State Commission on Aircraft Accidents Investigation

FINAL REPORT

2024-0073

OCCURRENCE NUMBER

ACCIDENT

LOC-I: Loss of control – on the ground.

The sole objective of the investigation and the final report is the prevention of future aviation accidents and incidents.

The Commission does not apportion blame or liability. The investigation is independent and separate from any judicial and administrative proceedings.

Any use of the report for any purpose other than the prevention of aviation accidents and incidents may lead to wrong conclusions and interpretations.

EKO-TYNK Sp. z o.o.

AIRBUS helicopter, type EC 120 B, SP-PBW.
Jastrząb, Mazovian voivodeship, szydłowiecki poviat
27 August 2024

The Final Report has been issued by the State Commission on Aircraft Accidents Investigation on the basis of information known at the time of its publication.

This Report presents the circumstances of the aviation occurrence concerned, as well as its causes, contributing factors and safety recommendations.

The report was drawn up in Polish.

27 May 2026

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Table of Contents

INTRODUCTION 4
SYMBOLS AND ABBREVIATIONS 6
1. FACTUAL INFORMATION 9
1.1. Flight History 9
1.2. Injuries to Persons 14
1.3. Damage to the Aircraft 14
1.4. Other damage 16
1.5. Personnel information 16
1.6. Aircraft information 17
1.7. Meteorological information 20
1.8. Navigation aids 22
1.9. Connectivity 22
1.10. Aerodrome information 22
1.11. Flight data recorders 22
1.12. Information on the wreckage and the occurrence 24
1.13. Medical and pathological information 24
1.14. Fire 24
1.15. Survival factors 25
1.16. Tests and studies 25
1.17. Information on organisations and management 30
1.18. Supplementary information 30
1.19. Useful or effective investigation methods 30
2. ANALYSIS 30
2.1. Air operations 30
2.2. Aircraft 32
2.3. Survival 32
3. CONCLUSIONS 33
3.1. Findings 33
3.2. Causes and contributing factors 33
4. SAFETY RECOMMENDATIONS 33

INTRODUCTION

LEGAL BASES

The State Commission on Aircraft Accidents Investigation is the safety investigation authority referred to in Article 4(1) of Regulation (EU) No. 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC (Official Journal of the European Union L 295, p. 35, as amended).

The Commission conducts investigations based on the provisions of the Act of 3 July 2002 – Aviation Law (Journal of Laws 2002 No. 130, item 1112, as amended) and European Union law in the field of civil aviation accidents and incidents and taking into account the standards and recommended practices contained in Annex 13 to the Convention on International Civil Aviation, drawn up in Chicago on 7 December 1944 (Journal of Laws of 1959, item 212, as amended).

BASIC INFORMATION ABOUT THE OCCURRENCE

Operator (user), flight number or type – EKO-TYNK Sp. z o.o., private flight.

Manufacturer: Airbus Helicopters France, type EC 120 B, aircraft registration marks: SP-PBW.
Place and date of occurrence – Jastrząb, Mazovian voivodeship, szydłowiecki poviat, 27 August 2024

OCCURRENCE REPORT

PKBWL was notified of the occurrence under the mandatory occurrence reporting system on 27 August 2024.

The occurrence was assigned the registration number – 2024-0073.

Based on initial information, the occurrence was classified as an accident.

In the course of the investigation, the qualification of the occurrence was not changed.

NOTIFICATION OF THE OCCURRENCE

PKBWL notified the following bodies of the occurrence:

- the state of aircraft design and manufacturer – France (BEA);
- ICAO;

- EASA;
- European Commission;

ORGANISATION OF THE INVESTIGATION

The investigation was conducted by PKBWL (State Commission on Aircraft Accidents Investigation).

Investigator-in-Charge (IIC) – Mieczysław Wyszogrodzki.

Commission Member – Dominik Głowacki

Commission Member – Paweł Ruchała

Commission Member – Paweł Jajkowski

Commission Member – Andrzej Lancholc

Accredited representatives (and their advisers) – The country/countries highlighted below has/have appointed their ACCREP: France

RECOMMENDATIONS

No recommendations were formulated.

TIME

The times in the report are given in the LMT. On the day of the occurrence, LMT was UTC + 2.

DATE

If a date is given in digital format in the report, individual digits stand for DD.MM.YYYY, where DD stands for day, MM for month and YYYY for year.

DRAWINGS AND TABLES

Unless otherwise stated in the report – source: PKBWL.

SUMMARY

On 27 August 2024, the pilot planned a flight in a private helicopter, type EC 120 B, registration marks SP-PBW, from Wólka Załęska to the “Autodrom Jastrząb” circuit, located in the town of Jastrząb, near Szydłowiec. The pilot looked at the weather conditions, checked whether areas of the planned flight route were free

from other traffic, and submitted flight plan. Upon arrival at the base where the helicopter was, the pilot went on with a pre-flight inspection. Afterwards, he took his place on the right seat in the helicopter cabin and started the engine. After obtaining the parameters for take-off, the pilot took off and a short while later established communications with the FIS Warsaw service (128.575 Mhz), receiving clearance to fly. In flight, the pilot reported his intention to land in Jastrząb.

The landing site was agreed with the organiser and was located within the premises of the “Autodrom.” After the presentation of the helicopter, which lasted about 15 minutes, the interested parties moved away to a safe distance. The pilot performed the pre-flight inspection, took his seat in the cabin and started the engine.

During engine start-up, the helicopter suddenly rotated left and the gas temperature rose to around 1,100°C. Moments after this, the pilot felt substantial vibrations, and a few seconds later, the helicopter rolled over onto its right side.

The pilot suffered minor bodily injuries and the helicopter was severely damaged.

