FINAL REPORT

on

investigation of an aviation occurrence with P92 Echo-S airplane, reg. No LZ-BAT, owned by Cabelcommerce Ltd, Sofia, occurred on 02.07.2004 in the area of Dolna Banya Airfield

2004

The materials about the aviation occurrence investigation have been classified under state file number 05/02.07.2004.

Owner: Cabelcommerce Ltd, Sofia, with main office at Buckstone Housing Estate No 24, Sofia.

Aircraft Manufacturer: TECNAM Construzioni Aeronautichi, Italy.

National and Registration Marks: LZ-BAT, according Technical Certificate, issued on 18.11.2003 by CAA and valid till 17.11.2004.

Place and Date of Occurrence: Dolna Banya airfield area, 02.07.2004 at 20:05 local time (17:05 UTC).

Notified: Civil Aviation Authority (CAA) and Aircraft Accident Investigation Unit (AAIU).

A commission has been appointed for investigation of the aviation occurrence by order RD-08-434/13.07.2004 of the Minister of Transport and Communications.

In accordance with Para.3 of Additional Provisions to Regulation No 13 of the Ministry of Transport of 27.01.1999 about aircraft accident investigation the occurrence was classified as an Aircraft Accident.

Type of Flight: Training Flight

On the 02.07.2004 the commander of P92 Echo-S aircraft reg. No LZ-BAT fulfilled the second flight for the day.

After engine start the commander taxied and took-off from runway 09 of Dolna Banya Airfield for a training flight over the runway. After the take-off the aircraft climbed and made a turnover for a touch-and-go on RWY27.

After the touch-and-go the aircraft according to the witnesses' information the aircraft flew about 200…300m away from the threshold of the runway in west direction, started a steep right-hand turn in climb, climbed about 60…80m, then started left-hand turn with steep bank to approach to RWY09. During the turn the aircraft lost altitude and in a course of 120…130° it hit the ground.

The pilot received injuries with fatal outcome and the aircraft was fully destroyed (Fig.1).

Fig. 1

1. Factual Information

1.1 History of Flight

1.1.1 Flight Number: Second training flight for the day.

1.1.2 Preparation and description of the flight and events:

In the day of the aviation occurrence, according to the information from the witnesses, the commander arrived at Dolna Banya Airfield at about 18:30 for execution of training flights.

Before the first flight for the day a daily check was performed which was registered in the folder for preflight checks. During the check no problems have been found out.

The aircraft was refueled with 40 liters of gasoline and this was registered in the Flight Sheet No 61 from 02.07.2004 (the date was erroneously written as 02.06.2004).

The commander fulfilled preflight check of the aircraft, started and warmed-up the engine, then taxied and took-off for a training flight over the runway of Dolna Banya Airfield.

According to the Flight Sheet No 61 the first flight lasted 0:38 hrs and ended with a RWY27 landing.

After about 15 min the commander requested clearance for execution of the second flight for the day, again over the airfield runway. After the clearance he started the engine, taxied and performed a take-off from RWY09. After the take-off he climbed, made a 180°-turn and an approach for RWY270.

After the touch-and-go the aircraft increased the speed in horizontal flight, flew about 200…300 m in west direction, started steep climbing and ascended about 60...80m and started a steep right-hand turn to approach course of 90°. During the turn the aircraft lost speed, descended and hit the ground in a course of 120°…130°.

The pilot received injuries with fatal outcome and the aircraft was fully destroyed.

1.1.3 Location of the Occurrence: Area of Dolna Banya Airfield, 300 m to the west from the threshold of RWY27 and 32 m to the left from the extension of the RWY27 center line.
Coordinates: N $42^0$18,549' and E $023^0$48,871', elevation 552 m.

1.2 Injuries to Persons

Injuries to persons	Crew	Passengers	Other persons
Fatal	1	0	0
Serious	0	0	0
Minor	0	0	0
None	0	0	0

1.3 Damage to Aircraft

The Commission determined the following damages during the inspection:
Aircraft cockpit was badly deformed and the engine was displaced back axially at about 35…40 cm. As a result of the engine fire arisen the instruments of the right-hand part of the console were burnt (Figure 2).

The right hand door of the cockpit was torn and was at 2.8 m from the place of the first impact and the left one – under the aircraft fuselage.

The left pilot seat was very deformed end inclined forward, but it wasn't torn from the main fixing assemblies (Figure 3).

During the inspection of the console in front of the pilot in the left-hand lower part the Commission established that the flap control lever was missing.

The safety belt was torn from the fixing point on the column of the aircraft fuselage.

The right-hand seat was very deformed and torn from the front support.

