HELLENIC REPUBLIC

MINISTRY OF INFRASTRUCTURE AND TRANSPORT

AIR ACCIDENT INVESTIGATION AND

AVIATION SAFETY BOARD

(AAIASB)

ACCIDENT INVESTIGATION REPORT
INVOLVING A PARAGLIDER
AT THE AREA OF AGIOS SPYRIDONAS
IN KOLIAKI, EPIDAURUS
ON THE 23rd OF APRIL 2018

03 / 2019

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The accident investigation was carried out by the Air Accident Investigation and Aviation Safety Board in accordance with:

- **ICAO Annex 13;**
- **Regulation (EU) No. 996/2010;**
- **Hellenic Republic Law No. 2912/2001.**

'In accordance with Annex 13 to the Convention on International Civil Aviation, Regulation (EU) No. 996/2010 and Law No. 2912/2001, the purpose of investigations into aviation accidents and incidents is not to apportion blame or liability. The sole objective of the investigation and its findings is the prevention of accidents and incidents.
As a result, use of the findings for any purpose other than the prevention of future accidents could result in erroneous conclusions.'

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LIST OF ABBREVIATIONS

^{o}	degrees
^{o}C	degrees Celsius
A.A.I.A.S.B.	Air Accident Investigation and Aviation Safety Board
A.G.L.	Above Ground Level
A.M.S.L.	Above Mean Sea Level
E.	Easterly
E.A.P.R.	European Academy of Parachute Rigging
E.E.N.	European Emergency Number
EKAB	National Emergency Medical Aid Center
ELAO	Hellenic Aeronautical & Air Sports Federation
E.N.	European Norm
F.A.I.	Fédération Aéronautique Internationale
F.D.	Fire Department
F.F.V.L.	Fédération Française de Vol Libre
F.F.A	Free-flying foot-launched glider aircraft
G.P.S.	Global Positioning System
h	hours
HCAA	Hellenic Civil Aviation Authority
hPa	hecto Pascals
H.P.C.	Hellenic Paragliding Commission
H.Pol.	Hellenic Police
H.R.T.	Hellenic Rescue Team
I.P.P.I.	International Pilot Proficiency Information Card
kg	kilograms
km/h	kilometers per hour
L.A.A. C.R.	Light Aircraft Association of the Czech Republic
m	meters
m^2	square meters
min	minutes

mm	millimeters
M.U.	Municipal Unit
N.	Northerly
NE.	Northeasterly
NW.	Northwesterly
SafePro	Safe Progression
SE.	Southeasterly
sec	second
U.T.C.	Universal Time Coordinated
V.H.F.	Very High Frequency
V.I.	Visual Inspection
W.	Westerly

OPERATOR	: PRIVATE
OWNER	: PRIVATE
NATIONALITY	: FRENCH
MANUFACTURER	: U-TURN GmbH
MODEL	: BLACKLIGHT M
SERIAL NUMBER	: AP-BLA-1M-40C-0523
YEAR OF MANUFACTURE	: 2013
COUNTRY OF MANUFACTURE	: GERMANY
TYPE	: PARAGLIDER (FFA)
REGISTRATION	: N/A
PLACE OF ACCIDENT	: AGIOS SPYRIDONAS IN KOLIAKI, MANICIPAL OF EPIDAURUS
DATE & TIME	: 23 APRIL 2018 at 17:49:05 h
Note	: All times are local (local time = UTC + 3h)

SYNOPSIS

On the 23rd of April 2018, a paraglider pilot who was a foreign national took off from a natural launch site, which is used for paraglider take-offs, in the area of Agios Spyridonas in Koliaki, Municipal Unit of Epidaurus, Municipality of Epidaurus. In the course of the flight the pilot was fatally injured as a result of a fall a short distance from the take-off site.

The Air Accident Investigation and Aviation Safety Board (AAIASB) was notified of the accident and appointed an Investigation Team as well as a Technical Expert, under documents AAIASB/1260/24-04-2018 & AAIASB/3159/18-09-2018.

1. FACTUAL INFORMATION

1.1 History of the flight

In the afternoon of 23 April 2018 a group of foreign paraglider pilots, among them the pilot who was fatally injured, went to a natural launch site in the area of Agios Spyridonas in Koliaki, located in the township of Trachia, Municipal Unit of Epidaurus, Municipality of Epidaurus, near Palea Epidaurus, with the intention of conducting flights in the said area.

The group of foreign pilots consisted of three pilots accompanied by a Greek pilot who essentially provided consulting and guiding services with regard to the most suitable areas for takeoff/landing and flight in reference with the prevailing weather conditions of the day. The said foreign pilots had been in Greece for the last seven days prior to the day of the accident, conducting flights in the said but also in the broader area.

The accident flight was the second flight on that day. A morning flight of a short duration had been conducted in the area of Lygourio, which lasted approximately 20 min. Then, after looking for a more suitable area in terms of weather conditions, in the afternoon they ended up in the area of Koliaki.

According to his interview the Greek pilot, being the guide of the group of foreign pilots, briefed them prior to takeoff about the prevailing weather conditions, about the appropriate span of their flight, areas to be avoided and at the same time he provided information of the landing site. He also cautioned the group of pilots to avoid the area east of the launching site given that in that area the hills and the terrain profile form a sort of a narrow pass. This narrow pass combined with specific meteorological conditions that often prevail there give rise to a physical phenomenon called Venturi Effect. Venturi effect causes wind to accelerate in and near the constriction and can cause difficulty in the smooth flight of a paraglider (*see Sections **1.19.2** & **2.4** below*).

Fig. 1: The launching site, the flight track and the impact point

The duration of the flight of the said pilot was approximately 14 min and for its most part was confined to the east of the launching site and at a distance up to 1,000 m therefrom. The accident occurred at around 17:49 h and the impact point, located to the south-east of the launching site, is in a rough, rocky and bushy area about 88 m away from the nearest dirt road. The impact site coordinates are 37º35΄57.3΄΄N., 023º09΄49.2″E and its elevation is approx. 387 m A.M.S.L. (*see **Fig. 1** & **Fig. 14***). It is also pointed out that the pilot did not deploy his emergency parachute.

Another pilot in the group became aware of the pilot's fall and immediately alerted the other pilots over the VHF radio. When they had all landed, they formed small search groups to locate the exact point of the fall. Following a short search, the pilots located the exact spot and contacted the Fire Department (F.D.), the European Emergency Number (112), the National Emergency Medical Aid Center (EKAB), Hellenic Police (H.Pol) as well as the Hellenic Rescue Team (HRT). The group established that the pilot was conscious after the fall but was unable to move or respond to the calls on the VHF radio that he carried.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	1	--	--
Serious	--	--	--
Minor/None	--/--	--/--	--/--

1.3 Damage to the paraglider

The visual inspection (V.I.) of the pilot's equipment revealed minor abrasions to the left of the wing's leading edge most probably caused on impact.

1.4 Other damages

No damages or injuries were caused to third parties.

1.5 Pilot information

The pilot was a 53-year old male, a French national and resident, a member of the French Hang-gliding and Paragliding Federation (Fédération

Française de Vol Libre – F.F.V.L.) and holder of a Paragliding Pilot License. According to the F.F.V.L. records, the pilot first became involved in paragliding in 2010, he obtained his first license in 2011 and since then he had been flying regularly doing 60 to 80 flying hours per year. Moreover, the pilot had a valid (renewed) Paragliding Pilot License for 2018 but did not possess the internationally accepted IPPI (International Pilot Proficiency Information) Card issued by F.A.I. (Fédération Aéronautique Internationale).

1.6 F.F.A. information

The paraglider is made up of three parts: the glider (wing or canopy), the emergency parachute and the seat (harness).

1.6.1 Paraglider information

The technical data of the glider were as follows:

Technical Data	
Manufacturer:	U-TURN GmbH
Model:	Blacklight M
Type:	Paraglider
Serial number:	AP-BLA-1M-40C-0523
Country of manufacture:	Germany
Year of manufacture:	2013
Certification:	EN-926/1 & EN-926/2, LTF 91/09
Classification:	EN-B/LTF-B
Certification number:	EAPR-GS-7547/12
Certification date:	16-04-2012
Flat area:	27.50 m^2
Projected area:	23.23 m^2
Flat wingspan:	12.63 m
Projected wingspan:	9.80 m
Aspect ratio:	5.80
Projected aspect ratio:	4.13

Max. chord:	2.79 m
Min. chord:	0.70 m
Number of cells:	50
Total line length:	249.2 m
Weight of glider:	5.2 kg
Max. take-off weight:	110 kg
Min. take-off weight:	85 kg
V-Trim:	39-40 km/h
V-Max:	51-52 km/h
Best sink rate:	1.1 m/s
Glider ratio:	10+

The glider was certified in class EN-B/LTF-B per EN926-1 & EN926-2 and LTF91/09 by the German certification center E.A.P.R. (European Academy of Parachute Rigging), under certificate number EAPR-GS-7547/12 issued on 16 April 2012 (see ***Fig. 4***).

