

FINAL REPORT

ACCIDENT 1511/18



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FINAL REPORT

ACCIDENT

OCCURRENCE NO – 1511/18

AIRCRAFT – aeroplane, VANS RV-10, UR-PMAV

DATE AND PLACE OF OCCURRENCE – 9 June 2018, Rzeszów (EPRZ)



The Report is a document presenting the position of the State Commission on Aircraft Accidents Investigation concerning circumstances of the air occurrence, its causes and safety recommendations. The Report was drawn up on the basis of information available on the date of its completion.

The investigation may be reopened if new information becomes available or new investigation techniques are applied, which may affect the wording related to the causes, circumstances and safety recommendations contained in the Report.

Investigation into air the occurrence was carried out in accordance with the applicable international, European Union and domestic legal provisions for prevention purposes only. The investigation was carried out without application of the legal evidential procedure, applicable for proceedings of other authorities required to take action in connection with an air occurrence.

The Commission does not apportion blame or liability.

In accordance with Article 5 paragraph 5 of the Regulation (EU) No 996/2010 of the European Parliament and of the Council on the investigation and prevention of accidents and incidents in civil aviation [...] and Article 134 of the Act – Aviation Law, the wording used in this Report may not be considered as an indication of the guilty or responsible for the occurrence.

For the above reasons, any use of this Report for any purpose other than air accidents and incidents prevention can lead to wrong conclusions and interpretations.

This Report was drawn up in the Polish language. Other language versions may be drawn up for information purposes only.

WARSAW 2020

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ABBREVIATIONS

AC	Aircraft
EFIS	Electronic Flight Instrument System
EPRZ TWR	EPRZ Tower
LPR	Polish Medical Air Rescue
PANSA	Polish Air Navigation Services Agency
PKBWL	State Commission on Aircraft Accidents Investigation
POH	Pilot's Operating Handbook
RWY	Runway
UTC	Universal Time Coordinated
VFR	Visual Flight Rules

GENERAL INFORMATION

Occurrence reference number:	1511/18			
Type of occurrence:	ACCIDENT			
Date of occurrence:	9 June 2018			
Place of occurrence:	Rzeszów (EPRZ)			
Type and model of aircraft:	VAN'S RV-10 aeroplane			
Aircraft registration marks:	UR-PMVA			
Aircraft user/operator:	Private/AQUANOVA HYDRORESOURCE			
Aircraft Commander:	PPL(A)			
Number of victims/injuries:	Fatal	Serious	Minor	None
	-	1	1	1
Domestic and international authorities informed about the occurrence	<ul style="list-style-type: none"> – Polish Civil Aviation Authority; – Ukrainian National Bureau of Air Accidents Investigation (NBAAI) 			
Investigator-in-Charge:	Jacek Bogatko			
Investigating Authority:	STATE COMMISSION ON AIRCRAFT ACCIDENTS INVESTIGATION (PKBWL)			
Accredited Representatives and their advisers:	NONE			
Document containing results:	FINAL REPORT			
Safety recommendations:	NONE			
Addressees of the recommendations:	NOT APPLICABLE			
Date of completion of the investigation:	4 March 2020			

SYNOPSIS

On 09 June 2018, around 11:52 hrs UTC (all times in the Report are in UTC) two Van's aeroplanes took off for the group flight on the route Lviv – Rzeszów Jasionka (EPRZ). After about 45-minute flight the leading aircraft landed on RWY 09 of EPRZ aerodrome. When on a stand, the crew of the leading aircraft noticed that the other one was not visible. After several attempts to establish communication on both the EPRZ TWR and emergency frequency the crew of the leading aircraft informed the Tower that the other plane landed before reaching RWY 09 threshold. Rescue teams were activated and the aerodrome was closed. About 5 minutes after the occurrence time the emergency services arrived at the accident site (Fig. 1).



Fig.1. Damaged airplane and cars of the aerodrome rescue services. [source: PKBWL]

The crew and a traveler left the aircraft unaided. One pilot and the traveler were transported to the hospital by ambulances and the other pilot by LPR helicopter. As a result of the accident one of the pilots suffered serious injury, the other minor injury and the traveler was not injured. After arriving at the accident site, the State Commission on Aircraft Accidents Investigation found that there was no fuel in the right fuel tank of the aircraft.

The investigation into the occurrence was conducted by the PKBWL Investigation Team in the following composition:

Jacek Bogatko	Investigator-in-Charge
Roman Kamiński	Team Member
Ireneusz Boczkowski	Team Member

In the course of the investigation PKBWL determined the following most likely causes of the accident:

- 1. Improper monitoring of fuel consumption by the crew during the flight.**
- 2. Fuel exhaustion from the right tank which led to the engine stopping and emergency landing.**

Contributing factors:

1. POH not consistent with the actual state of the aircraft cockpit regarding the setting and description of the fuel selector valve.
2. Little experience of the pilots in flying RV-10 aircraft.

After conclusion of the investigation PKBWL has formulated one safety recommendation.

1. FACTUAL INFORMATION

1.1. History of the flight

On 09 June 2018 around 8:32 hrs RV-10 aeroplane, registration marks UR – PMAV, took off from the Biała Cerkiew aerodrome near to Kiev for a flight to Dresden with a stopover in Lviv and Rzeszów. There were two pilots and a traveler on board. The flight was carried out according to VFR. Before departure from Lviv, the pilot, who had more experience (hereinafter referred to as Pilot 2), visually checked the fuel quantity in the tanks and stated that each of them was filled with fuel to "more than a half". From Lviv the flight was performed as a group flight according to the flight plan of the RV-14 aeroplane with UR-PWTF registration marks. The planes were planned to land on EPRZ for customs clearance, refueling and meeting with RV aircraft from Lithuania.

Prior to entering the EPRZ control zone the crew of the leading airplane established communication with EPRZ Tower and received clearance for both aircraft to land (the leader as number one and UR-PMAV as number two). In order to increase the separation between the planes, the pilot of UR-PMAV made two circles and only then turned on final for landing (Fig. 2).



Fig 2. Final portion of the flight according to GPS recording.

After landing on RWY 09 and vacating it the crew of the leading aircraft expected that UR-PMAV was on final and would land just after them. Because it did not land, the crew of the leading aircraft and EPRZ Tower attempted to establish communication with it but failed. Around 12:42 hrs the crew of the leading aircraft reported to the Tower that UR-PMAV had made an emergency landing short of RWY 09 threshold (Fig. 3). They obtained such information by phone from the crew of UR-PMAV.



Fig 3. Sketch of the accident site.

