MINISTRY FOR
INNOVATION AND TECHNOLOGY
TRANSPORTATION SAFETY BUREAU

FINAL REPORT

2021-0195-4
accident

1 km SE of Apostag
03 July, 2021

Discus bT
D-KIBT

General information

This investigation is being carried out by Transportation Safety Bureau on the basis of

- Regulation (EU) No 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC,
- Act XCVII of 1995 on aviation,
- Annex 13 identified in the Appendix of Act XLVI. of 2007 on the declaration of the annexes to the Convention on International Civil Aviation signed in Chicago on 7th December 1944,
- Act CLXXXIV of 2005 on the safety investigation of aviation, railway and marine accidents and incidents (referred to as Kbvt. throughout the document),
- NFM (Ministry for National Development) Regulation 70/2015 (XII.1) on safety investigation of aviation accidents and incidents, as well as on detailed investigation for operators,
- In matters not covered by Kbvt., Act CL of 2016 on General Public Administration Procedures

The competence of the Transportation Safety Bureau of Hungary is based on Government Regulation № 230/2016. (VII.29.) on the assignment of a transportation safety body and on the dissolution of Transportation Safety Bureau with legal succession.

Pursuant to the aforesaid legislation,

- Transportation Safety Bureau of Hungary shall investigate aviation accidents and serious incidents.
- Transportation Safety Bureau of Hungary may investigate aviation and incidents which – in its judgement – could have resulted in accidents of more severe consequences in different circumstances.
- Transportation Safety Bureau of Hungary is independent of any person or entity that may have interests in conflict with the objectives of the investigating body.
- In addition to the aforementioned legislation, TSB of Hungary shall conduct safety investigations in line with ICAO Docs *9756* and *6920 Manual of Aircraft Accident Investigation.*
- This Report shall not be binding, nor shall an appeal be lodged against it.
- The original of this report was written in Hungarian.

No conflict of interest has been found between safety investigators of the IC. No investigator assigned to a safety investigation has been involved as an expert in any other procedure pertaining to the same case and shall not do so in the future.

The IC shall retain all data and information having come to their knowledge in the course of the safety investigation. Furthermore, the IC shall not be obliged to make such data and information available to other authorities, whose disclosure could have been legally refused by their original owner.

This Final Report

was based on the draft report prepared by the IC and sent to all affected parties (as specified by the relevant regulation) for comments.

No comments on the draft report were received within the regulated deadline from any affected parties.

Copyright

Translation

This document is a translation from Hungarian. Although efforts have been made to provide a translation as accurate as possible, discrepancies may occur. In such eventuality, the Hungarian version shall prevail.

Table of Contents

Definitions and Abbreviations

AD	*Airworthiness Directive*
Aerodrome	*A defined area (including any buildings, installations and equipment) on land or water or on a fixed offshore or floating structure intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft*
AFM	*Aircraft Flight Manual*
AGL	*Above Ground Level*
AMP	*Aircraft Maintenance Program*
ARP	*Aerodrome Reference Point*
AT	*Aero Tow Launch Method Rating*
CAMO	*Continuing Airworthiness Management Organisation*
CAO	*Combined Airworthiness Organisation*
DOF	*Date of Manufacture*
EASA	*European Union Aviation Safety Agency*
FAI	*Fédération Aéronautique Internationale*
FI	*Flight Instructor*
IC	*Investigating Committee*
ICAO	*International Civil Aviation Organization*
ITM	*Innovációs és Technológiai Minisztérium / Ministry for Innovation and Technology*
Kbvt.	*Act CLXXXIV of 2005 on the safety investigation of aviation, railway and marine accidents and incidents and other transportation occurrences*
LAPL	*Light Aircraft Pilot Licence*
LAPL(S)	*Sailplane LAPL*
LT	*Local Time*
MTOM	*Maximum Take-Off Mass*
NFM	*Ministry of National Development*
NKH LH	*National Transport Authority Aviation Authority, Hungary (till 31 December 2016)*
Pilot-owner	*Based on the M.A.803 section of Commission Regulation (EU) No 1321/2014 of 26 November 2014 on the continuing airworthiness of aircraft and aeronautical products, parts and appliances, and on the approval of*

	organisations and personnel involved in these tasks (hereinafter: Pilot or Owner, both words refer to the Pilot-owner)
SL	*Self launch rating*
SPL	*Sailplane Pilot Licence*
Sustainer Engine	*A low power retractable light aircraft engine that provides limited climbing performance for glider aircraft in flight. Engine power is not suitable for taxi and take-off.*
TSB	*Transportation Safety Bureau*
UTC	*Coordinated Universal Time*
VFR	*Visual Flight Rules*
WL	*Winch launch rating*

Synopsis

Occurrence Class		accident
Aircraft	manufacturer	SCHEMPP HIRTH
	type	DISCUS bT
	registration	D-KIBT
	operator	private owner
Occurrence	Date and time	03 July, 2021, 16:45 LT / 14:35 UTC
	Location	SE of Apostag (*Figure 1*)
Fatalities / severe injuries related to the occurrence		0 / 1
Aircraft Damage		substantially damaged

All times indicated in this report are in local time (LT). LT at the time of the occurrence: UTC+ 2 hours.

