

AIR, MARITIME, AND RAILWAY ACCIDENT INVESTIGATION NATIONAL BOARD 9, Dyakon Ignatiy Street, 1000 Sofia, Bulgaria https://www.ntib.bg

SAFETY INVESTIGATION REPORT



Ref.: AAIU-2023-04

Issue date: November 5, 2024

Status: FINAL ACCIDENT, OCCURRED ON JULY 26, 2023, INVOLVING M-18A "DROMADER", AIRCRAFT REGISTRATION LZ-KEC OPERATED BY "KENTAVAR" SOLE TRADER, DURING AGRICULTURAL FLIGFT IN THE AREA OF ZEMLEN VILLAGE, STARA ZAGORA DISTRICT.

Purpose of Report and Responsibility Level

Under Annex 13 of the Chicago Civil Aviation Convention of 07.12.1944, Regulation 996/20.10.2010 of the European Parliament and the Council on the investigation and prevention of accidents and events in Civil Aviation and Ordinance No. 13/27.01.1999 of the Ministry of Transport (last amendment and addition - 22.01.2016) of the Republic of Bulgaria, the investigation of an aviation event aims at identifying the reasons that led to the event to eliminate and exclude these in future **without identifying someone's guilt or liability**.

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ALT	-	Altitude;
AMRAINB	-	Aircraft, Maritime and Railway Accident Investigation National Bord;
AMM	-	Aircraft Maintenance Manual;
A/C	-	Aircraft;
BULATSA	-	Bulgarian Air Traffic Services Authority;
CAA	-	Civil Aviation Authority;
CPL (A)	-	Commercial Pilot License;
FIC	-	Flight Information Centre;
FCL	-	Flight Crew Licensing;
DG CAA	-	Directorate General Civil Aviation Administration;
EASA	-	European Aviation Safety Agency;
FH	-	Flight Hour;
FCL	-	Flight Crew Licensing;
ft	-	Foot;
ICAO	-	International Civil Aviation Organization;
KT	-	Knots;
MAG	-	Magnetic course
MSN	-	Manufacturer Serial Number;
MTITC	-	Ministry of transport, information technology and communications;
MTOM	-	Maximum Take-Off Mass;
FI(A).	-	Flight instructor;
RWY	-	Runway;
TLB	-	Technical Log Book;
SCAAI	-	State Commission of Aircraft Accident Investigation of the Republic of Poland;
SEP (Land)	-	Single Engine Piston
UTC	-	Universal Coordinated Time;

01. List of abbreviations

1. Introduction

Date and time of the aviation event: July 26, 2023, 06:10 h (local time) 03:10 h UTC The difference between local and universal coordinated times is +3 h. All times in the report are given in local time.

Notified: Air, Maritime and Railway Accident Investigation National Board (AMRAINB) and Directorate General "Civil Aviation Administration" (DG CAA) of the Republic of Bulgaria, the European Commission, the European Aviation Safety Agency (EASA) and the State Commission of Aircraft Accident Investigation (SCAAI) of the Republic of Poland.

On the grounds of Regulation (EU) No. 996/2010 on the investigation and prevention of accidents and incidents in civil aviation and the provisions of Article 9, Paral of Ordinance No 13 of the Ministry of Transport of the Republic of Bulgaria dated 27.01.1999 on Investigation of Aviation Accidents the occurrence was classified as an accident by the AMRAINB. The materials on the aviation occurrence have been filed in case No 04/2023 in Aviation Transport Unit archives at AMRAINB.

In accordance with the provisions of Article 5, para 4 of Regulation (EU) No. 996/2010 on the investigation and prevention of accidents and incidents in civil aviation, Article 142. Para. 2 of the Civil Aviation Act of the Republic of Bulgaria, dated 01.12.1972, and Article 10, para. 1 of Ordinance No. 13 of the Ministry of Transport, dated 27.01.1999, on the Investigation of Aviation Occurrences, and on the grounds of the provisions of Article 6, para 1, point 8 of the Rules of procedure on the activity, structure and organization of the AMRAINB by Order No. RD-08-29 dated August 3, 2023, of the Chairperson of the Management Board, a Commission is appointed for investigation of the accident.

