APPROVED BY

Acting Director
of the National Bureau of
Air Accidents Investigation

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«___»_____ ___2021

FINAL REPORT

on Investigation into Fatal Accident with Y1 "Dolphin" UR-OAP Aircraft of the State Enterprise "Odesa Aviation Plant", which Took Place on 17.06.2020 at 9:14 UTC During Test Flight Operation in Odesa Aerodrome Area

In accordance with Part 1 of Art. 119 of the Air Code of Ukraine, Standards and Recommended Practices of the International Civil Aviation Organization (ICAO), this report is published for the sole purpose of future accident prevention. The technical investigation, on which results is based this report, shall not establish anyone's fault or responsibility. The criminal aspects of the accident shall be investigated separately from the technical investigation.

The investigation into the fatal accident of the Y1 Dolphin aircraft was carried out by the Investigation Team appointed by Order of the National Bureau of Air Accidents and Incidents Investigation with Civil Aircraft (NBAAI) No. 41 of 17.06.2020.

The report of a fatal accident with Y1 "Dolphin" aircraft was received by the NBAAI from the Municipal Enterprise «Odesa International Airport» on June 17, 2020, 10:11 UTC.

Taking into account that the aircraft engine was manufactured in France (Safran Aircraft Engines) SR-305-230-1, MSN 1124, the NBAAI notified BEA of the fatal accident on June 24, 2020.

The Investigation Team departed for the accident site on June 18, 2020, and began a field investigation at 14.00 Kyiv time.

Synopsis

On 17.06.2020, at 12:14 Kyiv time, in the visual meteorological conditions (VMC), during a test flight operation (Flight Assignment No. 139-24/2) on a light aircraft of Y1 Dolphin UR-OAP, after takeoff, in the climb to 9000 ft, the engine power loss occurred at crossing 4750 feet. PIC informed the ATS controller of the termination of the assignment performance and requested clearance for descent and landing approach. At a distance of 900 m from the threshold of the Runway 16, the plane impacted the ground with a high vertical speed. The plane suffered significant damage; the crew suffered fatal injuries.

BEA has appointed an Accredited Representative.

Investigation was instituted on 18.06.2020.
Investigation was completed on 18.06.2021.

Note:
This report is a translation of the Ukrainian original investigation report.
The text in Ukrainian shall prevail in the interpretation of the report.

Abbreviations Used in Final Report

OAP – Odesa Aviation Plant;
SAS – State Aviation Administration of Ukraine;
BEA – Bureau of Enquiry and Analysis for Civil Aviation Safety
GPB – glide path beacon;
Local time – time in Ukraine;
UTC – Universal Time Coordinated;
CCTV – Closed Circuit Television;
VMC – Visual Meteorological Conditions;
OM – Operation Manual;
FOM – Flight Operation Manual;
OFP – Operational Flight Plan;
PIC – Pilot-in-Command;
NBAAI – National Bureau of Air Accidents and Incidents Investigation with Civil Aircraft;
MI – Municipal Institution;
ME – Municipal Enterprise;
MH – magnetic heading;
KSRIFE – Kyiv Scientific Research Institute of Forensic Expertise;
ATS SE – State Air Traffic Service Enterprise (UkSATSE);
ICAO – International Civil Aviation Organization;
ARW – artificial (paved) runway;
EGPWS – Enhanced Ground Proximity Warning System;
SIGMET – Significant Meteorological Report – decoded warning on the relevant Flight Information Region on the forecasted special weather phenomena that affect the aircraft safety;
CG – Center-of-Gravity.

1. Factual Information

1.1 Flight History

On 16.06.2020, at 06:09 UTC, a representative of the Odesa Aviation Plant applied for a training flight (but actually – test flight) on 17.06.20 for a period from 07.00 to 14.00 UTC in the area of the Odesa aerodrome. On 15.06.2020, from 10:00 to 17:00 local time, the preliminary training of the crew was held with recording on a tape recorder. On 15.06.2020, the PIC and co-pilot, together with the head of the Civil Aircraft Operation Bureau and experimental work and air tests engineer, studied in detail the flight purpose, flight area and route, calculated the required amount of fuel for the flight, chose alternate aerodromes, etc. On 17.06.2020, the preflight training of the crew was held with recording on a tape recorder, and the crew was acquainted with the actual weather and forecast for the Odesa aerodrome and alternate Kulbakino (Mykolaiv) aerodrome.

On 11.06.2020, works were carried out on the plane to eliminate the critical comments of the PIC on the previous flight carried out on 04.06.2020, according to maintenance release 17/11. After the work completion, the aircraft was refueled with 60 liters of fuel.

On 16.06.2020, the aircraft was refueled with 10 liters of fuel in accordance with the flight assignment No. 139-24/2. The aircraft operation engineer set the actual fuel amount on FS-450 fuel consumption device, reported to the PIC, and wrote that down in the logbook.