All geographical locations throughout this document are provided in WGS-84 standard.

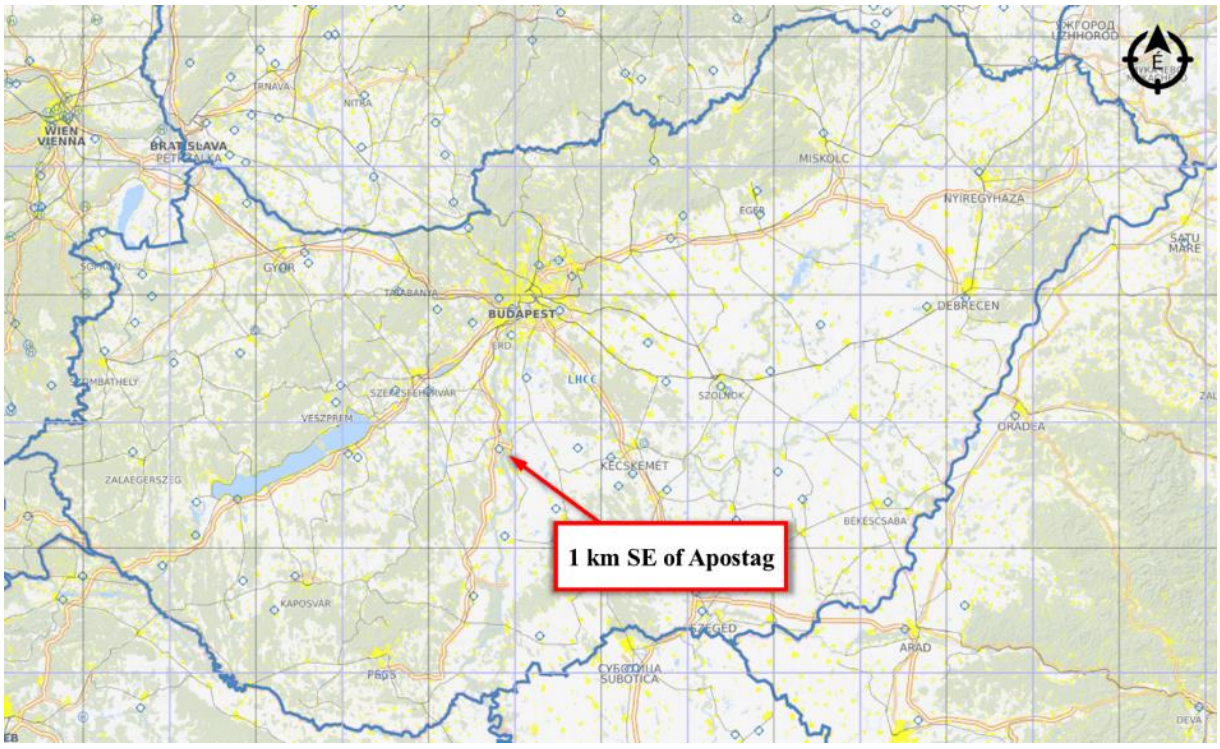


Figure 1: Occurrence location in Hungary

Reports and Notifications

The occurrence was reported to TSB's call center on 03 July 2021, at 17:30, by the on-call officer of Hungarian Air Ambulance Nonprofit Kft.

TSB Hungary notified the following organisations.

- Accident Investigation Authority of the State of Registry, Design and Manufacture (Germany) on 05 July 2021 at 14:08
- EASA on 05 July 2021 at 14:06
- Accident Investigation Authority of the State of Continuous Airworthiness (Slovakia) on 13 July 2021 at 16:17

The following of the notified foreign organisations appointed an accredited representative for the investigation.

- State of Registry, Design and Manufacture of the aircraft (Germany): Bundesstelle für Flugunfalluntersuchung (BFU)
- State of Continuous Airworthiness of the aircraft (Slovakia): Ministry of Transport Construction and Regional Development of the Slovak Republic Specializied Unit (MINDOP)
- EASA

Investigation Committee

The Head of TSB appointed the following persons in the investigating committee (hereinafter: IC).