Summary:

On July 26, 2023, the PZL M18 A "Dromader" aircraft, registration marks LZ-KEC, performed an agricultural flight (fertilization of rice crops with urea) from the landing area of Kolarovo village. At about 03:10 UTC, while performing a reconnaissance flight over the field before starting the operation, the pilot lost control of the aircraft at low altitude, stalling to the left and impacted the ground. In result of the collision with the ground surface, the aircraft was destroyed, and the pilot died.

The Safety Investigation Commission points to the following as the probable cause of the accident:

Pilot errors in piloting technology at low altitude which lead to aerodynamic stall, and the aircraft impacted the ground.

2. Factual information

2.1.1. Flight number and type, the last point of departure and time, and planned destination point Flight Number: LZ-KEC.

Type of flight: Specialised Operations (Aerial Work) - Agricultural **Last point of departure:** Landing area of Kolarovo village, Bulgaria. **Take-off time:** 06:03 h Local time.

Planned destination point: Landing area of Kolarovo village, Bulgaria.

2.1.2. Flight preparation and description of the flights

From 20.07.2023 to 26.07.2023 PZL M18 "DROMADER" aircraft with registration LZ-KEC performs Agricultural flight (fertilization of rice crops with urea) in the village of Zemlen, Stara Zagora district. For this purpose, the aircraft is based at the landing area near the village of Kolarovo,

which is located 5...6 km from the landing area. According to the technical staff, prior to the flight on 26 July, the aircraft had undergone pre-flight preparation to the extent specified by the Maintenance Program, with 400 liters of petrol loaded on board and the chemical hopper loaded with about1500 kg of urea. The aircraft's technical logbook did not record the amount of chemical loaded for the Agricultural flight, nor did it record the maximum take-off mass of the aircraft.

The aircraft took off at 06:03 h with the sunrise at maximum flight mass. The air temperature was 22° C. The aircraft was flying towards the fertiliser section at an altitude of about 50 m above the terrain, but the pilot did not see the showing person and returned on course to detect them. The pilot flew to the middle of the block and, now seeing the showing person at both ends of the block, executed a left 180° turn to return to the initial position for entry into the working approach. The aircraft then executed a left turn to keep in range to the showing person, whereby the aircraft was stalling to the left and impacted the ground ahead of the block.

2.1.3. Location of aviation occurrence

The location of the aviation accident is a rice field with geographical coordinates: 42°19'09.724"N; 25°47'21.074"E.

Date and time: 26 July 2023, 06:10 h local time.

The event was realized early in the morning, during daylight hours.



2.2. Injuries to persons

Fig. 1

Injuries	Crew	Passengers	Total in the	Others
			aircraft	
Fatal	1	0	1	0
Serious	0	0	0	0
Minor	0	0	0	0
None	0	0	0	Not applicable
Total	1	0	1	0

2.3. Damage to aircraft

During the inspection of the aircraft at the site of the accident, the following damage was found: The main landing gear, the engine and the four-bladed propeller were destroyed and were under water. The front of the cabin was destroyed on impact with the ground. The right door is in the closed and locked position. The wings were destroyed in the rotation after the collision with the earth embankment. The flaps are severely deformed and separated from the wings, but are in normal flight position (retracted), based by their control mechanism, which was not damaged on impact. Numerous small pieces of debris are scattered in a small area around the aircraft. The rear part of the aircraft fuselage behind the cockpit is almost without damage. The tailplane are undamaged. The push-pull control tube to the horizontal and vertical elevators were remain unscathed.

2.4. Other damages

No other damage.

2.5. Personnel information:

2.5.1. Commander

The 71-year-old pilot in command held a Commercial Pilot License CPL (A) with date 15 November 2004 issued in accordance with Part-FCL (Flight Crew Licensing) for Civil Aviation Aircrew by the Bulgarian civil aviation authority, with the class rating SEP (Land) valid until 30 June 2024. He had a class 1 medical certificate valid until 14 January 2024 limited to VML (Valid only with correction for defective distant, intermediate and near vision). The pilot must carry multifocal goggles as well as a spare set on the aircraft.