After an emergency landing, the crew and traveler left the aircraft unaided. Then Pilot 2 asked the passenger to check setting of the fuel selector valve. The passenger found the valve in the sum (Σ) setting. About five minutes later airport emergency services arrived at the scene. The pilot from the left seat (Pilot 1) was transported to the hospital by LPR helicopter, while Pilot 2 and the passenger by ambulances. The airport management notified the State Commission on Aircraft Accidents Investigation (PKBWL) of the occurrence. Upon arrival PKBWL investigators inspected the scene of the accident. Then the plane was transported to a hangar at EPRZ, where further checks were carried out.

1.2. Injuries to persons

Injuries	Crew	Passengers	Others	TOTAL
Fatal	0	0	0	0
Serious	1	0	0	1
Minor	1	0	0	1
None	0	1	0	1

1.3. Damage to aircraft

The airplane was substantially damaged. It sustained damage to the wings, front and center of the fuselage, propeller and landing gear, which was broken (Fig. 4,5,6).



Fig. 4. Damaged airplane - front view. Visible damaged propeller, wings and separated nose landing gear. [source: PKBWL]



Fig. 5. Damaged airplane – right side view. Visible damaged right main landing gear, right wing, lower part of the fuselage and broken aileron. [source: PKBWL]



Fig. 6. Damaged airplane - left side view. Visible damaged the left main landing gear and left wing. [source: PKBWL]

1.4. Other damage

As a result of the accident, the grass surface of the aerodrome in the area of approach lights on the right side of the runway centre line was slightly damaged. A small fuel leakage occurred but it did not pose a hazard to the environment.

1.5. Personnel information (crew data)

Pilot 1 – male, aged 44, holder of PPL with SEP(L) and VFR ratings, valid until 26 Dec 2018. Aero-medical certificate, class 2, valid until 08.06.2020 with VDL limitation. According to his statement the pilot had a total flight time about 100 hours. The accident flight was his first flight (under the supervision of pilot 2) on RV-10.

Pilot 2 – male, aged 48, holder of PPL with SEP(L), VFR and FI ratings, valid until 15 Jul 2018. Aero-medical certificate, class 2, valid until 19 Jul 2018 with no limitations. The pilot had a total flight time of 1033 h 18 min. Prior to the accident flight the pilot made two flights on RV-10 lasting 2 h 24 min. Over last ten days prior to the accident (without the accident flight) he made 54 flights in 14 h 08 min.

Traveler – male aged 20 – his task was to take photos and videos.

1.6. Aircraft information

Fuselage of semi-monocoque metal structure. Landing gear fairings, engine cowlings, propeller spinner, the tips of the wings and tail are fabricated from fiberglass. The fuselage houses a four-person cabin with a classic arrangement of seats - two at the front for pilots, two at the rear.

Wings of metal construction, covered with sheet metal, with a rectangular contour and a fixed profile along the span. The wing structure consist of the main flange spar with flanges narrowing towards the end, and a supporting rear spar with a fixed cross-section along the wingspan.

The aileron and flap attachments are on the rear spar. The leading edge of the wing is riveted to the front outside part of the spar and the fuel tank is inside. The fiberglass wing tips are attached to the wings with screws. The landing and taxiing lights are at the ends of both wings.

The aircraft is equipped with a tricycle landing gear with a nose wheel and a classic empennage. The flight control system is dual. The three view figure and basic dimensions of the aircraft are shown in Fig. 7.

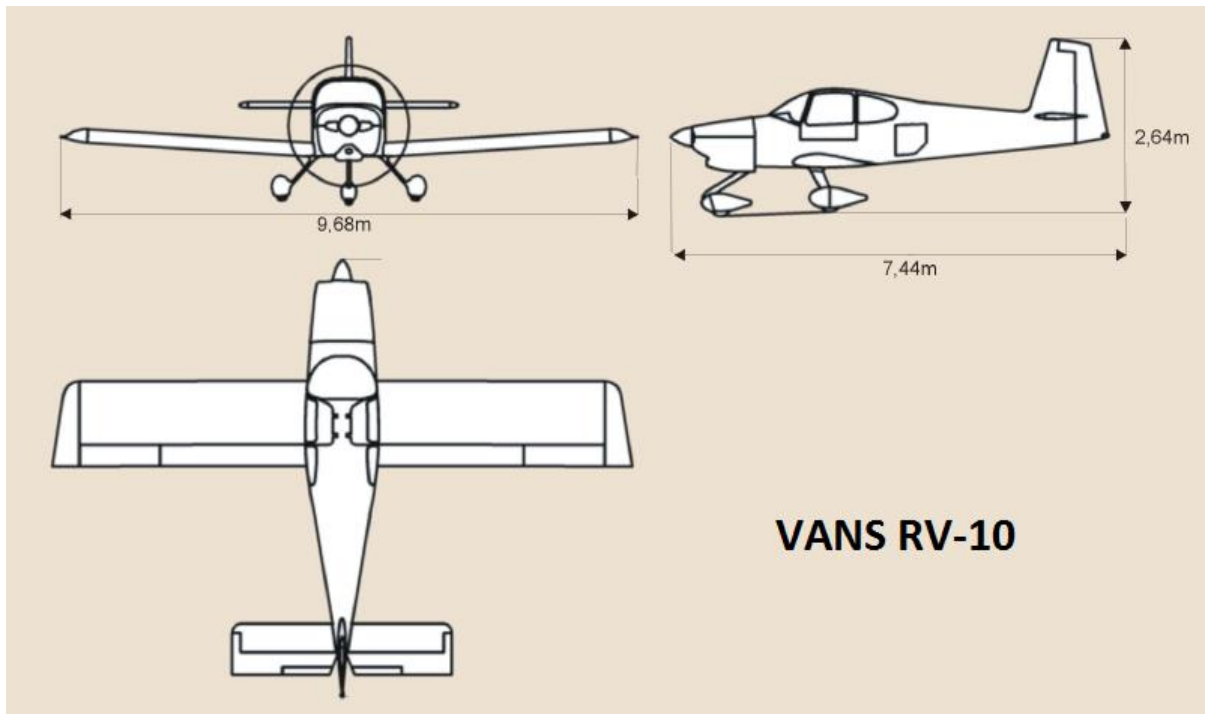


Fig. 7. Three view figure and basic dimensions of the plane. [source: POH]

The aircraft has two fuel tanks located in the wings with a capacity of 110 l each. The unusable quantity of fuel in the tanks is 10 liters.

The fuel system in the accident aircraft consists of the fuel tanks in wings, connected via rigid pipes with a four-position fuel selector valve (*closed*, and written with felt-tip marker *left, right, sum* (Σ)) then via rigid pipes with a fuel filter and electric fuel pump and flowmeter. Then, via flexible hoses, the fuel flows to the engine fuel pump, injection pump and pressure sensor and then it is transferred to the engine's fuel system.