On 17.06.2020, the Odesa Aviation Plant representative agreed with the senior air traffic controller of the Odesa ACC the time of Dolphin aircraft departure.

Note: *the recording time on the video recorder does not coincide with the actual one (less than Kyiv Time by 37 minutes 44 seconds)*

The video recorder time - 10:54:10.

11:31:54 – PIC requested the Odesa Tower controller for clearance to start the engine; (according to the radio exchange, the time was 08:31:54 UTC.)

The fuel amount indication was:

Left tank: 4/4 (full);

Right tank: in the middle of 3/4 to 4/4 range (not full).

At 11:10:49, PIC started the engine. The fuel tank selector valve was set in the position - "Left + Right";

At 11:12:10, PIC began the engine warming up;

At 11:13:37, PIC performed the flap operability test;

At 11:17:00, PIC completed the engine warm-up and made a taxi request;

At 11:17:08, the plane began taxiing;

At 11:18:23, the fuel amount indication in the aircraft tanks was as follows:

At 11:22:44, while taxiing, the right fuel quantity indicator fluctuated between 1/2 and 3/4, while the left fuel quantity indicator remained unchanged at 4/4.

At 11:24:39, at 180˚ turn, the right fuel quantity indicator showed the fuel amount between ¼ and ½ of the tank, and the left one constantly showed 4/4.

At 11:25:50, PIC requested the controller for clearance to take off (Radio exchange time: 8:54:17 UTC.)

At 11:26:13, PIC set the landing gear control switch to the GEAR UP position.

At 11:26:21, PIC set the flaps switch to the up position.

At 11:26:30, flaps retracted.

At 11:26:32, "flaps down!" display turned on. Photo 1.

Note. This display lighting up means that the landing gear *was not retracted!!!*

(Photo 1)

At 11:26:58, PIC switched the fuel tank selector valve to the "*Left Tank*".

The process of switching the fuel tank selector valve from the "Left + Right" to the "Left" tank position. Photos 2,3,4,5,6.

(Photo 2)

(Photo 3)

(Photo 4)

(Photo 5)

(Photo 6)

At 11:41:35, at an altitude of 4,750 feet, a drop in the fuel pressure, engine rpm, and boost manifold air pressure is observed.

PIC switched the aircraft to descent, increasing vertical speed to 1,800 feet per minute and aircraft speed to 205 km/h.

The last minute of the plane's flight was recorded by CCTV located in a private territory next to the alley. The descent was carried out with a left bank, onto the left landing gear and the front landing gear simultaneously with a high vertical speed.

(Photo 7)

The plane impacted an asphalt road.

The fatal accident area is flat, the altitude above sea level is + 53m (174 ft).

Impact site coordinates: - 46°26'20.9"N 30°39'36.7"E.

1.2. Injuries.

Injuries	Crew	Pax	Others
Fatal	2	0	0
Serious	0	0	0
Minor/None	0	0	0

1.3 Aircraft Damage.

As a result of the fatal accident, the aircraft suffered the following damage:

- wheels of the front, left and right landing gears were broken off;
- broken in half fuselage in the wing area;
- 2 propeller blades were broken;
- propeller spinner was torn off.
- cockpit hood was torn off.

1.4 Other Damage.

The fatal accident caused minor damage to the asphalt pavement, oil and fuel contamination of the fatal accident site.

1.5 Personnel Data.

Position: Aircraft Pilot-in-Command (referred to as PIC)
Date of birth: 20.06.1954
Education: Kharkiv VVAUL 1976, pilot-engineer
Total flight hours: 3753 h 26 min.
on (aircraft type):
Mig-15 09 h 00 min.
Mig-21 677 h 00 min.
Mig-23 992 h 00 min.
Mig-27 1009 h 13 min.
Mig-29 36 h 37 min.
L-29 197 h 00 min.
L-39 455 h 21 min.
Yak-52 59 h 32 min.
Yak-18t 49 h 26 min.

An-2 114 h 13 min.
"Farmer" 11 h 02 min.
Y1 Dolphin 166 h 22 min.

PIC's flight hours:

for the last 90 days	21 h 56 min.
for the last 7 days	0 h
for the last 24 hours	0 h

Private Pilot Certificate - PA No. 011096 issued by the State Aviation Administration (referred to as the SAA) on September 28, 2011.
Valid until 03.10.2021
Commercial Pilot Certificate – CA No. 010944 issued by the SAA on 01.09.2011.
Valid until 27.09.2019 (as of the day of the fatal accident – expired).
Minimum 200 × 3000 × 18.
VFR clearance.
Medical Certificate No. 87963
Date of issue 27.09.2019
Valid until 27.09.2020
Pilot Qualification (Professional) Check Act No. 629 dated 23.09.2019.
Flight (Certification) Pilot Check Act dated 13.09.2019
Total work experience 48 years 2 months, work experience at the enterprise 15 years 2 months.
From 01.06.1974 to 30.04.2005 – PIC served on flying positions in the Air Force.
From 04.05.2005 to 11.03.2018 – head of the flight test station
From 12.03.2018 to 17.06.2020 – Civil Aviation PIC at Flight Test Stations.