Type rating:

• •	-		
-	AN-2:	Captain - 28.0	4.1978, FI(A) -10.01.1983 г., FE (A) 27.01.2004;
-	Z-37:	Captain;	
-	PZL	104 VILGA: C	Captain, FE;
-	M18 DROMADER	: Captain,	
-	Z 526:	Captain;	
-	C-172:	Captain;	
-	PA-28:	Captain.	
He had	a total flying experient	nce of:	
-	AN-2		9511:00 h;
-	PZL M18 "DROMA	ADER	621:00 h;
-	Zlin Z-37		19:00 h;
-	Zlin 526		76:00 h;
-	PZL 104 VILGA		13:10 h;
Total fl	ying:		10240:00 h.

Note: The flight book in which the pilot recorded his daily flights has been filed since the beginning of 2005. There are no other documents certifying the previous logging of C-172, PA-28 and PZL-104 aircraft and therefore the total flying logged here is approximate.

Information on the working hours and rest:

For the last 24 hours:	02:30 FH.
For the last 7 days:	15:06 FH.
For the last 30 days:	25:06 FH.

There is no information regarding the pilot's rest before the flight. According to the strip mark made at CPI Sofia, the aircraft took off at 06:03 h from an uncertified airport near the village of Kolarovo. The pilot was accommodated in a hotel in the town of Kolarovo. The pilot was accommodated in Stara Zagora and had travelled to the village of Kolarovo before the flight.

The Commission assumes that the captain possess the required qualifications and medical fitness for flights in accordance with existing regulations.

2.6. Aircraft Information

2.6.1. Airworthiness Information

PZL M18A "DROMADER", registration LZ-KEC, serial number No IZ021-3 was manufactured in 1989 by PZL Mielec, Republic of Poland. The aircraft has registration certificate No 2459 issued on 04.11.2013 by General Directorate of Civil Aviation Administration of the Republic of Bulgaria. The aircraft is owned by "Kentavar"Sole Trader. The owner holds a National Air Operator Certificate BG.SPO.N-07 with date of initial issue 25.11.2016, date of renewal 05.09. 2022 and date of validity 05.03.2024.

The aircraft holds Certificate of Airworthiness No. 25-0035, issued by DG CAA on 04.11.2013 and Airworthiness Review Certificate No. BG-ARC-2459, issued on 10.03.2023 and valid until 09.03.2024.

The aircraft has not been issued an Aircraft Noise Certificate and therefore the maximum mass of the aircraft is not recorded.

From the beginning of operations until the last airworthiness review on 10.03.2023, the aircraft has flown 1752:13 h. The Maintenance Programme of the PZL M18A "DROMADER" of "Kentavar"Sole Trader recorded a total technical resource of the aircraft of 10 000 flying hours. At that date the remaining resource of the airframe was 8247:47 hours. For the period from 10.03. to 26.07.2023 according to the logbook, the aircraft has flown 25:06 h.

1. Ресурсна справка/ Resource reference					
Планер/Airframe MSN № 1Z021-3					
Craryc/Status	Наработка/TSN – Time Since New	Остатък/ TSO - Time Since Overhau			
От началото на експлоатацията/Since the beginning of operation	1753 h	8247 h			
Двигате	ел/Engine MSN№ KAA810077				
От началото на експлоатацията/Since the beginning of operation	1210 h	4990 h			
От последния ремонт/ since the last overhaul		190 h. To first overhaul			
Витло/Propeller MSN № W405047					
От началото на експлоатацията/Since the beginning of operation	435 h	1065h Календарен срок до Until to 10.2025			

The aircraft is equipped with ASz-62IR-M18 engine, factory No. KAA 8100077. The engine has a total operational life of 6200 hours. The last record of the engine hours in the engine form was made on 09.03.2023. As of this date the engine has operated 1210:00 hours since the beginning of operation. At the time of the entry, the engine's remaining total technical life was 4990:00 hours.

The aircraft is equipped with an AB-2-30 propeller, part number W405047, fitted to the 2012 aircraft. The propeller has a total operating life of 8000 hours and operational life of 1500 hours. The last record of hours on the propeller form was made on 09.03.2023. As of that date the propeller had 2247:00 hours since the start of operation and 435:00 hours since the last overhaul. As of this date, the propeller has 5753:00 hours remaining between repairs.

The foregoing evidence suggests that at the time of the occurrence, the airframe, engine, and propeller of PZL M18A "DROMADER" with registration LZ-KEC had the necessary resources to perform the flights.

The maintenance of the aircraft is carried out in accordance with the Maintenance Program of PZL M18A "DROMADER" by "Kentavar" Sole Trader, approved by DG CAA on 08.03.2023.