The two blades of the aircraft propeller were destroyed.

During the test it was established that the engine shaft rotated what was an indication the engine wasn't blocked.

The right-hand half-wing was very deformed. The main spar was bent at the fixing point. The skin of the wing end fairing was torn; the flap was torn at the left-hand fixing point of the wing. It was very deformed.

The fuselage was deformed and the cockpit truss construction was destroyed. The front and rear bearing walls were bent.

The fuselage longitudinal bearing elements were twisted to the left.

The fin and rudder were intact, without visible deformations.

The horizontal stabilizer was without residual deformation.

The lower strut of the left-hand half-wing was deformed. As a whole the wing was twisted in the fixing assembly and the skin was torn and bent in its central part.

The left-hand flap was deformed and with corrugated skin.

The left-hand half-wing fairing was very deformed. The left-hand aileron was torn from the wing at the left-hand fixing point.

Aircraft landing gear:
The nose landing gear was destroyed and the wheel was torn; the Commission found it at 1.3 m from the aircraft right-hand half-wing with punctured tire and very deformed wheel rim.

The attachment point of left-hand main landing gear was very bent and deformed together with the fixing assembly of the left-hand strut support (Figure 4).

The right-hand main landing gear was torn from the fixing assembly and the Commission found it at 4.7 m from the end of the left-hand half-wing.

The aircraft was destroyed and it was not repairable.

Figure 2

Figure 3

Figure 4

1.4 Other Damages
Not other damages were determined by the Commission

1.5 Personnel Information
1.5.1 Commander – with a PPL license and an out of date medical certificate.

During the technical investigation the Commission found out that in the Pilot's log- book no records were made about his flying hours after the graduation of PPL course.

After analyzing of the records in the aircraft log-book the Commission determined that there were inaccuracies in the registration of the aircraft flight hours and cycles; in Flight Sheet No 36/02.04.2004 were registered 100 flights more the real number of the aircraft commander's flights and this wasn't corrected till the last record in the log-book.

1.6. Aircraft information
1.6.1. Airworthiness information

P 92 Echo-S airplane, reg. LZ-BAT was manufactured on the 7.10.2003 by TECNAM Construzioni Aeronautichi, Italy, Technical Certificate No II-24, issued on 18.11.2003 and valid till 17.11.2004.

The aircraft has accrued 116:08 hrs and 296 cycles since new. The last 100-hrs maintenance was registered at 101 hrs on the 19.05.2004 and after it the aircraft has flown 15:08 hrs. During the execution of the approved Maintenance Program the airframe had no limitation in its life time.

A Rotax 912 ULS engine, manufactured by Bombardier Rotax Austria in 2003, was installed on the aircraft. The engine has accrued 123 hrs according the record from the motor watch taken from the flight sheets of log-book and according of the approved Maintenance Program the engine had no limitation in its life time. According to the manufacturer's life time limitation, the life time between the overhauls was 1200 hrs or 10 years (which occurs first).

A 100-hrs inspection was performed according to the Rotax 912 Engine Maintenance Manual at 101.6 hrs flown since new.

A F.lli Tonini Giancarlo & Felice S.n.c., GT-ECHO 2/172/164 Type, two-blade propeller with fixed pitch was installed. During the execution of the approved Maintenance Program the propeller had no limitation in its life time and time between overhauls.

According to Article 62, Para2 of Chapter V, Requirements and Control of the Persons, Performing General Aviation Flights" of Regulation No 24 of the Ministry of Transportation and Communications of 15.02.2000 for air operators certificates issuing, the aircraft owner or user is in charge for the aircraft airworthiness, ensuring:

1. Valid Aircraft Airworthiness Certificate, in which the category "Private" should be written;
2. Aircraft maintenance and continuous airworthiness by licensed personnel according the norms and technical requirements.
3. The operational clearance certificates were drawn up and signed by respective licensed persons.

The aircraft possesses a valid Technical Certificate, issued by CAA on 18.11.2003 and valid till 17.11.2004 with "private" category entered.

The maintenance was performed by certified technical personnel. All inspections of aircraft, engine and systems were registered according to the Maintenance Program, and the service bulletins of aircraft manufacturer were fulfilled and registered.

The 100-hrs inspection was performed and certified by certified technical personnel. The Operational Clearance Certificate was drawn up and certified by certified technical personnel.

Immediately before the LZ-BAT flights of 02.07.2004 a Daily Check was performed and certified by certified technical personnel. No faults were established during this check.

On the grounds of abovementioned the conclusion may be done, that at the moment of the air accident P 92 Echo-S, reg. № LZ-BAT aircraft was in airworthy condition.

