.

The inspection at the crash site began shortly after the aircraft was found and was completed the following day.

In accordance with the provisions of ICAO Annex 13, AIA issued a 'Preliminary Report' 30 days after the day of the accident, in which the information about the event and the findings obtained in the early phase of the investigation were stated.

At the end of the investigation, AIA issued this Final Report.

SUMMARY

On 29 May 2022, the subject aircraft took off from Split Airport (LDSP) to Laichingen Airport (EDPJ) in the province of Baden-Württemberg in Germany.

Meteorological conditions at Split Airport were favourable for VFR flying, however, by moving to the hinterland, i.e. to the continental area, the aircraft entered significantly more complex meteorological conditions.

At one point the pilot informed the control that he was losing altitude and shortly after that the aircraft disappeared from the radar.

Competent services launched a search and rescue operation. The aircraft was found the next day in the morning hours, destroyed and burned. Persons who were on board the aircraft did not survive. The investigation determined that the cause of the accident was the loss of control over the aircraft, and the contributing factors were meteorological conditions unsuitable for VFR flying, insufficient flight preparation, insufficient awareness of the pilot about the real situation and the pilot's incompetence to fly in IFR conditions.

AIA did not issue safety recommendations, considering that the factors that led to this accident are well known in aviation practice and recognized and satisfactorily addressed by existing aviation regulations.

1. FACTS AND INFORMATION

1.1. FLIGHT HISTORY

1.1.1. Arrival to Split Airport

On 26 May 2022 (Thursday) the aircraft in question flew from Laichingen Airport (EDPJ) in Germany to Split Airport (LDSP), where it landed at 16:44 LT.

After parking at position no. 16 and engine shutdown, the aircraft was secured against uncontrolled movement and safety cones were placed around the aircraft.

According to the information received from Split Airport employees, no problems were observed during the acceptance of the aircraft.

1.1.2. Flight preparation and take-off

Through the statement of the safety manager of Split Airport, the following information was obtained regarding the dispatch of the aircraft on the day of the accident, 29 May 2022:

General aviation employees of Split Airport picked up the crew and passengers at the information desk in the passenger building. The standard procedure of dispatching passengers to the aircraft was then performed with the passengers. This includes security inspection of the crew and passengers, inspection of passports and crossing the state border, and driving from the exit (gate) to the aircraft that was parked at Split Airport at position 16.

At the request of the pilot of the aircraft, the INA Avioservis tanker was called in for refuelling, and around 10:00 local time (LT), 210 litres of Avgas 100LL fuel were fuelled into the aircraft in question.

The employees of the aircraft acceptance and dispatch of the Split Airport removed the ropes from the aircraft, while the employees of the general aviation service performed the billing of the services.

Upon completion of fuelling, the pilot inspected the aircraft, and the acceptance and dispatch employee removed the pads and cones that secured the aircraft from uncontrolled movement while standing in the parking position.

During the dispatch of the aircraft, no problems were observed with the aircraft and the passengers.

For the flight in question, the flight plan was duly completed and reported. Meteorological conditions at Split Airport were favourable for VFR flying.

At 10:37 LT, the aircraft took off from Split Airport to Laichingen Airport in Germany.

There were four persons on board the aircraft - the pilot and three passengers. Three persons were German citizens, while one passenger was a Croatian citizen.

Picture 2 shows the entire route as it should have progressed according to the reported flight plan.



Picture 2 –planned route from LDSP to EDPJ according to the reported flight plan

1.1.3. Flight progress

After taking off from Split Airport at 10:37 LT, the aircraft continued its flight according to the reported flight plan, in the northwest direction.

At 10:53:30 LT, the aircraft changed its flight direction in relation to the route reported in the flight plan and headed towards Tounj. The flight altitude was 4200 ft.

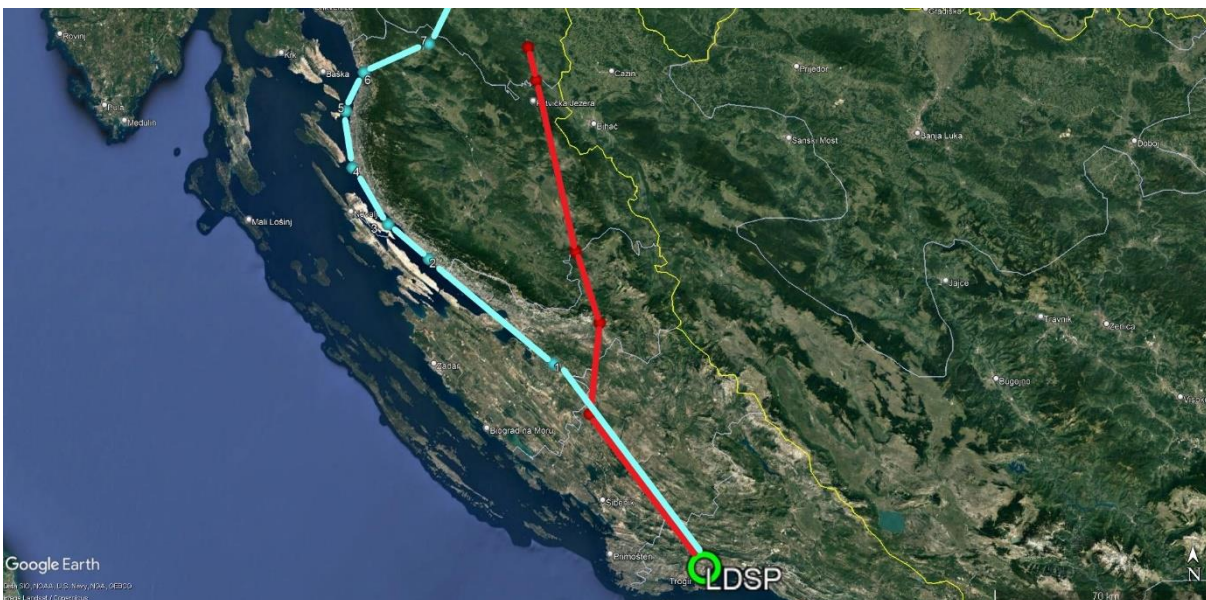
At 10:55 LT the aircraft bypassed 'big clouds' that were in front of it, generally maintaining the course towards Tounj.