2.6.2. Aircraft characteristics

The M-18A "Dromader" is a single-engine, single-seat, all metal, low wing, with non retractable tailwheel lnading gear, single piston for agricultural flight.

The chemical hoper is located forward of the cockpit. The aircraft has TCDS type certificate No.: EASA.A.056 /Date: 2 September 2020, Issue: 04.

The design and equipment of the aircraft permit operation in day and night operation under VFR conditions. The aircraft is EASA certified. The TCDS type certificate EASA.A.056 Issue 04, 2 September 2020 for the PZL M 18A aircraft specifies data for three categories - Normal (with a maximum take-off mass of 4200 kg), Restricted/overload (with a maximum take-off mass of 4700 kg) and Overload (Restricted/fire-fighting overload) with a maximum take-off mass of 5300 kg.

The aircraft of category "Normal" has the following Technical Characteristics and Operational Limitations:

Maximum Takeoff Weight (MTOW)– 4200 kg (fire-fighting overload-5300 kg); Maximum Landing Weight – 4200 kg;

Maximum Hopper Load – 1500 kg;

Empty mass - 2825,6 kg, in accordance with the mass and alignment report dated February 2022 with fertilizer spreading system installed;

Maximum load in baggage compartment- 30 kg;

AIRSPEED LIMITATIONS

Never Exceed Speed Limit VNE – 280 km/h;

Normal Operating Speed VNO – 230 km/h;

Design Manoeuvring Speed Limit VA – 228 km/h;

Maximum air speed with avionics equipment installed - 194 km/h;

Stalling Speed at flaps $0^{\circ} - 119 \text{ km/h}$;

Stalling Speed at flaps $15^{\circ} - 111$ km/h;

Load factors -+3.4 g, -1.4 g;

Engine speed – maximum 2220 min⁻¹, minimum 550 min⁻¹; Revolutions per Minute/RPM/ Length of take off run - 395 m, at maximum take-off mass 4200 kg;

Rolling length without brakes - 420 m;

Maximum headwind - 15 m/s;

Maximum crosswind - 6,5 m/s

On board the airplane on the first flight of the day there were (according to the technician) 400 litres of fuel A - 95 H (gasoline for engines with a lead content not exceeding 0,013 g/l and with octane number/RON/>=95 and <98), whose specific mass, according to the fuel test report, is 756,3 kg/m3 and 1500 kg of fertiliser, which when added to the 75 kg of the pilot's mass makes 1877,52

kg. With an empty airplane mass with fertilizer spreader according to the weighing protocol shown in Fig. 3, 2825,6 kg the takeoff mass is 4703,12 kg.

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/ C type / Тип на В	C PZL Dron	nader	Model / Модел	M18
rial № / Сернен N	1 Z 021-03	Regis	tration No / Persettoau	HOHEH NO 17 KEC
libration of devic	е / Калибриране на t / Брутно тегло на	а устройстват а самолета	a 02.2022	NONCH, SE LEPKER
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Fig.3

2.6.3. Information on the fuel used and its condition.

The fuel system capacity of the PZL M18 is 414 l. Two fuel tanks of 200 l each are executed together with the wings. The aircraft is fueled with RON 95 octane motor gasoline with eco additive. During pre-flight maintenance, the aero mechanic refuelled the aircraft with 200 litres of RON95 automotive gasoline

2.7. Meteorological information

Weather conditions in the area around the village of Zemlen in the period 02:00 - 04:00 UTC (05:00 to 07:00 local time) on 26.07.2023

In the period under consideration, Bulgaria is located in the eastern part of a baryonic valley associated with a cyclone located over the European part of Russia (Fig. 1). Since the previous day, an enhanced transport of hot air from the southwest has been observed along this valley, with maximum temperatures of the order of 39°C reported in the region on 25.07.2023. The intensity of the transport is also indicated by the presence of a jet stream over the country, as well as forecast information from the World Area Forecast Centre (WAFC London) of moderate turbulence in the layer up to about 5 km height.

Meteorological data for the area between Zemlen and Kolarovo

From the data obtained from the EUMETSAT MSG11 meteorological satellite, the weather radar networks of BULATSA and IABG it can be concluded that in the region and period under consideration, apart from patchy average cloud cover, no significant cloud cover or meteorological phenomena were observed.