SYMBOLS AND ABBREVIATIONS

SYMBOLS

°	Degree e.g. °C (temperature) and 1° (angle)
%	Percentage
'	Minute
”	Second

ABBREVIATIONS

C

C	Degrees Celsius °C (temperature) and 1° (angle)
CG	Centre of gravity
CofA	Certificate of Airworthiness

E

E	East / Eastern longitude
EGT	Exhaust Gas Temperature)

F

FCU	Fuel Control Unit

H

h	Hour(s)
hPa	Hectopascal

I

IIC	Investigator-in-Charge

K

kg	Kilogram(s)

L

L	Litre(s)
LCA	local

M

m	Metre(s)
MET	Meteorological / meteorology / meteorological services, respectively.
MHz	Megahertz
min	Minute(s)
MTOM	Maximum Take-Off Mass.

N

N	North / Northern latitude / Newton, respectively.
NSC	No significant clouds

P

PPL(H)	Private Pilot License (Helicopter)

Q

QNH	Query: Nautical Height Signifies the atmospheric pressure adjusted to mean level. This calibration is used by pilots to set aircraft's altimeter)

R

RPM	Revolutions per minute

S

s	Second(s)
S	South / Southern latitude, respectively
SKC	Sky clear
S/N	Serial number

V

VEMD	Vehicle and engine multifunction display
VFR	Visual Flight Rules
VMC	Visual meteorological conditions
VRB	Variable wind

W

W	West / Western longitude

1. FACTUAL INFORMATION

1.1. Flight History

On 27 August 2024, the pilot planned a flight in a private helicopter, type EC 120 B, registration marks SP-PBW, from Wólka Załęska to the “Autodrom Jastrząb” circuit, located in the town of Jastrząb, near Szydłowiec. A charity race car show was taking place at the destination.

Fig. 1. EC 120 B helicopter, SP-PBW, involved in the occurrence [source: www.lotnictwo.net.pl].

The pilot looked at the weather conditions, checked whether areas of the planned flight route were free from other traffic, and submitted flight plan. Upon arrival at the base where the helicopter was, the pilot went on with a pre-flight inspection. Afterwards (as there were no reservations regarding the inspection), he took his place on the right seat in the helicopter cabin and started the engine. Having started the engine and obtained the parameters for take-off, the pilot took off on the planned route at 13:51. After gaining altitude, he established communications with the FIS Warsaw service (128.575 Mhz), receiving clearance to fly the planned route. In flight, the pilot reported his intention to land in Jastrząb.

During the start-up and take-off, as well as en route, the parameters of the power unit were normal and the flight proceeded without reservations. The landing site was within the premises of the car track, near its boundary with the S7 expressway – . The area in which the helicopter was to stop over was accessible to the public.

The landing took place at 15:21 (as shown by the clock on the CCTV video). After the engine was switched off, the main rotor, unbraked, kept on spinning until it stopped on its own. Several bystanders were in the vicinity of the helicopter at the time.

The helicopter was within the “Autodrom” premises for around 30 minutes. Before departure, the pilot would make the helicopter available to members of the public and allow them to take a seat in the cabin. The presentation of the helicopter ended about two minutes before its start-up. According to the pilot’s statement, the pilot performed the pre-flight inspection, took his seat in the cabin and started the engine. At 15:51:25, the main rotor started spinning, and 15 seconds later, i.e., at 15:51:40, the helicopter toppled onto its side.

The pilot stated that he had set the power grip to idle after which he engaged the starter. During the start-up, the gas temperature rose to about 800°C which prompted the pilot to “abort” the start-up and cool the engine down. To do this, the pilot reduced the engine power by turning the power grip slightly; without reaching the “OFF” position, he reengaged the starter. At this point, the engine temperature began to rise rapidly, reaching 1,100°C. It was not possible to determine whether the collective pitch lever was locked with a ratchet at that time.

A sequence of images captured by a CCTV camera at “Autodrom Jastrząb” (Fig. 2) shows the rapidly accelerating rotation of the main rotor, followed by the sudden and uncontrolled left turn of the helicopter’s by about 90°. The rotation started in the eleventh second after the main rotor was started. Shortly after that, the front of the fuselage rose; the helicopter lifted off, and subsequently tilted and toppled onto its right side. The engine continued to run for some time after the helicopter toppled over; the pilot was unable to determine when the engine stopped running.

1) Initial position, main rotor blades rotating

2) Skids starting to rotate to the left (11s after rotor was started)

3) Continued rotation to the left

4) Continued left turn, simultaneous fuselage lift

5) Continued rotation, the helicopter tilting and the left skid leaving the ground

6) Continued rotation, both skids having left the ground, Fenestron touching with the ground

7) The helicopter toppling onto its right side, helicopter components destroyed

8) Main rotor blades colliding with the ground, blade debris (on both sides of the S7 expressway).

Fig. 2. Sequence of events based on CCTV footage. A timer is visible in the top left corner of each image [source: “Autodrom Jastrząb”]

The pilot stated that he had tried (unsuccessfully) to shut down the engine by setting the power grip to “OFF.” The fuel shut-off valve remained in the open position.

The main rotor blades, engine, fuselage covering and tail boom were destroyed. Parts of the helicopter’s structure became scattered, with an impact mark, presumably of a fragment of the main rotor blade, observed on the other side of the S7 expressway.

The pilot switched off the generator and battery, then exited the helicopter on his own through the left cabin door. After about two minutes, an ambulance arrived at the scene, followed moments later by the Fire Brigade.

Ambulance staff provided medical assistance to the pilot. The pilot suffered minor bodily injuries as a result of the accident.

The Fire Brigade applied a stream of water, preventing a fire from starting. The next action was to disconnect the battery and secure the scene.