Class EN-B/LTF-B includes gliders offering a good level of passive safety which are designed for pilots without extensive flying experience. The wing in this class, by means of its inherent neutral behavior, is tolerant of pilot errors (forgiving flying characteristics) and unexpected turbulence, recovering to normal flight without any pilot input.

The Investigation Team made a visual inspection (V.I.) of the glider and a specialized laboratory conducted porosity testing and lines geometry measurements. The results of the said inspections and testing revealed that, even though small abrasions were present to the left of the leading edge of the glider wing, most probably caused as a result of its hard impacting the ground, the wing was nevertheless in a good condition on both its upper and its bottom surface. The lines, however, presented remarkable length differences compared to the specified EAPR values, as well as between the left and the right half-wing (see ***Section 1.16.2*** *&* ***Annex 5.1*** *below*).

The signboard sewn on the paraglider wing indicated the wrong certificate number EAPR-GS-7538/12 (*see* ***Photo 4****)*. The correct certificate number is

EAPR-GS-7547/12, pursuant to the certificate issued by the certification body E.A.P.R. for the model concerned (Blacklight M). This wrong certificate number (EAPR-GS-7538/12) relates to another paraglider model (Bodyguard 3L) of the same manufacturer (U-TURN). This erroneous indication escaped the paraglider manufacturer’s attention and the same problem was also identified in the paraglider’s operation manual, in brochures presenting the paraglider’s flight characteristics as well as in advertising material of the manufacturer. In a query by the Investigation Team, the manufacturer stated that this was a mistake inadvertently made by the signboard printing firm which had, indeed, escaped their attention. It is clarified that this specific problem was not a contributing factor to the accident but rather it is a matter of internal handling and control to be addressed by the manufacturer.

1.6.2 Information on the emergency parachute

The emergency parachute, being part of the required safety equipment, was manufactured by the Czech company Karpo Fly s.r.o., model RS 100, serial number (s/n): 100-2010-04-0830, year of manufacture 2010. The said parachute was type-certified by the Light Aircraft Association of the Czech Republic (L.A.A. C.R.). The relevant type certificate was approved by the L.A.A. C.R. Technical Commission, it was registered under registration sign ZS 01/2009 and the parachute conforms to E.N. 12491 (*see **Fig. 2***).

Fig. 2: The emergency parachute

The visual inspection conducted on the emergency parachute revealed no findings or wear in its materials or its lines. Furthermore, in the operation manual its manufacturer specifies that proper maintenance requires consistent and regular checks, and re-packing to be performed on an annual basis over the ten-year life of the equipment. It is noted therein that re-packing should only be done by the manufacturer or an authorized person/company. The parachute was within such ten-year life, however there is no information available as to whether the annual checks and re-packing of the emergency parachute were being performed as specified by the manufacturer. Also, its specified All Up Weight is 100 kg; this weight is inclusive of the weight of the pilot and the weight of the pilot's entire equipment, including the weight of the emergency parachute itself.

1.6.3 Information on the harness

The harness was manufactured by the Korean company Gin Gliders Inc., model Genie Lite. It was certified per E.N. 1651 & L.T.F. 91/09 by E.A.P.R. under certificate number EAPR-GZ-7535/12 (*see **Fig. 3***).

Genie Lite is fitted with a back protector of a thickness of 120 mm. Also, a hard foam layer protects the harness against punctures in case of a hard impact on the ground. According to the manufacturer, the back protector is divided into separate compartments to prevent air being dissipated too quickly in the event of a hard impact. The harness protection has been designed to reduce the energy of the impact as much as possible, however it cannot not completely eliminate the risk of injury.

Moreover, the visual inspection of the harness revealed minor abrasions and tears beneath it most probably as a result of the impact.

Fig.3: The harness

1.6.4 Information on maintenance

In page 16 of the Manual, section "Maintenance and Care", it is stipulated by the manufacturer that, for the purpose of proper glider maintenance, after two years or 300 flight hours, whichever occurs earlier, the glider has to be inspected by the manufacturer or a representative of the manufacturer. It is furthermore stipulated that should there be a need for any repairs, they are to be done by the manufacturer or a party authorized by the manufacturer. Moreover, in page 41 of the Manual, section "*Topic of the inspection and reinspection intervals*", the manufacturer stipulates that gliders used for recreational solo flights must be inspected after two years or no later than 150 flight hours. Also, ground handling hours must be included in the sum of the flight hours. To the question posed by the Investigation Team as to which one of the two figures of flight hours needs to be observed for the proper maintenance of the glider, the company replied that the number of relevance is 150 flight hours, as also indicated on the glider's signboard.

The glider in question was manufactured in 2013, and the space on its signboard reserved for entry of its inspection dates bears no signature or stamp to indicate its initial inspection or reinspection by the manufacturer or other authorized party (see ***Fig. 4***). Moreover, the Investigation Team was unable to locate any other record (inspection log) that would demonstrate whether or not the required inspections of the glider had been performed as stipulated by the manufacturer.

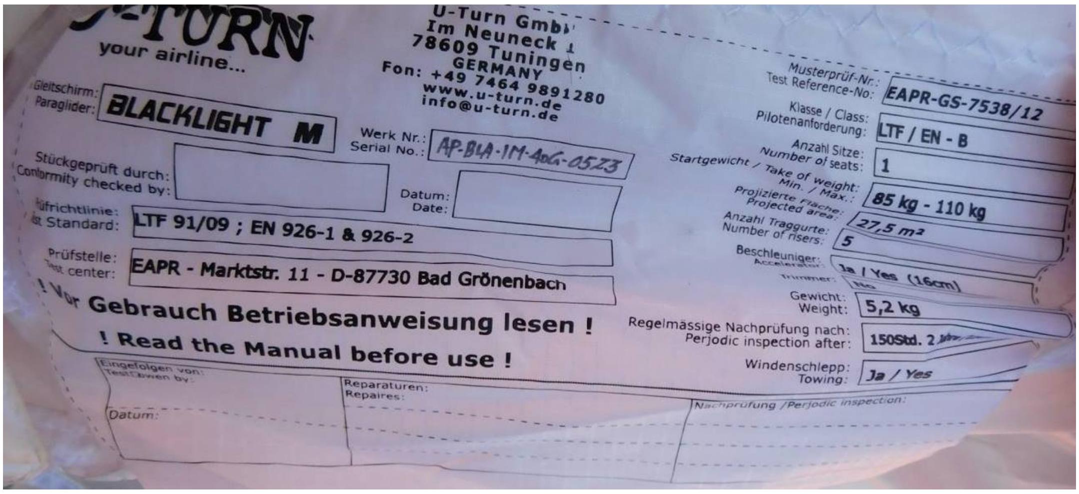


Fig. 4: The signboard sewn on the wing

1.7 Meteorological information

The weather stations of Aegina and Argos, within the Network of Weather Stations operated by the National Observatory of Athens, are those located closest on either side of the accident site. The former is approximately 30 km N/NE and the latter approximately 40 km NW from the site of the accident, at an elevation of 7 m and 38 m A.M.S.L. respectively (see ***Fig. 5***).