Investigator-in-Charge	**Zsigmond Nagy**	Investigator
Member	**Klementina Joó**	Investigator

Overview of the Investigation Process

Subsequent to the notification, the on-call duty officer of the TSB ordered an immediate dispatch to the site.

This investigation is based on paragraph 7 chapter (1) section a) subsection aa) of the Kbvt.

In the course of the investigation the IC has taken the following steps.

- obtained the technical and maintenance documentation of the aircraft;
- interviewed witnesses;
- carried out a supplementary inspection to examine the aircraft and it's engine;
- examined and analysed data from the GPS-based data recording device with the aid of a specialist.

Synopsis

The Pilot of a Discus bT (registered D-KIBT) participated in the 66th Hungarian National Gliding Championship in Dunaújváros on 3 July, 2021. About 4 hours and 20 minutes into the flight, having covered ca. 300 km, the Pilot was not able to reach Dunaújváros, his original departure airfield and decided to land out on a cultivated stretch of land outside Apostag. On approach to the selected landing site the aircraft collided with a harvester, hitting its grain hold doors, and crashed to the ground. The Pilot suffered serious injuries while his aircraft sustained substantial damage. Significant material damage was also realised in the harvester, while its 2 occupants remained uninjured.

The IC identified human factors as the cause of the accident.

The IC found no grounds to issue a safety recommendation.

1. Factual Information

1.1. Flight History

The pilot and owner (hereinafter *Pilot*) of D-KIBT, a Discus bT glider (*Figure 2*) was a FAI club class[1] contestant in the 66th Hungarian National Gliding Championship in Dunaújváros. The first task of the competition was declared as a 3-hour AAT[2] flight on the course of Dunaújváros Airfield - Kálóz - Nagyveleg - Bátaszék - Solt N - Dunaújváros Airfield. In their investigation the IC made use of the data recorded in the Pilot's GPS-based on-board data logger (hereinafter *logger*) that he carried in order to verify his flight in the competition event (1.11).

Figure 2: D-KIBT during take-off for the accident flight
(image: Ferenc Kolos)

Following a tow launch[3] the Pilot started the on-board sustainer engine at 12:52:03 for approximately 20 seconds to register the engine noise level for reference, then stowed the engine and resumed his gliding flight. In his recall the Pilot accounted for good thermal conditions with wind speeds up to 30 km/h at higher altitudes.

In about 300 km into the flight at 16:41 and a GPS altitude of 420 meters the Pilot decided to cross the Danube from the west in the vicinity of Bölcske to reach areas of more favourable thermal conditions. Having crossed the river 2 km N of Harta his altitude dropped to 250 meters. At this point he decided to give up soaring and deployed his sustainer engine at 16:49. During the standard windmill start he lost further altitude. Engine power became available at 79 meters AGL and the Pilot started climbing away. About 5 minutes after engine start the Pilot experienced a significant drop in engine power. At ca. 480 meters AGL he shut down the engine and glided on, hoping to catch a thermal and gain enough altitude to reach the airfield.

[1] There are several glider classes recognised by the FAI, including Club Class.
[2] AAT (Assigned Area Task): Speed over a course through two or more designated Assigned Areas, with a finish at the contest site. *(source: Annex A to Section 3 – Gliding, Rules for the world and continental gliding championships)*
[3] GPS altitude 163 meters

Figure 3: Flight of D-KIBT prior to the accident

At 17:00 at 139 meters over Dunaegyháza east the Pilot started his limping engine again, only to encounter a similar loss of power following 4 to 5 seconds of normal operation. Leaving the struggling engine on, the Pilot continued heading north while hardly maintaining altitude (90-130 meters) on engine power. At 17:04:58 he reached the south-eastern limits of Apostag at 117 meters AGL, where he started spiralling left in an attempt to gain altitude. He kept on trying for nearly 3 minutes while he was continuously losing altitude and only abandoned spiralling at 28 meters AGL (*Figure 3, 1*). The Pilot then rolled out, heading for the southern edge of his intended landing stretch in crossing tailwind, while he shut down the engine and initiated the stowing sequence. At 17:08:18, reaching the end of his intended landing strip at 8 meters over the ground, the Pilot engaged in a left turn to line up for landing (*Figure 3, 2*). During the turn, at 17:08:, the aircraft hit a combine harvester at work in the field, with the landing gear snagging at the harvester's grain hold doors (*Figure 3, 3*). The aircraft then impacted the ground nose first and came to a halt across the harvester (*Figure 3, 4*).