Fig. 3. Autodrom Jastrząb - helicopter landing site, stopover site and accident site, marked white (geographical coordinates: 51°15’53.16”N, 20°56’07.26”E) [source: www.torjastrzab.pl].

1.2. Injuries to Persons

Table 2. General – summary of the number of injuries

Injuries	Crew	Passengers	Total on board the aircraft	Others
Fatal	-	-	-	-
Serious	-	-	-	-
Minor	1	-	1	-
None	-	-	-	-
TOTAL	1	-	1	-

1.3. Damage to the Aircraft

The incident resulted in:

– thermal damage to the engine (the turbine blade ring melted);

– thermal damage to left and right engine cover;

– damage to the main rotor hub;

– damage to main rotor blades;

– damage to the engine-MGB coupling;

– damage to the place where the tail boom is attached to the fuselage;

– the twisting of the Fenestron[1] driveshaft;

– the destruction of the right-hand cabin door;

– damage to the fuselage cover on the left and right sides of the helicopter;

– thermal damage to the exhaust system;

– thermal damage to the casing of the gas generator turbine;

– damage to the blades of the gas generator turbine.

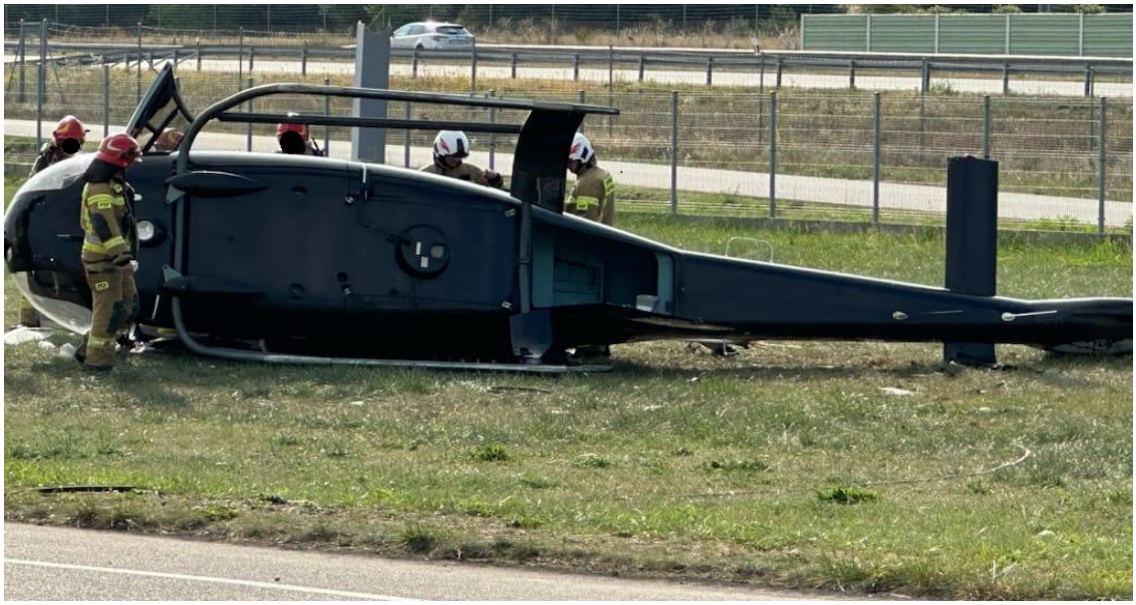

Fig. 4. SP-PBW helicopter after the accident – view from the skid landing gear side

[1] Fenestron – enclosed helicopter tail rotor blades

Fig. 5. SP-PBW helicopter after the accident – view from the main rotor side

1.4. Other damage

None.

1.5. Personnel information

1.1.1. Pilot-in-command

Pilot: male, aged 54.

Licence: PPL(H).

Competences included in the above licence:

R44 helicopters, EC 120 B.

- TR for EC 120 B helicopters valid until 31 January 2025;
- TR for Robinson R44 helicopters valid until 30 April 2025;
- ICAO Level 6 in Polish.

General flight time: approx. 300 h, including approx. 220 h in-command flight time.

Type flight time:

- EC 120 B, approx. 70 h;
- R44, approximately 230 h.

Pre-occurrence flight time on EC 120 B:

- in the last 24 hours: 45 min;
- in the last 7 days: 3 h 2 min.
- in the last 90 days: 35 h 4 min.

Aero-medical certificate – class 2 without restrictions, valid until 22 August 2025

Rest in the last 48 h – the pilot was provided with the rest at home.

Familiarity with the airfield – the accident took place at an off-airfield site where the pilot was landing for the first time.

Position in the cockpit and activities performed – during the occurrence, the pilot was occupying the right-hand seat and was pilot flying the aircraft.

1.6. Aircraft information

a) General description of the aircraft

The EC 120 B is a light, single-engine, five-seat helicopter certified for (day and night) VFR flights with a single-person crew. The pilot takes the right-hand side seat in the cabin.