Fuel tanks are equipped with electric resistance fuel gauges. The reading of fuel quantity is possible on any (main or auxiliary) or both EFIS displays.

Year of manufacture	Manufacturer	Airframe Serial No	Registration marks	Register Number	Register date
2018	Amateur construction	41759	UR-PMAV	4520	23.05.2018

Permit to fly issued	31 May 2018
Airframe total flight time since new:	24h 48 min
Total cycles since new:	27
Flight time until the next overhaul or inspection	25h 12 min
Date of the last periodic operations:	08.06.2018
Next periodic operations	„50” H

Engine: Lycoming YIO-540 D4A5, six-cylinder, horizontally opposed, air-cooled, fuel injected. Fuel: AVGAS 100LL or automotive fuel 91/96 octane.

Year of manufacture	Manufacturer	Serial number
-	Textron Lycoming	LL-36740-48E

Date of the engine installation on the airframe: 04.04.2018

Maximum take-off power: 260 HP

Engine total operation time since new: 24h 48 min

Date of the last periodic operations: 08.06.2018

after operation time: 22h

Next periodic operations: „50” H

During the periodic operations engine oil was changed – recommended oil change in a new engine - after 25 h of operation.

Oil & lubricants prior to the flight:

Fuel (approximately): AVGAS 100 LL;110 l;

Oil: Aero Shell W 100;9qt;

Aircraft loading:

- empty mass: 725 kg
- fuel mass: 84 kg
- oil mass: 8,0kg
- crew mass: 250 kg
- baggage mass: 10 kg

Total mass:

- permissible: 1199 kg
- actual: 1077kg

The aircraft mass was within the limits specified in POH.

Balance of the aircraft complied with requirements specified in POH.

1.7. Meteorological information

Meteorological conditions had no impact on the accident.

1.8. Aids to navigation

The aircraft was equipped with the GARMIN GTN 650 GPS / NAV / COMM SYSTEM, GPS GARMIN GPS MAP 696 and the GARMIN G3xGcm 307 PILOT.

1.9. Communications

The aircraft was equipped with the GARMIN GTN 650 GPS / NAV / COMM SYSTEM, GARMIN COM RADIO GTR 225A and GARMIN GTX-335 DIGITAL TRANSPONDER, for which Radio Permit No. 7763 was issued.

The accident airplane was flying as the lead one, therefore the communication with EPRZ Tower was maintained by the leader. The correspondence was readable and conducted in English (a copy of the communication record obtained from PANSA).

1.10. Aerodrome information

EPRZ aerodrome: geographical coordinates: 50°06'35"N; 022°01'08"E, elevation AMSL 693 ft. Runway direction 09/27. Runway dimensions 3200mx45 m.

The runway is made of 700 m cement concrete, the rest is asphalt concrete.

On the direction of 09 it is equipped with ALPA-ATA precision approach lights CAT I with flashing lights.

On the direction of 27 it is equipped with ALPA-ATA precision approach lights CAT II with flashing lights and PAPI. In this direction, the aerodrome has NDB/BIA, DVOR/DME and ILS/DME systems.

1.11. Flight recorders

The aircraft was equipped with GARMIN GTN 650 GPS / NAV / COMM SYSTEM, which enables graphical planning of flight and records some flight parameters.

1.12. Wreckage and impact information

The plane collided with the ground at an angle of about 27°. The plane was in a stall. According to PKBWL, this was the first phase of autorotation to the right (Fig. 8).



Fig. 8. Last portion of the flight. [source: aerodrome management]

The touchdown took place about 630 m from RWY 09 threshold and about 20 m from its centre line (Fig. 9).

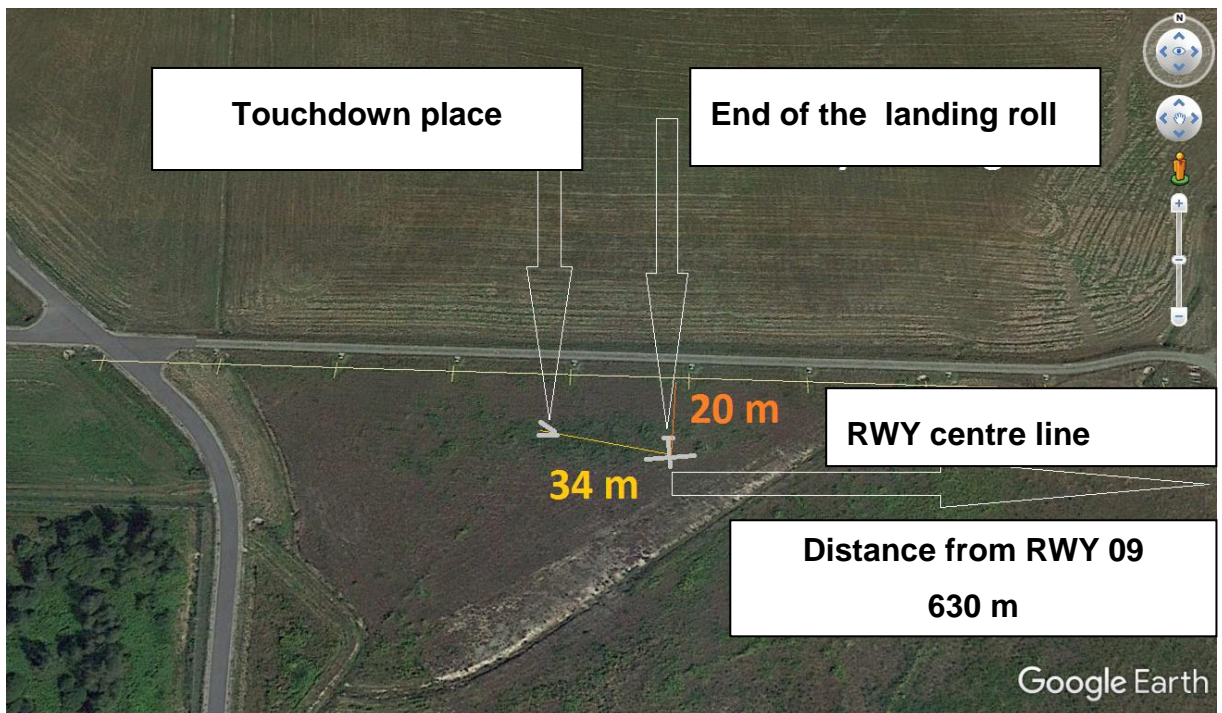


Fig. 9. Sketch of the occurrence place [source: PKBWL]

During the touchdown landing gear was broken. The plane came to rest after about 34 meters of the landing roll, during which it turned to the right by about 80° in relation to the direction of landing. The main landing gear did not separate from the plane, it was symmetrically broken backwards, its wheels damaged the wings of the plane. The fairings of the main landing gear wheels were destroyed, their fragments were found between the touchdown place and the wreck of the plane. The strut of the nose landing gear was broken and moved to the right during the rotation of the aircraft after the touchdown, the nose wheel was separated and was found next to the right wing (Fig. 10,11).