1.6.2. Airplane performance

Aircraft maximum take-off weight of P 92 Echo-S is 450 kg. Aircraft empty weight is 280 kg. At the moment of the aviation accident there was about 27 liters of fuel and one-man crew, having a weight of about 410 kg and the center of gravity was in the operational range. Following are some characteristic P92 S aircraft speeds and limitations according the Aircraft Operation Manual.

Speed Limitations, km/h		**Indicated Airspeed (IAS)**
V_{NE}	Maximum Speed	**260**
V_{NO}	Maximum Cruising Speed	**200**
V_A	Maneuvering Speed	**150**
V_{FE}	Maximum Speed with extended flaps	**110**

Stalling Speeds

	Aircraft Bank			
	0°	**30°**	**45°**	**60°**
Flaps	IAS km/h	IAS km/h	IAS km/h	IAS km/h
0°	**69**	**73**	**79**	**95**
15°	**65**	**71**	**74**	**91**
30°	**61**	**65**	**73**	**85**

A Rotax 912 ULS engine was installed on the aircraft.
Rotax 912ULS is a four-cylinder engine, boxer-type, with combined cooling and maximum power output limitation of 73.5 kW (100 h.p.) at a speed of 5800 min^{-1} for 5 minutes. Idle speed is 1400 min^{-1}.

1.6.3. Fuel

According to the record in Flight Sheet No 61 of the log-book, the aircraft was refueled with 40 liters motor gasoline A-95H before the first flight, which was in compliance with Operation Manual of Rotax 912 engine.

At the scene of accident the Commission determined there were about 27 l of gasoline in the aircraft tanks. Samples were taken from the refueling barrel and from the aircraft tank. The samples were analyzed in Chemical Laboratory of Fuel and Lubricant Materials at Sofia Airport Ltd. The conclusion in the Quality Certificate No 495 & 496 of 07.07.2004 was both samples corresponded to the FTS 1.15:2004 requirements for the tests made.

1.7. Meteorological information

Day, visual flight conditions, CAVOK, calm, temperature 25°.

1.8. Aids to navigation

Standard aids for P92 S aircraft.

1.9. Communications
Standard communication equipment for P92 S aircraft.

1.10. Airport
The accident was realized at Dolna Banya Airfield with coordinates of the runway middle point:

N 42°18’35,0
E 023°49’14,7

1.11. Flight data recorders
Not required for the type of aircraft

1.12. Wreckage and impact information
During the inspection of the scene of the accident the Commission determined that the first touch between the aircraft and the ground occurred at 208 m to the west from the runway of Dolna Banya Airfield. The aircraft met the ground at a small angle and a left-hand bank of about 10°…15°. The total direction of the scattered elements of the aircraft construction was 115°…295° in a radius of 15…17m.

At the place of the first touch the Commission found an oar trace from the engine propeller, which was evidence that the propeller was still rotating at the moment of the impact.

After the first impact the aircraft bounced off, turned to the right with the second impact into the ground and stopped at course 230°.

As a result of the rupture of the petrol and oil tubing by the dynamic impact the engine fired caught fire and it burned in its upper and left-hand part. The emergency fire team arrived on time and extinguished the fire.

Aircraft cockpit was badly deformed and the engine was displaced back axially at about 35…40 cm. As a result of the engine fire emerged the instruments of the right-hand part of the console were burnt out. From the aircraft instrumentation (Figure 5), placed at the left-hand part of the console, the following instruments were well preserved: speed indicator, showing 0 km/h, because the tube for pressure to the aneroid was torn; the compass, showing CC=210°, slide slip indicator with a ball at end left-hand position and rate-of-climb indicator, showing vertical speed of 350 ft/min (about 2 m/s).

Figure 5

Aircraft gyroscopic horizon and altimeter were found at a distance of 4.5 m from the cockpit in aircraft flight direction at the moment of the second impact. An altitude of 5580 ft was fixed on the altimeter and the altimeter setting was 951 hPa (Figure 6)=

Figure 6

The receiver of the Global Positioning System (GPS) was found 10 m away, left from the cockpit.

The safety pin of the aircraft parachute system was found at 3 m outside the cockpit.

The magnetos were in “ON” position.

Cockpit right-hand door was at 2.8 m from the place of first impact and the left-hand one was under the aircraft fuselage.

The damages of the aircraft were described in Para1.3 and part of them was shown on Figure 7.

Figure 7

The fuselage was deformed and the cockpit truss construction was destroyed. The front and aft bearing walls were bent.

Fuselage longitudinal bearing elements were twisted to the left. The fin and rudder were intact, without visible deformations. The horizontal stabilizer and elevator hadn’t any residual deformation.