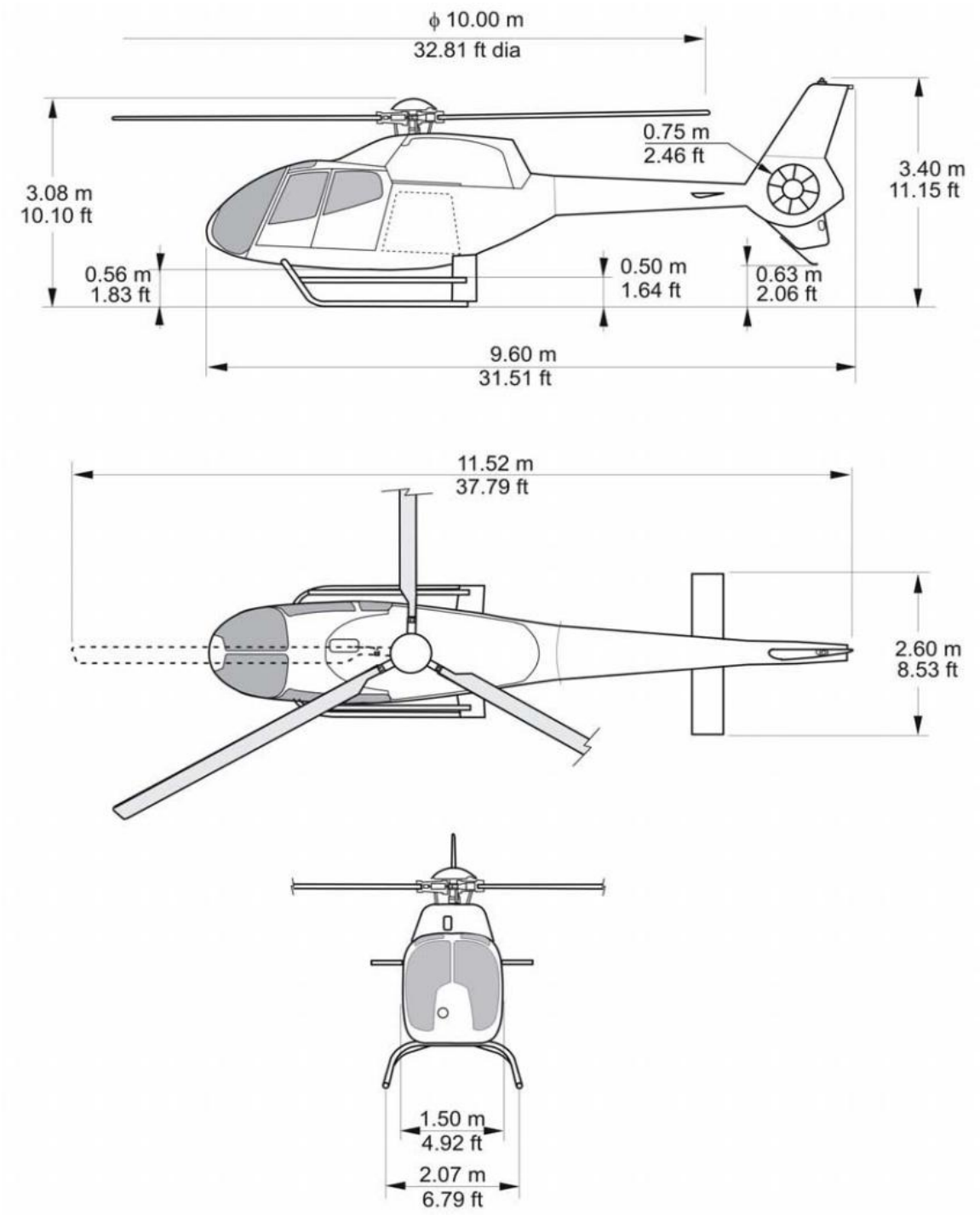

Fig. 6. Main dimensions of the EC 120 B helicopter in three projections [source: Airbus Helicopters]

The helicopter is powered by a single Arrius 2F engine manufactured by Safran HE (formerly Turbomeca). It is a low-speed turbine engine controlled by an FCU.