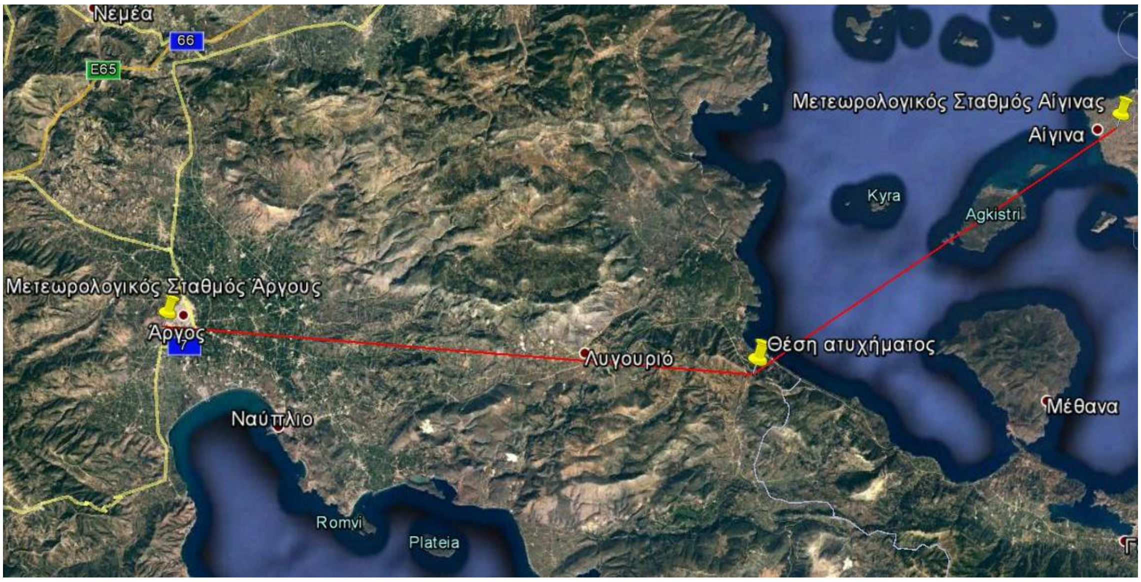


Fig. 5: The location of the weather stations on either side of the accident site

The weather conditions record closest to the time of the accident by the weather station of Aegina was given at **15:10 h** as follows:

- (**15:10 h)**: **Wind strength**: 0.00 km/h, **air temperature**: 21ºC, **pressure**: 1014.00 hPa, **dew point**: 14ºC.

The weather conditions records closest to the time of the accident by the weather station of Argos were given at **17:30 h** and **18:00 h** as follows:

- (**17:30 h)**: **Wind strength**: 2.00 km/h, **air temperature**: 16ºC, **pressure**: 1015.00 hPa, **dew point**: 14ºC.
- (**18:00 h)**: **Wind strength**: 1.00 km/h, **air temperature**: 14ºC, **pressure**: 1015.00 hPa, **dew point**: 13ºC.

Furthermore, according to the Greek pilot's interview, local winds at the takeoff site had a N/NE direction and were not more than approximately 9-10 km/h.

1.8 Aids to navigation

The equipment handed over to the Investigation Team included an alti-vario-GPS unit manufactured by Syride, model SYS'Nav v3 variometer, with an integrated g-force meter (see ***Fig. 6***). This unit provides worldwide airspace data, worldwide topographical data on ground elevation above mean sea level (A.M.S.L.) and thus supports worldwide Above Ground Level (A.G.L.) function which means that the pilot's altitude above the ground can be obtained at all times. Naturally, above ground level is given with a ±20m accuracy, to which the GPS accuracy is added, i.e. a few additional meters (m) of error. Moreover, the unit supports navigation features and its memory is 1500 flight hours at a rate of 1 point per second.

The pilot also carried two magnetic compasses and a digital clock.

Fig. 6: The pilot's variometer

1.9 Communications

The pilot carried a V.H.F. transceiver manufactured by KENWOOD, model TH-K20 FM TRANSCEIVER (see ***Fig. 7***).

Fig. 7: The pilot's communication unit

1.10 Information on the take-off & landing sites

The takeoff site was in the area of Koliaki, local community of Trachia, municipal unit of Epidaurus, Municipality of Epidaurus; its coordinates are 37º36΄12.23΄΄N and 23º9΄15.63΄΄E and its elevation approximately 470 m A.M.S.L. (see ***Fig. 1*** & ***Fig. 8***). The site is approximately 3.8 km from Palea Epidaurus and approximately 2.0 km from the selected landing site. This particular site had been chosen for paraglider launches both for its size, being larger than 950 m^2, and its good sloping ground, making it safe for takeoffs; and its length enabled a timely and safe abortion of the takeoff process in the event of any problem arising.

Fig. 8: The takeoff site

The landing site coordinates are 37º37΄16.78΄΄N and 23º9΄22.75΄΄E (see ***Fig. 1*** & ***Fig. 9***). It was practically a narrow strip of land naturally formed by the beach, approximately 100 m long and 3m to 5 m wide. In contrast to the spacious takeoff site, the narrow landing site combined with the NE crosswind common in the area required of pilots to exercise caution in the approach and show a high skills level for a smooth landing.

Fig. 9: The landing site marked in red

1.11 Flight recorders

In addition to the variometer that recorded a tracklog of his flight, the pilot had been provided by the Greek pilot and guide with a device for the live streaming broadcast of the flight in real time. This is a combined GPS receiver and mini mobile phone in a small and handy pack; its main features include high GPS position accuracy and a 10 sec rate at which it transmitted data to the website.

1.12 Wreckage and impact information

Not applicable

1.13 Medical information

According to the autopsy report, the pilot sustained fatal injuries as a result of fall from a height.

1.14 Fire

Not applicable.

1.15 Survival aspects

The variometer recorded the pilot going down at approx. 17:49 h. According to the interviews, another pilot in the group who was flying in the same area became aware the fall and immediately advised the other pilots and the guide over the VHF radio about the incident and the location of the fall. Then, the foreign pilots together with the Greek pilot and one other person, having formed two small search groups, moved separately towards the area of the accident in order to locate the exact point of the pilot's fall. The two groups moved in different directions in the steep and rough hillside where the pilot had fallen, one group moving from the top to the toe of the hill and the other in the opposite direction. Following a brief search, they located the exact point at approx. 18:30 h, as reported in the interviews. After assessing the severity of the injuries and given the rough terrain they judged that it was necessary to notify the competent emergency services and request their assistance.

According to the interviews but also from news reports on several websites, the first phone call was made at approx. 18:34 h to the Fire Department - F.D. (call number 199) but no connection could be established and no contact was made. A second phone call was then made at approx. 18:41 h to the European Emergency Number-E.E.N. (112). Then at approx. 18:45 h to 18:50 h another call was made to the F.D. which was successful this time. Subsequently several calls were made to various services, i.e. EKAB (National Emergency Medical Aid Center), the Hellenic Police (H.Pol.) and the Hellenic Rescue Team (HRT) local branch. According to the interviews, H.Pol. were the first to arrive onsite, about 30 min after the first phone call was made. The F.D. and one person from HRT arrived 50 min thereafter and, finally, EKAB arrived near the scene of the accident approximately 1 h after the first phone call was made. Also, a doctor who arrived at the location of the accident was unable, due to the rough terrain, to reach the precise point where the pilot had fallen and remained at the dirt road at the toe of the hill. By the time of conclusion of the rescue operations, more than 25 persons had been mobilized by F.D., HRT, EKAB, H.Pol and volunteers in order to recover and bring the injured pilot down from the hillside.

A factor that hindered rescue operations on the part of the parties involved and the emergency services was the steep (ground inclination 60°) and rough terrain (rocky with dense bush coverage). The said features made the impact site hard to approach, even though the nearest dirt road at the toe of the hill was only 88 m away (see ***Fig. 10***). Furthermore, the area where the accident occurred was far away from the base of the respective departments that were called to assist the operations.

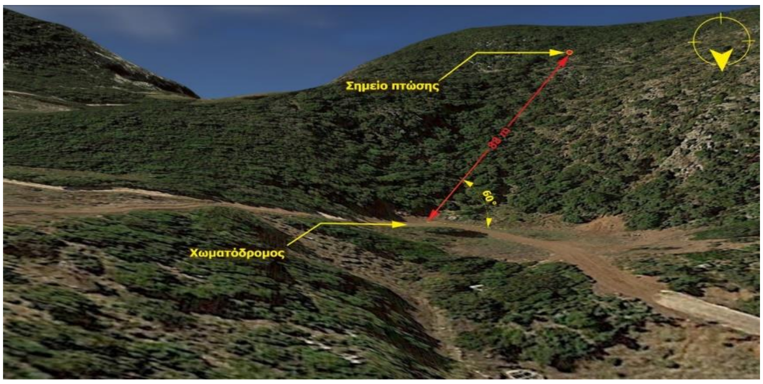


Fig. 10: Distance of the fall site from the nearest dirt road

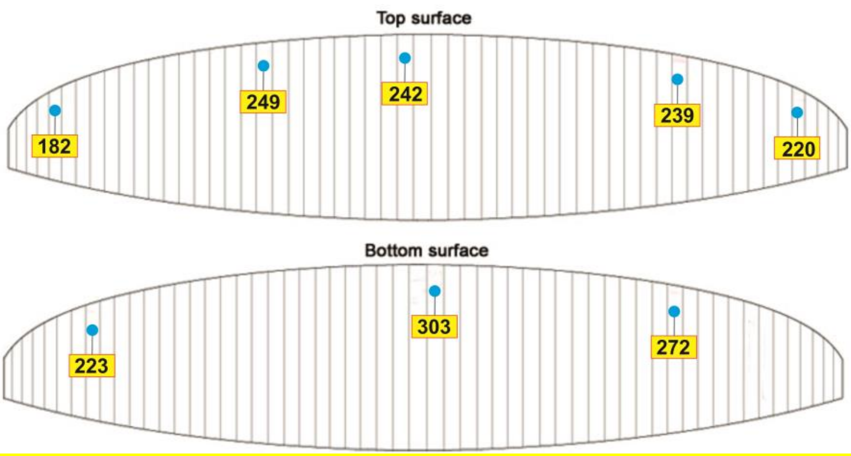
From the other equipment found at the site of the accident it is evidenced that the pilot wore a helmet, gloves and sports boots.