Position:	**Co-Pilot**
Date of birth	05.11.1955
Education	Chernihiv VVAUL, 1978, pilot engineer
Total flight hours:	2339 h 46 min
Mig-15	19 h 40 min
Mig-21	62 h 35 min
Mig-23	1393 h 48 min
Mig-29	414 h. 38 min
L-39	413 h 05 min
Y1 "Dolphin"	15 h 59 min

Test pilot, retired Colonel, 1st class
Flight time: co-pilot:

For the last 90 days	18 h 13 min.
7 days	0 h
24 hours	0 h.

Admission to flights was issued in 2020 according to the Order of the General Director of SE "OAP" dated December 11, 2019, No. 571/AG.

On 18.05.2020, a qualification training was carried out in operation of Mig-21 Mig-23, L-39, Dolphin aircraft on the ground and in the air, and actions in inflight abnormal circumstances in accordance with Section 4, Clause 14, Article 205 of Rules for Engineering and Aviation Support of State Aviation of Ukraine, 2016. The rating - "Good".
On 19.03.2020 - Flight to the zone to check the piloting technique in the advanced aerobatics.
The rating – "Excellent".
On 20.03.2020 – Check of the piloting and navigation techniques: The rating – "Excellent".
On 20.03.2020 – Flight to the zone to check the piloting technique using duplicate instruments: Total Rating: "Qualified".

1.6 Aircraft Data.

Aircraft:	Y1 Dolphin
Serial number:	59012
State and registration mark (Ukraine):	UR-OAP
Owner:	SE OAP
Operator:	SE OAP
Manufacturer:	SE OAP
Aircraft Manufacture Date:	08.07.2011
Aircraft Registration Certificate:	No. RP 4041/1 issued on 28.08.2019.
Flight Operation Permit No. 1495	issued on 31.10.2019.
Validity:	until 30.10.2020
Conditions for Flight Operation Permit	approval form No. Y1.00.0SF.
Issue No. 02:	issued by SAA on 06.06.16. and approved on 30.06.16
Operating time since new	155 h 58 min and 357 landings;
Assigned life	2000 h/12000 landings;
MTBF	500 h/3000 landings;
Maintenance:	as per technical condition;

Maintenance:
18.05.2020 – works on transition to spring-summer navigation were completed. Maintenance release 05/18;
11.06.2020 – 7-day aircraft parking works performed according to RO 001.30.08; Maintenance release 17/11.
17.06.2020 – works performed according to the form "A". Maintenance release 20/17. Number of overhauls - NO.
All aircraft maintenance work was performed by SE OAP.

Engine and Propeller.
Engine:
Type SR-305-230-1 No. 1124.

Manufacturing plant:	S.M.A. Safran Group. France.
Manufactured:	29.08.2007

Operating time since new: 454 h 09 min.
The last maintenance was carried out in the amount of 500 hours of works on 25.02.2020 (4 years). Operating time – 433 h 27 min. There were no critical comments.

Propeller:
Drawing No.: MTV-9-B-S/198-58B
Serial No.: 070451
Manufactured on: 30.08.2007
Manufacturer: MT-Propeller, Germany
Serial numbers of blades:
1. YH 31627
2. YH 31628
3. YH 31629
Operating time since new: 41 h 16 min.
Installed on the engine on: 11.01.2018

Fuel:
The aircraft used the fuel: TS-1

Aircraft Defects and Faults:
On 04.06.2020, the following findings were recorded on the plane after the flight:
1. Tapping noise of the front landing gear at taxiing.
2. Sometimes GPS satellites signal disappears.
3. Uneven fuel consumption from tanks.
4. Sliding: 1 ball diameter "to the left".

Information on elimination of the findings is provided in the maintenance release 17/11 and check lists No. 028.PKV 113-20, 032.PKV.114-20, 032.PKV.115-20, 032.PKV.116-20.

Weight Specification:
Empty aircraft weight – 970 kg
Maximum takeoff weight – 1400 kg
Multipurpose – 1200 kg
Maximum landing weight – 1400 kg
Multipurpose landing weight – 1200 kg
Max front CG – 22% CAX
Max aft CG – 32% CAX.