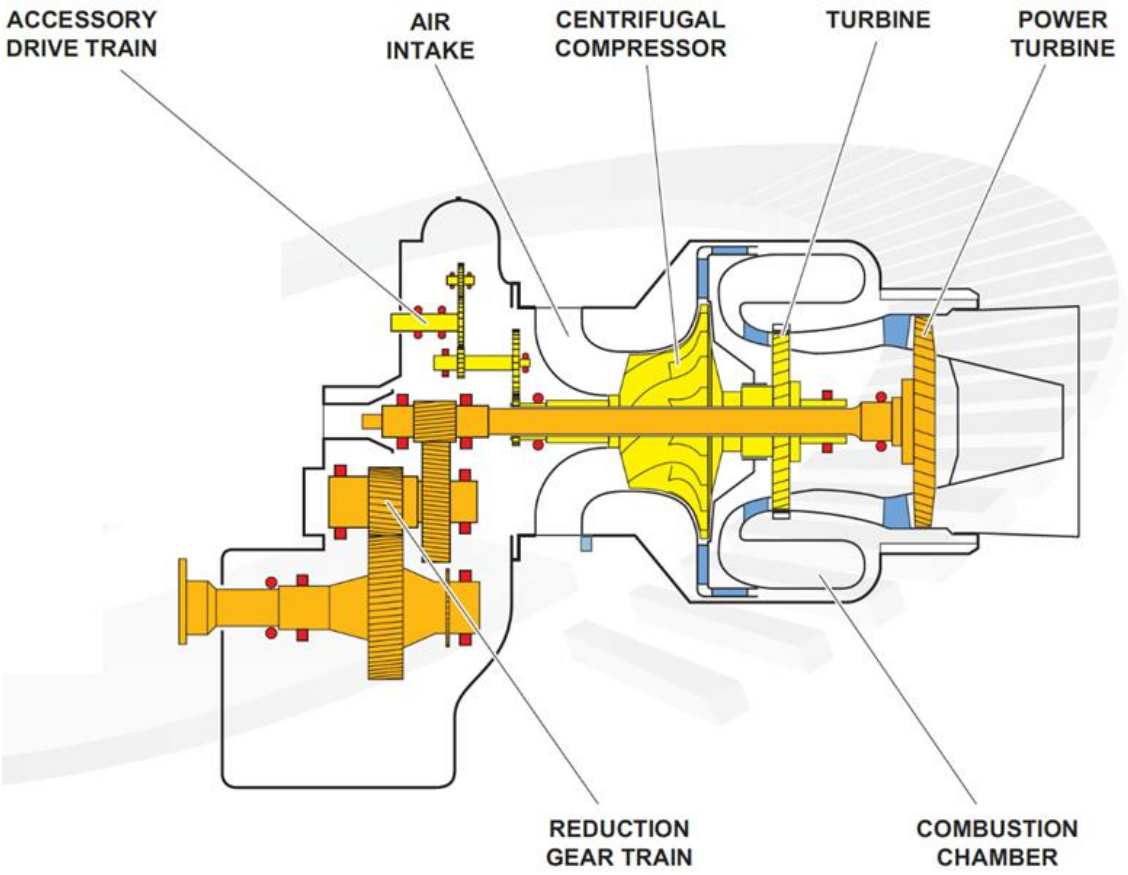

Fig. 7. General diagram of the Arrius 2F engine [source: Safran HE]

Table 3. Aircraft details

Factory designation (model)	Factory number	Year of manufacture	Registration marks	Registration number	Date of registration
Airbus EC 120 B	1485	2007	SP-PBW	963	10 August 2023

- Owner and operator – EKO-TYNK sp. z o.o.;
- Registration certificate – valid on the day of the occurrence;
- Certificate of airworthiness – issued 5 September 2023, without restrictions, valid on the date of the occurrence

b) Aircraft history:

- flight time from the beginning of operation – 1,709 h 32 min;
- flight time after 12-year inspection – 393 h 32 min;
- flight time since the last inspection (24M) – 53 h;

- airworthiness directives – all airworthiness directives were completed on time;

c) Aircraft engine details:

Table 4. Aircraft details

Manufacturer	Type	Serial No.	Year of manufacture
Safran	Arrius 2F	34292	1998

- flight time from the beginning of operation: 6,907 h 24 min;
- flight time since last major repair: 53 h;

d) Main rotor blades and Fenestron:

- Main rotor blades: operating time since the beginning of operation: 1,709 h 32 min; after last periodic inspection: 53 h – inspection completed on 10 April 2024;
- Fenestron blades: operating time since the beginning of operation: 1,709 h 32 min; after last periodic inspection: 53 h – inspection completed on 10 April 2024;

e) Fuel:

- recommended (per POH) – Jet A-1;
- used in flight – Jet A-1;
- amount on board (according to fuel gauge) – 186 kg.

f) Aircraft load:

- MTOW – 1,715 kg;
- BEW – 1,096 kg;
- CG – 4.13 m;

The centre of gravity of the aircraft was in the envelope.

1.7. Meteorological information

On 27 August 2024 in the afternoon, the sky was clear over central Poland. The southeastern part of Poland was slightly to moderately cloudy. There was chance of thunderstorms and scattered showers in the evening, with the area affected moving southeast. This barometric situation brought stable weather conditions over most of Poland.