1.16 Tests and research

As above mentioned, the glider was sent to a specialized laboratory for porosity testing on the wing fabric and for state of lines trim measurements.

1.16.1 Porosity test

Porosity testing demonstrated that the glider wing, both at its top and its bottom surface presented no significant porosity. It is noted that the readings presented in ***Fig. 11*** refer to the time required (in seconds) for a certain volume of air to permeate the canopy fabric through a given surface and under a given pressure. Therefore, the smaller the porosity readings are (in sec) the easier a certain volume of air passes through a given surface under a given pressure and therefore the greater the wing porosity is. As an indication, the values for a brand-new wing are around 400 sec or close to it, whereas values below 19 sec indicate a wing that is not serviceable. For the paraglider wing in this accident, the lowest reading (182 sec) taken was at the top surface of the left half-wing.



New >384 Good 249-110 X Well used 49-19

Excellent 383-250 Satisfactory 109-50 Fail <19

Fig. 11: Porosity test locations and values

1.16.2 Line geometry measurements

A specialized laboratory conducted state of lines trim measurements on the glider lines (material: Aramid/Kevlar). The results (see *Annex **5.1** below*) demonstrated that the lines presented considerable length differences compared to the lengths specified in the E.A.P.R. technical datasheet; and in actual fact the lines for which the greatest difference in length (49.4 mm) was observed were the A-lines. It is noted that the tolerance, in terms of line length, allowed by the manufacturer does not exceed ± 1.5 mm. Furthermore, the lines presented considerable length differences (asymmetries) between the left and the right half-wing.

In much the same way, state of trim measurements conducted by the laboratory also revealed length differences in the brake lines as well, with such differences in certain cases exceeding 90 mm. Also, an one side asymmetry in the lengths of the brake lines was observed between the right and the left half-wing. In other words, the brake lines in the right half-wing were clearly longer than those in the left half-wing (*see Section **2.3** below*).

1.17 Organizational and management information

1.17.1 Hang-gliding and Paragliding Regulation

Decision No. HCAA/D/D2/7259/2071/01.03.06 issued by the Governor of Hellenic Civil Aviation Authority (published in Government Gazette issue No. B/309/15.03.06) is the regulatory framework governing hang-gliding and paragliding activities, operations and flights, as well as any other similar activity. In the said regulation there is no mention of a pilot’s license being required for this type of sport, how such a license can be obtained and its equivalence to pilot licenses obtained abroad. Moreover, the Regulation specifies that: “*Paraglider pilots are not required to hold a medical certificate*”. The paragliding activity by the foreign pilot in the accident fell under the said regulatory framework.

1.17.2 Paragliding Commission Regulations

Hellenic Aeronautical & Air Sports Federation (ELAO), vested by HCAA with authority to elaborate organization, operation, administration and flight regulations for air sports clubs pursuant to section (3.h) of the act published in Government Gazette issue No. B/155/10.04.86, and more specifically its

Paragliding Commission (EAP) has issued the ‘Paragliding Regulation’ (issue 6, October 2011), applicable to all its members and to participants of paragliding competitions. The Commission has also issued the Training Regulation for Free-flying Foot-launched Glider Aircraft (FFA) (issue 14, 2014) and the Examinations Regulation for obtaining/upgrading Paraglider Pilot Licenses (issue 9, 2018). The said regulations set forth the types/ratings of FFA pilot licenses as well as the manner that these may be obtained, however they have not been approved by HCAA.

1.18 Useful and effective investigation technique

Not applicable

1.19 Additional information

1.19.1 The FAI I.P.P.I Card

The FAI International Pilot Proficiency Information (IPPI) Card is an internationally accepted card that was introduced in 1992. Since that time, associations and pilots throughout the world have benefited from its internationally recognized status. The IPPI Card is based on safety and training standards defined in the SafePro Delta and SafePro Para programs. The IPPI Card provides a standard reference by which all national rating programs may be compared. The SafePro Delta (for hang gliding) and SafePro Para (for paragliding) stage on the IPPI Card, reflect the pilot’s proficiency. For the paraglider pilot who flies outside of his/her local area, it is a quick and easy method of providing proof of flying experience and proficiency. When a pilot travels abroad, the IPPI Card - together with the national license/rating card - will identify his/her skills. It gives instructors and flying site managers an easy way of verifying the pilot experience level prior to approval of flight activities. The IPPI Card is valid only together with a current national license/rating card and, in Greece, it is issued by ELAO.

1.19.2 Venturi Effect in gliding

In general, the Venturi effect is a natural phenomenon occurring when a fluid flowing in a pipe is forced through a constricted section of the pipe, resulting in the reduction of pressure and the increase of speed at the point of the narrowing.

In gliding, the Venturi effect is observed when wind flowing above a landscape meets a constriction to its flow, for example a pass between two mountains, and all this airmass is forced through the constriction. This results in an increase of wind velocity and decrease in wind pressure as the pressure-related dynamic energy is converted into kinetic energy (*see* ***Fig. 12***). As air flows through the narrowing at an increased speed, low pressure is a force that causes the surrounding air to be sucked in as well. This concentration of flow through the narrowing can adversely affect a F.F.A.'s speed forward. Moreover, the increased air speed through the narrowing may be greater than the maximum speed of the F.F.A., stopping in practice its horizontal forward movement in relation to the ground. One other element is that air speed value in the narrowing depends on the latter's width but also on air's initial speed.

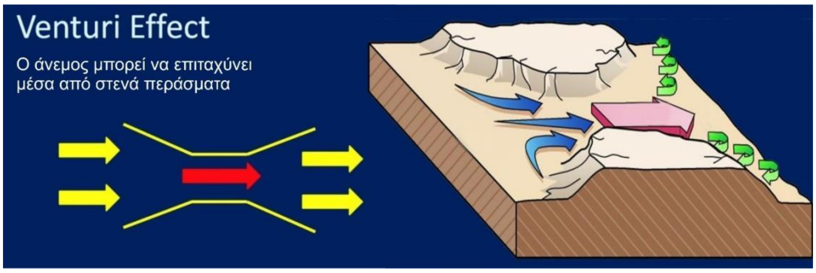


Fig. 12: Venturi effect in gliding

When conditions favor this phenomenon, F.F.A.'s pilots must modify their trajectory to avoid the respective areas (*see* ***Fig. 13***). However, if they do find themselves in such circumstances the problem they will have to tackle is the decrease or loss of the F.F.A.'s forward speed in relation to the ground and not problems having to do with F.F.A.'s stability.

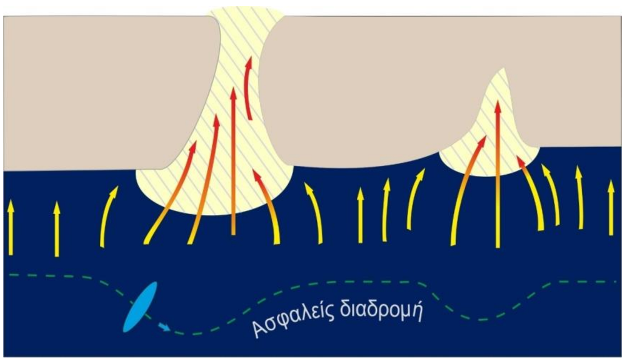


Fig. 13: Safe flight path to avoid the Venturi effect

2 ANALYSIS

2.1 General

A paraglider is a F.F.A. that demands high levels of attention, judgment and right mental attitude on the pilot’s part. In the course of a flight, the pilot will try to exploit rising air streams as well as the flow of wind in relation to the terrain in order to gain and maintain altitude covering great distances by means of this technique.