The left-hand strut was deformed. The wing as a whole was twisted in the fixing assembly and the skin was torn and bent in its central part.

The main wing spar was deformed.
The left-hand flap was deformed and with bent skin.
The end fairing of the wing was very deformed. The left-hand aileron was torn from the wing at the left-hand attachment point as a result of the dynamic impact.

Aircraft landing gear:
The nose landing gear was destroyed and the wheel was torn; the Commission found it at 1.3 m from the aircraft right-hand half-wing with punctured tire and very deformed wheel rim.

The attachment point of left-hand main landing gear was very bent and deformed together with the fixing assembly of the left-hand strut support.

The right-hand main landing gear was torn from the fixing assembly and the Commission found it at 4.7 m from the end of the left-hand half-wing, as it was shown on Figure 8.

Figure 8

1.13. Medical and pathological information
The pilot was determined as fit for flying activity by a protocol of the Medical Certification Commission, but it was out of date at the moment of the aviation accident.

On the base of the abovementioned conclusion a Medical Fitness Certificate was issued for the pilot with issue date 21.05.003 and valid till 19.05.2004.

As a result of the heavy impact the pilot was injured with lethal outcome.

According to the Forensic Chemical Expert Examination, issued by Alexandrovska CSMD - UBAL Ltd there was no presence of alcohol in the pilot's blood.

According to the Forensic Chemical Expert Examination, issued by Alexandrovska CSMD - UBAL Ltd there was no presence of drugs in the pilot's blood.

1.14. Fire

As a result of the aircraft impact into the ground the petrol tubing to the engine was destroyed and a fire emerged in the engine area.

The fire affected the from left-hand part of the aircraft and destroyed a part of the engine cowling, part of the elements in the front left-hand part of the engine and some of the instruments on the console in front of the pilot.

A car with three men and fire extinguishing equipment (three small extinguishers) arrived from Dolna Banya Airfield at the scene of the accident. At first the extinguishing started with the small extinguishers and the efforts were concentrated for extracting the pilot's body out of the fire area.

According to the witnesses and participants in the emergency and rescue actions the first car arrived after 2…3 min after the aircraft impact with the ground and the main car with extinguishing equipment arrived after about 2 minutes more.

As a result of timely and effective actions of the group from Dolna Banya Airfield the fire was localized in the front part of the aircraft and afterwards it was extinguished by using of carbon dioxide bottles, big extinguishers and covering the engine with asbestos blankets.

About 10…12 min after fire extinguishing a specialized fire engine and a team of Fire and Emergency National Service arrived and it used foam for additional securing of the aircraft part under fire and the area around it.

1.15. Survival aspects

As a result of the powerful dynamic impact the area in front and under the left-hand pilot seat was very deformed, but this seat wasn't torn from its support. The right-hand seat was torn from the front support.

As a result of the impact the safety belt was unlocked; its fixing bracket to the side column in the aircraft cockpit was torn.

The safety pin of the aircraft parachute system was found at 3 m outside the aircraft cockpit. No attempt was made to operate the aircraft parachute system in flight.

According the witnesses' explanations the pilot's body was almost entirely outside the aircraft at the left-hand door and lied prone on the ground.

The presence of fire and the risk of explosion imposed to remove the pilot outside the fire area immediately.

1.16. Tests and research

For the purpose of the technical investigation the following tests and research were conducted:

- inspection of the scene of the air accident;
- inspection of the aircraft, engine and systems condition on the place of the air accident and photographing of the aircraft position, aircraft wreckages, airframe and engine elements, condition and position of the valves and switches in the cockpit and the instrument readings, safety belts and aircraft emergency and rescue system;
- examination of the fuel, taken from the aircraft tanks at the place of accident and from the refueling barrel;
- comparative analysis of the written explanations of the accident witnesses and the participants in emergency and rescue activities;
- pathological and anatomical expert examination;
- examination of the documents and materials related with air accident investigation;
- inspection of the same type of aircraft of another air operator;
- inspection and analysis of the GPS receiver readings of the P 92 Echo-S aircraft, reg. LZ-BAT.

The materials and results of the tests and research conducted are enclosed to the deed.

2. Analysis

The commission rejected practically uncertain hypotheses and analyzed four most probable hypotheses for air accident origin:

I. In-flight engine shut down.
II. In-flight fire.
III. Aircraft controls failure.
IV. Pilot's errors, leaded to the air accident.

P92 Echo-S doesn't possess any on-board flight data records. The ground for the analysis made were the objective findings, Commission's researches, witnesses' explanations and the readings from the aircraft GPS receiver GPSMAP 295 type.