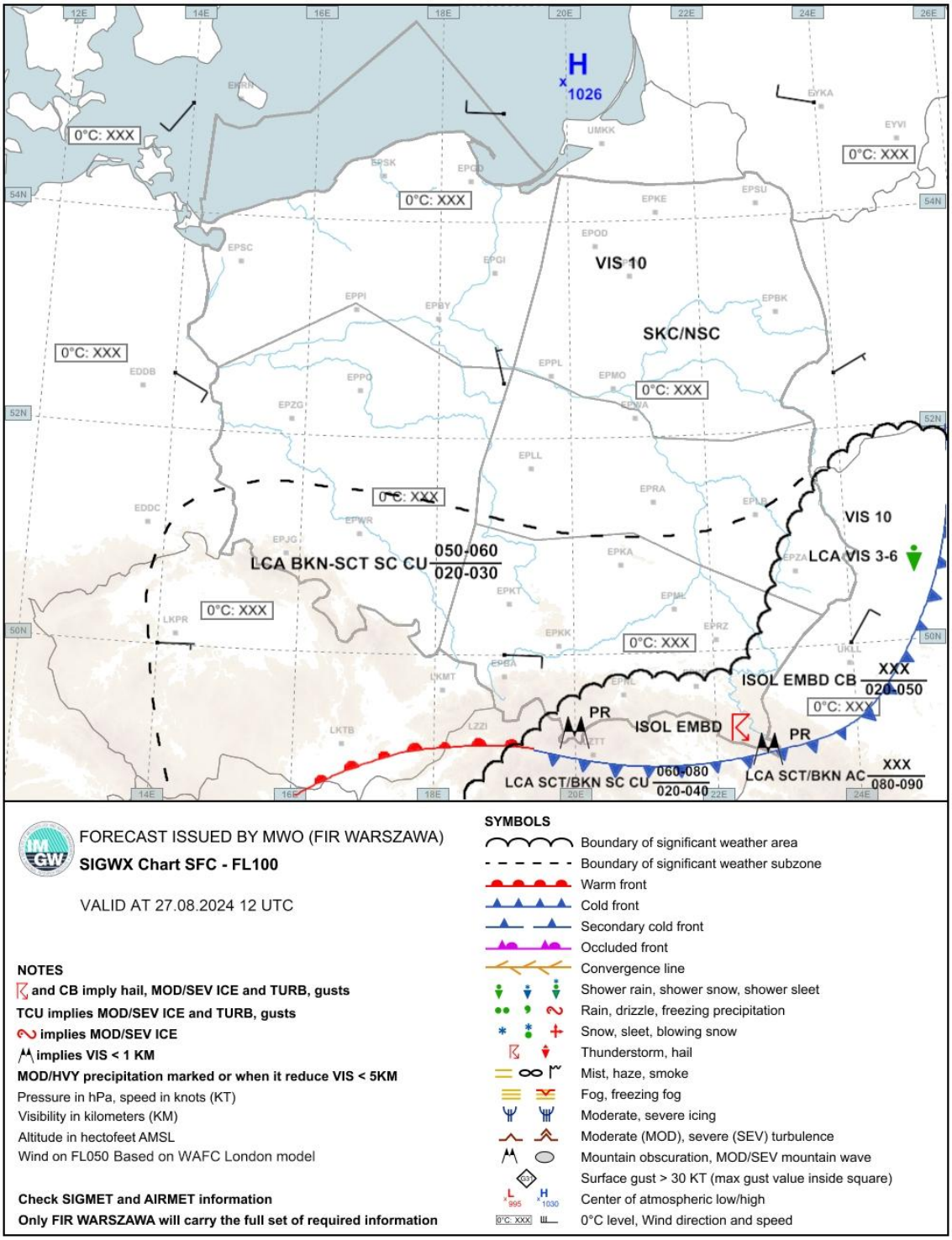

Fig. 8. GAMET synoptic weather chart for Poland [source: IMGW]

The forecast for the moment of the occurrence (i.e., 14:00 UTC) was consistent with the measurements taken at the Hydrological and Meteorological Station of the IMGW in Kozienice (18 km from the site):

- Date 27 August 2024, forecast hours 10:00 to 16:00 UTC (8:00 to 14:00 LMT);
- wind direction: 030°:
- wind speed: 10 to 06 kt / LCA VRB 02 kt;
- visibility: 10 km;
- cloudiness: SKC/NSC;
- ambient temperature: 25°C:
- dew point: 15°C:
- pressure: QNH 1026 hPa.

1.8. Navigation aids

Not applicable.

1.9. Connectivity

The pilot carried out standard radio correspondence with FIS EPWA in Polish. The correspondence in both directions was clear.

1.10. Aerodrome information

The helicopter took off from its base of operations in the village of Wólka Załęska. The landing, with the permission of the show's organiser, took place within the premises of the "Autodrom Jastrząb" car track in Jastrząb (). The landing site was right next to the stands and not fenced off from the area accessible to the audience. Consequently, there were bystanders in the vicinity of the helicopter after it landed while the engine and rotors were running.

1.11. Flight data recorders

The helicopter was not equipped with a flight data recorder (FDR) or cockpit voice recorder (CVR); they were not required for this class of aircraft. Selected parameters describing the operation of the engine and some airframe systems, were stored in the VEMD. It is an integrated multifunction display, built into the central position of the EC 120 B helicopter's instrument panel. The VEMD's electronic modules are doubled to provide display redundancy.

Fig. 9. VEMD (marked with a frame) built into the SP-PBW instrument panel

The VEMD does not record the current values of the measured parameters; however, a selection of data that was used in the investigation of the occurrence is stored in its memory:

- Flight reports (flight summary, including helicopter operating time, number of cycles and engine wear);
- Failure message;
- Overlimits report;
- Engine Power Check.

The VEMD records the following data, when value limits for the following parameters are exceeded:

- shaft torque (TRQ);
- turbine outside temperature (T_4 / TOT);
- N_1 compressor revolutions (N_G);
- N_2 turbine revolutions (N_f);
- N_R main rotor revolutions.

The VEMD records exceeded values in terms of their duration and maximum value.

1.12. Information on the wreckage and the occurrence

After the destruction of the helicopter, most of its elements were found within approx. 60 m². In contrast, one of the main rotor blade fragments struck the ground on the other side of the S7 expressway.

1.13. Medical and pathological information

The pilot left the wreckage on their own. An ambulance arrived at the scene to secure the car show. The pilot suffered minor bodily injuries and was medically attended to at the scene of the occurrence.

1.14. Fire

Thanks to the quick efforts of the Fire Brigade (who were providing the security for the charity event at the track), there was no fire. Its actions consisted in applying a stream of water, securing the scene and disconnecting the battery in the helicopter. There were no leaks of fuel or functional fluids.

Fig. 10. Marks due to high temperature in the area of the helicopter's engine cover.

1.15. Survival factors

The pilot was wearing seatbelts. He freed himself from them after the helicopter toppled, and he left the wreckage on his own by exiting through the left cabin door.

All seats installed inside the helicopter were in good condition after the accident.

The ETL transmitter signal was not being sent due to the damage to the external antenna as a result of the crash.

1.16. Tests and studies

The investigation involved a number of inspections of the helicopter and its engine, VEMD data readings, and a reconstruction of the pilot's performance at the time of the occurrence.

1.1.2. Helicopter and engine inspections

The helicopter was inspected by a representative of Airbus Helicopters and the engine – by a representative of Safran HE. Representatives of the PKBWL participated in both inspections. The following tests were carried out as part of the inspection:

1. The correct operation of the power grip on the collective pitch lever was verified. Correct operation was confirmed.
    - For the grip in the "flight" position, the angle of the fuel control lever was 56°, i.e., within the correct range (53°...59°).
    - For the grip in the "idle" position, the angle of the fuel control lever was 27°, i.e., within the correct range (approx. 27°);
    - For the grip in the "OFF" position, the angle of the fuel control lever was -1°, i.e., within the correct range (-1°...-10°).
2. The correct operation of the kinematics, the collective pitch lever and the pitch-power correlation system was verified. Despite damage to the head of the rotor as a result of the blades hitting the ground, correct position of the correlation system indicator for extreme collective pitch lever positions, as well as free movement of the extreme collective pitch lever across its entire range was confirmed.