2.2 The incident and flight log analysis

According to the data on the pilot’s variometer, he took off at 17:36:53 h and headed off mostly in a westerly direction. Having crossed approx. 900 m, he altered course to the east passing almost in front of the takeoff site, obviously not having encountered rising air. In those first 3.5 min of flight until point 207 (*see **Fig. 14***), the pilot’s paraglider lost about 44 m of height from the altitude of the first point when flight recording started (point 0). Then, a few meters from the said point he started encountering weak rising currents, in which the rate of ascent increased the more the pilot moved in an easterly direction. The pilot, in an effort to remain within the area of the rising air, started doing figure-8 turns being thus able to gradually recover the height previously lost. Indeed, at point 278 he had climbed to 443 m A.M.S.L (*see **Fig. 14***).

According to the tracklog up until point 278 (*see **Fig. 14***) and considering the glider airspeeds along the flight track in relation to the direction followed, it is concluded that a weak N/NW wind was prevailing, of a variable speed up to 10 km/h. The flight could be characterized as a dynamic flight for the most part, i.e. he flew trying to maintain but also to recover height, near and parallel to the mountain slope following the terrain and exploiting the upward movement of air when hitting the slopes. Glider airspeed and altitude varied along the flight track according to direction, distance from the mountain slope and terrain. Further, the paraglider encountered very few rising thermals and those encountered were relatively weak, of a short duration and small diameter. The strongest rising thermal encountered was at point 278 (*see **Fig. 14***) with a rate of ascent of +2.5 m/sec, still of a short duration and small diameter. Rising thermals of a small diameter tend to cause a steep lift to an entering paraglider and, naturally, a steep change to its angle of attack. The reverse is true when the glider exits such a thermal. The said thermals, although not dangerous in themselves, require a heightened level of alertness and attention given the sudden change they cause to the angle of attack, whilst not offering significant gain in height.

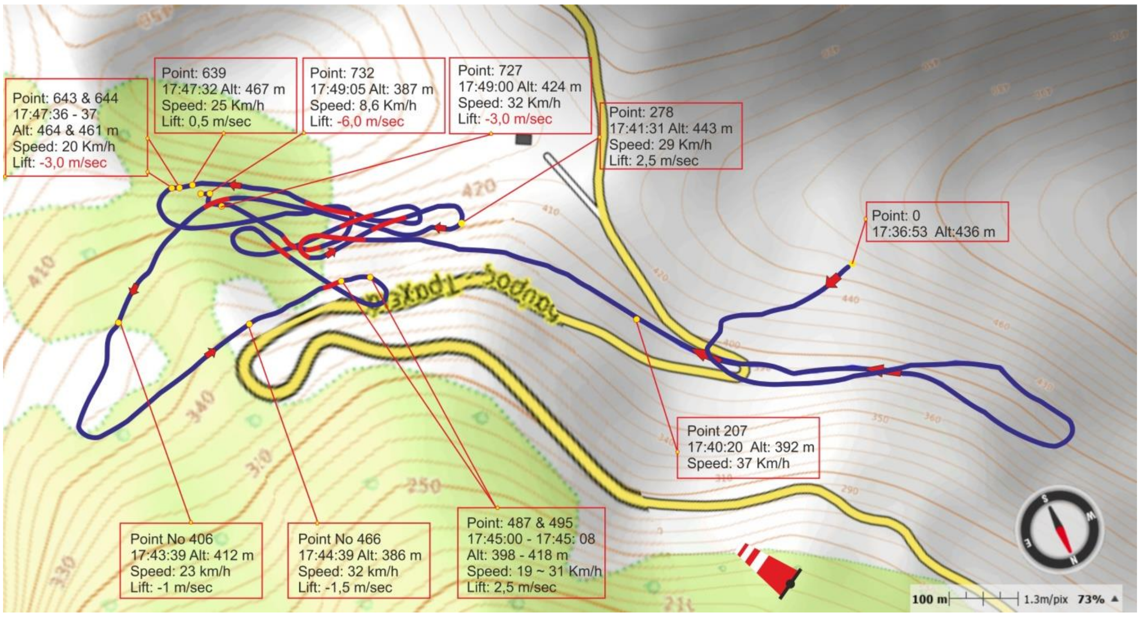


Fig. 14: The flight track

The pilot’s course continued in a similar way into the next leg of the flight track, up to approx. 10 sec prior to the accident; i.e. the pilot performed a mostly dynamic flight with small fluctuations in altitude. A significant change is noted at points 487 and 495 (*see* ***Fig. 14***), where he encountered a rising thermal with a rate of ascent of +2.5 m/sec, which had a greater diameter compared to the previously encountered ones. The pilot remained within this thermal for approx. 9 sec and gained 23 m of height. Even though the duration of the thermal was satisfactory, showing that this was probably the first thermal that he could exploit in order to significantly increase his altitude, he nevertheless chose for no clear reason to not spiral within the thermal but rather make a turn and move away. Also, in points 643 and 644 (*see* ***Fig. 14***) he encountered sinking thermals having a descent rate of -3 m/sec.

The last leg of the pilot’s course lasted very few seconds. The pilot, moving in a SE direction, at point 723 (*see* ***Fig. 15***) encountered a sinking thermal having a sink rate of -2.5 m/sec, which (rate) increased in the next second (point 724) to -3.5 m/sec. The altitude at point 724 was 429 m A.M.S.L., however the pilot's height was 45 m A.G.L. Apparently, realizing his low height combined with the sinking thermal encountered, he chose to slightly change course to the east thus trying to steer away from the slope and maintain a safe height.

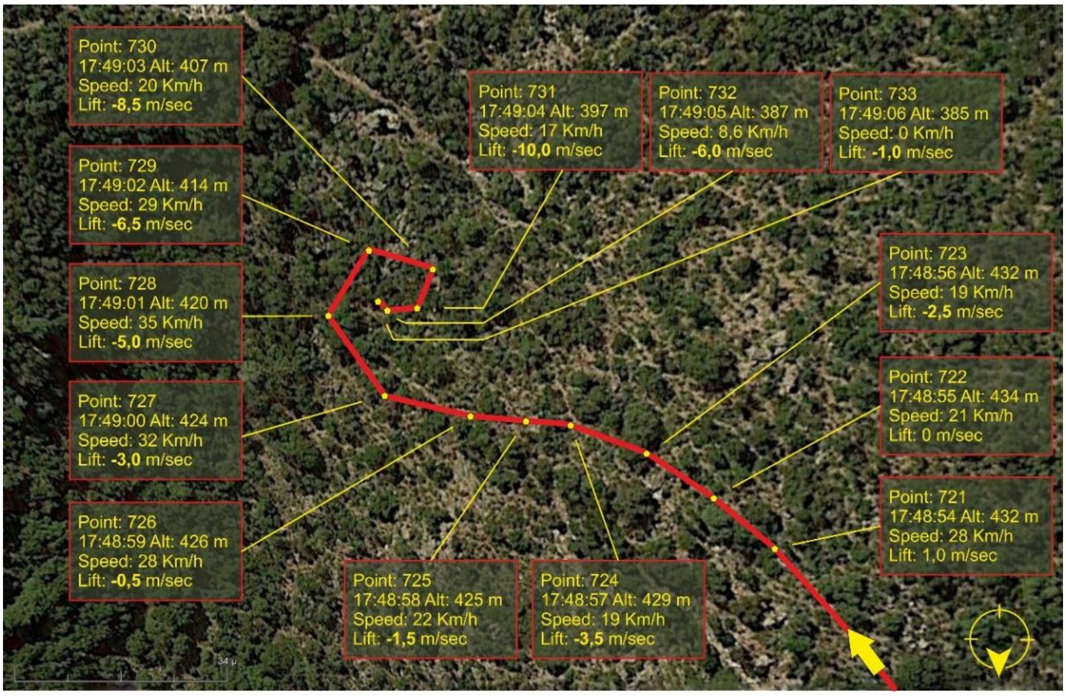


Fig. 15: The last leg of the pilot's course

In the next two points 725 and 726 (*see* ***Fig. 15***), the rate of descent decreases to -1.5 m/sec and -0.5 m/sec respectively, but this is not kept up given that at point 727 the descent rate is once again -3 m/sec. This is the starting point, as shown in the three-dimensional vertical plotting of his track (*see* ***Fig. 15***), of his steep loss of altitude which led to the pilot's fall, seeing that in the next point 728 a high rate of descent, -5 m/sec, is observed and at the same time his course abruptly changes to a SE direction. The following points 729, 730, 731 show a clearly spiraling movement at an increasing descent rate that reaches -10 m/sec (*see* ***Fig. 15***). This spiraling descent goes on for a further 1 sec up until the point of the glider's fall at an altitude of 387 m A.M.S.L. at a sink rate of -6 m/sec (point 732). The two next points, subsequent to the fall, probably reflect the glider being dragged on the ground as a result of its initial vertical and horizontal speed. Indeed, at these points, the altitude of the point of the original fall changed by 2 m.