At 10:59 LT the aircraft started to climb and gradually reached an altitude of 6900 ft. During this time, the aircraft flew in a straight line towards Tounj.

All the mentioned changes happened with informing and approval of the flight control.

At 11:24:53 LT, the pilot declared an emergency, and the aircraft was losing altitude.

At 11:26:36 LT the radar recorded the last record. After that, the aircraft disappeared from the radar.



Picture 3 – the actual route the aircraft flew (red line) and the first part of the route reported by the flight plan (blue line)

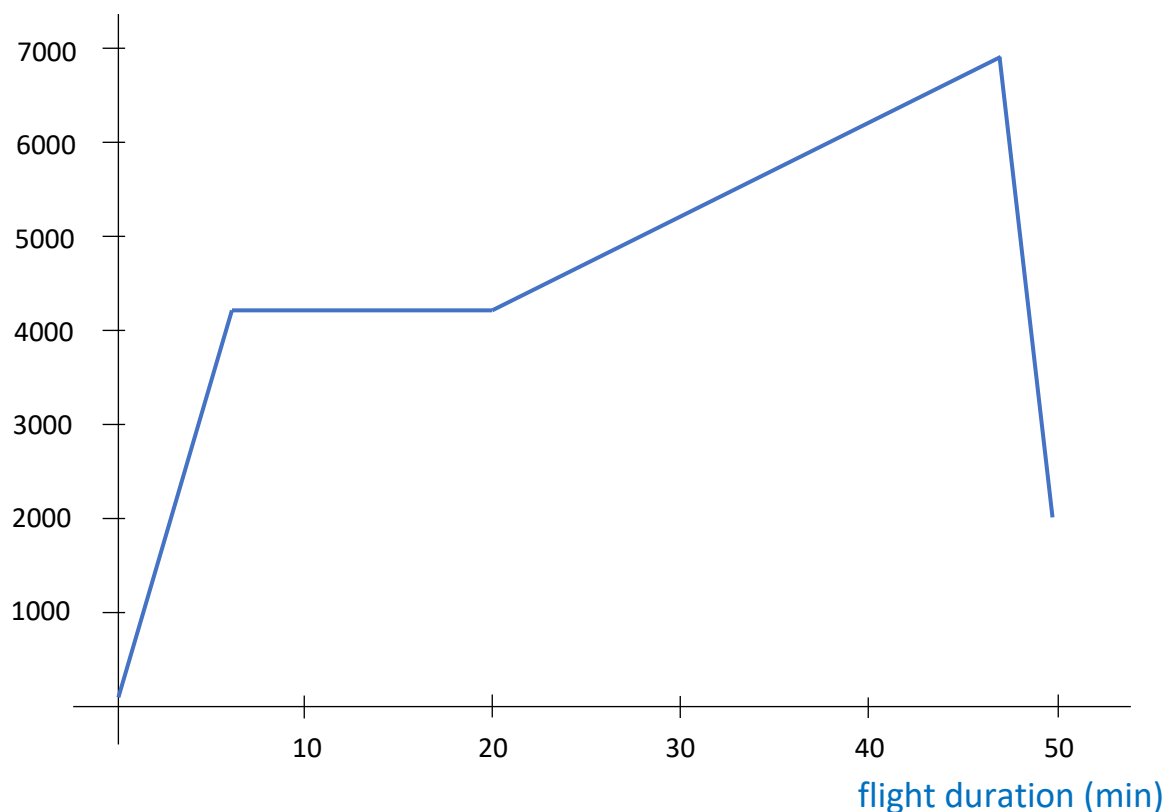
1.1.4. Radar record

The following is visible from the radar record:

Flight altitude

The flight lasted approximately 50 minutes in total. For the first 6 minutes after take-off, the aircraft constantly climbed to an altitude of 4200 ft. The aircraft maintained that altitude until the twentieth minute of the flight, after which the following 27 minutes it gradually increases the altitude to 6900 ft. After that, at 47th minute of the flight, it began to lose altitude for approximately 3 minutes, during which the aircraft descended from 6900 ft to 2000 ft, when it disappeared from the radar.

altitude (ft)



Picture 4 - display of the altitude of the D-EGLF aircraft during the flight

Ground Speed

The flight speed of the aircraft in question during most of the flight was adequate and enabled a stable flight. In the 47th minute of the flight, the aircraft entered a large right turn and began to lose height, and the ground speed dropped. This took approximately one minute. In that interval, the aircraft descended from 6900 ft to 4900 ft.

After that, large speed oscillations (ground speed) began, which was significantly reduced in the entire following period. The aircraft continued to lose altitude and in approximately two minutes descended from 4900 ft to 2000 ft. During that period, the flight speed fell below the minimum speed, at one point even to only 6.5 kt.

Flight path

From take-off to the moment the aircraft began to lose altitude, there are no unexpected elements in the flight path.

In the 47th minute of the flight, the aircraft started turning to the right and at the same time started descending. The path of the mentioned turn was in the shape of a regular circle of about 270°. After that, the radius of the circular path decreased together with a further loss of altitude. The path further became extremely irregular. It could be said that the aircraft circled to the right three more



times, although these were no longer regular circles, but extremely irregular 'circles' with several sharp changes of direction to the right and with considerable changes in radius.

In total, the aircraft, from the moment it began to lose altitude at 6900 ft, until it disappeared from the radar at an altitude of 2000 ft, made four full circles, the first of which was of a regular shape, while the other three were extremely irregular.

1.2. INJURIES

Injuries	Crew	Passengers	Others
fatal	1	3	0
serious	0	0	0
minor / none	0	0	0

In this accident, all four persons on board the aircraft died.

1.3. DAMAGE TO THE AIRCRAFT

After the crash the aircraft in question burned almost completely. Only the outer parts of the wings and the rearmost part of the fuselage with vertical and horizontal stabilizers remained unburnt. The front and centre of the fuselage, as well as parts of the wings next to the fuselage, were completely burned. The parts located at the front end of the fuselage - the propeller and the propeller cone - were preserved to some extent from burning.