1.7 Meteorological Information

Regular report for the Odesa aerodrome was compiled at 08.00 UTC on June 17, 2020:

- surface wind 160°, wind speed 05 m/s, visibility 10 km, scattered cumulonimbus with 690 m ceiling, air temperature 24°C, dew point temperature 18°C, QNH 1008 hPa, tendency for the next two hours: no significant changes forecasted.

08.30 UTC:

- surface wind 160°, wind speed 03 m/s, direction of the surface wind varied from 090° to 210°, visibility 10 km, insignificant cumulonimbus with 720 m ceiling, air temperature 24°C, dew point temperature 18°C, pressure QNH 1009hPa, tendency for the next two hours: no significant changes forecasted.

09.00 UTC:

- surface wind direction 140°, wind speed 04 m/s, surface wind direction varied from 110° to 180°, visibility 10 km, insignificant cumulonimbus with a height of 780m, air temperature 24°C, dew point temperature 17°C, pressure QNH 1008 hPa, tendency for the next two hours: no significant changes forecasted.

09.30 UTC:

- surface wind direction 140°, wind speed 05 m/s, visibility 10 km, insignificant cumulonimbus with 750 m ceiling, air temperature 24°C, dew point temperature 18°C, pressure QNH 1009 hPa, tendency for the next two hours: no significant changes forecasted.

The weather forecast for the Odesa airport was compiled at 05.07 UTC on 17.06.2020 and was valid from **06.00 UTC** 17.06.2020 **to 06.00 UTC** 18.06.2020:

- surface wind 170°, wind speed 03 m/s, gusts 8 m/s, visibility 6000 m, significant clouds - 210 m ceiling, scattered cumulonimbus - 450 m ceiling, maximum air temperature 28°C is expected at 12:00 UTC on 17.06.2020, minimum air temperature 17°C is expected at 2:00 UTC on 18.06.2020, variable surface wind direction with a probability of 40% occasionally between 06.00 UTC and 15.00 UTC on 17.06.2020, surface wind speed 8 m/s with gusts up to 16 m/s, visibility 1000 m, thunderstorm, moderate rain with hail, squall, significant clouds – 90 m ceiling, significant cumulonimbus – 450 m, visibility gradually decreases to 2100 m during the period between 19.00 UTC and 20.00 UTC on 17.06.2020, haze, with a probability of 40% occasionally between 20.00 UTC 17.06.2020 and 06.00 UTC 18.06.2020 visibility 300 m, fog, vertical visibility – 60 m.

1.8 Navigation Aids

The aircraft has the following equipment installed:

- flight-navigation system G-500;

-ARC KR87 - automatic radio compass;

-KN62- radio distance meter;

- GPS navigator "GPS map 296 Garmin" (portable one was at the co-pilot);

The following navigation aids are installed on the Odesa aerodrome:

- SP-80M landing system;

- nondirectional radio beacon with both landing headings;

- VOR/DME;

- radio direction finders ARP-75;

1.9 Communication

The crew had constant communication with the ATS units. The radio exchange with ATS units is set out in the appendices (investigation materials.)

1.10 Aerodrome Data.

Odesa aerodrome is a certified civil aviation aerodrome entered into the State Register of Civil Aerodromes of Ukraine (Certificate of Aerodrome Registration No. AR 15-01, issued on 04.08.2003 by the State Department of Aviation Transport). The owner and operator of the aerodrome is the Municipal Enterprise "Odesa International Airport".

The paved runway has dimensions of 2800×56m, pavement type – mixed, PCN 35/R/B/X/T, equipped for precision landing approach according to ICAO I Landing Category according to the landing magnetic heading – MHlanding 157°/337°.

The aerodrome is equipped with high-intensity lighting (HIL-I), approach lights and light horizons, paved runway entrance and end lighting, angle-of-approach lights, runway side lights, taxiway lights.

The airfield is suitable for operation day and night, all year round.

Coordinates of aerodrome reference point: 462536N 0304035E.

Aerodrome elevation + 52 m (171 ft)

Magnetic dip + 6° E

Runway thresholds elevation:

- with MHlanding = 157° 52.3 m
- with MHlanding = 337° 50.4 m

1.11. Flight Recorders.

A MiVue M300 video recorder, s/n M303AR00187 and Xvision F-800 video recorder s/n 8000644 were installed on the cockpit dome. The MiVue M300 video recorder was completely destroyed as a result of the fatal accident. There were no other recorders on the aircraft.