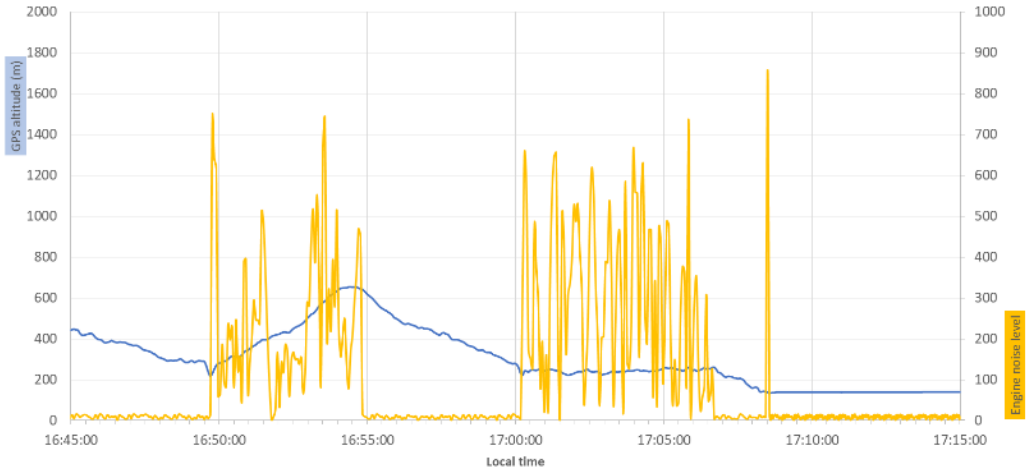


Figure 4: Altitude and noise level data of the last 30 minutes before impact (extracted from the logger of D-KITB)

1.2. Injury to Persons

Injuries	Crew		Passengers	Others
	Pilot	Cabin		
Fatal	-	-	-	-
Serious	1	-	-	-
Minor	-	-	-	
None	-	-	-	

The combine harvester's 2 occupants were not injured in the accident.

1.3. Aircraft Damage

The aircraft was substantially damaged in the ground collision (*Figure 5*). Ground impact forces damaged the wings. The left wing trailing edge cracked open at about 26 cm from the root rib and there were several breaches on the wing skin around this area. The left wing's composite skin buckled and cracked over the root rib and main spar joint. The left spar stub dislocated and the left aileron's outboard section was also damaged. Scrape marks were found on the right wing's skin surface.

The nose section forward of the canopy broke off with the instrument panel expelled, ending up on the ground in front of the wreckage. The aircraft's batteries were found outside the aircraft, disconnected from the aircraft electric systems. Landing gear suspension and its immediate surrounding area also sustained heavy damage. The tail boom snapped and broke clean off with the tail assembly still holding the rudder and elevator.

Figure 5: Aircraft wreckage

1.4. Other Damage

The combine harvester's grain hold doors and their hinges were damaged on impact with the glider.

1.5. Personnel Information

1.5.1. Data of the Pilot-in-Command

Age, Nationality, Gender		55, Hungarian, male
Licence data	type	SPL
	valid until	does not expire
	ratings	Sailplane, FI(S)
Certificates		Cloud flying; Sailplane: AT, SL, WL; FI(S): Cloud flying, FI, LAPL(S), SPL
Medical Class and Validity		1 / 2 / LAPL, 10 May, 2022
Flight Hours	in the preceding 24 hours	4 hrs 18 min
	in the preceding 7 days	4 hrs 18 min
	in the preceding 90 days	17 hrs 41 min
	total	1574 hrs
	total on this type:	181 hrs

The Pilot's logbook was not kept up-to-date. It did not contain any entries from 2021. According to the Pilot's written statement, he had flown 15 hours and 38 minutes (8 take-offs) in 2021, prior to the accident flight, including 15:06 hours (5 take-offs) in D-KIBT. The source of data in the table above is a combination of the Pilot's log, aircraft logbook entries and the Pilot's written statement submitted to the IC.

In his interview the Pilot reported to the IC that he would habitually ignore to enter his flights in his flight log or the aircraft log book after each flight. He would catch up with administration and take care of the lagging paperwork all at once at the end of each year in retrospect. He claims to have a total of 2,500 hours of glider flying experience in the past 29 years, including about 300 hours[4] in the aircraft involved in the accident. He said to have flown in several competition events with fair results: he was once a Hungarian national champion or other times he came in second or third in a championship. In addition to glider flying he also said to have logged 6,500 to 7,000 flight hours in powered aircraft, both as pilot and flight instructor.

The flight times in the table above do not include the 2021 flight records found in the logger but not accounted for by the Pilot (1.11).