The propeller was found in a vertical position, where one blade was bent under the aircraft fuselage and pressed into the ground, while the other blade remained in an upward position. The blade that was bent under the fuselage did not suffer significant damage from burning, while the paint on the other blade was burnt. That second blade was not significantly deformed, however in one place near its tip there was a visible trace of melting, and the tip itself was torn off and found in the immediate vicinity. The propeller cone was found pressed in the ground and significantly mechanically deformed.

The front left door was found separated from the aircraft, about ten meters from the wreckage and partially burnt.

The outer parts of both wings, which were preserved from the burning to some extent, were mechanically significantly damaged and deformed.

Although damage and deformations were visible on it, the tail of the aircraft with its vertical and horizontal stabilizer was the least damaged. The damage to the mentioned parts was mostly of a mechanical type, and traces of burning were visible mainly in the form of smoky surfaces.



Picture 5 - The wreckage of the D-EGLF aircraft at the accident site

1.4. OTHER DAMAGE

The accident site is located on a slope overgrown with dense low-growing trees. The vegetation could be described as thicket.

At the crash site, in the immediate vicinity of the wreckage, the vegetation was completely burned. The vegetation that surrounds the accident site in a slightly wider circle, in the upper part of the slope, was heavily burned. This is where the front part of the aircraft was located. On the left and right side of the wreckage, the burning marks on the vegetation were somewhat milder, while on the lower side of the slope, where the tail of the aircraft was located, the burning marks on the vegetation were the least apparent.

Broken branches and stems were also visible on the vegetation around the crash site, from which the direction of the aircraft passage immediately before hitting the ground can be seen.

There was no fuel penetration into the ground, since all the fuel burned on the surface.



1.5. PERSONAL INFORMATION

We provide information about the persons who were on board the aircraft in question:

1.5.1. Pilot

Male person, German citizen born in 1970. He possessed a valid PPL(A) license issued by the aviation authorities of the Federal Republic of Germany since 2015, as well as the required valid medical certificate.

The license does not have an authorization for instrument flying (IR – instrument rating).

Until the moment of the accident, he achieved 278 flight hours in 324 flights and 389 landings on Cessna 172 and Cessna 182 aircrafts.

During his flying career, he made 18 flights lasting more than two hours per flight. The longest flight was the penultimate, that is, the flight he flew from Leverkusen to Split and lasted 3 hours and 54 minutes. About ten flights went outside Germany, i.e. to Austria, Switzerland, Italy and Croatia (the last two flights).

1.5.2. Passenger 1

Male person, German citizen, born in 1971.

1.5.3. Passenger 2

Female person, German citizen, born in 1970.

1.5.4. Passenger 3

Male person, Croatian citizen, born in 1971.

1.6. AIRCRAFT INFORMATION

1.6.1. Cessna FR 182 Skylane RG – basic aircraft information

Manufacturer:	Cessna Aircraft Company (USA)
Type:	FR 182 Skylane RG
Capacity:	1 pilot and 3 passengers
Aircraft mass:	820 kg (1809 lb)
MTOW:	1406 kg (3100 lb)
Engine:	Lycoming O-540-J3C5D
Propeller:	Mc Cauley B2D34C214/90DHB-8
Maximum speed:	181 kt (335 km/h)
Cruise speed:	160 kt (296 km/h)
Minimum speed:	50 kt (93 km/h)
Climbing rate:	1040 fpm (5.28 m/s)
Maximum glide speed:	80 kt
Flight range:	1660 km (900 nm)

Maximum altitude: 5500 m
Take-off length: 480 m
Landing stop length: 400 m
Aircraft dimensions: length – 8.84 m
wingspan – 10,97 m
height – 2,84 m

The Cessna 182 Skylane RG is a high-wing single-engine piston aircraft of metal construction. The fuselage is not pressurized. The landing gear is retractable, tricycle type. The fuselage has one door on each side that is used for the entry and exit of pilots and passengers. This aircraft model has four seats installed.

The purpose of this aircraft is multiple. It can serve private users for the transport of passengers and luggage, it can be used for education, as well as for other sport and recreational purposes. It has been produced since 1956, since then it has undergone numerous modifications and variants. After Cessna 172, Cessna 182 is the second most popular aircraft of this manufacturer.

The aircraft in question was not equipped with de-icing or anti-icing devices. The engine had a built-in device for heating the carburettor.



Picture 6 - Cessna 182 RG Skylane aircraft, registration D-EGLF (photo used with permission of the author)



1.6.2. Information on the subject aircraft registration D-EGLF

Owner: LSC Bayern Leverkusen
Year of manufacturing: 1979
Total flight hours TT: 7975 (recorded during the last aircraft maintenance on 28 April 2022)
Aircraft serial number: FR 18200034
Engine serial number: L2076640E
Propeller serial number: 777184

There is proper documentation for the aircraft in question in accordance with all prescribed requirements.

Upon inspection of the technical documentation, it was determined that on 3 February 2022, the annual inspection of the aircraft was performed at a total of 7925:39 flight hours. No additional technical defects were found during the inspection.

The last maintenance on the aircraft was performed on 28 April 2022 in the city of Leverkusen at a total of 7975:17 flight hours, i.e. a regular 50-hour inspection being performed. As part of the aforementioned maintenance, an inspection of the rubber tubes in the engine compartment, an inspection of the carburettor screws (bulletin SB 366C) and an oil change and inspection for metal particles (bulletin SB 480F) were performed.

There is no record of technical defects in the technical documentation of the 50-hour inspection.

A further review of the technical documentation established that the aircraft was equipped with devices for visual (VFR) and instrument (IFR) flying, and the same equipment was inspected at an authorized service on 9 November 2020.

1.7. METEOROLOGICAL INFORMATION

1.7.1. Description of the meteorological situation

The area where the accident occurred was located at the north-western edge of an anticyclone that extended over southern and south-eastern Europe. At the time of the accident, a cold atmospheric front was moving over continental Croatia. In these circumstances, low cloud cover and precipitation of variable intensity can be expected.