1.12. Wreckage and Impact Information.

The plane fell on the drive way of the 4th Aeroportivsky lane, on a dry asphalt surface. The total width of the drive way was 5.4 m with no curb, no road marking. The total length of this lane before the turn to the right is 120 m. The descent trajectory at the final stage passed over trees with a height of 10 m and power line poles with a height of 5-7 m. To the left, along the alley, perennial tall trees 10 m high grow, immediately behind them is a brick fence of a private territory. To the right, there are the same tall trees, behind them a lowland and a brick fence. CCTV cameras are

installed on the private territory. The video recording shows the following:

- plane flies with a left bank of 10-15°;
- aircraft front and main landing gear are extended;
- flaps are deployed at an angle of 20° (configuration for aircraft takeoff);
- propeller does not rotate, the engine does not operate;
- descent trajectory is very steep;
- at a hard touchdown, wheels are completely flying away from the main and front landing gears;
- 2 propeller blades are destroyed. The third blade is partially damaged.
- separation of the propeller spinner from the engine shaft;
- ground impact resulted in the aircraft cockpit hood tearing off. The hood flips over in the air and falls in front of the aircraft on the ground;
- aircraft fuselage is moving by inertia along the road.
- left and right parts of the wing and flaps are being deformed.

The fuel tanks in both parts of the wing remained undamaged. At inspection of the fuel tank on the left side of the wing, *absence of fuel* was found. At inspection of the fuel tank on the right side of the wing, *the fuel presence of approximately half of the tank was detected*.

1.13 Medical and Post-Mortem Data.

According to the information of the MI "Odesa Regional Bureau of Forensic Medicine" the following was proved:

- On 18.06.2020, a doctor, forensic expert of the department of forensic medical examinations of corpses of MI "Odesa Regional Bureau of Forensic Medical Examination", on the basis of the instruction of the police lieutenant colonel of the Criminal Investigation Division of Main Department of the National Police in Odesa, an examination of the corpse of the PIC was carried out (Act No. 1956 dated 18.06.2020) in order to establish the cause of death, the time of its onset, the presence of injuries and presence of ethyl alcohol in the blood. According to the examination of the corpse, the death of the PIC was in a direct causal relationship with multiple injuries of the chest cavity organs. The immediate cause of PIC's death was acute blood loss.

According to the results of the forensic toxicological examination of the PIC's blood, ethyl alcohol was not detected (Act No. 3063/1956). PIC's death time: 17.06.2020, 12:45.

- On 18.06.2020, the doctor, forensic expert of the department of forensic medical examinations of corpses of the MI "Odesa Regional Bureau of Forensic Medical Examination", on the basis of the instruction of the police lieutenant of the Khadzhibeyivsky hub-station of the Suvorov police station in Odesa, conducted an examination of the corpse of the co-pilot (Act No. 1960 dated 18.06.2020) in order to establish the cause of death, the time of its onset, the presence of injuries

and the presence of ethyl alcohol in the blood.

According to the corpse examination, the death of the co-pilot was in direct causal relationship with injuries involving several areas of the body. Shock is the immediate cause of death of the co-pilot.

In a forensic toxicological examination of the blood taken from the corpse of the co-pilot, ethyl alcohol was not found (Act No. 3064/1960).

The time of death of the co-pilot, according to the medical documentation data: 17.06.2020, 13:45, does not contradict the data of the forensic medical examination.

1.14. Fire.

There was no evidence of a fire during the flight and after the plane impact.

1.15 Survival Factors.

On 17.06.2020, during the flight on the Dolphin aircraft owned by the Odesa Aviation Plant, reg. UR-OAP, the crew at 12:13 reported of the intention to make a forced landing. After that, communication with the aircraft was lost. At those time, the landing heading in use at the Odesa aerodrome was 157°. At 12:14, the flight director announced the Alarm and established a place for gathering near the Taxiway 3. The Operational Center of the Main Department of the State Emergency Service of Ukraine in the Odesa region received from the dispatcher on duty of the Main Department of the National Police in the Odesa region on 17.06.2020, at 12:21, a report about the aircraft ground impact outside the aerodrome. By the fact of the reporting, according to the departure schedule of the subdivisions of the Odesa city and region operational civil protection rescue service, the fire rescue units were sent to the site of the accident, arriving at the fatal accident site at 12:30. The personnel of the first fire rescue unit of the 8th state fire rescue brigade of the 6th state fire rescue squad found that at Dolphin ground impact outside the aerodrome onto the drive way of the asphalt road, one pilot died immediately, and the second pilot was unconscious in the cockpit, in a serious condition. The personnel of the fire rescue unit performed works on unblocking the co-pilot from the cockpit and flushing fuel and lubricants out from the roadway. The fuel tanks were filled with water to safely transport the wreckage of the damaged aircraft.

1.16 Tests and Research.

1. Fuel analysis was conducted at the Kyiv Scientific Research Institute of Forensic Expertise (hereinafter - KSRIFE) on 25.03.2020.

Conclusions:

The liquid provided for the analysis, withdrawn on 17.06.2020 from the engine of the Y1 Dolphin aircraft, reg. UR-OPA (serial number 59012), by the characteristics, meets the requirements of DSTU 4796:2007 "Aviation Fuel for Gas Turbine Engines JET A-1. Specifications".