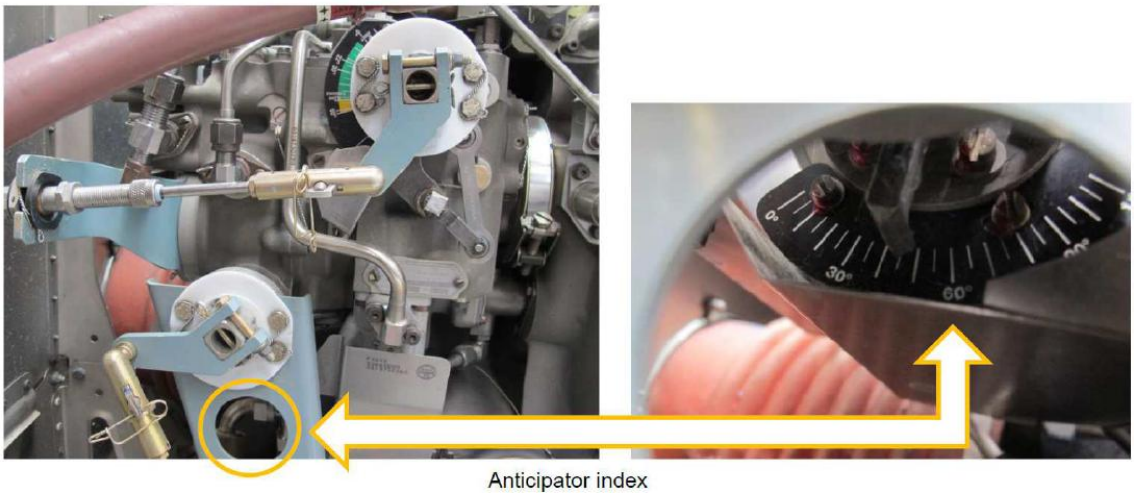

Fig. 11. Pitch-power correlation system indicator [source: Airbus Helicopters]

3. The correct operation of the collective pitch lever locking mechanism was verified and confirmed.

Fig. 12. Collective pitch lever locking mechanism in the locked position (left) and unlocked (right)

4. The position of the fuel shut-off valve lever was verified and confirmed (in “open” position, seal intact).
5. The position of the rotor brake lever was verified and confirmed (brake released).
6. The continuity of the tail rotor control was verified (positive result); the movement of the foot controls (smooth, without jamming) results in the correct displacement of the lever at the angle gearbox and the correct change of pitch of the Fenestron blades).
7. The continuity of the Fenestron drive was verified, yielding a negative result. The tail rotor shaft was twisted and partially cut due to the impact

of the main rotor blade against the tail boom at the time of the accident. This caused the splined connection at the angle gearbox to disconnect.

8. A general inspection of the engine was carried out, revealing traces of hot gases entering the engine chamber (in the form of soot deposits) and thermal damage to the fire sensor mounts. In addition, traces of power turbine blade shedding were revealed: deformed retaining ring and several broken flange bolts between the turbine casing and the combustion chamber casing. The blade shedding occurred after the main rotor blades hit the ground.
9. An attempt was made to verify the engine mount. The rear engine fittings had no visible signs of damage. The front mounting interface was not accessible for a check, as the engine was not removed.
10. The connection of the oil system to the engine was verified and confirmed as correct. No leaks or loose connections were found in the oil cooling system.
11. The connection of the fuel system to the engine was correct. There were no leaks in the fuel system.
12. The condition of the engine's air intake and gas outlet systems was verified. The air intake grids have been cut. It was deliberately dismantled after the accident by the PKBWL for investigation purposes. The exhaust nozzle was damaged by turbine blade debris. The engine cowling had traces of exposure to high temperatures.
13. The connection of the electrical harness to the engine was checked; all were connected and properly tightened.
14. Potential engine shaft rotation was checked. The gas generator shaft did not rotate; the drive turbine shaft did despite the blade shedding.
15. The interior of the engine was inspected using a borescope, which evidenced:
    - contact between the impeller and the casing;
    - damage to the compressor cover;
    - damage to the gas generator turbine blades (Fig. 13);
    - damage to the power turbine blades (Fig. 14);
    - damage to the power turbine guide vanes.

Fig. 13. Damage to the gas generator (HP) turbine blades

Fig. 14. Damage (missing blades) to power turbine.

1.1.3. VEMD data readings

Data stored in the VEMD memory (see section 1.11) were read at the Airbus Helicopters laboratory, see Fig. 15. The record of the flight, ending in the accident, was closed correctly.

Fig. 15. VEMD on the test bench [source: Airbus Helicopters]

The following was read out:

- GPS receiver error, 15 s after start of recording – no impact on accident;
- "NG TRQ T4 INCOH" error, 22 s after start of recording – indicates inconsistent engine parameters. In this case, the error display was caused by a drop in shaft torque. At the time of the error, the rotor speed was zero and the low-speed turbine speed N_f was excessive (421 rpm). This indicates a broken mechanical connection between the engine and the main gearbox. T_4 at the time of the message was in the correct range;
- T_4 was exceeded at 66 s after start of recording (by 44 s).

1.1.4. Reconstruction of the pilot's performance at the time of the occurrence

In the presence of PKBWL representatives, the pilot involved in the accident performed a demonstration of his actions during the occurrence, taking a seat in the cabin of the helicopter involved in the incident. This demonstration included an attempt to switch off the engine by turning the grip from the IDLE position to

the OFF position. According to the pilot's earlier statement, the shutdown attempt failed. However, during the reconstruction, the correct operation of the engine control system was proven.

1.17. Information on organisations and management

The flight was organised by the pilot as a private individual, in consultation with the organiser of the race car show.

1.18. Supplementary information

Prior to the publication of the final report, PKBWL consulted its draft version, asking the involved and interested persons, entities and authorities for comment:

- pilot-in-command submitted a comment that were not taken into account;
- continuing airworthiness management organisation did not submit any comments;
- BEA (representing the state of the aircraft's manufacturer and designer) submitted comments that were taken into account.