1.7.2. Meteorological conditions at Split Airport

The aircraft in question took off from Split Airport at 10:37 LT, i.e. 08:37 UTC. The meteorological conditions that prevailed at Split Airport at that time are described by the METAR report which reads:

METAR/SPECI from LDSP, Split / Resnik (Croatia)

SA 29/05/2022 09:00-> METAR LDSP 290900Z 09005KT 060V130 CAVOK 24/10 Q1005 NOSIG=

SA 29/05/2022 08:30-> METAR LDSP 290830Z 12007KT CAVOK 23/10 Q1004 NOSIG=

SA 29/05/2022 08:00-> METAR LDSP 290800Z 12004KT 100V200 CAVOK 24/11 Q1004 NOSIG=



From the METAR report can be seen that at the time of take-off of the aircraft in question, a light wind from approximately south-easterly direction was blowing in the Split Airport area, visibility was satisfactory for the needs of visual flying, without low clouds or the presence of TCU or CB type clouds (storm clouds) and without precipitation. The air temperature was 23°C, and the dew point temperature was 10°C. The pressure was 1004 hPa and no significant changes were expected in the near future.

1.7.3. Meteorological conditions on the flight route

Data on meteorological conditions along the flight path of the aircraft in question were obtained by analysing measured data from meteorological stations and reanalysis using the WRF numerical model.

During the initial part of the flight path, the weather was partly cloudy, but the meteorological situation changed considerably when crossing to the continental Lika area. Clouds increased along the flight path. Somewhere in the Gračac area, the amount of cloud cover was 8/8 of the stratus type, which changed to precipitation nimbostratus further north.

There is a weather station in the Plitvice Lakes area, near the accident site. Data obtained from the aforementioned meteorological station indicate that at the time of the accident, the Plitvice Lakes were cloudy with rain. The wind at the ground was weak, from the north, while the air temperature was 8°C.

By reanalysing the meteorological situation using a numerical model, wind data was obtained for the area around the accident site. At an altitude of 1500 m, the wind was laminar and weak (less than 5 m/s) to moderate (5 to 10 m/s). At an altitude of 2000 m, the wind was laminar, of moderate strength (5 to 10 m/s). The wind direction was from the northeast quadrant.

The air temperature along the entire flight path was above 0°C. In the area of the accident, at an altitude of 1500 m, the air temperature was 3°C, and at 2,000 m it was 5°C. The dew point temperature was 3°C at both heights. The zero isotherm was at a minimum of 3000 m.

In the area of Gračac, above the clouds of the lower layers, in the middle layers of the atmosphere, there were clouds of the altostratus and altocumulus type with a base height of about 3000 m. Between those two cloud layers, there was probably a cloudless layer in the Gračac area that gradually closed towards the north.

It is evident from the meteorological data that there was a possibility of the carburettor icing on the part of the flight path between Gračac and the accident site.

1.8. COMMUNICATION

The D-EGLF aircraft maintained radio communication with flight control. At the request of the Agency, the air traffic control provided a transcript of the audio recording of the conversation between the aircraft in question and the control for the purposes of the safety investigation.

After taking off from Split Airport at 10:37 LT, the aircraft continued its flight according to the reported flight plan in the northwest direction. Here are the important moments of the aforementioned communication between the aircraft in question and control:



At 10:51 LT, the pilot requested a change of flight direction in relation to the route reported in the flight plan, i.e. steering from the current position to 350°. He receives permission to proceed directly to Tounj from his current position. Tounj is also one of the points indicated by the pilot in the flight plan.

The pilot was not familiar with the position of Tounj and asked the control for help in finding this point. The controller gave him information about the location of the mentioned point in relation to the current position of the aircraft, and at 10:53:30 LT the pilot directed the aircraft towards Tounj.

At 10:55 LT, the pilot reports that there are large clouds in front of him and asked for permission to bypass them from the side, which the controller approved.

At 10:59 LT the pilot requested to climb and the control approves him to climb to 5000 ft.

At 11:04 LT the pilot requested to climb to 5500 ft, at 11:09 LT to 6000 ft, and at 11:14 LT to 6500 ft. Control approved all mentioned requests.

At 11:21 LT, the pilot, with control approval, directs the aircraft towards Karlovac.

At 11:23 LT, the control informs the pilot that, due to Zagreb RDR's request, he should continue the flight towards the OBUTI point, which is the exit point from Croatia on the Croatian-Slovenian border. It was not a big deviation from the current flight direction, almost on the same line. The pilot declares that he does not know where OBUTI is and asks for help in finding the point, to which the controller gives him information about the position of the point in relation to the current position of the aircraft. The pilot does not respond to this information.

At 11:24:53 LT the pilot announces an emergency. When asked by the controller what the problem was, the pilot answers unintelligibly.

At 11:25:46 LT the controller repeats the question about the nature of the problem, to which the pilot replies that he is losing altitude.

At 11:26:36 LT the radar records the last record. After that, the aircraft disappears from the radar.

1.9. FLIGHT DATA RECORDERS

The aircraft was not equipped with the Flight Data Recorder (FDR) or the Cockpit Voice Recorder (CVR).

1.10. AIRPORT INFORMATION

Split Airport (LDSP) is the second busiest airport in Croatia. It is located in the Resnik area on the western side of the Kaštela Bay, 25 km from Split, at an altitude of 24 m. This is an international airport where most of the traffic occurs in the summer months during the tourist season.

At Split Airport, there is permanent air traffic control, a fire department, customs and police services, and all other services necessary for an international airport.

The runway of this airport is 2550 m long and 45 m wide. It has an asphalt surface and stretches in the direction of 50°/ 230°.



At the time of take-off and flight of the aircraft in question, traffic at Split Airport was light.

1.11. OPERATOR INFORMATION

The operator of the aircraft in question is the aviation club Luftsportclub Bayer Leverkusen. It is an active club with a large membership in which several branches of aviation operate - motor flying, gliding, ultralight aviation, paragliding, model aircraft and ballooning.

Along with the gliding department, the motor flying department is the largest department of this club with almost 100 active members who achieve over 1000 flight hours per year. The club owns 5 aircraft, including the aircraft in question which was equipped for IFR flights and was often used by more experienced pilots for longer flights.