LZ-KEC



There are no meteorological phenomena that have influenced the realisation of the event.

Fig.4

According to the regional numerical weather forecast model BULATSA WRF at about 03:00 UTC at a point with geographical coordinates approximately N42°.321 E025°.75 the wind, temperature and relative humidity are as follows:

Hour	Wi	nd	Temperature	Humidity
[UTC]	Direction [deg]	Speed [m/s]	[°C]	[%]
02:30	341	2	21.2	81
03:00	036	3	22.2	74
03:30	037	2	22.0	77
04:00	351	2	23.8	76

According to the astronomical calendar for 2023 issued by the Bulgarian Air Force, sunrise for the Radnevo area is at 06:03 local time.

The location of the sun in the sky is determined by two numbers: azimuth and height above the horizon. Azimuth and elevation of the Sun every five minutes on 26.07.2023. Coordinates: 42.3233613, 25.7568074

Time	Elevation	Azimuth
6:03:11	-0.833°	62.29°
6:10:00	0.28°	63.44°
6:15:00	1.11°	64.28°
6:20:00	1.95°	65.11°
6:25:00	2.79°	65.94°
6:30:00	3.63°	66.76°
6:35:00	4.49°	67.58°
6:40:00	5.34°	68.39°
6:45:00	6.2°	69.2°
6:50:00	7.07°	70°
6:55:00	7.94°	70.8°
7:00:00	8.81°	

It should be noted that at sunrise the azimuth of the sun is 63.44°

Figure 5 shows the visual conditions for sunrise in flight. The photograph was taken on 27.07.2023 at sunrise with PZL M18 A "DROMADER" aircraft.



Fig. 5

2.8. Aids to navigation

Standard navigation equipment of the aircraft.

2.9. Communications

Standard communication equipment of the aircraft.

2.10. Aerodrome information

The temporary landing area Kolarovo is located about 1.5 km east of the village of Kolarovo, Stara Zagora District. It is a former agricultural aviation field.

The runway is unpaved, 800 m long, 38 m wide, with no safety strips and 060°/240° directions. The altitude of the landing area is 144 m. The landing area is enclosed by a net stretched on concrete stakes with a distance between them of 2 m.

2.11. Flight recorders

Not used on the aircraft type.

2.12. Wreckage and impact information

The aircraft took off from the temprary landing area "Kolarovo", Stara Zagora municipality, to carry out agricultural flight (fertilization of rice plantations with urea) in the vicinity of the village of Zemlen, Stara Zagora district. The aircraft flew about 50 m above the terrain near the rice field, but the pilot did not see the showing persons and returned on course to detect them. At the last turn to keep in range for visual contact to the see the showing persons and enter a working approach, the aircraft stalled to the left and impacted the ground ahead of the block. The coordinates of the impact point of the aircraft colliding with the ground are 42°19'09.298 "N 25°47'20.095 "E and in the direction 160° and it slides 22...25 m. The location of the final stop is 42°19'09.724 "N 25°47'21.074 "E, Figure 1 of Annex 1. A spill of petroleum products and urea was observed around the staging area, Figure 2 of Annex 1. There was no evidence of a fire in the air or on the ground.

The impact of the aircraft with the ground was in the containment embankment (dyke) between the two rice fields. At 22 m in the north-west direction, the trace of the contact of the aircraft with the rice field was observed and was a strip of fallen vegetation reaching the aircraft 1,5 m wide. As a result of the impact, the aircraft turned to the right. During this rotation the left wing hit the adjacent rice field and was deformed, Figure 5 of Annex 1. There was damage to the right wing. The engine is detached from the front of the aircraft, Figure 4 of Appendix 1. Also crushed is the fertilizer tank containing a white granular substance scattered behind it. The front of the cabin was destroyed on impact with the ground. The main landing gear and the four-bladed propeller were destroyed and were not observed as they were under water, Figure 6 of Appendix 1.

The right door was in closed and locked position. The rear wings are deformed and separated from the half wings. Numerous small pieces of debris are scattered in a small area around the aircraft. The rear of the aircraft fuselage behind the cockpit is almost unscathed. The tailplane are undamaged. The push-pull control tube to the horizontal and vertical elevators were remain unscathed.