Fig. 10. Separated nose wheel and bent propeler blade. [source: PKBWL]



Fig. 11. Touchdown marks and fragments of the landing gear fairings [source: PKBWL]

During the accident one of the aircraft propeller blades was bent (Fig. 10).

The kinematic continuity of the aircraft control system was preserved until the collision with the ground.

During the collision the control stick was blocked in the position fully tilted backward and slightly to the left. The right aileron drive (pusher) was broken.

1.13. Medical and pathological information

Pilot 1 was transported to the hospital by helicopter. Due to the fact that he suffered only minor injuries, on the day of the accident he left the hospital on his own request. No alcohol was found in the pilot's blood.

Pilot 2 was transported by ambulance to Kliniczny Szpital Wojewódzki nr 2 in Rzeszów. The examinations carried out in the hospital showed numerous fractures of the lumbar spine, fracture of the L1 vertebral body, trauma to the right upper and lower limb and abdominal injury. After initial treatment the pilot left the hospital for further treatment in Kiev. No alcohol was found in the pilot's blood.

The traveler (sitting in the rear seat on the left) was transported to the hospital by an ambulance. The admission room did not record his admission to hospital. Most likely he abandoned hospitalization.

1.14. Fire

The aircraft did not catch fire after the emergency landing.

1.15. Survival aspects

All persons on board had the seat belts properly fastened.

When the airplane came to rest after the accident Pilot 1 left the cockpit as the first one. After leaving the cockpit, he disconnected the power supply with the main switch to prevent the airplane fire. The next was Pilot 2 who left the airplane, followed by the traveler. Then Pilot 2 instructed the traveler (who was not injured) to return to the cockpit and check setting of the fuel selector valve. He did not instruct the traveler to close the fuel selector valve, which could have resulted in the airplane fire if the engine fuel system had been unsealed.

Emergency services arrived at the scene about 5 minutes after the occurrence. LPR helicopter was called to ensure quick transport of Pilot 1 to hospital. Pilot 2 and the traveler were transported to hospital by ambulances.

After arriving at the scene the Airport Fire Brigade found a slight fuel leak and did not cover the aircraft with fire foam. A firemen vehicle was placed near the aircraft in full readiness to carry out a firefighting operation.

1.16. Tests and research

Upon arrival at the scene of the accident on 9 June 2018 PKBWL members found the plane in the same condition as it was after the emergency landing. Visual inspection was carried out and photographic documentation of the accident site was made.

On 12 and 13 June 2018 PKBWL members conducted a detailed inspection of the engine and the fuel system of the aircraft and read out the data stored in GARMIN GTN 650 GPS / NAV / COMM SYSTEM.

On 20 June 2018, the interior of the fuel tanks was inspected using the XL LV VIDEOPROBE endoscope.

1.17. Organizational and management information

The aircraft is the property of LLC "AQANOVA HYDRORESOURCE" company. A power of attorney was issued for both pilots authorizing them to fly RV-10 aircraft with UP-PMAV registration marks.

1.18. Additional information

In accordance with item 6.3 of the ICAO Annex 13, Draft Final Report was sent for comments to the Ukrainian NATIONAL BUREAU FOR INCIDENTS AND ACCIDENTS INVESTIGATION OF CIVIL AIRCRAFT, which submitted its comments to PKBWL. These comments were taken into account in the Final Report.

1.19. Useful or effective investigation techniques

Standard investigation techniques were applied.

2. ANALYSIS

2.1. On-site activities

Upon arrival at the scene members of the Commission first checked the fuel quantity in the aircraft tanks. The right tank was empty, while the left one was filled with fuel to about half of its capacity. The fuel level in both tanks was measured with a ruler. After removal from the right tank the ruler was dry and after removal from the left tank the ruler was wet up to 8 cm on the scale. (Fig. 12).

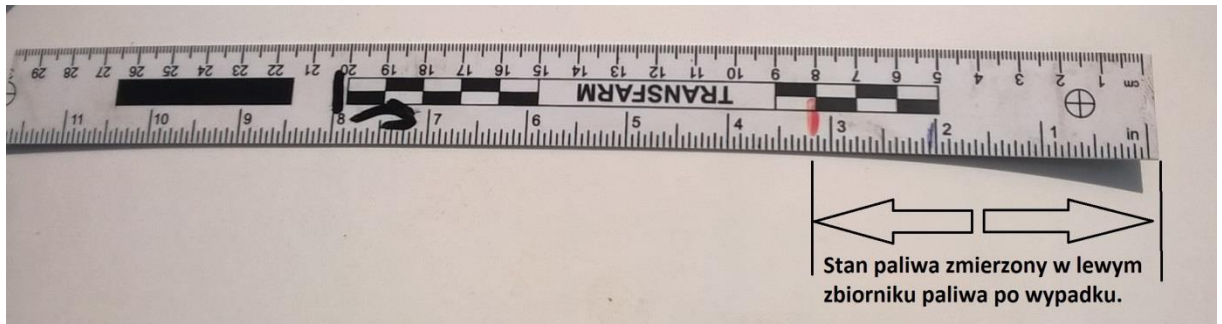


Fig. 12. Level of fuel in the left tank marked with red line on the ruler. [source: PKBWL]

There was a slight smell of fuel in the air. Probably a small quantity of it leaked to the ground through drain valves located at the bottom of the wing near to fuselage. The leakage was so small that the fire brigade decided not to use foam to protect the aircraft against fire.

On 30 August 2018, a RV-10 aircraft similar to the accident one (identical fuel tank capacity) was refueled to the level marked after the accident on the ruler scale. After refueling, the fuel gauge indicated 54,82 liters.

During inspection of the cockpit it was found that the fuel selector valve was set on the sum (Σ) setting. The description of the valve settings was made with a felt-tip pen on the factory sticker - not in accordance with the original (Fig. 13).