As already stated, the steep loss of height that caused the pilot's fall occurred in the last seconds of his flight. However, the two foreign pilots and their guide were unable to provide more information with respect to those crucial seconds even though one of the two foreign pilots was flying relatively close to the site of the accident; and this, either because they did not notice the incident or they were flying at a location different from that of the accident. Therefore, the cause for the paraglider's steep loss of height can only be inferred from its effects on the paraglider, according to the data recorded on the pilot's variometer.

The pilot's glider went into spiral descent in the last seconds of the flight leading to abrupt loss of height until it fell to the ground. This spiral descent may have been caused by either a spiral dive or auto-rotation (spin); there is, however, a fine difference between these two movements:

A glider will only go into spin if the pilot pulls one of the two brake controls so much that half the wing goes into a stall and the other half, still flying freely, starts a circular accelerating and violent movement to the shut side. The spin shall go on for as long as the pilot pulls on the brake control and shall recover as soon as the pilot fully releases it. Other signs observed during a paraglider spin are: rotation at great speed around the glider's yaw axis, half side of the wing moves forward and the other half side moves backwards, descent at a rate of approx. -5 m/sec, descent at a small angle of attack and insignificant increase of g forces, etc. The above applies practically to all types of maneuvers, including collapses. Therefore a spin is almost always triggered by the pilot and therefore is for the most part pilot-induced.

A spiral dive is different: in normal flight, a spiral dive is simply the extension of a steep turn, that goes on for several full circles or 360's. Pilots often initiate a spiral dive when they want to lose height fast, faster than with any other technique (up to -20 m/sec, in the case of the accident paraglider), for a number of reasons, e.g. when they want to move away from imminent adverse weather conditions which they had failed to notice in the first place. Moreover, wing collapses may cause a paraglider to go into a spiral dive in a similar manner. A collapse causes drag which in turn causes the paraglider to turn to the collapsed side and the turning will keep intensifying unless the pilot acts on it. Therefore, a spiral dive may be pilot-induced or not.

The above maneuvers, however, when pilot-induced, are at all times performed when there is sufficient height from the ground. An experienced pilot, like the pilot in the accident, would never initiate such maneuvers unless at a safe altitude. The height of approx. 40 m A.G.L. where the pilot was at the moment when his steep loss of altitude (and consequent fall) started is not considered sufficient to give him the time and space necessary to recover from such a maneuver. Therefore, the most plausible explanation for the right spiral descent of the glider, as recorded by the pilot's variometer, is an asymmetric front collapse of the right side of the wing, which then caused a steep right spiral dive to the right towards the mountain slope.

As mentioned above, the pilot's flight was mostly a dynamic flight with sudden rising thermals with a rate of ascent up to +2.5 m/sec and sudden sinking thermals with a rate of descent up to -3.5 m/sec. Most of the above thermals were relatively weak, of a short duration and a small diameter. When flying in narrow thermals a paraglider may have one side of its wing within a rising thermal with the other half of the wing being outside or even being inside an adjacent sinking thermal. In such conditions, the pilot must pay very close attention and engage in active flying, i.e. make constant corrections to the wing reactions by acting on the brake controls and also by shifting his/her weight, otherwise the wing side located outside the rising thermal may sustain a partial or full asymmetric collapse. The more extensive the collapse the stronger its impact on the paraglider's normal flight.

Given the presumed front asymmetric collapse of the wing that caused the steep spiral dive and considering the pilot's altitude of 40 m A.G.L, his reactions had to be quick, first putting a stop to the glider's tendency to turn right to the slope. For this reason, he should have shifted his weight fully to the open side of the wing and pulled the brake control on the said side, to avoid impacting the slope, keeping a straight course. Also, if the collapsed side of the wing had not recovered, then, while flying parallel to the slope, the pilot should have firmly and decisively pumped the shut side to assist its opening. Active pilot input as above described was the only way for recovery from the dangerous situation that had arisen. The data available suggests that he did not make any recovery attempts or, if he did, these were ineffective. The spiral descent continued over a period of 5 seconds and, during that time, the rate of descent increased reaching up to -10 m/sec in the first 270°, whereas in the remaining 90° the rate of descent decreased to -6 m/sec, evidencing that the wing had started to recover (*see **Fig. 15***).

2.3 The glider's condition and fitness to fly

As above stated, a visual inspection was performed on the paraglider, as well as porosity testing at several locations on the canopy fabric, together with lines measurements. Pursuant to the results of the visual inspection and the porosity test, it is considered that the fabric of the glider canopy in general was in a good condition, at both its top and its bottom surface; the highest porosity reading, i.e. the lowest value measured (182 sec), was taken at the top left surface of the wing (*see Section **1.16.1** above*).

The results of the lines measurements, however, revealed significant line length differences compared to the values specified by E.A.P.R. The greatest difference (49.4 mm) was found at the A-Lines, with max. tolerance ±1.5 mm. Furthermore, the lines presented considerable length variations between the left and the right side of the wing. In much the same way, considerable length differences were also established in the case of the brake lines as well, compared to the values specified by E.A.P.R. Indeed, in certain cases the differences exceeded 90 mm. Moreover, a one-sided asymmetry in the lengths of the lines was observed between the right and the left side of the wing, with the lengths in the right-hand side always being longer than those of the left side of the wing. (*see Section **1.16.2** and Annex **5.1***).

Taking into account the above information and the fact that there were no signatures on the paraglider's signboard attesting to the performance of the necessary maintenance tasks by the manufacturer or other authorized person, it is evidenced that the manufacturer's maintenance instructions had not been adhered to in accordance with the applicable specifications. Even though the said instructions perhaps leave room for misinterpretation with regard to the specified period and number of flight hours for proper glider maintenance, given that the glider's manual mentions two different flight hour values (300 h / 2 years & 150 h / 2 years), in this particular case it is not considered likely that this might have occurred given the pilot's experience and also due to the fact that clarifications in this regard could easily have been obtained by addressing a simple e-mail message to the manufacturer. Further, if only the specified time limits for maintenance (2 years) were being observed, even if the specified limits of flight hours (150 h or 300 h) were not, then the said problems in the glider would have been detected and repaired.

Paraglider manufacturers specify the individual characteristics of the material of the lines used in terms of resistance to ageing and use, its elasticity, etc. In general, the length of the lines changes with time and use and the lines must be replaced as the wing aerodynamics change and the flight performance characteristics of the glider are certainly not as originally intended by the manufacturers. Common signs indicating a change in lines length are: difficulty in wing inflation during a launch, erratic wing recovery following a collapse, difficulty in control, a tendency to fly on one side, a glider which is slow or more susceptible to collapses, etc. It must be noted that the above signs do not necessarily mean that a glider with the above problems is dangerous to fly but rather that it is more difficult to control than a glider which is properly maintained, the latter behaving much better in take-off, flight and landing. In other words, the safety level afforded to the pilot by gliders exhibiting the above problems is clearly lower than as intended by the manufacturers. The picture resulting for the pilot's glider under the lines' measurement is that of an improperly maintained glider with signs of wear from age and use. Indeed, this is most evident in the A-Lines, where the greatest length difference (49.4 mm) compared to E.A.P.R. values was observed, these lines being those receiving the greatest loads from the wing's leading edge and being the first to show wear from time and use. Moreover the brake lines, where the lengths of the right side of the wing were invariably greater than the lengths of the left side, bear witness -in the form of elongation wear - to the pilot's tendency over time to use the right brake control more often than the left one. The pilot's experience has been the main factor helping him overcome the difficulties in handling his glider.

Regarding the lines of the brake system, here things are different compared to the other lines. The manufacturer settings of the brake lines of the glider involved in the accident, in terms of free travel, is from 0 mm to 50 mm.