No foreign impurities were found in the analysis object.

The liquid provided for the analysis, withdrawn from the aircraft fuel filter, by the specified characteristics, meets the requirements of DSTU 4796:2007 "Aviation Fuel for Gas Turbine Engines JET A-1. Specifications".

No foreign impurities were found in the analysis objects.

2. OAP conducted the research of the fuel system for operability.

Conclusions:

At inspection of the fuel system elements, a malfunction of the fuel quantity indicator sensor of the left fuel tank was detected. The float mechanism of the sensor *was blocked* in the upper position, which caused the indicator of the fuel quantity in the left tank to give false, overestimated readings, and caused not to decrease during the flight.

1.17 Information on Organizations and Administrative Activities Related to Accident.

Aircraft Y1 "Dolphin", serial No. 59012, state and registration mark UR-OAP, was manufactured at the State Enterprise "Odesa Aviation Plant". The SAS issued the following documents:

- Certificate of Approval of Designer's Organization No. UA.21.0035 issued on 14.02.2020;
- Certificate of Approval of Continuing Airworthiness Management Organization No. UA.MG.0076 issued on 17.11.2014;

aircraft documents:

- Type Certificate Limited TL 0055 issued on 01.03.2019.
- Aircraft Registration Certificate No. RP 4041/1.
- Flight Operation Permit No.1495.

Aircraft maintenance was performed by OAP.

The flights preparation and operation took place in cooperation with the administration of the Odesa aerodrome, air traffic services (ATS), meteorological service, and the military sector.

1.18. Additional Information

No additional information is available.

1.19. New Methods Used in Investigation

No new methods were used in the investigation.

2. Analysis

Considering that there are no stationary recorders on the Dolphin aircraft, the following materials were used in the analysis of the accident circumstances:

- explanatory notes of witnesses and other persons related to the incident;
- Flight Operation Manual of the Dolphin aircraft;
- documentation for aircraft registration and flight permits;
- meteorological documentation;
- the results of the accident site inspection;
- the results of the aircraft wreckage inspection;
- conclusions of the forensic medical examination;
- GPS-navigator and decoding of its data;
- video materials from the recorder installed in the cockpit;
- video footage from CCTV of buildings adjacent to the fatal accident site;
- analysis and conclusions on the aircraft fuel and oil analysis.

During the investigation, the following versions of the fatal accident were considered:

2.1. Meteorological Conditions.

It was found that the meteorological conditions in the area of the flight were fully consistent with the VMC, and could not affect the occurrence and development of an emergency. The flight took place in the first half of the day, there were no dangerous meteorological phenomena.

2.2. Poor Quality Fuel and Lubricating Materials.

According to the KSRIFE's research, by the specified characteristics, the fuel meets the requirements of DSTU 4796:2007 "Aviation Fuel for Gas Turbine Engines JET A-1. Specifications". No foreign impurities were found.

2.3. Causes Associated with Failure of Aviation Technical Equipment.

On 04.06.2020, having performed the previous flight, the PIC wrote down findings on the aircraft:

1. Tapping noise of the front landing gear at taxiing.
2. Uneven fuel consumption from tanks.
3. Sliding: 1 ball diameter "to the left".
4. Sometimes GPS satellites signal disappears.