The club also conducts training for the PPL license, which is taken care of by about ten club members with the authorization of motor flight instructors.

The club LSC Bayer Leverkusen operates at Leverkusen Airport (EDKL). It is a small airport in the German province of North Rhine-Westphalia, near the city of Cologne. The airport is located at an altitude of 48 m above sea level and has a 925 m long grass runway in the direction of 15/33.

1.12. INFORMATION ON WRECKAGE AND ACCIDENT SITE

1.12.1. Examination of the wreckage of the aircraft

The remains of the aircraft were examined at the accident site on 31 May 2022 by AIA investigators and a Cessna 182 aircraft type licensed aircraft mechanic.

The aircraft sustained significant damage because of hitting the ground and burning, and the following was determined:

The fuselage and wings

The aircraft fuselage was completely burned from the firewall to the tail. The left door was thrown ten meters to the left of the fuselage and was partially burnt. The vertical stabilizer was partially burnt and with minor mechanical damages. Due to high temperature and mechanical forces, the wing structure was significantly damaged around the area of the fuel tanks. The leading edges of both wings were significantly deformed due to mechanical forces and high temperature.

Engine

The engine and associated components suffered significant damage in the form of mechanical breaks, bending, burns and complete burning to the point of melting. The engine mount was cracked at several joints, deformed and burnt. The fuel carburettor was found broken into several pieces and partially melted. The housing of the carburettor heating device was almost completely destroyed.

Both magnets were found almost completely destroyed. Several spark plugs were torn from their sockets.

The vacuum pump was found attached to the engine, with traces of mechanical damage and burns, while the rubber tubes of the vacuum system were completely burned.



Propeller

The aircraft was equipped with a two-bladed variable pitch propeller. It was found in a position with one blade pointing vertically upwards and the other tucked under the fuselage.

Minor deformation and minor mechanical damage on the tip of the blade could be observed on the first blade of the propeller. The effect of high temperature was visible in the form of minor traces of melting near the tip of the blade and burnt paint.

On the other blade of the propeller, tucked under the front part of the fuselage, a large deformation caused by mechanical force was visible, while there was almost no thermal damage. During the burning of the aircraft, that blade was pressed into the ground and below the burning point.

The types of propeller damage indicate that at moment of impact, the propeller was rotating in the position of the maximum number of revolutions at low or medium engine power.

Commands and control surfaces

The soft and rigid controls of the control surfaces inside the cabin were burnt and melted. The controls inside the wings were partially melted and burned and torn off in some places.

Instrument panel

It burned completely. The supports of the instrument panel cracked, and it was pressed against the engine. Some navigation devices were found in the instrument panel area, while some were found scattered throughout the accident site. All instruments were significantly damaged due to mechanical force and high temperature.

ELT

The remains of the ELT device were not found. The fuselage at the installation place of the ELT device was completely melted by the fire.

Landing gear

All parts of the retractable landing gear were significantly damaged due to mechanical force and high temperature. The position of the remains of the landing gear components indicates that the landing gear was retracted at the time of impact.

1.12.2. Traces at the accident site

Description of the terrain

The aircraft accident site was located on a slope with an inclination of about 30°. The terrain was overgrown with very dense evergreen vegetation up to ten meters high (thicket). The soil was of an earthy type with rare stones and smaller rocks. At the very place of impact there was earth, without harder segments. Due to the heavy rain that had been falling for the previous few hours, the ground was soaked and additionally softened.

Position of the wreckage

The wreckage of the aircraft was found with the front part of the aircraft on the upper part of the slope, while the rear part of the aircraft was laid down the slope. The wings were next to the fuselage, but completely separated due to the burning of the central part of the aircraft and the root of the wings where the fuel tanks were located. The left door was thrown ten meters to the left of the fuselage and partially burned. The tail part of the aircraft, which was positioned the lowest in



relation to the rest of the wreckage, was less damaged than the other parts of the aircraft – less deformation and smaller traces of burning on the surfaces.

Damage to vegetation

The narrowest circle around the burnt part of the wreckage was completely bold due to burning. In a slightly wider circle of a few meters, the vegetation was visible, but completely burned, on both sides and above the wreckage. Around the lowest part of the wreckage - the tail part of the aircraft, the traces of burning on the vegetation in the immediate vicinity were minimal.

Broken branches were visible on the surrounding burned trees, indicating the direction of the aircraft's arrival just before it hit the ground. That direction was at an angle of about 80° in relation to the horizontal level.

Tracks in the ground

In the ground under the very front of the aircraft, a depression about 50 cm deep viewed perpendicular to the slope, was formed. On the ground surface immediately next to the aforementioned depression, a cut was clearly visible that was created by the impact of the propeller blade.

Furthermore, the very top of the aircraft was pressed into the aforementioned depression – the propeller cone, one propeller blade that was bent under the fuselage and a small part of the most prominent front part of the aircraft.

1.13. MEDICAL AND PATHOLOGICAL INFORMATION

All four persons from the aircraft in question died at the accident site. Their bodies were transferred to the Department of Forensic Medicine and Criminalistics of the Faculty of Medicine in Zagreb, where an autopsy was performed to determine the cause of death, toxicology analysis and DNA analysis to determine identity.

Through the aforementioned procedures, multiple physical injuries were determined as the cause of death for all four victims.

Three bodies were also fully carbonized, while one was partially carbonized.

Neither alcohol nor drugs were found in any of the bodies.

1.14. SEARCH AND RESCUE

The last communication of the control with the aircraft in question was at 09:25:53 UTC, and at 09:26:36 UTC the aircraft disappeared from radar. After that, the control tried unsuccessfully on several occasions to establish contact with the aircraft in question.

At 9:38 UTC, the Operational center of Civil Protection was notified by the Croatia Control about the situation, after which communication was initiated with the search and rescue services. Croatia Control had also started the process of collecting the operational records that could contribute to the faster finding of the aircraft.

The services that would conduct the search went to the field, and for this purpose, a base with a command post was established in the town of Broćanac.



The information that the search services received from eyewitnesses was very limited. Due to the rain and extremely reduced visibility, no one saw the aircraft, smoke or anything that could be of use in the search. Several local residents reported that at some point they heard the sound of an engine, even some sort of explosion. With the help of this information, it was not possible to precisely locate the aircraft.

