



Transporta nelaimes gadījumu un incidentu izmeklēšanas birojs

Transport Accident and Incident Investigation Bureau of the Republic of Latvia

Brīvības iela 58, Rīga, LV-1011, Latvia, phone +371 67288140, mob. phone +371 27882103, fax +371 67283339,
e-mail taiib@taiib.gov.lv, www.taiib.gov.lv

FINAL REPORT 4-02/2-21(2-22)

on accident, collision with ground shortly after take-off at the Cēsis airfield on August 8, 2021 with the amateur built aircraft ANBO-II (replica), registered LY-BDJ (Lithuania)

The Aircraft Accident and Incident Investigation Bureau of the Republic of Latvia (further – TAIIB) is a governmental, independent of all aviation authorities and, in general, of any other party or entity the interests or missions of which could conflict with the task entrusted to the safety investigation authority or influence its objectivity, organization established by law to investigate and determine the cause or probable cause of accidents and serious incidents that occurred in the civil aviation, as well if necessary for enhancing flight safety incidents. The sole objective of the safety investigation in accordance with Annex 13 to the Convention on International Civil Aviation, the 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 as well as Cabinet Regulation No.423 of May 31, 2011 “Procedures of Civil Aviation Accident and Incident investigation” is the prevention of future accidents and incidents. The Report shall contain, where appropriate, safety recommendations.

Safety investigation is separate from any judicial or administrative proceedings and Investigation Report is not deal with purpose to apportion blame or liability but only for purpose of the safety enhancement.

The Report shall protect the anonymity of any individual involved in the accident or serious incident.

Address: 58 Brivibas street, Riga, Latvia, LV-1011

Tel.: 67288140

Fax: 67283339

E-mail: taiib@taiib.gov.lv

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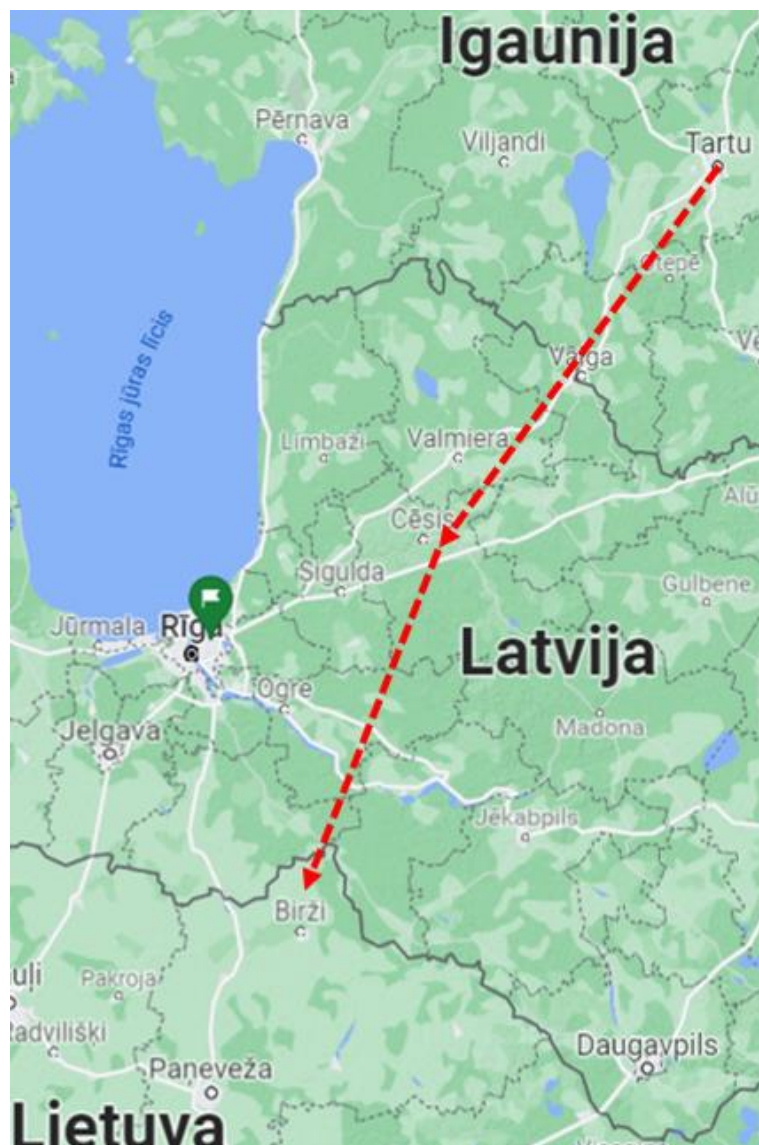
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Synopsis

Unless stated otherwise all times in this Report are UTC time

On August 8, 2021 a group of aircrafts was flying from the airfield Tartu (EETR), Estonia, to the airfield Cēsis (EVCA), Latvia, for rest and aircraft refuelling in order to fly to the airfield Biržai (EYBI), Lithuania (see picture 1). While the aircraft ANBO-II registration LY-BDJ was flying the route from Tartu to Cēsis, its engine was running smoothly, without any technical problems during the flight.



Picture 1: Planned flight route

The flight was performed during the day's visual meteorological conditions. After take-off from the airfield Cēsis the aircraft ANBO-II suffered engine malfunction due to unstable operation and reduced power. During the left turn the aircraft lost suddenly the altitude and collided with the ground surface (see picture 2).



Picture 2: Accident site

The pilot was fatally injured, the passenger was taken to hospital unconscious. There was no fire after the accident.

The Transport Accident and Incident Investigation Bureau's (TAIIB) investigators went to the accident site in order to carry out the necessary procedures and to preserve material evidence in accordance with the laws and regulations.

The TAIIB initiated the collection of data from the institutions involved in this accident. The wreckage was placed in the TAIIB hangar for the further technical investigation (see picture 3).



Picture 3: Transportation of the aircraft wreckage

Notification

At 14:42 local time on August 8, 2021 the TAIIB was informed on the phone by the State Fire Fighter and Rescue Service (VUGD) operational manager about the occurrence at the airfield Cēsis with the aircraft ANBO-II registration LY-BDJ, Lithuania.

Immediately after the occurrence the TAIIB notified the Lithuanian Safety Investigation Authority as a State of design, manufacturer and a State of registry of the aircraft, as well as EASA and Latvian CAA of the accident.

General information of the accident

Operator	Private pilot
Nationality	Lithuania
Aircraft Type	ANBO-II
Registration	LY-BDJ
Manufacturer	Amateur build (replica)
Owner	The aircraft was owned by Asociacija "ANBO ESKADRILE" (Lithuania).
Year of manufacture	2016-2018
Place of Accident	Airfield Cēsis, Priekuli district, Latvia;
Date and time	August 8, 2021, approximately at 10:55 UTC

Investigation

According to the article 5. Obligation to investigate, paragraph 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, the TAIIB shall investigate every accident or serious incident involving an aircraft other than specified in Annex II to Regulation (EC) No 216/2008 of the European Parliament and of the Council of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency shall be the subject of a safety investigation in the Member State in the territory of which the accident or serious incident occurred.