1.6. Aircraft Information

1.6.1. General Information

Class	Glider (equipped with a retractable sustainer engine)
Manufacturer	Schempp-Hirth Flugzeugbau GmbH
Model	Discus bT
Year of manufacture	1994
Serial number	142/1994
Registration	D-KIBT
State of Registry	Germany

[4] For explanation of logged flight time discrepancies see chapter 2.2.

Date of registry	19 October, 2015 (Certificate of Registration issued upon change of ownership)
Owner	Private (Pilot)
Operator	Private (Pilot)

	Flight hours	Take-offs
Total	3104:51	1714
Since last inspection	15:06	5

FCL.010 of Commission Regulation (EU) No 1178/2011 of 3 November 2011 laying down technical requirements and administrative procedures related to civil aviation aircrew pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council defines '*powered sailplane*' as an aircraft equipped with one or more engines having, with engines inoperative, the characteristics of a sailplane.

The glider involved in the accident is of outstanding flight characteristics that make it particularly suitable for performance gliding. It is also equipped with a retractable sustainer engine to avoid the hassle of landing out when conditions are not met to reach an airfield within gliding distance.

1.6.2. Airworthiness Certificate

Airworthiness Certificate	Number	L 19450
	Date of issue	28 July 1994
	Valid until	Until withdrawal
	Restrictions	None

Airworthiness Review Certificate	Number	002/21
	Date of issue	12 January, 2021
	Valid until	19 January, 2022
	Date of latest review	12 January, 2021

The Airworthiness Review Report of 12 January, 2021 needed to be made out on the basis of the AFM, the manufacturer's maintenance manuals and the necessary documentation, apparently all available at the time. These documents were missing from the documentation submitted by the Pilot, who only presented, upon request, the AFM at a later date. According to his statement, the review was carried out in Hungary by an employee of a Slovak CAO accepted by the German authorities.

1.6.3. Engines

Category	two-stroke, two-cylinder gasoline engine
Engine manufacturer	SOLO-Kleinmotoren GmbH
Type	SOLO 2350 (*Figure 6*)
Serial number	382
Hours / cycles flown	
Total	148 hours
Since overhaul	N/A
Since last inspection	7 minutes

The sustainer engine manual's maintenance chapter was not available on site and the Pilot has not been able to present it since. A manufacturer's version obtained by the IC can be found in section *1.18 Additional Information.*

In terms of sustainer engines, no special training is required for glider pilots otherwise qualified to fly the same aircraft model without such engine – it is sufficient for the pilots to familiarise themselves with the information and procedures provided in the AFM. To keep this two-cylinder two-stroke engine as simple as possible, no starter motor is included; engine start is achieved by windmilling. For the same reason there is no throttle either. After start-up the engine runs at a pre-set full continuous power until shut down. Fuel consumption, according to the manual, is 8.5 liters per hour.

The Pilot communicated during his interview that the engine does not have mandatory overhaul or inspection cycles; it only needs to be serviced every 5 years designated repair kit available in the market and the engine's cycles and operating hours do not have to be followed or documented. He also stated that the original 200-hour engine lifetime limitation was at some point lifted.

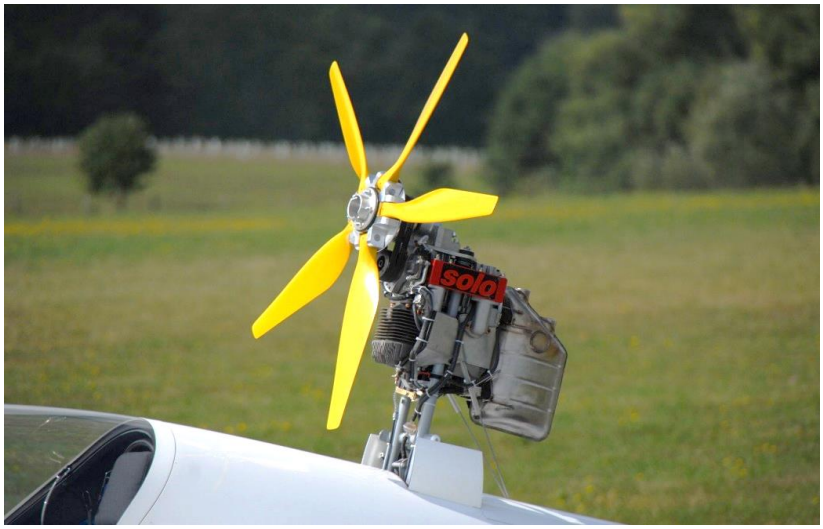


Figure 6: Solo 2350 engine (source: https://www.schempp-hirth.com)