<u>On the first hypothesis – In-flight engine shut down.</u>

During the inspection of the place of the first touch of the aircraft with the ground the Commission found an oar trace from the engine propeller, which was evidence that the propeller was still rotating at the moment of the impact. The Commission found out that both blades of the propeller were broken. The kind of destruction confirmed the

conclusion that the engine was operational at the moment of impact and the propeller was rotating.

The Commission made a check and established that the shaft rotated freely and the engine wasn't blocked in flight.

The Commission found out presence of fuel in the tanks and aircraft fuel system. The fuel analysis made showed it was in compliance with the requirements of the standard.

Aircraft ignition system is double-circuit type and both engine magnetos were ON.

Explanations of the witnesses, who observed the flight, testify that the aircraft engine was working till the impact into the ground. Indirect evidence about this was also the fire originated from the torn of fuel and oil system elements and fuel and oil falling on the hot engine surface.

Analysing the abovementioned facts the Commission consider there were no real evidences to confirm the hypothesis about in-flight engine shut down.

<u>On the second hypothesis – in-flight fire</u>
During the inspection of the scene of air accident the Commission found out right-hand cover of engine cowling at a distance of 9 m from the place of the first impact, which was torn by the hit. No traces of in-flight fire were found on it.

During the inspection of the cockpit it was established, that:
- the magnetos were in ON position;
- the fuel cocks were opened;
- the airborne fire extinguisher wasn't used.

The kind of burning of the engine and the traces of the fire indicated that it originated as a result of tearing of the fuel and oil tubing from the dynamic impact into the ground. Most intensive fire was in the area of the main fuel filter and the place of connecting of the tubing of the fuel tanks.

The witnesses who observed the aircraft in the air till the hit into the ground didn't notice visible and specific signs of in-flight fire.

During the inspection of the cabin and the elements of the aircraft construction the Commission didn't find visible and material traces of fire.

On the grounds of the abovementioned facts the Commission consider there were no evidences or signs, which could confirm the hypothesis about in-flight fire.

On the third hypothesis – aircraft controls failure.
During the inspection of the scene of air accident and the examination of the condition of the controls' elements it was established that there were no evidences for their destruction in flight. This fact was confirmed by witnesses, who observed the flight.

The aircraft construction condition after the impact into the ground was such, that a detailed inspection of the elements and connections of aircraft control system and their functioning along the bank, roll and pitch axes was possible.

Lateral (roll) control:
The inspection and check of the lateral control established the ailerons of the left- and right hand half-wings were preserved. The right-hand aileron was deformed and the left-hand one had destructed left-hand attachment point as result of dynamic impact of the aircraft into the ground and the resulted wing deformation.

The movement transmission cables were out of guiding rollers after the impact. During the test made the Commission established the circuits of the lateral control retained their intactness from the control stick to the ailerons.

Directional control:
The fin was without obvious deformations. The rudder was intact, movable and without deformations. The movement transmission cables were out of guiding rollers, but the connection from the pedals to the rudder was safe.

Longitudinal control:
The all-movable stabilizer and the trim were without visible residual deformation.
In order to check the condition of the longitudinal channel control circuit the Commission made a section in the aircraft fuselage and during the inspection it was established that the control rod from the horizontal control surface to the aft bearing wall was intact. As a result of the dynamic impact and the deformation of the cockpit floor in axial direction rearward, the control rod between the crank and the control stick was torn.

The Commission's conclusion on this hypothesis was that there ware no real grounds to confirm aircraft controls failure as a possible reason for the air accident.

On the fourth hypothesis - pilot's errors, leaded to the air accident.
Analyzing this hypothesis, in addition to the abovementioned the Commission considered the following facts;
- theoretical and practical training, licensing and training level of the pilot;
- character of the flight missions fulfilled before the air accident;
- physical condition, psychological characteristic and medical licensing of the pilot;
- outside factor influence, which may contribute for the air accident.

The theoretical training of the pilot was performed in the licensed air training centre (ATC) under the program for theoretical training of ultra-light aircraft, approved by CAA. The pilot completed the theoretical course Initial Course for Private Pilot License

of Ultra-Light Aircraft (PPL-ULA), what was confirmed by Certificate reg. No 003443/10.06.2003, issued by a licensed ATC.

The practical flying training was conducted in a licensed ATC under a flight training program, approved by CAA.

After a flight and navigational check on 24.10.2003 the manager of the Flight ATC certified by Certificate No 07/24.10.2003, that the pilot graduated an initial course for Private Pilot License of Ultra-Light Aircraft.

The Commission established that the training course included 25:56 hrs and 111 cycles flown.