The aircraft ANBO-II is specified in the categories set out in Annex II to Regulation (EC) No 216/2008, but taking into account that accident had a fatal outcome where a foreign state citizen was deadly injured, the TAIIB of the Republic of Latvia as the state of occurrence according to Annex 13, Section 5.1. instituted an investigation into the circumstances of the accident and started to conduct the investigation.

1. Factual information

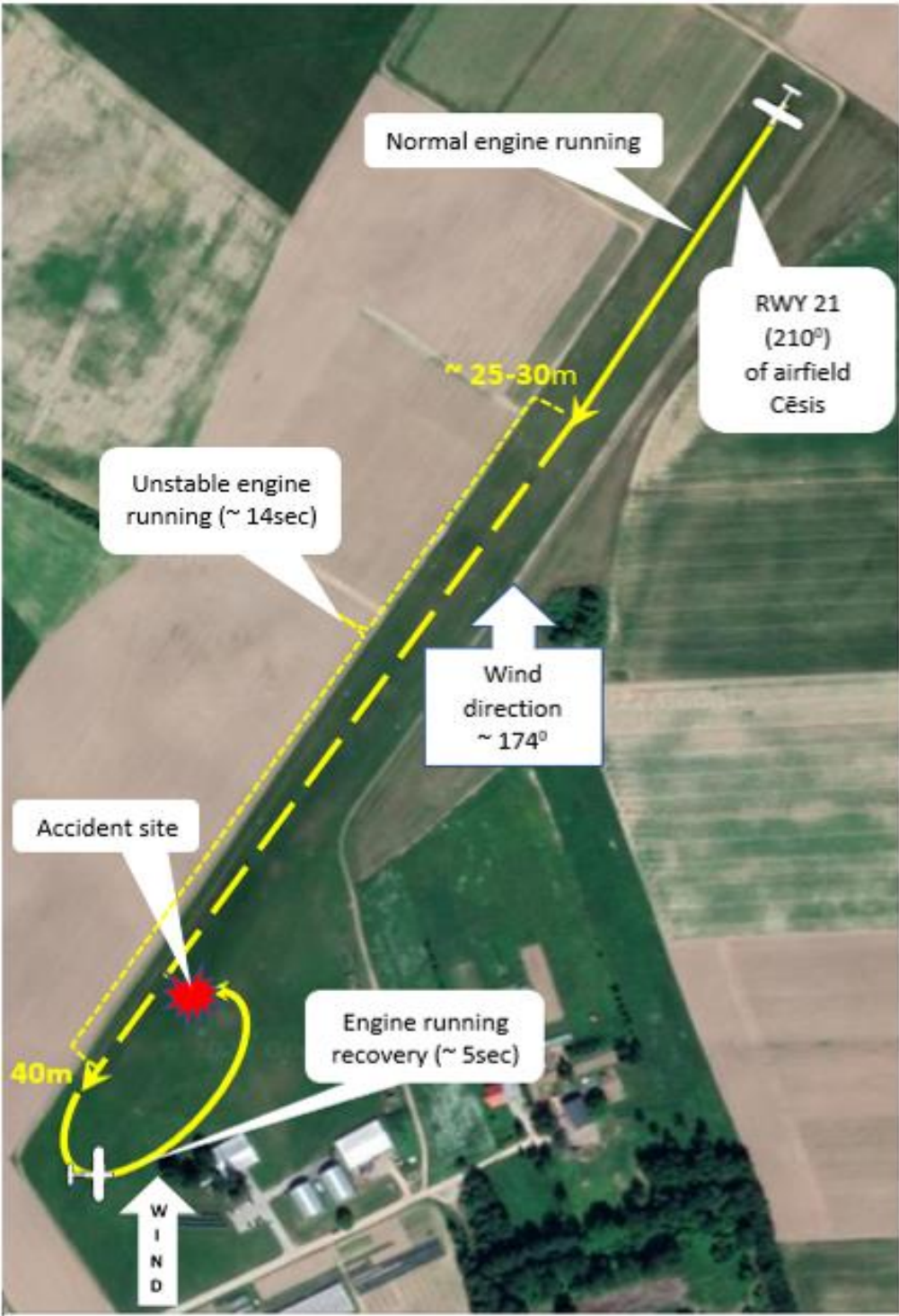
1.1. History of the flight

On August 8, 2021 at 13.30 local time the aircraft ANBO-II registration LY-BDJ took off from the airfield Cēsis (EVCA), Latvia, with the other four aircrafts intended to fly to the airfield Biržai (EYBI), Lithuania.

According to the video and the testimonials of the passenger, other pilots and witness who observed flying, the aircraft ANBO-II took off from RWY21. After 10 seconds of flight at approximately 25-30 meters above the airfield runway the engine's running became unstable but the aircraft continued climbing during 14 seconds while the aircraft speed was decreasing. When the aircraft was at altitude of about 40 meters, the pilot warned the passenger over the radio about turning left. According to the passenger's testimony, when the aircraft had turned to against the wind until 270 degrees, the pilot informed the passenger in a calm voice that he would give the

full engine power to eliminate the engine running interruptions; at that moment the aircraft speed was up to 80-90 km/h, according to the passenger.

The engine running of the aircraft has stabilized, the aircraft went into a left spin and collided with the ground at the high vertical speed within 5 seconds (see picture 4).



Picture 4: The flight trajectory of the aircraft

As a result of the accident, the pilot of the aircraft died, the passenger was taken to the hospital, the aircraft overturned after the collision and was destroyed.

The accident occurred during the daylight time under visual flight conditions.

1.2. Injuries to persons

Injuries	Crew	Passengers	Total in the aircraft	Others
Fatal	1	-	1	-
Serious	-	1	1	-
Minor	-	-	-	-
None	-	-	-	-
Total	1	1	2	-

1.3. Damage to aircraft

The inspection of the wreckage at the accident site revealed that the aircraft suffered substantial damage to the engine and the fuselage.



Picture 5: The wreckage of the aircraft at the accident site



Picture 6: The wreckage of the aircraft at the accident site



Picture 7: The wreckage of the aircraft at the accident site

1.4. Other damage

NIL

1.5. Personnel information

The flight crew was certified and qualified for the flight in accordance with existing regulations.

PIC	Male, age – 59;
Licence	PPL(A), Serial number LT.FCL.PPL-881 issued 28/05/2018;
Medical Certificate Class 2	No LT-LT/MED-2-P-009001, valid until 03/03/2022;
Total flying time with the ANBO II aircraft	According to existing data about 91 h;
Flying experience on aircraft type	Documented flight hours with aircraft type was not found.