The manufacturer thus recommends that, following the first flight, these lines are to adjusted by the pilot to suit his/her own style. The manufacturer expects that most pilots will shorten the free travel of the brake controls given that the values quoted by E.A.P.R. for the lengths of these lines are quite high. Indeed, for this reason the manufacturer cautions the pilots against shortening the lines too much as it thus becomes possible that the glider will then be flown on a small but constant brake application. This could prove very dangerous at take-off, during the flight and when landing. On the contrary, the accident glider was found with an elongation of the lines that in some instances exceeded 90 mm. These differences show that the pilot had greatly interfered with the original lengths of the lines to make them more suited to his personal style. However, if the elongation of the lines of the brake controls is extensive the glider is likely to react slowly to pilot action and landing can prove to be quite difficult.

Considering the above, it is concluded that the glider was most probably difficult to handle and thus presented a diminished level of safety given its above problems, in addition to the fact that it was not serviceable since the manufacturer’s instructions on maintenance had not been adhered to. This fact may have been a latent factor, at the moment that started the abrupt loss of height that led to the pilot’s fall, that contributed to the glider’s failure to recover from the difficult situation encountered.

2.4 Venturi effect

As above stated (*see Sections **1.1** & **1.19.2** above*), in the view of the Greek pilot the accident may have been due to the Venturi effect, a frequent phenomenon in the area and mainly the reason why he cautioned the foreign pilots against flying in the area east of the launching site.

However, when looking at the airspeeds of the glider throughout the flight it is established that they were never so low as to cause a problem to its forward speed and furthermore the glider was never found trapped in strong headwind. Also, the prevailing light wind, up to 10 km/h, combined with the width of the pass (greater than 230 m) (*see **Fig. 16***) near the accident site, could not have created favorable conditions for the Venturi effect to occur. In conclusion, according to the above, it is not considered likely that the Venturi effect has been a cause of or a contributing factor to the accident.

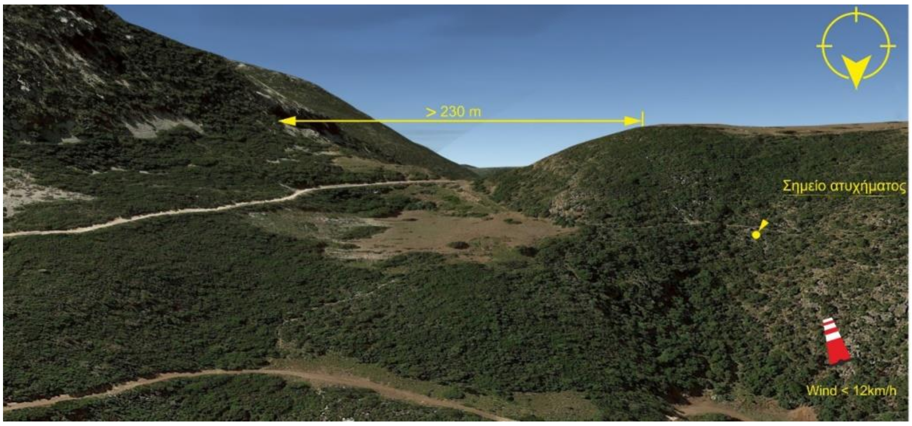


Fig. 16: The opening between the two peaks

3 CONCLUSIONS

3.1 Findings

3.1.1 The pilot was a member of the French Hang-gliding and Paragliding Federation (Fédération Française de Vol Libre – F.F.V.L.) and holder of a Paragliding Pilot rating issued by the said Federation.

3.1.2 The pilot did not hold the internationally accepted IPPI (International Pilot Proficiency Information) Card issued by F.A.I. (Fédération Aéronautique Internationale).

3.1.3 The pilot's flying experience started in 2011, when he obtained his first license and since then he had been flying regularly doing 60 to 80 flying hours per year.

3.1.4 The results of the glider's visual inspection and porosity test establish that the wing fabric was generally in a good condition.

3.1.5 The results of the state of trim check (lines geometry) have revealed considerable differences in lines length compared to the values specified by E.A.P.R.

3.1.6 The Investigation Team did not find on the signboard any signature or stamp evidencing performance of the initial inspection or reinspection of the paraglider by the manufacturer or other authorized party.

3.1.7 The Investigation Team was unable to locate any other record (inspection log) that would demonstrate whether or not the required inspections of the glider had been performed as stipulated by the manufacturer.

3.1.8 The paraglider was certified however it was not serviceable given that the manufacturer’s maintenance instructions had not been observed.

3.1.9 The paraglider was most likely difficult to handle and control due to the fact that it was not properly maintained, presenting signs of wear associated with age and use.

3.1.10 The paraglider’s signboard, sewn on the wing, indicated a wrong certificate number. This fact is not considered to have been a cause of or a contributory factor to the accident; it is a matter that needs to be addressed and handled internally by the manufacturer.

3.1.11 The paraglider manufacturer’s instructions perhaps leave room for misinterpretation, with respect to the limit of flying hours following which the first initial check must take place. This vague point is not considered to have been a cause of or a contributory factor to the accident.

3.1.12 The emergency parachute was certified, however the Investigation Team has not found any record demonstrating whether its annual checks and re-packing were performed as specified by the manufacturer.

3.1.13 The visual inspection conducted on the emergency parachute has not revealed any findings or wear in its materials or its lines.

3.1.14 The pilot did not deploy his emergency parachute.

3.1.15 The pilot’s other safety equipment was certified and serviceable.

3.1.16 Weather conditions were well within the limits accepted for the conduct of safe flights.

3.1.17 The Investigation Team does not consider it likely that the Venturi effect may have been the cause of or a contributory factor to the accident.

3.1.18 In the last seconds of the flight the paraglider went into a spiral dive to the right towards the mountain slope, consequent to a probable asymmetric frontal collapse of the right side of its wing.

3.1.19 The paraglider’s trajectory for the duration of its fall shows that the pilot made no effort, or if he did his efforts were ineffective, to recover from the dangerous situation encountered.

3.2 Probable causes

The most plausible explanation for the right spiral descent of the paraglider is the violent asymmetric frontal collapse of the right side of its wing, consequent to flying through a narrow steep rising thermal, which then caused a deep right spiral dive towards the mountain slope.

3.3 Contributing factors

3.3.1 The height of approx. 40 m. A.G.L where the pilot was at the moment when the abrupt height loss that caused his fall began is not considered sufficient to give him the time and space necessary to recover from the dangerous situation he encountered.

3.3.2 The pilot made no effort, or if he did his efforts were ineffective, to recover from the dangerous situation encountered.

4 SAFETY RECOMMENDATIONS

4.1 To the Hellenic Civil Aviation Authority

4.1.1 In-flight loss of control, U-Turn GmbH-BLACKLIGHT M, Koliaki-Epidaurus, 23 April 2018, one (1) fatal injury

Having regard to the following:

Outdoor adventure sports tourism, being a form of sports tourism addressed to visitors-tourists who travel to a destination for the purpose of actively participating in a sport leisure activity, paragliding in this particular case, is a fast-growing sector of the tourism industry in the Hellenic Territory.

The regulatory framework governing the activities, the operation and the conduct of hang-gliding and paragliding flights, as well as any other similar activity, is the Hang-gliding and Paragliding Regulation, issued by the Hellenic Civil Aviation Authority. In the said regulation there is no mention of the conditions that must be met by visiting foreign paragliding pilots intending to engage in this sport within the Hellenic Territory. Furthermore, the observed increase in the number of flights conducted by foreign paragliding pilots, who lack knowledge about the regulatory framework applicable in Greece, constitutes a potential risk to civil aviation at large.

For these reasons AAIASB recommends the following:

2019-04 Hellenic Civil Aviation Authority in cooperation with Hellenic Aeronautical & Air Sports Federation should consider reviewing and revising the Hang-gliding and Paragliding Regulation to include the new forms of sports tourism and lay down the conditions that must be met by visiting foreign paragliding pilots when intending to engage in paragliding in the Hellenic Territory; furthermore, they should examine ways by which foreign paragliding pilots intending to engage in paragliding in the Hellenic Territory are to be informed of the said regulatory framework.

4.2 To the Hellenic Aeronautical & Air Sports Federation and the Paragliding Commission

4.2.1 In-flight loss of control, U-Turn GmbH-BLACKLIGHT M, Koliaki-Epidaurus, 23 April 2018, one (1) fatal injury

Having regard to the following:

Outdoor adventure sports tourism, being a form of sports tourism addressed to visitors-tourists who travel to a destination for the purpose of actively participating in a sport leisure activity, paragliding in this particular case, is a fast-growing sector of the tourism industry in the Hellenic Territory.