At 8 m in 360° direction from the nose of the aircraft, an oil filter from its engine is seen. The right instrument panel is undamaged. The left instrument panel group was found broken with the barometer and clock stopped. Altimeter showed 700 m altitude, magneto switch was in operating position, frequency gauge showed "0", pressure showed "0", fuel again showed "0" for left and right tanks.

There are no deformations on the tailplane and the rear part of the airplane airframe and the rear support wheel is upright and in the base of the dyke. A portion of the seat is visible on the right side of the downed right wing.

The control power lever is in the maximum forward position (maximum throttle) and the speed control is in the position corresponding to RPM 1850-1900 ^{min-1}, Fig. 7 and Fig. 10 of Appendix 1. The character and location of the tail confirmed the assumption that they are the result of impact with the ground.

On inspection of the accident site and subsequently on a second inspection of the wreckage of the aircraft, neither the multifocal goggles prescribed for the pilot nor a spare set were found in the aircraft in accordance with the Class 1 medical certificate from the last aeromedical examination.

2.13. Medical and pathological information

A forensic examination of the pilot's body was carried out at the Forensic Medicine Clinic at the University Hospital "Prof. Dr. St. Kirkovich AD. The examinations are attached to the case with the investigation materials. The conclusion of the same states the following:

"The cause of death was severe multiple traumatic injuries incompatible with the life.

The traumatic injuries found are from the action of hard blunt objects and correspond to being received from parts in the cockpit of the aircraft. Toxic chemical examination was performed from a blood sample taken at the autopsy of the pilot did not reveal the presence of narcotic drugs, narcotic substances and alcohol.

2.14. Fire

The realized event is not related to the fire arising before or after contact of the aircraft with the ground.

2.15. Factors for Survival

During the flight, the pilot probably did not use a seat belt. After the final stop of the aircraft, the pilot was alive and managed to disconnect all electrical circuits, then left the cockpit and remained on the starboard side upside down.

For the purposes of the safety investigation, the Safety Investigation Commission were carried out: 1. Inspection of the site of impact of the aircraft with the ground, a rice field in the village of Zemlen.

2. Inspection of aircraft PZL M18 "DROMADER", registration LZ-KEC, serial No. IZ021-3, at the site of the occurrence;

- 3. Discussions with witnesses of the realized event;
- 4. Research and analysis of aircraft technological and operational documentation.
- 5. Assessment of aircraft flight performance;
- 6. Laboratory analysis of the fuel with which the aircraft is loaded;
- 7. Inspection of the condition and operation of the aircraft fuel system;
- 8. Logical-probabilistic analysis of possible causes of the aviation event;
- 9. Analysis of the functional status of the pilot during the event.

On the first item, the results of the site visit are reflected in paragraphs 2.1.2, 2.1.3, 2.4 and 2.12.

On the second item, the results of the inspection carried out on the aircraft after the occurrence are reflected in paragraphs 2.3 and 2.12.

On the third item, the results of the interviews conducted with witnesses of the event and officials of the aviation operator are reflected in paragraphs 2.1.2 and 2.6.1.

On the fourth item, the results of the review and analysis of operational and process documentation for the aircraft are reflected in paragraphs 2.6.1, 2.6.2 and 2.6.3.

For the fifth item, the assessment and analysis of the flight performance of the aircraft is given in paragraphs 2.6.2 and 2.6.3.

On item six, the results of the laboratory analysis of the fuel with which the aircraft was loaded are set out in paragraph 2.6.3.

For item 7, material relating to the condition and operation of the aircraft fuel system is set out in paragraphs 2.12 and 2.6.3.

Regarding item 8, a logical-probabilistic analysis of possible causes for the realisation of the serious accident is carried out in chapter 3 of this report.

Information on item 9 is given in paragraphs 2.5 and 2.13.

2.17. Additional information.

The PZL M18A "DROMADER" aircraft is equipped with ASH-62IR-M18 engine and in the type, certificate issued for this engine by EASA No. E.140 is written fuel - aviation gasoline, minimum 95 octane and oxygen content maximum 2.7% in accordance with PN EN 228 standard.

The airworthiness review applications from 2014 to 2022 state a maximum take-off mass of 5300 kg. No justification is provided for the change in take-off mass and associated changes in equipment and aircraft performance.