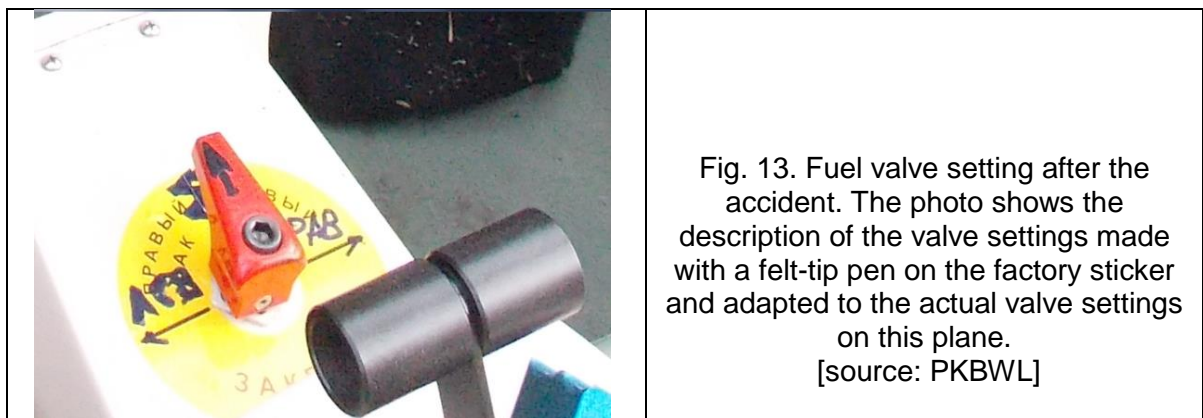


Fig. 13. Fuel valve setting after the accident. The photo shows the description of the valve settings made with a felt-tip pen on the factory sticker and adapted to the actual valve settings on this plane.
[source: PKBWL]

Despite this valve setting, the fuel did not flow from the left to the right tank during the visual inspection. After visual inspection of the aircraft at the scene it was lifted by the

airport fire brigade on air cushions. During this operation, the aircraft was moving up unevenly and the fuel from the left tank began to flow through the open fuel selector valve to the right tank. Next, the fuel was drained from tanks through drain valves (Fig. 14). About 23 liters of fuel was drained from the right tank and about 30 liters from the left one.

The quantity of fuel drained from the aircraft tanks (about 53 l) was close to the quantity in the left tank measured with the ruler after the accident. This indicates that all the fuel has been consumed from the right tank during the accident flight.



Fig. 14. Fire brigade in the course of emptying the left tank. [source: PKBWL]

2.2. Visual inspection of the engine and fuel system

On 12-13 June 2018 the Commission members conducted a detailed inspection of the aircraft engine and fuel system. During the inspection the following facts were established and the following checks were carried out.

1. Lack of fuel or oil leaks.
2. When rotating the propeller, no resistance that could indicate engine damage.
3. The engine oil quantity - 9 qt, enough for the flight.
4. Magnetos connected correctly, no loose cable connections.
5. Oil filter sealed.
6. Electrical installation connected except for the landing light.
7. The landing light was fixed by one of the three mounting screws only.
8. Lack of fuel in the supply line after disconnecting it from the fuel selector valve.
9. Dry fuel lines supplying fuel from the fuel selector into the cylinders.

10. Only traces of fuel were found in the line supplying fuel to the engine after disconnecting the fuel lines on the fuel pump. No fuel in the fuel pump and the line supplying fuel to the fuel selector valve.
11. The condition of the spark plugs indicated that the fuel-air mixture during the flight was rich.
12. When the aircraft electrical system was turned on the fuel gauge of left fuel tank indicated that the tank was empty. The fuel gauge of the right tank showed 10 liters of fuel (both tanks were empty).
13. The carburetor fuel filter was removed. The filter was clean. During removal only traces of fuel leaked out.
14. Four-position fuel selector valve; description of valve settings made with a pen.
15. No irregularities were found in the part of the fuel system under seats and in the tunnel between the seats where the fuel selector valve, fuel filter, electric fuel pump and flow meter are mounted.
16. Connection of the fuel selector valve with the fuel system was checked and found as shown in Fig. 15.

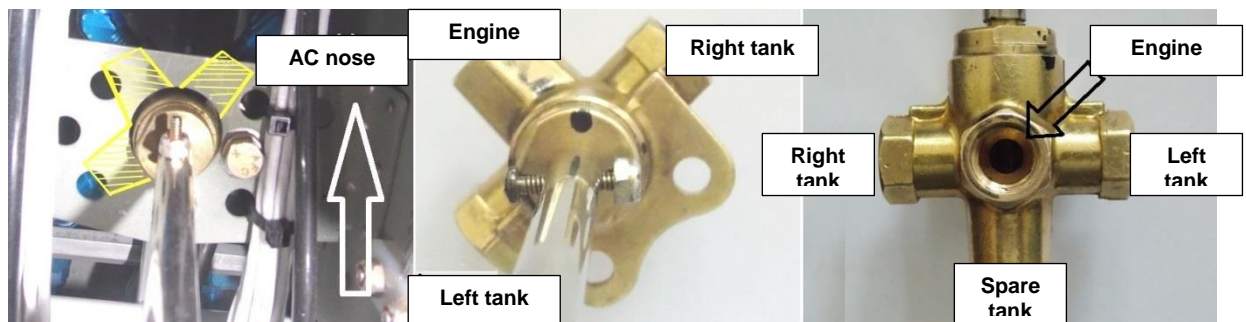


Fig. 15. Connection of the fuel lines to the fuel selector valve [source: PKBWL].

17. The tanks were filled with fuel and the flow through the fuel selector valve was checked in all settings - the fuel selector valve was working properly.
18. Fuel lines preserved their continuity and patency even if the left line was indented.
19. The fuel selector valve was removed for further inspection, which confirmed its proper operation.

On 20 June 2018 the following additional checks of the fuel system were carried out.

1. Patency of the fuel tanks venting system - with a positive result.
2. Patency of the fuel lines - with a positive result.
3. Purity of fuel removed from the fuel tanks - no impurities found.

4. Inside of the fuel tanks was checked using an endoscope. No damage or contamination of the tanks was found during the above checks. The photographic documentation was made (Fig. 16).

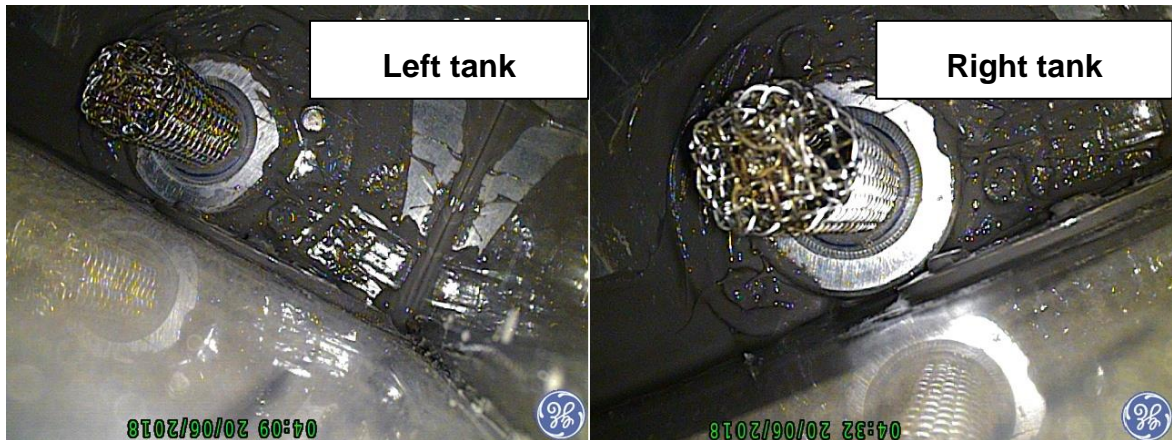


Fig. 16. The inside of the left and right fuel tanks. Visible fuel mesh filters mounted on the ends of fuel lines [source: PKBWL].