The Croatian Mountain Rescue Service (hereinafter HGSS) soon began a search that lasted until the end of the day and continued throughout the night. The meteorological conditions were demanding and aggravating. It was raining, and the local mountains were covered by low clouds that reduced visibility to only a few tens of meters. In such conditions, it was impossible for a helicopter to participate in the search, and a drone search would also be pointless and ineffective. The only way to search in such conditions was to 'comb' the terrain on foot.

During the first day of the search and during the night, a large part of the terrain was inspected, but no aircraft was found on it. The following day, the search continued in the still unexamined sectors. Meteorological conditions improved to some extent, and the HGSS drone was involved in the search.

At 10:50 LT on that day (30 May 2022), HGSS spotted and located the wreckage of the aircraft in question using the drone. Immediately after that, the police and HGSS rescuers came to the accident site. It was established that the aircraft was destroyed and that there were no survivors.

The police secured the accident site and on the same day at 13:15 LT, a field investigation was commenced by the police, the state attorney's office and AIA investigators. The investigation continued and ended the next day.

1.15. ADDITIONAL INFORMATION

1.15.1. Audio recording of the communication

By listening to the audio recording of the communication between the aircraft and the flight controller, in the last communication before the disappearance of the aircraft, it is evident that the pilot was under great pressure. After announcing the Mayday, upon asking the controller to define the problem, the pilot declared that he was losing altitude. At the end of this transmission, the phrase 'I have no idea' can be heard uttered in German, which was most likely an answer to the passenger's question.

1.15.2. Statements of Split Airport employees

For the purposes of this safety investigation, employees of Airport Split provided the following information:

After the arrival and landing of the aircraft in question at Split Airport, a few days before the accident, employees of Split Airport carried out all the necessary procedures related to the reception of the aircraft and its crew and passengers. They stated that they did not notice any problems on that occasion.

On the day of take-off, at the request of the pilot of the aircraft in question, the INA Avioservis tanker was called in for refuelling and 210 l of Avgas 100 LL fuel was tanked into the aircraft.

The employees of Split Airport then performed the necessary actions related to the dispatch of the aircraft, while the pilot inspected the aircraft.



Furthermore, the employees of Split Airport stated that during the dispatch of the aircraft, no problems related to the aircraft and the passengers were observed and that the passengers were in a good mood and were looking forward to the flight.

1.15.3. Flight preparation

According to the statement of the deceased pilot's wife, he used to use the SkyDemon application for flight preparation, including familiarizing himself with the weather situation. It is not known whether and to what extent the pilot got acquainted with the weather situation before the flight in question through the aforementioned application.

2. ANALYSIS

2.1.1. Flight preparation

According to the statements of Split Airport employees, the pilot inspected the aircraft before take-off and fuel was tanked into the aircraft.

From the records of the communication with the control, it can be seen that during the flight the pilot repeatedly asked for clarifications regarding the positions of certain points on the route towards which the aircraft should have been directed, both on the changed route that he requested during the flight and on the route that he reported in the flight plan (points TOUNJ and OBUTI were common to both routes). It is evident from these facts that the pilot was not well acquainted with the planned flight route.

It is not known whether and to what extent the pilot familiarized himself with the meteorological situation on the route before taking off, however, by all accounts, it can be assumed that he had no realistic idea of the conditions that awaited him along the route.

2.1.2. Change of route

During the flight, shortly after take-off, the pilot requested and received permission to change the route in relation to the reported route, apparently with the intention of shortening it to some extent and flying more directly towards the destination.

The route reported by the flight plan would lead along the coast to the northwest to the area of the northern Adriatic, and then turn to the northeast and cross into continental Croatia. The pilot shortened this route and moved to the continental area much earlier.

The meteorological conditions along the coast were far more favourable than the conditions in continental Croatia. If the aircraft had stayed on the original route reported by the flight plan, it would have flown longer in more favourable meteorological conditions, although later it would have again found itself in unfavourable conditions on the territory of continental Croatia, and also in the zone where the accident occurred.

It is difficult to say how staying on the original route would have affected the development of events and whether the accident thereby would have been avoided, however the change of route that the pilot requested was certainly not a better solution than the original route reported in the flight plan, quite the opposite. The pilot most likely did not request the change of route because of the



conditions he would have expected on the route, but rather to shorten the route to some extent. With this change in route, the aircraft sooner got to and thus stayed longer in unfavourable meteorological conditions.

From the above, it can be concluded that the pilot was not sufficiently aware of the meteorological situation that awaited him on the route.

At the end of this analysis of the flight path, it is important to note that the route reported in the flight plan could not be considered as a 'good solution', because the meteorological situation in the continental Croatia area was generally unfavourable for flying small aircraft.

2.1.3. Take-off and development of the first part of the flight

The part of the flight that took place normally, under the full control of the pilot and in which, analysing the trajectory and parameters of the flight, no unusual and undesirable elements can be observed, will be considered as the first part of flight.

The take-off from Split Airport went normally, under favourable weather conditions, just like the Flight in Dalmatia. By crossing the mountain range and entering the continental part of Croatia, in the area of Lika, the meteorological situation changed. The aircraft encountered cloud cover and the pilot requested the controller for permission to change direction to avoid the 'large clouds in front of him', then he also requested for a change in altitude and began a gradual climb. It can be assumed that the aircraft was climbing so as not to enter the clouds. Considering that it was a layered cloud, it is possible that the pilot was 'slinging' the aircraft between two cloud layers.

The whole time the aircraft climbed uniformly, until the moment when it started to lose altitude.

2.1.4. The second part of the flight - loss of altitude

The part of the flight in which, by analysing the flight path, elements that are not expected in a normal, usual flight can be observed, will be considered as the second part of the flight. This part of the flight began at moment when the aircraft stopped its gradual climb, entered a right turn and began to lose altitude.

By analysing the radar record, the following can be established:

The loss of altitude of the aircraft in question began immediately after the phase of gradual climb and lasted approximately 3 minutes, until it hit the ground.