For the flight performed on 26.07.2023, assuming the 400 1 (302,52 kg) of fuel recorded in the technical logbook, the available amount of fertiliser 1500 kg, (according to the explanations of the person who carried out the load) and the 75 kg mass of the pilot, the take-off mass is 4703 kg and is close to that intended for Restricted/overload use with a maximum take-off mass of 4700 kg.

3. Analysis

The following hypotheses were considered to determine the causes of the accident:

- First hypothesis, related to a technical failure leading to a violation of aerodynamic structure, engine failures, failure of the aircraft controls leading to the loss of control of the aircraft;

- A second hypothesis related to adverse external conditions - weather conditions, collision with birds, deterioration of the pilot's health, or other external factors leading to the impossibility to control the aircraft;

- A third hypothesis related to pilot errors in piloting technology that led to an aerodynamic stall of the aircraft;

In the process of investigating the circumstances of the flight, the Commission has not found any facts related to abnormal functioning of the aircraft controls, engine, propeller or aircraft systems.

During the examination of the wreckage of the aircraft it was found that during the flight the aircraft controls, propeller group and mechanics functioned without deviations from the technical requirements. There were no preparations for a forced landing. The flaps were retracted. These facts exclude the possibility that the first hypothesis had led to the accident.

On the second hypothesis - at the time of the flight in which the event occurred, in accordance with the meteorological situation in the area of c. Zemlen in the period 02:00 - 04:00 UTC on 26.07.2023, as set out in paragraph 2.7, there were no conditions for dangerous meteorological conditions that would directly affect the flight trajectory. There was also no information on any deterioration of the pilot's health during the flight. The damage received on the aircraft is reflected in paragraph 2.3. There were no evidence of bird strikes on the aircraft.

On the third hypothesis, the piloting technology that led to the aerodynamic stall of the aircraft, the Commission focused its attention on the control of the aircraft in the area of the treatment. The aircraft took off at sunrise from the Kolarovo site to perform flight for fertilisation. The aircraft was loaded with 1500 kg of urea fertiliser and was loaded with 400 l of fuel. It should be noted that the aircraft began the flight to the arable field with maximum flight mass. The air temperature at 6:00 was 22° C.

In accordance with the flight plan, the aircraft was flying towards the fertilizer section at an altitude of 50 m on the ground, but the pilot did not see the showing person and returned on course to detect them. He then flew to the middle of the block and, already seeing the showing persons, he executed a medium left turn to take up an exit position for entry into a working approach. At the start the turn is a gradual bank of probably about 30 degrees which gradually increases. It is reasonable to suggest that the pilot was concentrating his attention on the showing persons and was not paying attention to the instrument's readings in the cockpit. During the turn, the aircraft stalled to the left and impacted the ground, see Figure 8.

The question to be answered should be why the pilot allowed the airplane to stall.

The aircraft, in accordance with its airworthiness designation, is in the Normal category (see page 8) and its maximum take-off mass is 4200 kg, but in this case its actual load is about 4700 kg and it is in the Restricted/overload category, which limits its manoeuvring capability. In these conditions piloting required a special attention and turns are executed with a smooth without slipping.

During the final turn, which is executed to exit to keep in range to the showing persons and enter a working approach, it is possible that the pilot has not made sufficient engine power to execute the turn. The power flown up to this time was sufficient for horizontal flight, but insufficient to execute the turn. In this situation, the pilot counteracted the loss of altitude in the turn by pulling the control stick, by raising the nose of the aircraft.

But then the plane began to fly at high angles of attack. As the wing reached circumcritical and postcritical angles of attack, the wrap-around flow began to break off. If outward slip is allowed, then the outboard (right) wing is getting a better wrap and increasing lift at the expense of the inboard (left) wing, which is ripping off the wrap and losing lift. A torque to the left results, accompanied by the aircraft stalling and impacting the ground.

From observing the cockpit of the aircraft, it can be concluded that the pilot reacted correctly to the stall, attempting to manoeuver the aircraft out of the steep descent by increasing engine power. The throttle control is given in the maximum forward position (maximum throttle) and the speed control in the position corresponding to 1850-1900 min⁻¹. However, the height at which the stall occurred (50 m) was insufficient to recover the aircraft from this upset situation.