By an Order No 30/24.10.2003 the manager of the Flight ATC admitted the pilot to flights as a Private Pilot on Ultra-Light Aircraft – commander of P92 Echo-S aircraft.

The Commission established, that since 15.11.2003 the pilot started to fulfil solo training flights and as to the date of receiving of pilot's license by CAA he was accrued 79:45 hrs and 116 cycles.

The pilot received a pilot's license on 19.04.2004 and till this date he flew violating Art.2, Para1 of Regulation No 1 of the Ministry of Transport and Communications of 16.01.2003 about the licensing of air personnel.

In the pilot's log-book only the flying hours and cycles during the training course were registered.

After October 2003 till the date of air accident there was no registration of hours, cycles and type of missions flown. The abovementioned data the Commission took from the aircraft log-book.

From the pilot's log-book and aircraft log-book it was impossible to establish the character of missions flown, such as circle flights and in flight manoeuvring area, what was evidence for lack of regulation of flight activity organisation and the elements of flights conducted after receiving of pilot's license. The lack of such regulation and the possibility for control created conditions for conducting of "free" programs during the training flights in flight training areas by the private pilots of ULAs.

The physical condition and the medical fitness of the pilot were given in p.151 and 1.13 of this report. From the data in these points it was clear that as on 02.07.2004 – the day of the air accident, the pilot's medical fitness was expired. The validity, given in his Medical Certificate was till 19.05.2004. This fact has made void his license after 19.05.2004.

From the submitted to the Commission psychological characteristic of the pilot was visible, that the pilot demonstrated moderate abilities for operational mental performance and average values during a work in autonomous and imposed pace of work.

From all outside factors, which might contribute or influence indirectly in air accident origin, the Commission dueled on the following:

- possible use of psychotropic substances or alcohol before the flight;
- the feeling of public presence, which observed the flight and assessed the pilot qualification.

As to the first point, the medical report was negative and it was written in point 1.13 of this report.

As to the second point, the Commission established that during the flight before the air accident the flights were conducted and except the flight and engineering staff some gests presented, who observed the flights. The Commission considered that the flights over the runway and the presence of "public" to a certain extent had motivated additionally the pilot's will to demonstrate his skills.

The pilot had a total flight time of 133:36 hrs and 166 cycles, 25:56 hrs as a trainee and 107.30 hrs in solo flights. The flight course graduation gives the minimum required level of training for the private pilot according the conditions of licensing, determining the volume and character of the missions, for which he was trained to fulfil during the solo flights: circling flights and go-around, flights in manoeuvring area for execution of some elements and figures of elementary manoeuvring and en-route flights.

On 02.07.2004 the pilot fulfilled a training flight in flight manoeuvring area, during which according the witnesses he made some low level passes, side slips and landing approaches with go-around.

After a short rest of about 15 minutes and pre-flight check the pilot took-off for a second training flight in manoeuvring area over the runway.

According witnesses data the pilot took-off in CC=90°, levelled for speed increasing, climb to about 60…80 m with a next turnover with a bank of about 60°, resembling the hammer stall figure, descending with next go-around and he fulfilled these manoeuvres repeatedly (6…7 times) over the runway.

One of the witnesses - a licensed pilot of ULA – was impressed by abrupt and steep transition to climb.

During the initial inspection of the scene of the air accident the Commission found out the aircraft GPS receiver at 10 m from the aircraft. During the investigation it was established that it was operable and that gave the Commission the possibility to restore on the display the graphical pattern of the last flight (Figure 9). This pattern coincided with the elements, described by witnesses and actually confirmed the nature of the flight and the elements fulfilled.