PKBWL members participated in the disassembling of the aircraft for transport to Ukraine. After removal of the wings, the Commission members once again checked the patency of the fuel lines and the venting of the fuel tanks with the positive result. Float fuel sensors installed in the fuel tanks were removed and checked, they moved freely without jamming (Fig. 17).

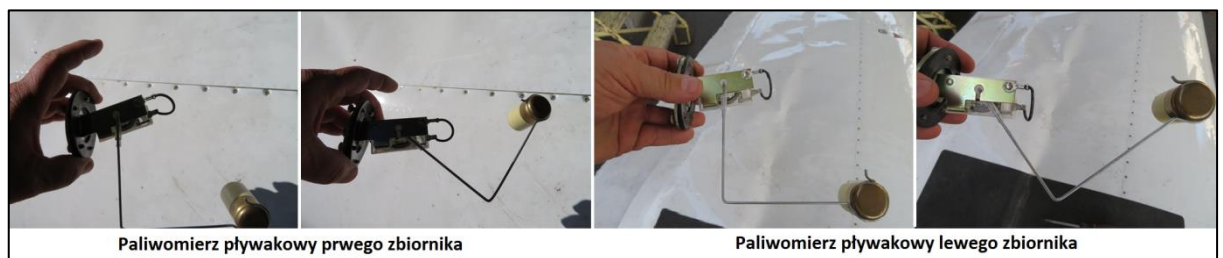


Fig. 17. Float fuel sensors after removal from fuel tanks [source: PKBWL].

Inspection of the engine and fuel system showed that there was no fuel in the fuel system of the engine, the system was patent and its individual elements were operative. This indicates that the engine stopped due to lack of fuel.

2.3. Pilot's Operating Handbook

Due to the fact that the RV-10 is an aircraft in the "Special" category sold in kits, a particular owner can adapt it to some extent to his own needs. However, it should be remembered that the POH should reflect such changes. A four-position fuel selector valve (left, sum, right, closed) was used in the accident plane while the kit supplied to a customer is equipped with three-position valve (left, closed, right) and the operation of such a valve is described in POH. PKBWL found, that the accident airplane was equipped with a fuel selector valve operating in a way different from that described in the check lists in POH. POH check lists describe, inter alia, the crew actions to be effected before the engine start and before entering a runway (Fig. 18, 19).

КАРТА КОНТРОЛЬНОЙ ПРОВЕРКИ ПЕРЕД ЗАПУСКОМ ДВИГАТЕЛЯ

Выключатели зажигания в положении - «ВЫКЛ».

На приборной доске включить АЗС:

- «СЕТЬ»;
- «ГЕНЕР»;
- «РАДИОСТ»;

Проверьте:

- стрелки приборов - в исходном положении;
- показания топливомера;
- работу радиостанции - на рабочей частоте запросите РП.

Установите:

- тормоз в положение - включен;
- **топливный кран в положение - открыт;**
- РУД в положение – 0,5 см. выше МГ.

Fig. 18. **Prior to engine start** checklist

ПЕРЕД ВЫРУЛИВАНИЕМ НА ВПП

Осмотреться: нет ли помех впереди, слева, справа, не заходит ли самолет на посадку;

проверить:

- показания приборов контролирующих работу двигателя;
- температура головок цилиндров – не менее 65 °С и не более 220°С;
- температура масла - не менее 65 °С и не более 118°С;
- давление масла - не менее 3,7 кг/см² и не более 6,4 кг/см²;
- фонарь кабины – закрыт;
- частота радиостанции – установлена правильно;
- полетные приборы показывают заданные параметры;
- запас топлива соответствует полетному заданию;
- топливная смесь богатая;
- **топливный кран установить на правый или левый бак;**
- триммер руля высоты стоит нейтрально;
- включение топливного насоса;
- работу 2-х магнето (разница в оборотах не более 50 об/ мин.);
- винт изменяет обороты с высоких до малых;
- установку РУДом оборотов от минимальных до взлетных;
- колеса заторможены;
- закрылки во взлетном положении от 0 до 20°.

Fig. 19. **Before entering runway** check list

“Prior to engine start” checklist reads: *“fuel valve setting - open”*. It means that for starting engine the fuel selector valve can be in the position: left, sum or right.

However, the **“Before entering runway”** check list reads: *“set the fuel valve on the right or left tank”*. The *“sum”* setting was not listed, which in this case seems to be the most appropriate to perform a flight. As Pilot 2 testified, *“Pilot 1 took off in Lviv ... I was Pilot Flying for the rest of the flight”*. Pilot 1 had no experience in flying this

aircraft. If he had completed the actions according to **“Before entering runway”** check list, he would have changed the fuel selector valve setting from the **“sum”** to the **“right”** setting.

2.4. Fuel consumption

The first segment of the flight began in Biała Cerkiew near Kiev at 8:32 hrs and ended in Lviv at 10:32 hrs (Fig. 20).



Fig.20. The flight route from Kiev to Lviv and the flight time as recorded by GPS.

The pilot stated that during the flight to Lviv the fuel selector valve was set to the sum (the engine was taking fuel from both tanks). The pilot stated *"I refueled aircraft in Biała Cerkiew with 220 liters of fuel, i.e. 110 liters in each tank, I checked visually in Lviv, it was half in each tank. The plane consumes up to 45 liters per hour, I would fly to Dresden with this fuel"*.

On the Kiev-Lviv segment of about 477 km, the engine consumed about half of the fuel, the flight lasted 2 hours, so the fuel consumption was about 55 l/h. From Lviv (where the pilot checked the fuel level visually) to Dresden about 740 km remained, so on the flight parameters maintained during the flight from Kiev to Lviv, the aircraft would not have reached Dresden. The pilot incorrectly assessed the fuel consumption.

The POH for the accident airplane does not specify fuel consumption per hour or range of the aircraft dependent on flight parameters.

In further considerations, the assessment of fuel consumption in the accident flight was carried out based on a table in POH of the same type of aircraft flying in Poland. Based on the table (Fig. 21), it was assumed that fuel consumption was 14,4 US Gal/h (54,72 l/h).