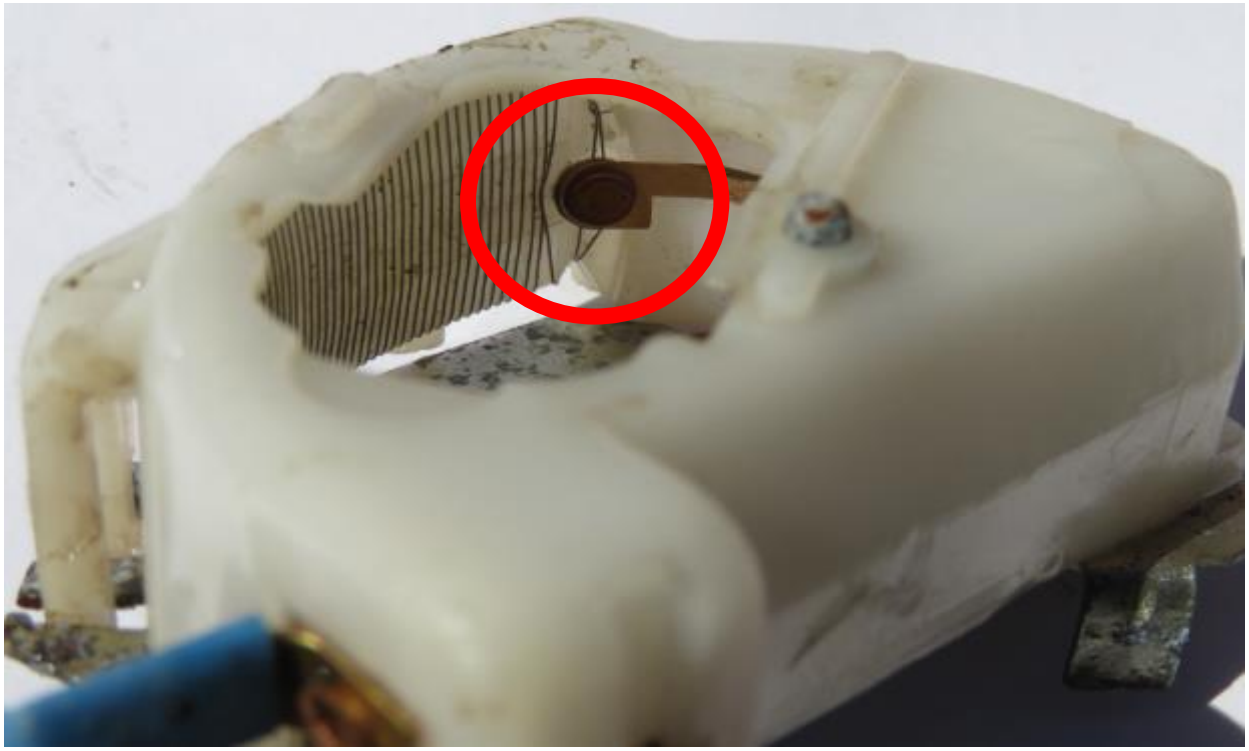
On 11.06.2020 and 12.06.2020, OAP Engineering Support Service carried out the

works to eliminate these findings and made an entry in the maintenance release No. 17/11 of 11.06.2020.
To eliminate the first finding, the maintenance work on the landing gear was carried out with the check of extension and retraction.
To eliminate the second finding, the fuel was completely drained from the tanks, there was conducted refueling and checking the fuel supply to the engine from the valve positions "Left", "Left + Right", "Right". No deviations were found. At the same time, operation of the tank fuel quantity sensors was not checked.

After the fatal accident and a detailed examination of the fuel system, it turned out that the left stop of the sensor float lever was deformed and the sensor potentiometer wiper was "blocked" in the upper position and retained in this position by the turns of the potentiometer wire. Thus, the wiper constantly retained the sensor float in the upper position, and an electrical signal provided the indicator with the readings that the left tank was full. Fuel consumption and fuel quantity lowering in the left tank were not reflected in the left fuel indicator readings. "Emergency fuel" annunciator panel at a residue of less than 12 liters also did not operate, because it depended on the float mechanism.
The works on elimination of the third and fourth findings are not related to the causes of the fatal accident.

Deformed left stop of the sensor float lever.

(Photo 11)
The sensor potentiometer wiper is "blocked" in the upper position and is retained in this position by the turns of the potentiometer wire.



(Photo 12)

2.4 Causes Associated with Human Factor During Aviation Technical Equipment Operation or Piloting Technique Error in Flight.

At 11:26:13, PIC set the landing gear control switch to the “retracted” position.

At 11:26:21, PIC set the flaps switch to the “retracted” position.

At 11:26:30, the flaps retracted.

At 11:26:32, "flaps down!" display lit up.

Note. *Lighting up of this display indicates that the landing gear has not retracted!!!*

Such position of the landing gear did not allow to carry out the assignment of measuring the forces applied to the controls. According to the flight assignment, in the event of aircraft systems and engine failure, the PIC should stop the flight.

At 11:26:58, the PIC switches the fuel tank selector valve to the "Left Tank".

***Warning**: Aircraft take-off and landing should be performed **only** with the fuel tank selector in the “**Left+Right**” (Page 4A-14 of the Dolphin Flight Operation Manual.) If it is necessary to equalize the fuel in the tanks, it should be done in a level flight.*

At 11:41:33, signs of engine starvation appeared: engine rpm drop, air pressure drop in the manifold, fuel pressure drop and a characteristic sound of a significant engine power loss due to lack of fuel in the left tank. It took place at the flight altitude of 4750 feet.

(Photo 13)

PIC switched the aircraft to descent with a vertical rate of 2400 ft/min., accelerated the aircraft to 260 km/h, contacted the air traffic controller and reported:

"Odesa Radar, request... I am forced to terminate the assignment, request descending for landing approach."

PIC did not report engine problem to the Odesa ACC controller and did not seek assistance. He received clearance for descent to 2000 feet and visual approach to Runway 16 (157°). Having crossed 2,000 feet, the crew was allowed to work with "Odesa Tower on the frequency of 125.5 MHz".