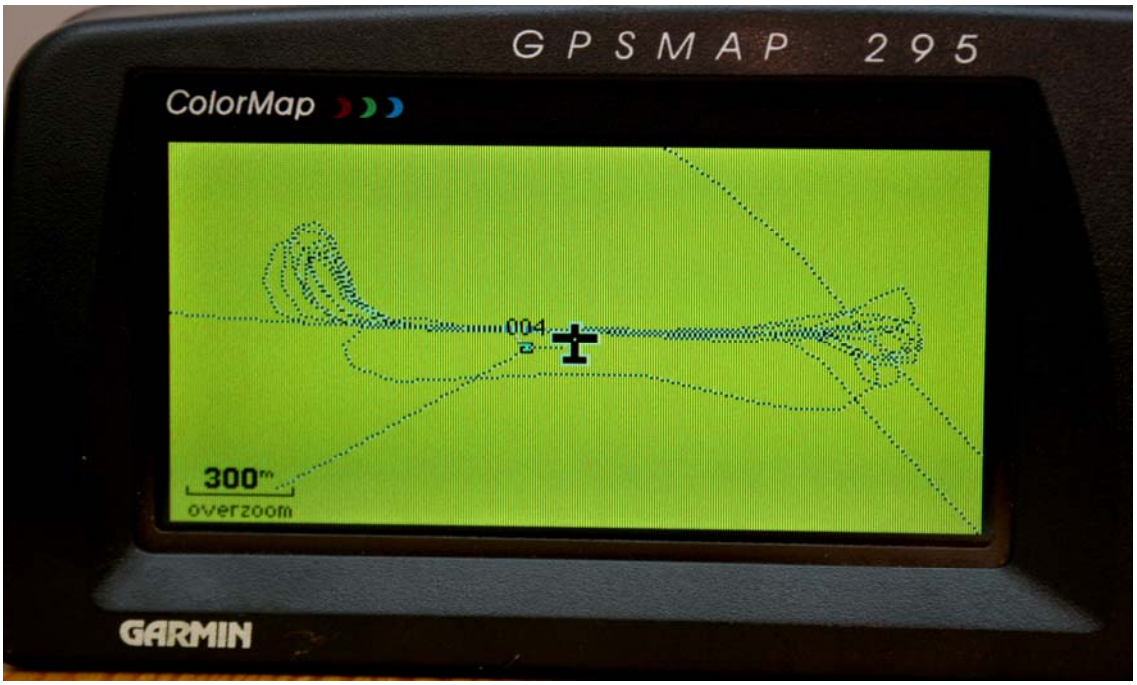

Figure 9

The fulfillment of any curvilinear aircraft motion is possible only by creating of acceleration, i.e. by creating of load factor. For execution of ascending maneuvers it is necessary to create normal g-load $n_y > 1$, and at that the induced drag increases according a certain principle. This was the reason for intensive flight speed reduction.

ULA possess small thrust-to-weight ratio, which is in order of 0.12…0.16 and this defines comparatively small normal operating range. For P92 Echo-S it is in the range between 110…200 km/h.

For this range in the Flight Manual, Section 2 "Limitations", on page 2.3 in the table "Airspeed Indicator Markings" it is written: "Normal operating range (lower limit is V_{S1} with maximum weight and flaps at 0° position and upper limit is maximal structural speed V_{NO})."

Limitation of aircraft minimal speed is imposed by the angle of attack limitation. Physical meaning of this is that at angles of attack close or greater than α_{cr} (stalling incidence), especially combined with presence of sliding, the laminar flow around the wing and a stalling process develops, characterized by stalling of the flow from the aerodynamic surfaces – wing, stabilizer, control surfaces.

Joint Aviation Regulations (JAR-1) determine the values of stalling speeds depending on the nature of flight:

- V_{S0} – speed, at which starts and develops stalling process when aircraft is in landing configuration;

- V_{S1g} – speed at which starts and develops stalling process in level flight, n_y =1;
- V_S – lowest speed, at which manoeuvring aircraft in normal flight configuration loses its ability for aerodynamic control because a stall.

The manoeuvres, performed by the pilot, could be defined as ascending irregular aircraft movement in inclined plane with progressive deceleration, with turnover with a great bank at the upper point of the manoeuvre, following by descending.

From flight dynamics point of view this type of manoeuvres is one of complicated manoeuvres, which are difficult for performing because of the continuous change of the main flight parameters (speed, height, g-load, bank, sliding, pitch, angle of trajectory, angle of attack), what is a result of different influence of the forces of weight, lift and thrust at each part of the trajectory. These peculiarities require very good pilot technique and already established pilot skills.

The operational capability of GPS receiver - Garmin GPSMAP 295, gave the Commission the possibility to establish roughly the radius of pilot's manoeuvres from the graphic pattern on the display by Measure Distance option. The radii of the single manoeuvres were respectively: R_1 = 157 m; R_2 = 142 m; R_3 = 110 m; R_4 = 91 m and R_5 = 72 m.

Progressively reducing turn radius at the upper point of the manoeuvre might be realized by progressive g-load augmentation. On the other hand G-load augmentation leads to increasing of the stalling speed V_S under a strictly defined law:

$$V_S = V_{S1g} . \sqrt{n_y}$$

From witness's explanations – a licensed ULA pilot, who observed the flight, turned out that the aircraft bank angle during the turnover was $\gamma = 60...65^0$, and $n_y = 1/\cos\gamma = 2…2.2$, and V_S respectively:

$$V_S = 69 . \sqrt{2,2} = 69 . 1,48 = 102,3 \text{ km/h.}$$

According witnesses' information the altitude at the end of ascending maneuver was 60…80m.