Altitude 3000 ft STD, $t_0 = 20^\circ\text{C}$, $p_0 = 1017 \text{ hPa}$

RPM	Manifold Pressure (in/Hg)	Speed (kts)	Power %	Fuel consumption (US Gal/h)
2100	22	126	54	11.0
2350	24	136	69	14.4
2450	25	148	77	16.6
2660	25,9	156	87	22.5

Fig. 21. Fuel consumption table for various cruise flight parameters taken from POH Chapter 5 Performance.

Prior to departure from Lviv to Rzeszów, the pilot visually checked the fuel quantity in both tanks and found that each of them was filled with fuel up to about half of its capacity. The total capacity of the fuel tanks given in POH of this aircraft is 220 liters (including 10 liters of unusable fuel). During the flight from Kiev to Lviv the engine consumed:

$$2\text{h} \times 54,72 \text{ l/h} = 109,44 \text{ l}$$

Assuming about 9 min of engine operation on the ground during warm-up, test run and taxiing on both airports (0,25 l per minute of engine operation) it makes:

$$9 \text{ min} \times 0,25 \text{ l/min} = 2,25 \text{ l}$$

So in total the engine consumed:

$$109,44 \text{ l} + 2,25 \text{ l} = 111,69 \text{ l}$$

Therefore, in Lviv the fuel quantity in the tanks would be:

$$220 \text{ liters} - 111,69 \text{ liters} = 108,31 \text{ liters}$$

So in each of the tanks there was about:

$$\frac{108,31 \text{ l}}{2} \approx 54,16 \text{ l}$$

The flight from Lviv to Rzeszów lasted 48 minutes (Fig. 22 (Fig. 22)).

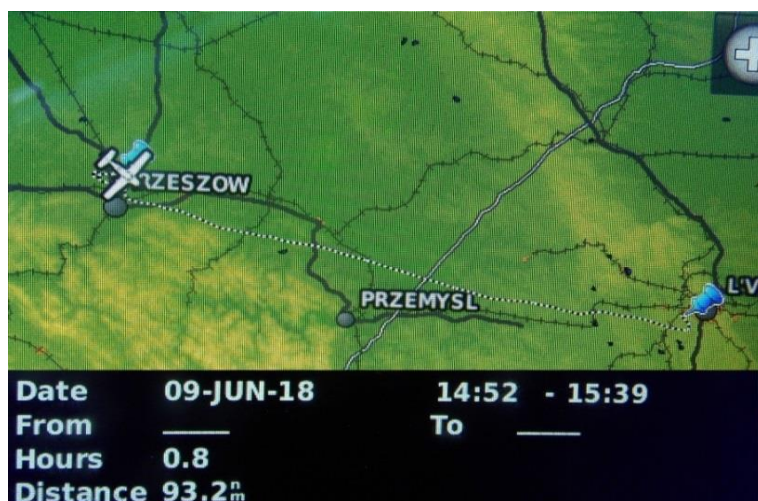


Fig.22. The flight route from Lviv to Rzeszów and the flight time recorded by GPS

Therefore, during this flight the engine consumed:

$$\frac{48 \text{ min} \times 54,72 \text{ l}}{60 \text{ min}} \approx 43,78 \text{ l}$$

Assuming 5 minutes of engine operation during warm up and taxiing in Lviv, it used:

$$5 \text{ min} \times 0,25 \text{ l / min} = 1,25 \text{ l}$$

Adding fuel consumption on the ground and during the flight, it makes:

$$43,78 \text{ l} + 1,25 \text{ l} \approx 45 \text{ l}$$

Since during the inspection no fuel was found in the right tank, it was assumed that the flight from Lviv to Rzeszów was performed on the fuel from the right tank only. The engine consumed 45 liters of fuel and according to earlier calculations before take-off from Lviv in each tank was about 54,16 liters left, so if the flight from Lviv to Rzeszów was carried out on the fuel from one tank only, the remaining fuel in it should be:

$$54,16 \text{ l} - 45 \text{ l} = 9,16 \text{ l}$$

The unusable fuel quantity for this aircraft given in POH is 10 liters, or 5 liters for each tank, therefore:

$$9,16 \text{ l} - 5 \text{ l} = 4,16 \text{ l}$$

According to the assessment, 4,16 l of consumable fuel should remain in the tank. Because the RV-10 was number 2 for landing, it made two circles to the left to increase separation between planes (leading and led - Fig. 2). The aircraft was rolled to the left, therefore the fuel remaining in the tank was close to the fuselage, from where fuel is supplied to the engine. After the second circle pilot rolled the plane to the right, correcting the flight direction to the right, and after a while the engine stopped its operation.

In PKBWL opinion, during this manoeuvre the rest of fuel in the tank could have moved to its outer part from which the fuel could not be supplied to the engine.

A Polish pilot, owner of the RV-10 aircraft stated that the average fuel consumption of his aircraft in en route flights was 55 l/h.

In PKBWL opinion, based on the analysis it can be concluded that the entire flight from Lviv to Rzeszów was performed on the fuel from the right tank.

2.5. Flight crew experience, preparation for the flight and the flight

The RV-10 accident aircraft was a new one. Pilot 1 had no experience in flying this type of aircraft. Experience of Pilot 2 was also little. According to the entry in the flight book, he made one 36-minute flight on this aircraft on 30 May 2018. His next flight was on the day of the accident from Biała Cerkiew to Kiev.

In his statement Pilot 2 said, *"The aircraft consumes up to 45 liters per flight hour"*. In the Commission opinion, if Pilot 2 assumed such fuel consumption, he did not take into account the fact that he would perform the flight as a led one and he would have to adapt to the flight parameters of the leader, flying an RV-14 plane. Estimated cruising speed on the segment was 135 kt. Based on the table in Fig. 21, at this speed the plane consumes approx. 14,4 Gal/h (over 54,72 l/h).

During the inspection of the aircraft it was found that in GARMIN GTN 650, which allows flight planning, the declared fuel consumption was 40 l/h at the speed of 135 kt. In the Commission opinion, the declared fuel consumption in normal conditions at the estimated cruising speed of 135 kt was impossible to achieve.

The occurrence of the accident could have been affected by incorrect readings of the right fuel tank gauge. With empty tank, the fuel gauge showed 10 liters. The pilots, when checking the fuel quantity with the fuel gauge, could have thought that its quantity have been enough to complete the flight. Pilots may have not noticed that fuel was unevenly drawn from the tanks.

The Commission was unable to determine whether the damage to the fuel gauge occurred prior to the accident or during the accident.

During the flight Pilot 1 occupied the left seat and Pilot 2 the right one. Pilot 2 testified that Pilot 1 took off in Lviv and in Rzeszów: *"I performed landing because I am a more experienced pilot because I have over 1000 flight hours, ... (Pilot 1) monitored and learned (trained) in landing"*.