Considering what has been mentioned in this chapter, as a probable cause of the accident the third hypothesis can be suggested, related to the Pilot errors in piloting technology at low altitude which lead to aerodynamic stall, and the aircraft impacted the ground.

4. Conclusion

4.1. Findings

As result of the investigation, the Commission made the following conclusions:

- 1. The aircraft PZL M18A "DROMADER", registration LZ-KEC, serial number No IZ021-3 was manufactured in 1989 by PZL Mielec, Republic of Poland.
- 2. The aircraft holds Certificate of Registration No. 2459 issued by the General Directorate of Civil Aviation Administration of the Republic of Bulgaria on November 4, 2013.
- 3. The aircraft is owned by "Kentavar"Sole Trader.
- 4. The owner holds a National Air Operator Certificate BG.SPO.N-07 with date of initial issue 25.11.2016, date of renewal 05.09. 2022 and date of validity 05.03.2024.
- 5. The aircraft holds Certificate of Airworthiness No. 25-0035, issued by DG CAA on 04.11.2013 and Airworthiness Review Certificate No. BG-ARC-2459, issued on 10.03.2023 and valid until 09.03.2024.
- 6. From the beginning of operation until the last airworthiness review, on 10.03.2023, the aircraft has flown 1752:13 h., with a total technical endurance of 10000 flight hours.

- 7. The aircraft is equipped with ASz-62IR-M18 engine, factory No. KAA 8100077.
- 8. At the time of the occurrence, the airframe, engine, and propeller of PZL M18A "DROMADER" with registration LZ-KEC had the necessary resources to perform the flights.
- 9. The maintenance of the aircraft is carried out in accordance with the Maintenance Program of PZL M18A "DROMADER" by "Kentavar" Sole Trader, approved by DG CAA on 08.03.2023.
- 10. The maximum take-off mass of the aircraft according to the TCDS type certificate No.: EASA.A.056 /Date: 2 September 2020, Issue: 04 is 4200 kg.
- 11. The aircraft has not been issued an Aircraft Noise Certificate and therefore the maximum mass of the aircraft is not recorded.
- 12. The mass of the empty aircraft with fertiliser spreader when weighed is 2825,6 kg.
- 13. The take-off mass of the aircraft for the flight in which the event occurred was 4703 kg.
- 14. The captain possesses the required qualifications and medical fitness for flights in accordance with existing regulations.
- 15. There was no information that physiological factors or incapacitation affected the pilot's performance.
- 16. No information is known about insufficient rest of the pilot before the flight in which the event occurred.
- 17. During the flight, the pilot probably did not use a belt.
- 18. The pilot may not have been using his prescribed multifocal goggles as none were found in the cockpit or at the accident scene.
- 19. After the final stop of the aircraft, the pilot was alive and had succeeded in disconnecting all electrical circuits, then left the cockpit and remained on the starboard side upside down.
- 20. There are no meteorological phenomena that have influenced the realisation of the event.

4.2. Causes

Based on the circumstances set out in this report and the analysis of the above, the Commission points to the following as the cause of the accident:

Pilot errors in piloting technology at low altitude which lead to aerodynamic stall, and the aircraft impacted the ground.

5. Safety Recommendations

Considering the cause of the accident, the Commission recommends the following measures to ensure flight safety:

BG.SIA-2024-05 The CAA DG of the Republic of Bulgaria to take measures for effective control of compliance with the correct entry of the approved maximum take-off mass of the aircraft in accordance with the type certificate and the operations executed by the aircraft as well as the procedures for mass and balance, loading in the flight manual of the aircraft operators.

The Investigation Commission reminds all organizations, to which flight safety recommendations are sent that, on the grounds of Article 18 of Regulation (EU) 996/2010 on Investigation and Prevention of Accidents and Incidents in Civil Aviation and Article 19, paragraph 7 of Ordinance No. 13 on the Investigation of Aviation Accidents is obliged to notify the Air, Maritime and Railway Accidents Investigation National Board in writing of the action taken on the recommendations made.

AIR, MARITIME AND RAILWAY ACCIDENTS INVESTIGATION NATIONAL BOARD COMMISSION ON INVESTIGATION OF THE ACCIDENT

Sofia

November 5, 2024

ANNEX 1



Fig. 1







Fig. 3





Fig. 5



Fig. 6



Fig.7



Fig. 8



Fig. 9



Fig.10