1.6. Aircraft Information

[Information taken from Wikipedia https://en.wikipedia.org/wiki/ANBO_II]

The ANBO II was a parasol-wing monoplane aircraft built in Lithuania in 1927 as a pilot trainer for the Army. It was eventually reequipped with more powerful engine for the Aero Club of Lithuania in 1931 before being written off in a crash in 1934 (see picture 9).



Picture 9: The aircraft ANBO II in 1931

A full-size flying replica was restored by Rolandas Kalinauskas and Arvydas Šabrinskas in 2012-2016. Due to difficulties in obtaining an original Walter engine, the amateur-builders used in the Soviet Union designed engine with similar parameters Shvetsov M-11. The Shvetsov M-11 is a piston five-cylinder air-cooled engine with radially arranged aluminium cylinder heads. The M-11FR engine modification which has been produced in China since 1954 was mounted on the aircraft ANBO II.

The test flight of the restored ANBO II took place on 18 October 2016. The aircraft was based at the airfield Pociūnai, Lithuania, and was mostly used for air shows with both amateur-builders dressing in Lithuanian Air Force uniforms of 1920s-1930s.

Year of Manufacture	2016-2018
Serial No	NIL
Class and Category	Experimental-Amateur Aircraft.
Manufacturers	Arvydas Šabrinskas/Rolandas Kalinauskas
Registration	Republic of Lithuania
Certificate of Registration	No 01984
Special Certificate of Airworthiness	No 01984
Nationality and Registration Marks	LY-BDJ
Owner	Asociacija "ANBO ESKADRILE"
Total time in service	70 FH 43 mins (2021-06-01)
Engine type	M-11FR
Engine Time since last OVH (2016)	70 FH 43 mins (2021-06-01)
Date of engine manufacture	1956
Engine SN	AC-015083
Propeller total time in service	48 FH

According to the Lithuanian Transport Competence (CAA), there are no accident or incident reports in the pilot file on 07/08/2021.

1.7. Meteorological information

According to the information of the State "Latvian Environment, Geology and Meteorology Centre" Ltd. meteorological observation stations of Priekuli (57.3142, 25.36104) and Zosēni (57.17283, 25.82867) the weather conditions on August 8, 2021 from 13:00 to 14:00 were following:

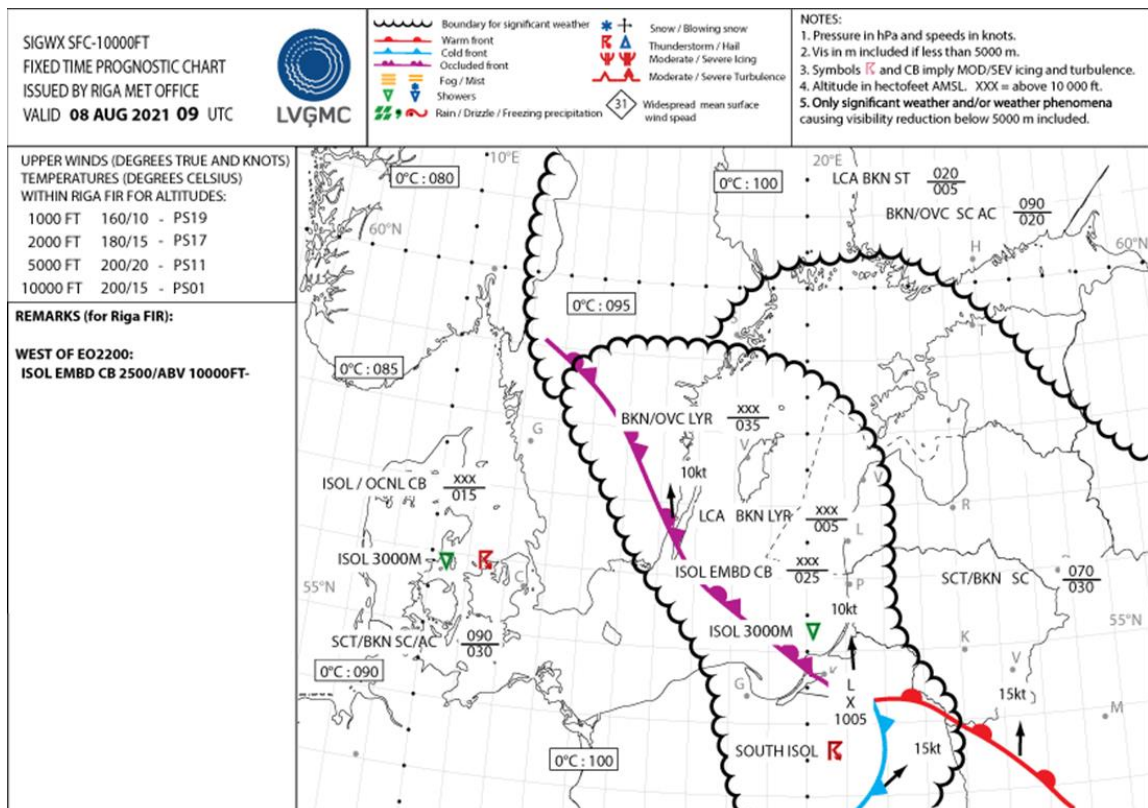
Priekuli

Hour (Latvian Summer time)	Hour average minimum meteorological visibility, m	Hour average wind speed, m/s	Hour average wind direction, azimuth degrees	Hour average wind direction	Hour max. wind gusts, m/s
13.00-14.00	20000	3.2	174	South	5.8

EVRR GAMET VALID 080900/081500 EVRA-
 EVRR RIGA FIR BLW FL100
 SECN I
 SIG SFC VIS: FOR AREA S, W OF 1 AND 12/15 FOR 2 AND E OF 1 ISOL 3000M SHRA
 SIGWX:12/15 FOR AREAS 1 2 ISOL TS
 SIG CLD: FOR AREAS S, W OF 1 AND 12/15 FOR 2 AND E OF 1 ISOL EMBD CB
 2500/ABV 10000FT AGL
 SIGMET APPLICABLE: NIL
 SECN II
 PSYS:NO MAJOR WX SYSTEM
 SFC WIND:140/07-12KT

WIND/T:
 1000FT 160/10KT PS19
 2000FT 180/15KT PS17
 5000FT 200/20KT PS11
 10000FT 200/15KT PS01
 SFC VIS:10KM
 CLD: FOR AREAS S, W OF 1 AND 12/15 FOR 2 AND E OF 1 BKN/OVC LYR 3500/ABV
 10000FT AGL
 FOR AREAS 2 3 NIL
 FZLVL: ABV 10000FT AMSL
 MNM QNH:
 09/12 1005HPA FOR S, 1007HPA FOR 1
 1008HPA FOR 2, 1010HPA FOR 3
 12/15 1006HPA FOR S 1, 1007HPA FOR 2
 1009HPA FOR 3
 SEA: T19 HGT 1.0M
 OTLK:081500/081800 SAME HAZARDOUS WX, FOR AREA E OF 3 ISOL EMBD CB
 2500/ABV 10000FT, ISOL 3000M SHRA AND ISOL TS=

Weather forecast in the form of a SWL map for August 8, 2021 at 12:00 PM (09 UTC)



Picture 10: The SWL weather forecast map

1.8. Aids to Navigation

NIL

1.9. Communications

The aircraft radio equipment functioned normally and had no relation with the cause of incident.