Pilot 2 has an instructor rating, he did not include the accident flight in his flight log.

The engine stopped when the aircraft was on final at a height of about 50 m at a distance of about 1 km from the runway threshold. Pilot 2 stated, *"I felt (noticed) that there was a lack of thrust and as the plane was falling down. I told (Pilot 1) to add power, he said that there was no power, I took hold of the engine control handle and tried to add power but it did not bring any results"*.

Pilot 2 stated that when he noticed that they were not able to reach the runway, he took control of the aircraft. He noticed in front of him the poles of approach lights and to avoid collision with them he turned right. The area on the left of the approach lights was better for emergency landing (Fig. 23).

As the pilots' relations were inconsistent and illogical, in the Commission opinion, the course of the occurrence could have been different.

However, it should be noted, that the pilots operated in a time deficit and the choice of a landing site was rather a matter of impulse. Immediately after correcting the flight direction, Pilot 2 pulled the joystick backward. The plane raised nose and entered the first phase of a stall and a moment later hit the ground with the main landing gear.

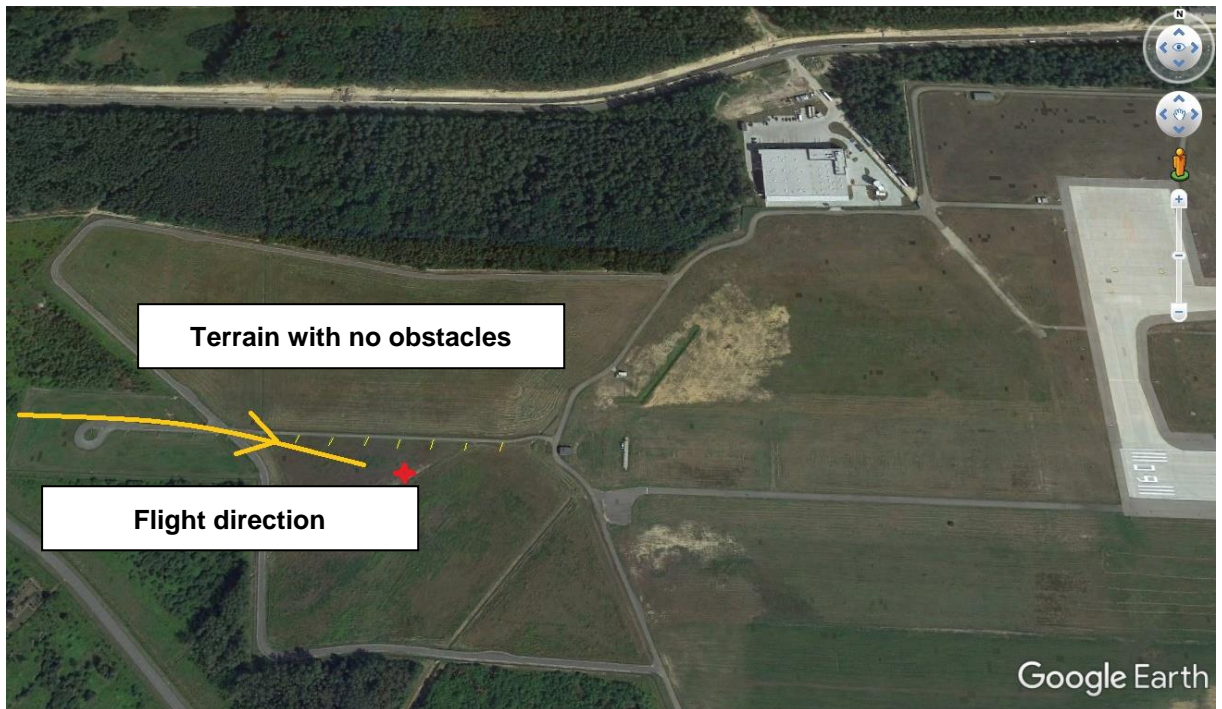


Fig.23. Terrain in front of the runway.

The nature of breaking the main landing gear indicates that it was the first to come in contact with the ground. The touchdown occurred symmetrically at a high vertical speed.

The nature of breaking the nose landing gear leg and wheel indicates that it occurred during the rotation of the aircraft after the touchdown.

The nature of damage to the propeller shows that it was not rotating and the engine was not running at the time of the touchdown.

After the emergency landing Pilot 2 asked the traveler for going to the cockpit to check the setting of the fuel selector valve. The traveler stated that the valve was in the sum (Σ) position.

In the Commission opinion, the pilot should follow the procedure from POH and instruct the traveler to set the fuel selector valve in the closed position to minimize the possibility of fire.

3. CONCLUSIONS

3.1. Commission findings

1. The aircraft was fit for flight and had all the documents necessary to perform the flight.
2. The pilots had the necessary ratings to perform the flight.
3. The pilots had little experience in flying RV-10.
4. Upon arrival at the scene PKBWL members stated that the right fuel tank was empty and the left one was half filled with fuel.
5. Upon arrival at the scene PKBWL members members stated that the fuel selector valve was set to the sum (Σ) position.

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6. Approximately 53 l of fuel was extracted from the aircraft fuel tanks.
7. Until the collision with the ground, the kinematic continuity of the aircraft control surfaces drives were preserved.
8. During the collision with the ground the stick was blocked in the backward position slightly tilted to the left.
9. The nature of damage to the propeller indicates that at the time of the touchdown the propeller did not rotate and the engine was not running.
10. The aircraft's fuel system was patent.
11. Only traces of fuel were found in the engine fuel system.
12. Fuel gauge of the right tank indicated 10 liters when the tank was empty.
13. The fuel selector valve settings were not correctly described in the checklists in POH (approved by the Civil Aviation Authority of Ukraine on 4 April 2018).
14. Based on the analysis of fuel consumption, it can be concluded that the flight from Lviv to Rzeszów was performed on fuel taken from the right tank.

3.2. Causes of the accident

Most likely causes of the accident were:

- 1. Improper monitoring of fuel consumption by the crew during the flight.**
- 2. Fuel exhaustion in the right tank which led to the engine stopping and emergency landing.**

3.3. Contributing factors

1. POH not consistent with the actual state of the aircraft cockpit regarding the setting and description of the fuel selector valve.
2. Little experience of the pilots in flying of RV-10 aircraft.

4. SAFETY RECOMMENDATION

The State Commission on Aircraft Accident Investigation recommends that the State Aviation Administration of Ukraine (CAA of Ukraine) carry out a check of the consistency of the fuel selector valve description in the cockpits of RV-10 aircraft registered in Ukraine with the descriptions contained in their respective Pilot's Operating Handbooks.

5. ANNEXES

None.

THE END

Investigator-in-Charge

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