The aircraft first made one slight right turn of 270° in a circle of approximately regular shape, and then continued to fall on a highly irregular path with sudden changes in direction, generally with a tendency to turn to the right. The speed (ground speed) oscillated a lot and dropped below the minimum speed, at one point even as low as 6.5 kt, then it rises to 80 kt and after a while it started to drop again. Based on the shape of the path and the described changes in speed and height, it can be concluded that the pilot lost control of the aircraft and that he was no longer able to return the aircraft to a stable flight state.

From the records of the communication between the pilot and the controller, it is evident that the pilot was under a lot of pressure, that he was aware that the aircraft was losing altitude, but that he was not entirely clear about what exactly was happening.

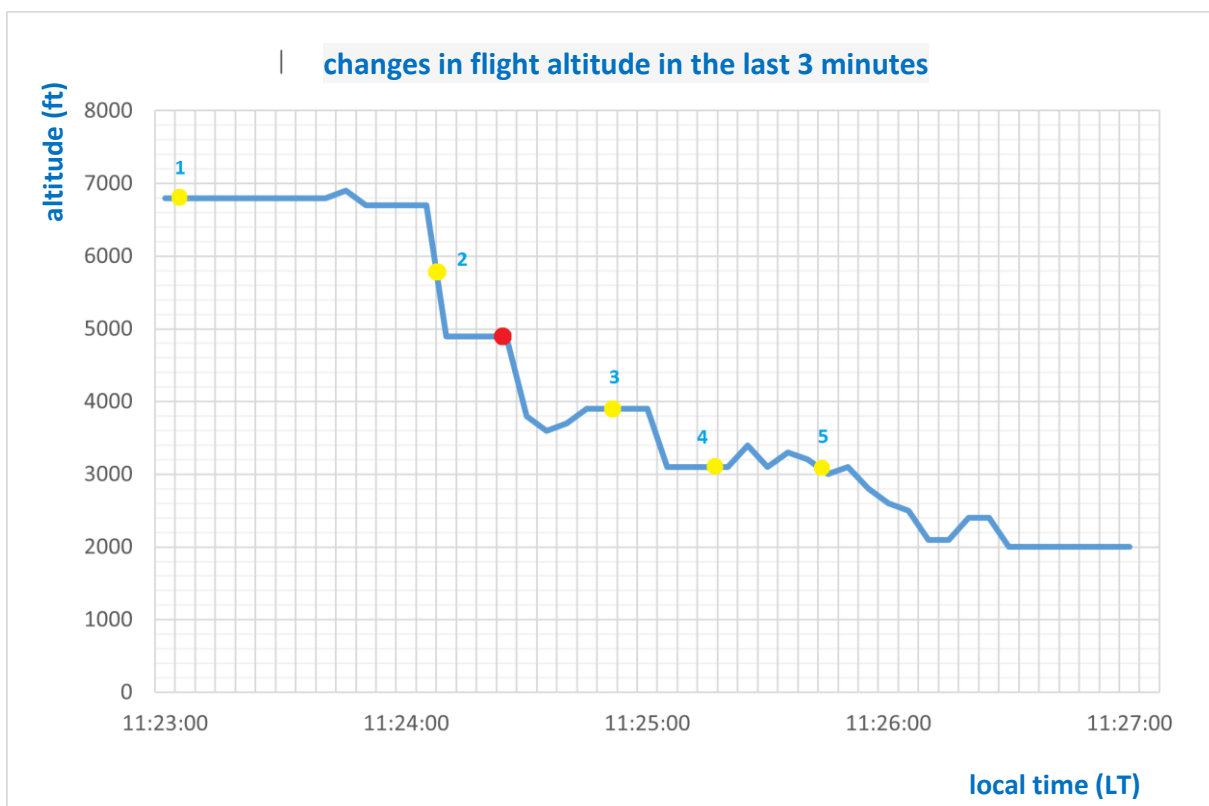
The following diagram show changes in flight altitude in the last 3 minutes of flight, and the moments of communication between the pilot and the controller are marked with yellow dots. The red dot



marks the moment when the flight path changed from a regular circle to irregular shapes, i.e. when the flight obviously became completely uncontrolled.

The yellow dots on the diagrams indicate the following communication:

- 1 last communication for the duration of the controlled flight, in which the pilot asked for clarification in finding the OBUTI point;
- 2 the controller gave the pilot clarifications about the position of the OBUTI point, to which the pilot did not respond;
- 3 pilot announced MAY DAY;
- 4 The controller asked for the identification of the aircraft, to which the pilot gave the requested information and repeated MAY DAY;
- 5 When asked by the controller to explain the problem, the pilot replied that he was losing altitude and said 'I have no idea' in German, probably to one of the passengers. That was the last communication between the aircraft and control.





During this investigation, no indicators were observed that would clearly point to problems with the aircraft propulsion system. Although there were meteorological conditions for carburettor icing (which can be avoided by turning on the carburettor heat in time), there is nothing to indicate to this from the pilot's communication with the control. Also, carburettor icing, as well as problems with the propulsion, should not cause the aircraft to enter an uncontrolled flight condition.

We exclude the aircraft icing as possible cause of the accident, because the meteorological conditions for that did not exist.

All the knowledge obtained in this investigation, points to the loss of control over the aircraft as the reason for the loss of altitude and the fall.

The pilot did not have an authorization, i.e. he was not trained for instrument flying (IR – instrument rating). In addition to the fact that, according to current regulations, a pilot without an IR authorization may not enter IFR conditions, entering flight conditions without visual contact with the environment can be very demanding for a pilot who is not trained for this. The loss of orientation, as well as the loss of the idea of the position and inclinations of the aircraft in all three axes, is then very possible.

2.1.5. Traces at the accident site – hitting the ground

Based on the traces at the accident site, it can be concluded that just before hitting the ground, the aircraft pitched nose down at an angle of about 80° in relation to the horizontal level.

Based on the depth of the depression where the plane's nose 'hit' the ground (about 50 cm in relatively soft ground), it can be concluded that the force of that impact, although sufficient to cause fatal injuries to the persons on board the aircraft, was not high. In other words, the aircraft did not crash into the ground at high speed.