1.10. Aerodrome information

Airfield Cēsis – EVCA;

Airfield is located – Priekuli district, Latvia;

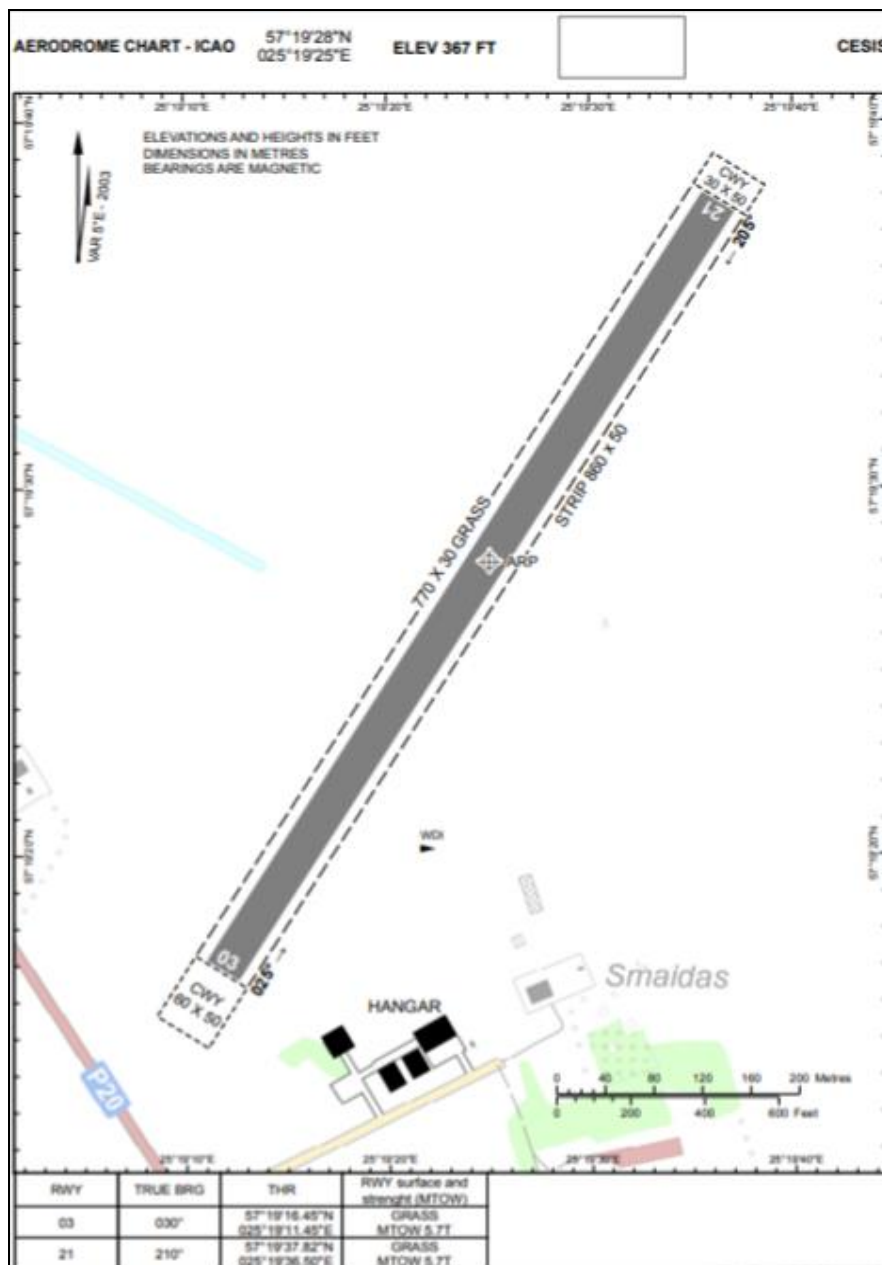
Runway surface – ground;

Lat: 57.3244438171 (57°19'27"N);

Long: 25.3236103058 (25°19'24"E);

Elevation – 367.00ft;

The airfield Cēsis is used for general aviation, and it is not equipped with instrument landing systems and is freely accessible (see picture 11).