The point of first touch of the aircraft with the ground was at a distance of 280 m from the west threshold of the runway 27. This conditions allowed to determine the approximate angle of slope of the aircraft trajectory as $\theta = 18...20°$.

The drastic change to climb and the considerable angle of climb coupled with the low aircraft thrust-to-weight ratio, the significant bank and the g-load shown leaded to possible deceleration during the turn under the value V_S, what instigated aircraft stall, loss of controls' effectiveness, loss of altitude and the impact into the ground.

Having in mind the abovementioned, the Commission accepted this hypothesis as the most probable for the origin of the accident.

3. Conclusions

The technical investigation conducted, the results of examination and analysis give the grounds for the Commission to make the conclusion, that the air accident was a result from the following

MAIN CAUSE:

Departure of the pilot technique, leaded to violation of the limitation on minimal admissible speed and aircraft stall.

Immediate cause:

Aircraft impact into the ground.

Contributing factors:

1. Pilot's self-sufficiency and inappropriate training for the elements executed during the flight.
2. Presence of visitors, observing the flights in the airfield area, which possibly influenced the pilot actions.

During the investigation the commission revealed also the following irregularities;

IRREGULARITIES:

1. Expired term of medical fitness of the pilot, what means that the validity of his Pilot License was suspended.
2. In the Maintenance Program, approved by CAA, the obligatory requirement of the manufacturer for 600 hrs check wasn't included.
3. In the pilot's flight log-book there were no records about the number and duration of flights during the period after the graduation of ATC, what was a violation of Article 240, Para1&2 of Regulation No 1 of 16.01.2003 of the Ministry of Transport and Communications about the certificates of air personnel.
4. Inaccurate keeping of aircraft log-book, where in Flight sheet No 36/02.04.2004 were registered 100 flights more than actually performed by the aircraft commander.
5. Unlawfully issued aviation operator's certificate of an operator without aircraft.

SAFETY RECOMMENDATIONS:

During the investigation the following recommendation were given:

1. CAA should organize and conduct theoretical study of 4 hrs with licensed private pilots of ULA on following topics:
   - Minimum admissible speeds in flight, limitations, aircraft behaviour;
   - Aircraft stalling speeds in clean and high-lift devices configuration, aircraft behavior, loss of altitude and pilot's activities – fulfilled by CAA
2. CAA should order one-time check of condition and locking of shoulder-and-waist harness of very-light and ultra-light aircraft with registration in the aircraft log-book - fulfilled.

3. CAA to speed up creation of Unified Program for Preparation and Training of Private Pilots of Small Aircraft (PPL-SA) according the requirements of Art. 237, Para2 of Regulation No1 of 16.01.2003 of the Ministry of Transport and Communications about air personnel licensing – fulfilled by CAA.

Taking into account the results of the investigation conducted the Commission recommended:

1. CAA to oblige the managers of flight ATC on the base of Unified Program for Preparation and Training of Private Pilots of small aircraft (PPL-SA) to submit to CAA for approval Principles of training of Private Pilots of Small Aircraft (PPL-SA) for the aircraft used for training, containing detailed exercises for each task of Unified Program with the respective limitations and in- and out parameters for the elements performed.
Time 31st of December 2004, person responsible: CAA

2. In order for effective execution of Art. 240 of Regulation No 1 of 16.01.2003 of MTC about the air personnel licensing CAA should oblige the managers (owners) of airfield and flight areas (without international airports) to submit for approval by CAA a form for Airfield Flight Journal, where the following data should be included as a minimum:

Date	Aircraft Type,reg. No	Name of the Pilot	Task, Exercise	Ready for flight, pilot's signature	Take-off (hour, minute)	Landed (hour, minute)	Signature of the manager (owner) of the airfield or air area

Time: 30th of October 2004. Person responsible: CAA.

3. CAA should organize an analysis of the air accident, realized on 02.07.2004 and to ensure the presence of:

- managers (owners) of airfields and air areas;
- managers and chief pilots of ATC;
- pilots, holder of PPL (A) and PPL (SA) and trainee pilots of PPL (A) and PPL (SA.

During the analysis the present should be informed by the Chairman of the Commission about the substance, resume, conclusions and safety recommendations of the Commission of the air accident investigation.
Time 15th of October 2004. Person responsible: CAA Main Director and the Chairman of the Commission for investigation of air accident.

4. The Maintenance Program of P92 Aircraft should be corrected to include the activities, related with the maintenance activities after 600 hrs flown.
Time 30th of October 2004. Person responsible: Air Operators, operating the type of aircraft.