The regulatory framework, that governs the conditions that must be met by visiting foreign paragliding pilots when engaging in paragliding in the Hellenic Territory, does not cover these new forms of sports tourism. The Paragliding Regulation applies to foreign pilots intending to stay within the Hellenic Territory for periods longer than 1 month.

For these reasons AAIASB recommends the following:

2019-05 Hellenic Aeronautical & Air Sports Federation in cooperation with the Paragliding Commission should consider reviewing and revising the Paragliding Regulation to include the new forms of sports tourism and lay down the conditions that must be met by visiting foreign paragliding pilots when intending to engage in paragliding in the Hellenic Territory; further, they should examine ways by which foreign paragliding pilots intending to engage in paragliding in the Hellenic Territory are to be informed of the said requisite conditions.

4.3 To the manufacturer U-Turn GmbH

4.3.1 In-flight loss of control, U-Turn GmbH-BLACKLIGHT M, Koliaki-Epidaurus, 23 April 2018, one (1) fatal injury

In the course of the investigation, it was found that the certificate number shown on the paraglider's signboard sewn on the wing was wrong. This problem was also found in the paraglider's manual, in brochures presenting the paraglider's flight characteristics as well as in advertising material of the manufacturer. The said problem could lead to a misunderstanding concerning the flight characteristics of this specific paraglider model.

For these reasons AAIASB recommends the following:

2019-06 The manufacturer should examine ways in which to communicate the said problem, as well as any corrective action intended in this respect, to the gliding community and owners of this particular paraglider model.

4.3.2 In-flight loss of control, U-Turn GmbH-BLACKLIGHT M, Koliaki-Epidaurus, 23 April 2018, one (1) fatal injury

In the course of the investigation, it was found that the paraglider manufacturer's maintenance instructions for this particular model, as contained in its Manual, may possibly lead to misinterpretation in respect of the limit of flight hours following which the glider's proper initial check is to be performed, given that two different values (300 h or 2 years and 150 h or 2 years) are stated for its initial maintenance check.

For these reasons AAIASB recommends the following:

2019-07 The paraglider manufacturer should consider reviewing and revising the manual of this particular model given that mistakes and vague points have been identified therein which could lead to misunderstandings with regard to the paraglider's initial maintenance check. Further, the manufacturer should examine ways in which to advise all holders of this particular model of the problems and possible changes to its manual.

5 Annexes

5.1 Tables of lines geometry measurements

A-Lines (left)			A-Lines (right)			A-Lines
EAPR Technical data (mm)	Lengths measurement (mm)	Differences (mm)	EAPR Technical data (mm)	Lengths measurement (mm)	Differences (mm)	Symmetry (mm)
7421,0	7932,7	-38,3	7421,0	7928,5	-42,5	4,2
7317,0	7832,7	-34,3	7317,0	7823,3	-43,7	9,4
7284,0	7794,4	-39,6	7284,0	7788,8	-45,2	5,6
7314,0	7823,2	-40,8	7314,0	7814,6	-49,4	8,6
7216,0	7734,7	-31,3	7216,0	7734,2	-31,8	0,5
7087,0	7602,8	-34,2	7087,0	7604,6	-32,4	-1,8
7030,0	7549,3	-30,7	7030,0	7545,6	-34,4	3,7
6721,0	7238,7	-32,3	6721,0	7233,8	-37,2	4,9
6408,0	6928,9	-29,1	6408,0	6924,4	-33,6	4,5
		-550,0			-550,0	0,0
		-550,0			-550,0	0,0
		-550,0			-550,0	0,0
		-550,0			-550,0	0,0
		-550,0			-550,0	0,0
		-550,0			-550,0	0,0

Table 1: A-Lines measurements

B-Lines (left)			B-Lines (right)			B-Lines
EAPR Technical data (mm)	Lengths measurement (mm)	Differences (mm)	EAPR Technical data (mm)	Lengths measurement (mm)	Differences (mm)	Symmetry (mm)
7364,0	7888,7	-25,3	7364,0	7876,9	-37,1	11,8
7261,0	7786,0	-25,0	7261,0	7777,6	-33,4	8,4
7230,0	7754,5	-25,5	7230,0	7747,2	-32,8	7,3
7265,0	7791,9	-23,1	7265,0	7779,6	-35,4	12,3
7162,0	7690,1	-21,9	7162,0	7683,9	-28,1	6,2
7040,0	7564,4	-25,6	7040,0	7558,2	-31,8	6,2
6983,0	7513,4	-19,6	6983,0	7505,0	-28,0	8,4
6674,0	7192,9	-31,1	6674,0	7183,6	-40,4	9,3
6422,0	6947,0	-25,0	6422,0	6936,5	-35,5	10,5
		-550,0			-550,0	0,0
		-550,0			-550,0	0,0
		-550,0			-550,0	0,0
		-550,0			-550,0	0,0
		-550,0			-550,0	0,0
		-550,0			-550,0	0,0

Table 2: B-Lines measurements

C-Lines (left)			C-Lines (right)			C-Lines
EAPR Technical data (mm)	Lengths measurement (mm)	Differences (mm)	EAPR Technical data (mm)	Lengths measurement (mm)	Differences (mm)	Symmetry (mm)
7477,0	7999,7	-27,3	7477,0	8000,5	-26,5	-0,8
7358,0	7886,9	-21,1	7358,0	7880,4	-27,6	6,5
7330,0	7862,0	-18,0	7330,0	7852,7	-27,3	9,3
7379,0	7910,6	-18,4	7379,0	7899,5	-29,5	11,1
7218,0	7747,9	-20,1	7218,0	7730,5	-37,5	17,4
7085,0	7616,1	-18,9	7085,0	7600,9	-34,1	15,2
7024,0	7557,4	-16,6	7024,0	7540,8	-33,2	16,6
6767,0	7284,9	-32,1	6767,0	7278,2	-38,8	6,7
6513,0	7037,8	-25,2	6513,0	7027,7	-35,3	10,1
		-550,0			-550,0	0,0
		-550,0			-550,0	0,0
		-550,0			-550,0	0,0
		-550,0			-550,0	0,0
		-550,0			-550,0	0,0
		-550,0			-550,0	0,0

Table 3: C-Lines measurements

D-Lines (left)			D-Lines (right)			D-Lines
EAPR Technical data (mm)	Lengths measurement (mm)	Differences (mm)	EAPR Technical data (mm)	Lengths measurement (mm)	Differences (mm)	Symmetry (mm)
7556,0	8083,1	-22,9	7556,0	8080,7	-25,3	2,4
7438,0	7969,5	-18,5	7438,0	7961,6	-26,4	7,9
7406,0	7941,2	-14,8	7406,0	7933,2	-22,8	8,0
7442,0	7972,1	-19,9	7442,0	7964,7	-27,3	7,4
		-550,0			-550,0	0,0
		-550,0			-550,0	0,0
		-550,0			-550,0	0,0
		-550,0			-550,0	0,0
		-550,0			-550,0	0,0
		-550,0			-550,0	0,0
		-550,0			-550,0	0,0
		-550,0			-550,0	0,0
		-550,0			-550,0	0,0
		-550,0			-550,0	0,0
		-550,0			-550,0	0,0

Table 4: D-Lines measurements

Brake-Lines (left)			Brake-Lines (right)			Brake-Lines
EAPR Technical data (mm)	Lengths measurement (mm)	Differences (mm)	EAPR Technical data (mm)	Lengths measurement (mm)	Differences (mm)	Symmetry (mm)
8113,0	8144,5	31,5	8113,0	8154,0	41,0	-9,5
7855,0	7900,0	45,0	7855,0	7904,9	49,9	-4,9
7657,0	7699,8	42,8	7657,0	7715,2	58,2	-15,4
7596,0	7639,5	43,5	7596,0	7652,5	56,5	-13,0
7459,0	7506,7	47,7	7459,0	7518,4	59,4	-11,7
7409,0	7458,1	49,1	7409,0	7464,4	55,4	-6,3
7308,0	7390,9	82,9	7308,0	7399,5	91,5	-8,6
7265,0	7345,5	80,5	7265,0	7357,4	92,4	-11,9
		0,0			0,0	0,0
		0,0			0,0	0,0
		0,0			0,0	0,0
		0,0			0,0	0,0
		0,0			0,0	0,0
		0,0			0,0	0,0
		0,0			0,0	0,0

Table 5: Brake-Lines measurements

Nea Philadelphia, 07 November 2019

THE CHAIRMAN

Antonios Athanasiou

True Copy

The Secretary

Kyriakos Katsoulakis

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