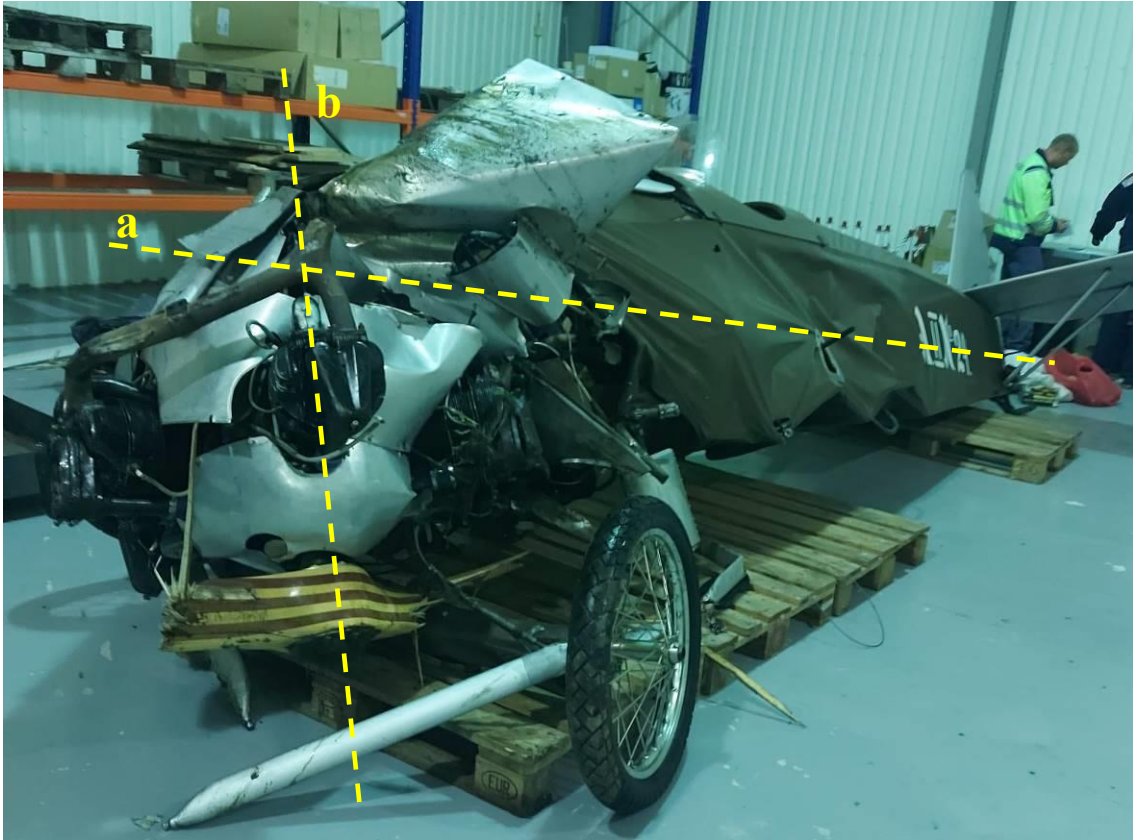
Picture 11: The airfield Cēsis

1.11. Flight recorders

NIL

1.12. Wreckage and impact information

The aircraft was transported from the accident site to the hangar of the TAIIB. The inspection of the aircraft revealed that the front part of the aircraft and the engine elements had sustained substantial damages: the landing gear was broken, the aircraft wings were deformed, the control elements were damaged. During the collision, the axis of the engine (see picture 12: **b**) shifted almost perpendicular to the axis of the aircraft (see picture 12: **a**).



Picture 12: Frontside of the aircraft

The destructions of the propeller indicate that the engine was running at the time of the collision. (see picture 13).



Picture 13: The aircraft propeller

The aircraft oil tank was damaged and had ruptured holes (see picture 14).



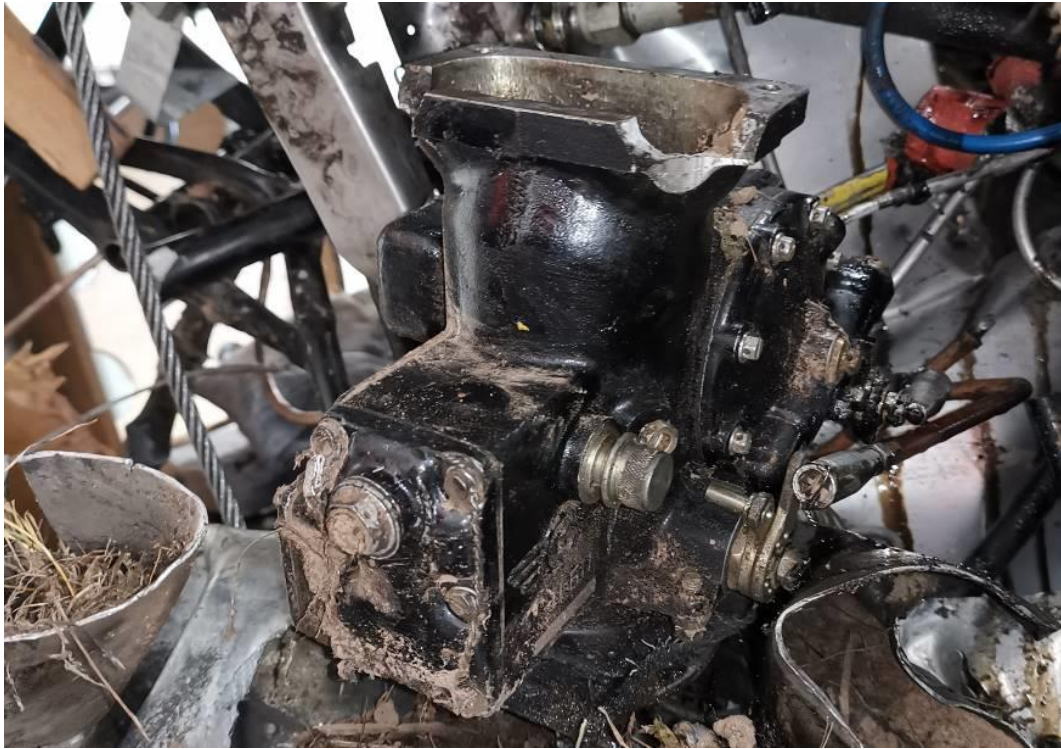
Picture 14: Damaged oil tank

In the hangar the engine was dismantled from the aircraft and prepared for a detailed inspection (see picture 15).



Picture 15: Dismounted engine

The carburettor housing was damaged in the collision (see picture 16).



Picture 16: Dismounted carburettor

1.13. Medical and pathological information

According to the Expert Conclusion No 4536-2021 issued by the National Forensic Expertise Center on December 23, 2021 the pilot's death occurred from polytrauma with subcutaneous hemorrhages, beatings and torn wounds, skin abrasions, damage to internal organs, fractures of many bones complicated by edema of the brain. The injuries found were the result of exposure to a rigid dull object(s), occurred shortly before death, and are serious in nature, which are life-threatening.

According to the result of the toxicological investigation (Act No. 4536-2021 / TTL-1740 of 11 August 2021) the ethyl alcohol was not detected in the blood and urine of the corpse.

1.14. Fire

NIL

1.15. Survival aspects

The front part of the aircraft fuselage was completely destroyed on impact with the ground at the high vertical speed, and the design of the seat belts could not ensure the survival of the aircraft pilot in the accident.

Seat belts were cut during the rescue operation, indicates that the crew were using a seat belt at the time of the accident.

1.16. Tests and research

1.16.1. Test of the aircraft fuel sample

The M-11 engine manufacturer maintenance manual requires to use the fuel with 57-59 octane number for the engine, that is a standard measure of fuel's ability to withstand the compression in the internal combustion engine without detonating. In accordance with the testimonials of witnesses the refuelling in the airfield Cēsis was performed by the crew. The aircraft was refuelled with A95 petrol in the amount of 20 litres and to reduce the octane number of A95 petrol the "Nephras" additive was added.

The required amount of the fuel has been taken from the aircraft fuel tank at the accident site for expertise and tested in the authorized laboratory "LATCERT" (Latvian Certification Center) (see picture 17).