1.19. Useful or effective investigation methods

Standard investigation methods were used.

2. ANALYSIS

2.1. Air operations

2.1.1. Pilot qualifications

The pilot had the required licence and valid authorisations to act as pilot-in-command.

2.1.2. Pilot's performance

The occurrence was very sudden, lasting several seconds after the engine started. It can be described as a mis-start of the helicopter. The correct start-up procedure involves setting the collective pitch lever to the lower position. In this position, the lever is locked by a ratchet, released in the EC-120 B helicopter by pressing it lightly and lifting it. The pilot was unable to answer whether the collective pitch lever had been locked prior to engine start-up. What must be

noted here, is that bystanders had gone into the cabin before the flight (during the presentation of the helicopter). In this case, the pilot should carry out a pre-flight inspection, also taking potential accidental interference (on the part of the visitors) with the condition of the aircraft into account. Meanwhile, the CCTV footage shows that the time between the visitors moving away from the helicopter and the engine starting was approximately two minutes. This raises doubts whether the helicopter was properly prepared for the flight. Presumably, the collective pitch lever locking mechanism was accidentally released during the presentation and not locked back before starting in the minimum pitch position.

The fact that the collective pitch lever rose above the minimum position may explain the abnormal engine start-up. Firstly, it increases the fuel supply to the engine as a result of the functioning of the FCU system. This unit is responsible for automatically adjusting the fuel flow to maintain the nominal speed of the main rotor and compensate for the increase in drag torque resulting from an increase in the main rotor blade angle. This phenomenon directly explains the initial increase in exhaust gas temperature. The pilot noted it to be 800°C, while the TOT during start-up should be in the range of 740°C ÷ 760°C.

The pilot's statement shows that, having seen the increase in the gas temperature, he decided to engage a cooldown procedure, so that TOT would fall below 200°C. In line with the Flight Manual for the EC 120 B helicopter, the grip should be put into the "OFF" position, causing the engine to be shut down, and subsequently the starter should be engaged for cooldown purposes. The starter then turns the compressor and drive turbine shafts and, in effect, removes hot air from the combustion chamber, drawing in cool air from the atmosphere. Only when the temperature drops below 200°C can the engine be restarted.

The pilot said that he had reversed the grip only slightly, without reaching the OFF position. In this situation, the attempt to cool down the engine may have had the opposite effect, the stater giving an extra dose of fuel to the engine that was still running. This explains the further increase in the gas temperature and the fact that TOT limits were exceeded (at 1100°C). This may also have resulted in a higher main rotor speed than intended for the idle mode. This, combined with an abnormally high collective pitch, resulted in an increase in the thrust of the main rotor, relieving the helicopter of weight on the skid landing gear. Consequently, unless the pilot applies countermeasures using foot control, the fuselage rotates because of the rotor's reaction torque. This spin was captured in the CCTV footage, at the eleventh second after the start-up procedure began.

The state of affairs, i.e., the rapidly rising gas temperature and the helicopter's rotation to the left on the skids, surprised and frightened the pilot, who was convinced that the engine was about to explode. According to his statement, the fact that he was emotionally overwhelmed and in a time deficit did not allow him to choose the simplest course of action, i.e., to cut off the fuel supply to the engine

(with an emergency brake). The pilot claimed that he had tried to shut down the engine by turning the grip to OFF, but this had had no positive effect. A subsequent attempt at a reconstruction of the situation, carried out during a visual inspection of the helicopter, as well as the verification of the correct operation of the grip (see section 1.16), revealed no malfunctions.

2.1.3. Weather

The weather had no impact on the occurrence.

2.1.4. Connectivity

The pilot carried out radio communications; the correspondence was clear in both directions.

2.1.5. Airfield

The occurrence took place off-airfield. The site of the occurrence was accessible to members of the public, i.e., spectators of the car show. The organisers did not provide security against the public's access to the helicopter during the landing and on-ground operation of the helicopter.

The pilot did not use the brake to stop the main rotor blades, which would have shortened the rotor operation time after engine shutdown. There were bystanders roaming around the helicopter, as the main rotor blades kept spinning until they stopped on their own.

One should also note the proximity to the S7 expressway. The organiser did not analyse the risks associated with the choice of the landing site. As a result, helicopter debris, i.e., a fragment of the main rotor blade, flew over the S7.

2.2. Aircraft

The aircraft was operated in accordance with applicable regulations. The aircraft's mass and centre of gravity were within the admissible limits. There was no technical fault reported that could have had impact on the occurrence.

2.3. Survival

The pilot was wearing seatbelts. He freed himself from them after the helicopter toppled, and he left the wreckage on his own by exiting through the left cabin door.

3. CONCLUSIONS

3.1. Findings

3.1.1. The aircraft was certified, equipped and operated in accordance with applicable regulations and approved procedures.

3.1.2. The aircraft had a valid certificate of airworthiness.

3.1.3. When the flight started, the aircraft was airworthy.

3.1.4. The aircraft's mass and centre of gravity were within the regulatory limits.

3.1.5. No evidence of malfunction or failure of the aircraft nor the engine was identified that could have contributed to the accident.

3.1.6. The pilot held licenses and qualifications for the flight in accordance with the applicable regulations.

3.1.7. The pilot was not found to have a sudden indisposition or incapacity that could affect his ability to control the aircraft.

3.1.8. The pilot was not under the influence of alcohol.

3.2. Causes and contributing factors

1. Incorrect application of the engine start-up procedure.
2. Loss of situational awareness and inappropriate action taken to stop the operation of the engine.

4. SAFETY RECOMMENDATIONS

No recommendations were formulated.

END