All described leads to an assumption that the aircraft was stalled at a low altitude above the crash site. The normal behaviour of an aircraft after stalling is to nose down and begin a dive during which it increases speed until it reaches the speed required for normal flight. In this process, the aircraft will lose some altitude and recover from stalling, provided it is sufficiently high above the ground. If the altitude is not sufficient, the aircraft will, in sinking phase after stalling, hit the ground. Everything found and observed during this investigation leads to the assumption that this is what happened here. In support of this is the fact apparent from the radar record, that the speed of the aircraft in question during the phase of losing altitude in an uncontrolled flight, fell below the minimum speed required for the flight of this aircraft.

2.1.6. Traces at the accident site - fire and explosion

The left door and the pilot's body were thrown into the surrounding bush, about ten meters from the wreckage of the aircraft. This fact points to an explosion. The body of the thrown pilot, as well as the thrown left door, were partially burned, while the other bodies that remained alongside the wreckage, as well as the central part of the aircraft, were completely burned.

From the above, it can be concluded that the aircraft caught fire after hitting the ground and that the explosion occurred shortly after the ignition. The body of the pilot, the door and other smaller parts of the aircraft, which were found a little further away from the wreckage of the aircraft, were thrown away by the explosion from the burning place and were only partially burned.



2.1.7. Change of route

During the flight, shortly after take-off, the pilot requested and received approval to change the route from the reported route, apparently with the intention of shortening the route to some extent and flying more directly towards the destination.

The route reported by the flight plan would lead along the coast to the northwest to the area of the northern Adriatic, and then turn to the northeast and cross into continental Croatia. The pilot shortened this route and moved to the continental area much earlier.

The meteorological conditions along the coast were far more favourable than the conditions in continental Croatia. If the aircraft had stayed on the original route reported by the flight plan, it would have flown longer in more favourable meteorological conditions, although later it would have again found itself in unfavourable conditions on the territory of continental Croatia, also in the area where the accident occurred.

It is difficult to say how staying on the original route would have affected the development of events and whether the accident thereby would have been avoided, however the change of route that the pilot requested was certainly not a better solution than the original route reported in the flight plan, quite the opposite. The pilot most likely did not request the change of route because of the conditions he would have expected on the route, but rather to shorten the route to some extent. With this change in route, the aircraft sooner got to and thus stayed longer in unfavourable meteorological conditions.

From the above, it can be concluded that the pilot was not sufficiently aware of the situation that awaited him on the route.

At the end of this analysis of the flight path, it is important to note that the route reported in the flight plan could not be considered as a 'good solution', because the meteorological situation in the continental Croatia area, where the aircraft would sooner or later find itself, was generally unfavourable for flying small aircraft.

3. CONCLUSION

3.1. FINDINGS

Aircraft

- No elements were found that would indicate the malfunction of the aircraft, and it can be concluded that the aircraft was in good condition;
- The aircraft in question was equipped for instrument flight.

Pilot

- He possessed a valid PPL license;
- He did not have an authorization for IFR flying written in his license;
- The pilot had some flying experience. During his flying career, he made 18 flights lasting over two hours per flight and about ten flights outside the borders of Germany;
- The penultimate flight he took from Leverkusen to Split was the longest flight in his flying career, as it should have been the flight in question that ended in an accident.



Meteorological conditions

- Unfavourable, they were a factor in this accident;
- At the take-off area (Split Airport) the weather conditions were favourable, however, when moving to the continental part, the conditions worsened significantly - cloud cover and rain;
- In the wider area of the accident, there were nimbostratus type rain clouds that completely covered the sky. The tops of the surrounding hills were in the clouds;

Flight preparation

- By the flight plan the pilot reported a VFR flight;
- The pilot did not familiarize himself well with the meteorological conditions that expected him along the route;
- The pilot was probably not fully aware of the upcoming changes in meteorological conditions that expected him along the route and that he would inevitably find himself in IFR flight conditions, for which the aircraft in question was equipped, however, the pilot was not trained nor authorized for.

Flight

- The aircraft took off from Split Airport, in favourable weather conditions;
- Shortly after take-off, the pilot changed the route in relation to the one reported in the flight plan;
- As the aircraft progressed along the route, the amount of cloud cover increased;
- The pilot, by changing altitude and partially changing direction, was probably trying to avoid clouds and stay in VFR conditions;
- At some point, the aircraft entered the clouds, which was inevitable on that route, and entered IFR flight conditions;
- In the 47th minute of the flight (about 3 minutes before the crash), the aircraft started to lose altitude and the pilot soon lost control of the aircraft;
- From that moment on, the flight was uncontrolled. During this period, the speed fluctuated a lot and fell below the minimum speed, and the pilot failed to stabilize the flight.

Crash of the aircraft

- The aircraft hit almost vertically into a slope covered with dense thickets;
- After the crash, the aircraft caught fire and there was an explosion. The central part of the aircraft was completely burnt;
- All four persons on board the aircraft died at the accident site as a result of injuries sustained at the time of the crash;
- The aircraft was completely destroyed due to mechanical damage caused by the impact and due to fire and explosion.

Search and rescue

- The search was organized immediately upon notification of the disappearance of the aircraft;



- The meteorological conditions in which the search took place made it impossible to search the terrain from the air (helicopters and unmanned aerial vehicles), so the search had to be carried out by classic pedestrian 'combing the terrain';
- The search began on the day of the aircraft's disappearance, continued at night and continued the next day, when the aircraft was found;
- The duration of the search did not affect the eventual rescue, considering that all the persons who were on board the aircraft died at the time of the crash.

3.2. CAUSE

Immediate causes:

- Loss of control over the aircraft

Contributing factors

- Insufficient flight preparation;
- Meteorological conditions, unsuitable for VFR flying;
- Insufficient pilot's situational awareness;

4. SAFETY RECOMMENDATIONS

The factors that led to this accident are well known in aviation practice and are also covered by existing aviation legislation. By consistently following the known and prescribed rules, this accident would most likely be avoided.

Therefore, the Air, Maritime and Railway Traffic Accident Investigation Agency does not have a safety recommendation in this case.

Investigator in Charge

Danko Petrin