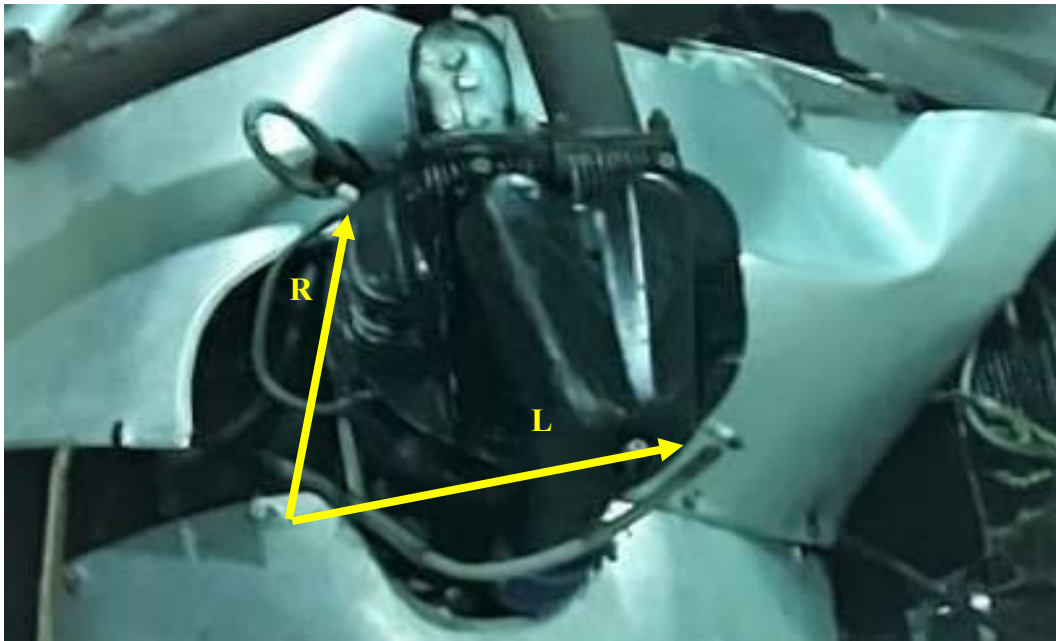


Picture 17: Samples of fuel

The aircraft fuel test was carried out at the laboratory in accordance with the standards "LVS EN ISO 3405:2019" and "LVS EN ISO 12937:2002" on August 12, 2021. In the test report No. 92528, the LATCERT laboratory confirmed the compliance of the fuel parameters in the fuel samples with the standards.

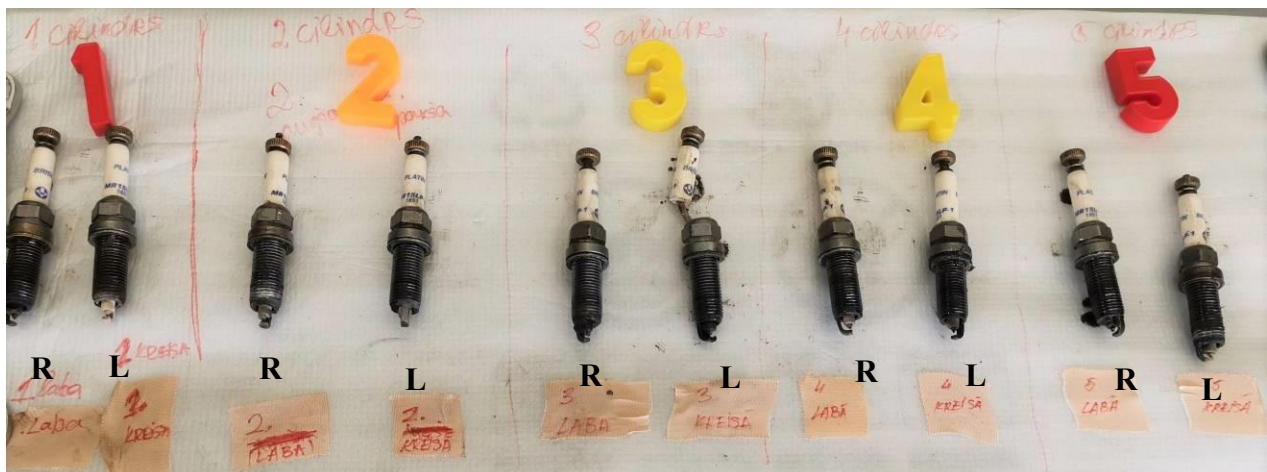
1.16.2. Inspection of the engine M-11FR spark plugs

The engine M-11FR of the aircraft ANBO II was equipped with 10 moderns [non-standard] BRISK Platin MR15LP spark plugs, two for each cylinder (see picture 18).



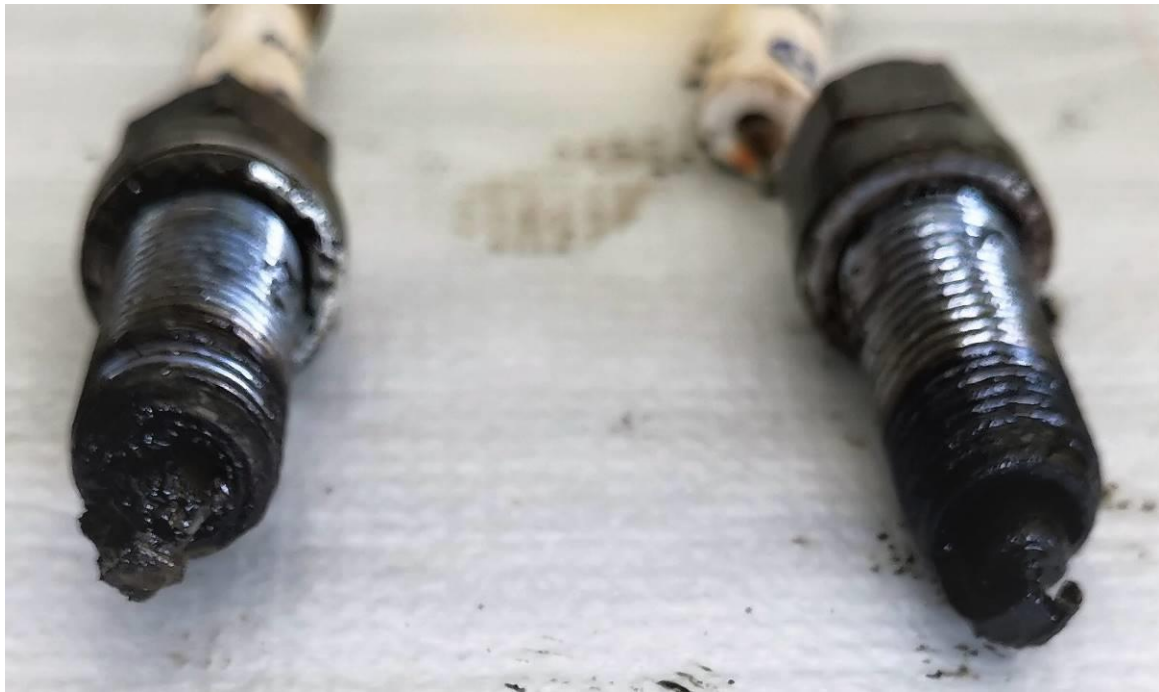
Picture 18: The location of the spark plugs on the engine cylinders

The engine spark plugs were unscrewed from the cylinder's heads and inspected (see picture 19).