Working with the Odesa Tower controller, the crew once again failed to report an engine problem. The air traffic controller, not having the information about the engine problem, gave a standard command: *"Follow to the turn to final to Runway 16"*.

The PIC headed for the area of the turn to final. In the process of descent, the crew was unable to restore normal engine operation and, given the landing gear extended, and later on, the flaps extension, the aircraft did not have a sufficient altitude to complete the approach and landing procedure. The aircraft made a forced landing at a distance of 900 meters west of the runway 16 end.

On the ground, during the inspection of the fuel tank of the left wing, an absence of fuel was found, and the amount of fuel in the tank of the right wing was about half of the tank (Protocol of Accident Site Inspection dated 17.06.2020. 14:30-15:45.)

3. Conclusion

3.1 Conclusions

3.1.1. The crew had the ratings for VMC flight operation permit for the Dolphin aircraft, had valid medical certificates and other required admissions, theoretical and practical skills, and piloting experience on Dolphin-type aircraft.

3.1.2. The aircraft weight and CG were within the operational limits.

3.1.3. The aircraft controls were serviceable and in a satisfactory condition.

3.1.4. The findings on the previous flight were corrected by the technical staff, about which the corresponding entries were made in the Maintenance Release No. 17/11 dated 11.06.2020 and checklists No. 028PKV.113-20, No. 032PKV.114-20, No. 032PKV.115-20, No. 032PKV.116-20, No. 032PKV.117-20. 12 cycles of landing gear retraction and extension were performed, there were no critical comments on the system performance, however, after takeoff, the landing gear failed to retract.

3.1.5. In the process of performing these works, the operation of the left float mechanism of the fuel quantity sensor was not checked, so the plane took off with wrong quantity of fuel indication in the left tank.

3.1.6. The aircraft was refueled according to the flight assignment, but the PIC did not pay attention to incorrect readings of the fuel quantity gauge in the left tank – since the engine start time point, during taxiing, at turns, during takeoff, in climb and till impact.

3.1.7. The actual weather and forecast for the Odessa aerodrome and alternate aerodromes met the visual meteorological conditions with no dangerous phenomena.

3.2 Causes of Fatal Accident and Factors Contributing to Emergency Evolution.

The cause of the Dolphin plane fatal accident was the coincidence of the following factors:

- ✓ Engineering Support Service failed to pay attention to incorrect readings of the fuel quantity sensor in the left tank on the ground;
- ✓ Setting by PIC of the fuel tank selector valve to the "Left Tank" position;
- ✓ PIC’s failure to comply with the requirements of the Flight Operation Manual, page 4A-14, regarding the prohibition of "fuel equalizing by tanks" in a non-level flight;
- ✓ PIC’s decision to continue to carry out the assignment with a faulty landing gear retraction system, which contradicted paragraph 9 of the methodological instructions of the flight assignment;
- ✓ Significant engine power decrease due to full fuel consumption from the left tank as a result of wrong quantity of fuel indication and failure to switch to fuel consumption from the right tank, or to consumption from both tanks;
- ✓ PIC’s decision on choosing the place for a forced landing with a non-operating engine;

- ✓ PIC did not restore engine operation at fuel availability in the right tank;
- ✓ PIC did not report the engine problems to ATS controllers and did not declare an emergency, which deprived the controller of the opportunity to provide a recommendation on choosing the optimal and safe place for a forced landing;
- ✓ Possible loss of speed, or a high vertical rate of descent before touchdown, which resulted in a hard landing of the aircraft with its destruction and death of the pilots.

Factor: Human**.**

Category: FUEL**.**

4. Safety Recommendations

1. To: OAP flight personnel:

- ➢ In case of aircraft engine and system failures in flight, inform the air traffic controller of occurrence of an emergency;
- ➢ Operate all stages of the Dolphin 1 Y aircraft flight with "Left + Right" position of the fuel tank selector valve.

2. To: OAP management:

- ➢ Conduct a debriefing with the OAP personnel on the causes and consequences of the Dolphin 1 Y aircraft fatal accident;
- ➢ Bring to the flight personnel's attention the location of suitable sites for performing a forced landing in case of an engine failure;
- ➢ Develop a manual on pilots' actions at occurrence of abnormal cases in flight with recommendations on crew actions and keeping the manual on board the aircraft;
- ➢ Develop and install an independent alarm system for the emergency fuel remaining at the Dolphin 1 Y aircraft;
- ➢ Improve the design of the float mechanism of the tank fuel quantity indication sensor at the Dolphin 1 Y aircraft;
- ➢ Consider the possibility of installing equipment for the basic flight data recording at the Dolphin 1 Y aircraft.
- ➢ Train each pilot in actions in case of an engine failure during a test flight.
- ➢ Develop clear technological operations for each crew member during flights operated by the crew consisting of more than one pilot.