1.6.4. Propeller Data

Category	folding propeller
Manufacturer	Ingrid Oehler TB GmbH
Type	OE – FL 5.83/83 a5, v92
Serial number	417
Date of installation	Same as aircraft DOF
Hours / cycles flown	
Total	148 hours
Since last inspection	7 minutes

1.6.5. Aircraft Loading Data

Aircraft Weight	303,20 kg
Fuel on board	12,5 liters
Maximum take-off weight	450 kg
Maximum landing weight	450 kg
Type of fuel	min RON 95 or AVGAS 100 LL

1.7. Meteorological Information

At the time of the accident weather was sunny with typical summer cumuli. The temperature ranged from 23 to 30 degrees Celsius. According to relevant weather reports issued at Budapest Liszt Ferenc International Airport and Kecskemét Military Airport, ground winds were north-westerly (320-330 degrees) of 12-14 knots. The accident took place at daytime in good visibility.

The Sun was shining 58 degrees above the horizon from 231 degrees at the time and location of the accident.

According to the Pilot, during the flight the wind was north-westerly, at around 30 km/h at higher altitudes.

1.8. Aids to Navigation

Navigation equipment had no influence on the course of events.

1.9. Communication

Communication equipment had no influence on the course of events.

1.10. Aerodrome Information

Departure from Dunaújváros Airfield was on July 3, 2021. The planned destination was also Dunaújváros Airfield.

Name of aerodrome	Dunaújváros Airfield
Location indicator	LHDV
Airport operator	Baracs Repülőtér Kft.
Reference point (ARP)	N46°53’42,00” E018°54’36,7” (WGS 84)
Elevation	123 m / 404 ft
Runway identification	14/32
Runway length	950x60 m
Runway surface	grass

The parameters of the airport did not affect the accident, further details are not required.

1.11. Flight Recorders

For competition logging purposes the Pilot used a Naviter OUDIE IGC (NAV-80Q) logger that was seized on site by the IC. Extracted data were subsequently analysed by the IC who sought an expert’s opinion. The logger records GPS flight track, altitudes and, by means of an ambient microphone, engine time.

The following information was determined using the logger data (*Figure 7*).

- Field elevation at take-off was recorded as 163 meters GPS altitude. Take-off commenced at 12:45:59. Flight time was 4:22:51, ending at 17:40 at 136 meters GPS altitude.
- Engine time with regular engine noise was recorded between 12:52:46 and 12:53:13.

– For periods between 16:49:46 to 16:52:54 and 17:00:14 to 17:06:38 engine noise level was significantly lower than regular.

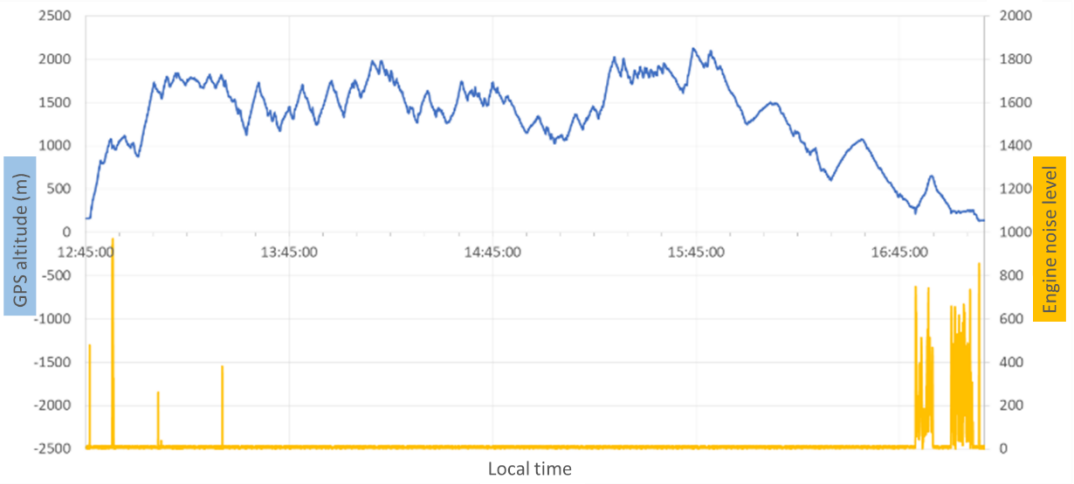


Figure 7: Altitude and noise level data for 3 July, as extracted from D-KITB's logger