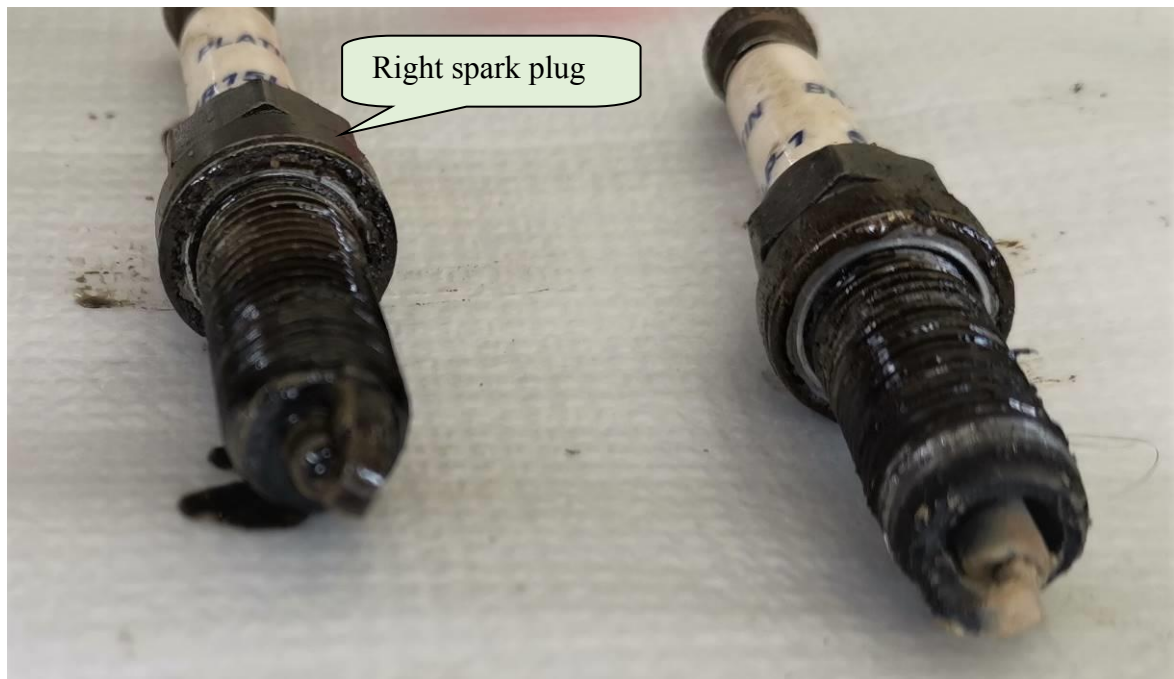


Picture 19: Ten spark plugs from the engine M-11FR

The spark plugs of each cylinder were visually inspected: the metal housing, ceramic insulators, electrodes and contact rods. The spark plug ceramic isolation was without cracks, the central electrodes were brown colour, with the exception of the 3rd cylinder where both spark plug electrodes were covered with black oily soot (see picture 20) and the 5th cylinder where the right spark plug was wet with engine oil (see picture 21). The distance between the spark plug electrodes and contact rods were within acceptable limits.



Picture 20: Spark plugs from cylinder No 3



Picture 21: Spark plugs from cylinder No 5

1.16.3. Engine carburettor inspection

After the visual carburettor inspection, the following damages were detected:

- the carburettor body was mechanically broken;
- the metal mesh of the air inlet to the carburettor was damaged (see picture 22).



Picture 22: The engine carburettor

The fuel filter was unscrewed from carburettor housing and inspected visually. The brass mesh of the fuel filter was without visible damage and had minor impurity particles (see picture 23).



Picture 23: Fuel filter

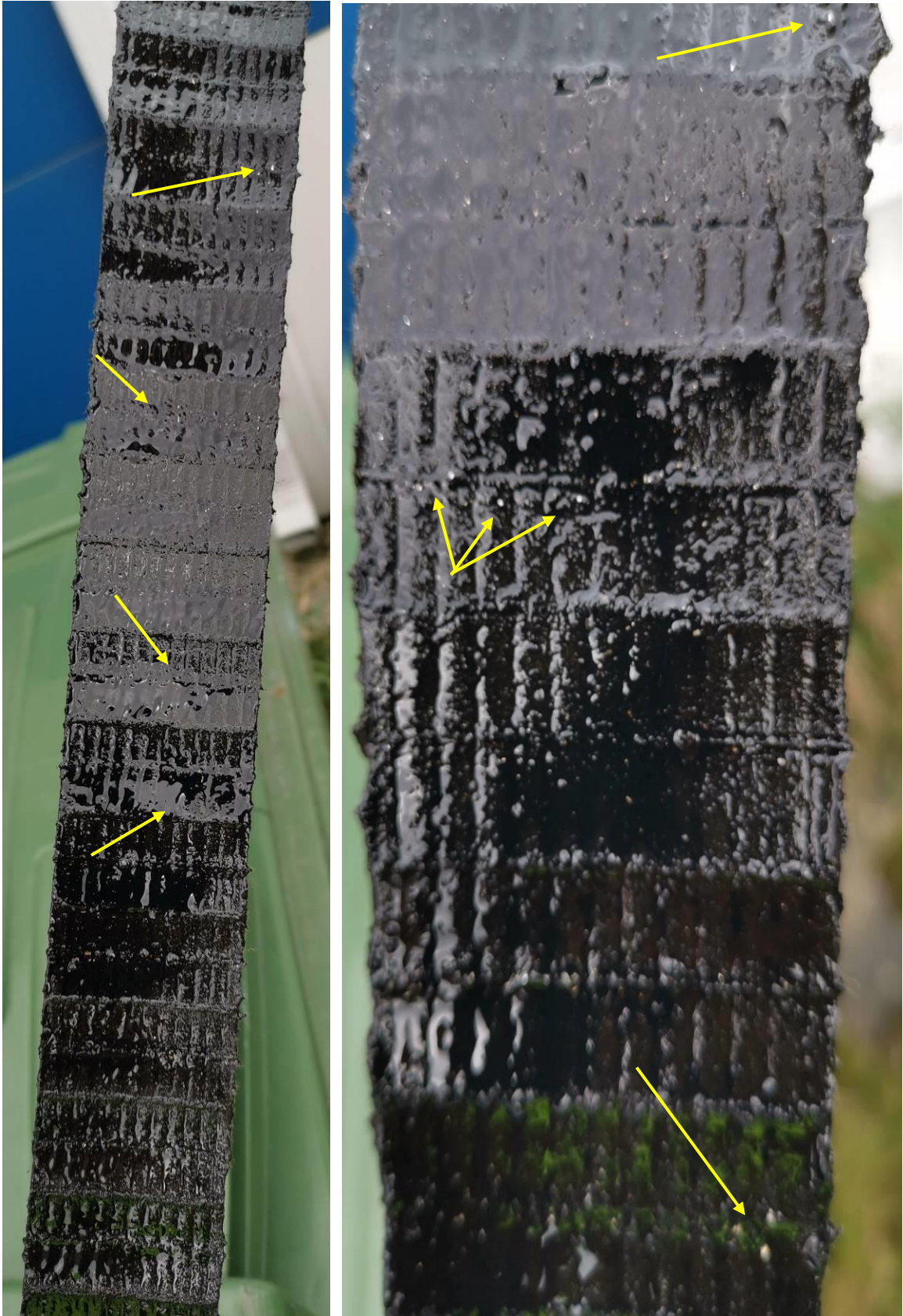
1.16.4. Engine oil filter inspection

Due to the engine oil tank damages in the accident the oil had been leaked out at the accident site, as a result the remaining amount of oil was insufficient for examination, therefore the oil filter was opened and checked (see picture 24).



Picture 24: Opened oil filter housing

The oil filter element was visually inspected. Not significant metal debris on the filter element were found (see picture 25).



Picture 25: The oil filter element

1.17. Organizational and management information

NIL

1.18. Additional information

NIL

1.19. Useful or effective investigation techniques

NIL

2. Analysis

2.1. Unstable engine running during the aircraft take-off

The analysis of the investigation was focused on the probable causes of the unstable aircraft ANBO II engine M-11FR running during the aircraft take-off from the airfield Cēsis. The investigation has identified the following probable causes:

- **Malfunction of some engine cylinders due to unworking spark plugs**

The fact that the 3rd cylinder spark plugs were covered with black oily soot and the 5th cylinder right spark plug was wet with oil lets to suppose that the spark plugs probably did not work during the aircraft take-off. Based on the results of a visual inspection of the spark plugs, it can be assumed that the 3rd and 5th cylinders of the engine could be a contributing cause of the unstable engine running.

- **Unstable engine running due to the altitude corrector**

It could be assumed that the aircraft pilot probably forgot to set the altitude corrector after the previous flight and landed at the Cēsis airfield with a poor air-fuel mixture. Thus, the pilot also took-off with a poor air-fuel mixture, because of which the engine malfunctioned. After the accident the aircraft was so destroyed that it is not possible to determine the true position of the altitude corrector before the aircraft take-off. But taking into account the testimony of the aircraft passenger that the pilot tried to eliminate the unstable engine running by giving a full throttle, it is possible to accept probability that the position of the altitude corrector was the correct position during the take-off.

- **Indirect technical faults**

Because of the multiple damages to the aircraft, it was not possible to detect other possible technical faults that could be contributing causes of the unstable engine running. In consideration of the normal operation of the aircraft before the take-off and the assumption that the possible cause of the accident were the incorrect actions of the aircraft pilot in an emergency flight situation no further technical examinations of the aircraft structure were carried out.

2.2. The aircraft pilot actions

No information was found during the investigation to indicate any mechanical defects or malfunctions of the aircraft engine systems in the previous flight and the aircraft pre-flight check time.

According to the passenger's testimony the aircraft engine was running smoothly when the aircraft was at the runway holding point before the take-off.

According to the meteorological information the accident occurred during the daylight time under the visual flight conditions. The hour average wind direction was South with azimuth 174 degrees, the hour average max speed of the wind gusts was 5,8 m/s and the meteorological visibility – 20000 m. Thus, the weather can't be considered as a causal factor in this accident. Rather, it seems that the circumstances of the accident were principally affected by operational factors which occurred during the flight.

After the take-off, at an altitude of 20-25 meters, the engine began to work intermittently, the thrust fell. In order to avoid an emergency situation due to the malfunction of the aircraft engine and to land safely, the aircraft pilot should have to remove the thrust and to land forward, but the pilot continued to fly with a climb.

It is possible that the pilot of the aircraft took a decision to make an emergency landing at the airfield Cēsis as well as to eliminate the engine malfunction by using the full throttle and warned the passenger of that. At the altitude of about 40 meters, the aircraft performed a left turn in the wind to about 270 degrees, continuing to lose the airspeed till the aircraft exceeded a critical stall.

Note: Any turn of the aircraft will result in a loss of altitude and an increase in stall speed (Aerodynamics of Flight).

After turning on the full engine power the aircraft received a momentum due to a rapid increasing of the engine torque, as a result of that the aircraft entered a spin with a left sideslip, that was the most likely a primary cause of the aircraft accident.

According to the location of the collision site and the damages to the aircraft, the angle of the impact was sharp enough that the pilot of the aircraft was unable to recover the aircraft from the spin and to avoid a collision with the ground due to lack of altitude. The damages to the propeller and its traces on the ground are typical for the situation when the aircraft engine was running at the moment of the collision with the ground.

3. Conclusion

3.1. Findings

- The aircraft engine was running at the moment of collision with the ground;
- The 3rd cylinder spark plugs were covered with black oily soot and the 5th cylinder right spark plug was wet with oil;
- The possible primary cause of the accident was not directly related to the malfunction of the aircraft engine;
- Due to the turn of the aircraft and the loss of airspeed, the aircraft entered a spin;
- The pilot of the aircraft was unable to recover the aircraft from the spin due to lack of altitude;
- The accident occurred during the daylight time under visual flight conditions;

- The actual meteorological conditions during the take-off of the aircraft couldn't be the cause of the accident;
- The toxicological examination revealed no alcohol in the pilot's blood and urine;
- The pilot had a valid PPL(A) licence and Medical Certificate;
- The amateur-built aircraft was serviced and operated in accordance with regulations;
- There was no any information of any accident or incident with the aircraft before the accident.

3.2. Causes

3.2.1. Proximate cause

The pilot's decision to turn the aircraft.

3.2.2. Root cause

- The unstable engine running;
- The pilot's incorrect actions in a non-standard flight situation;

3.2.3. Contributing causes

- Possible failure of the 3rd and 5th cylinders of the engine;
- The loss of airspeed due to engine running interruptions;
- Insufficient flight altitude to bring the aircraft out of a spin.

3.2.4. Primary cause

The entry of the aircraft into a spin with a left slip.

4. Safety Recommendations

The Transport Accident Incident Investigation Bureau doesn't consider it necessary to develop any Safety Recommendations for this accident.

Riga, June 13, 2022

Investigator in charge:
Head of Aircraft Accident and Incident
Investigation Department

Director of Aircraft Accident
and Incident Investigation Bureau

Vilis Ķipurs

Anita Šķinuma