Time	Event	GPS altitude	AGL altitude
12:45:59	Commencing tow launch take-off	163 m	0 m
12:52:46 - 12:53:13	Engine start to record noise stamp	974 m – 1001 m	811 m – 838 m
16:49:30 - 16:52:54	Pilot deploys the engine north of Harta at 128 m AGL and starts climbing from 79 meters straight towards Solt. At 500 m AGL engine power decreases.	229-487 m	128 m – 79 m - 349 m
16:54:46	Pilot shuts down and stows engine, gliding northbound.	644 m	506 m
16:59:54 - 17:00:14	Engine is started again 3 km east of Dunaegyháza.	277 m – 221 m	139 m - 83 m
17:05:02	Pilot reaches Apostag SE and begins spiralling to find lift in a thermal.	258 m	120 m
17:06:38	Engine noise ceases. Engine bay cover status unknown (stow button would have to be kept pressed until the end of the stow sequence – no information).	259 m	121 m
17:08:30	D-KIBT collides with the harvester.	142[5] m	4,9 m
17:08:36	Aircraft speed is 0 km/h.	138 m	0 m

The reference for AGL 0 meters during the first 30 minutes of the flight is the altitude of the departure airfield. AGL for the last 15 minutes of the flight is referenced to the accident site altitude recorded by the logger. Terrain elevation, according to Google Earth data, does not significantly vary throughout the affected areas.

[5] The altitude was calculated from terrain elevation and the harvester's height

The IC examined previous logger data (*Figure 8Figure 11*) and found 5 flights of 2021, about 13 hours in total, that the Pilot did not account for in his written statement. In this statement the Pilot also said to have only used the sustainer engine since the 5-year maintenance in 2021 for engine sound stamp registration.

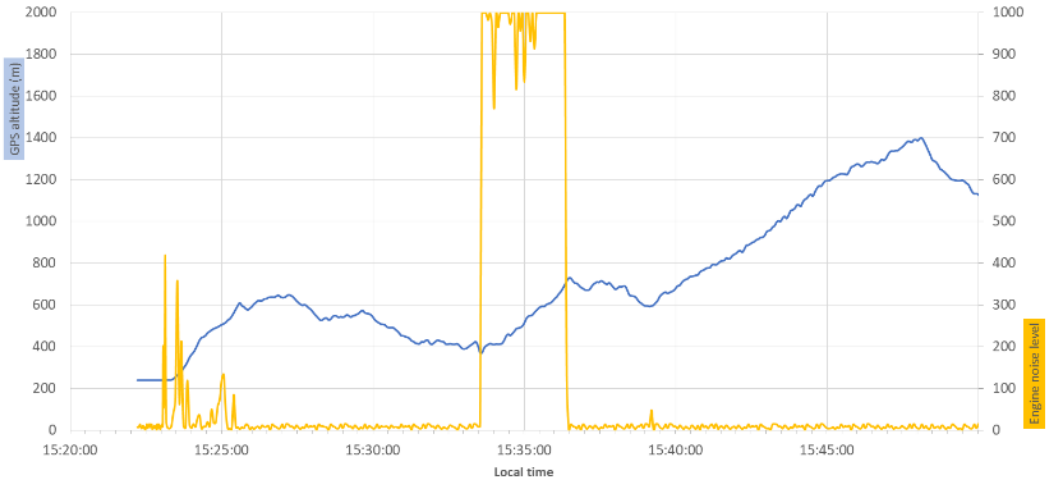


Figure 8: Altitude and engine noise level data for 29 March, 2020

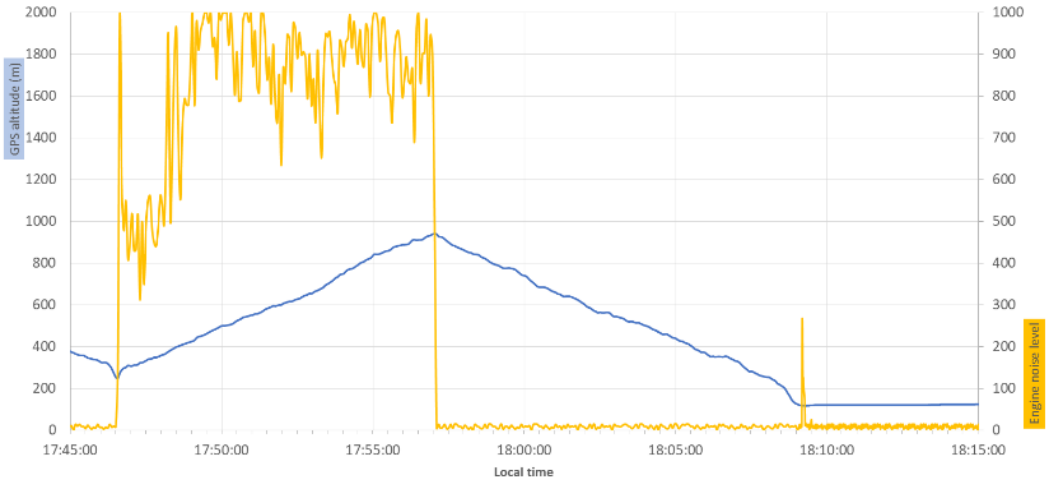


Figure 9: Altitude and engine noise level data for 25 April, 2021

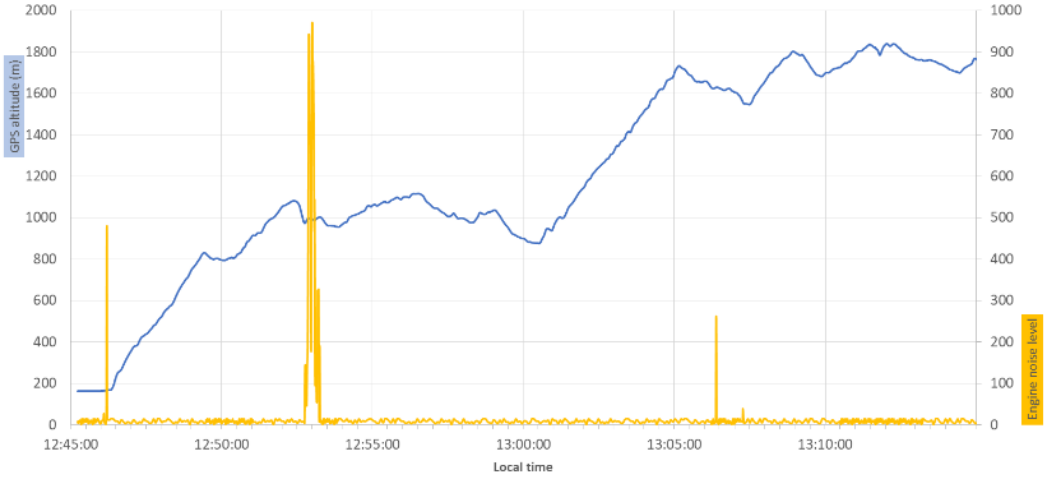


Figure 10: Altitude and engine noise level data for the 1st engine use on 3 July, 2021

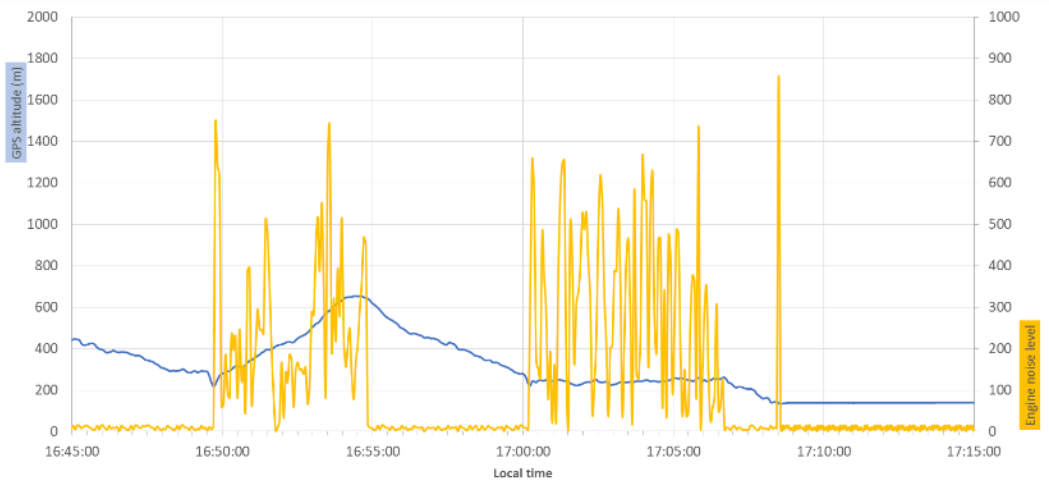


Figure 11: Altitude and engine noise level data for the 2nd and 3rd engine use on 3 July, 2021

1.12. Wreckage and Impact Information

The accident took place in the southern part of a fairly smooth plough field of about 25 hectares, with furrows running more or less north to south. It is bordered by roads 51 and 513. The impact with the harvester was recorded at 46.873200°, 18.977267°, the aircraft hit the ground 25.4 m northeast at 46.873350°, 18.977517°, coming to rest after a 5.3-meter slide (*Figure 12*).

The IC found the fuel cock open and the landing gear extended. The sustainer engine was not fully retracted in the hull and the engine bay doors were found ajar with the propeller blade tips outside the fuselage.

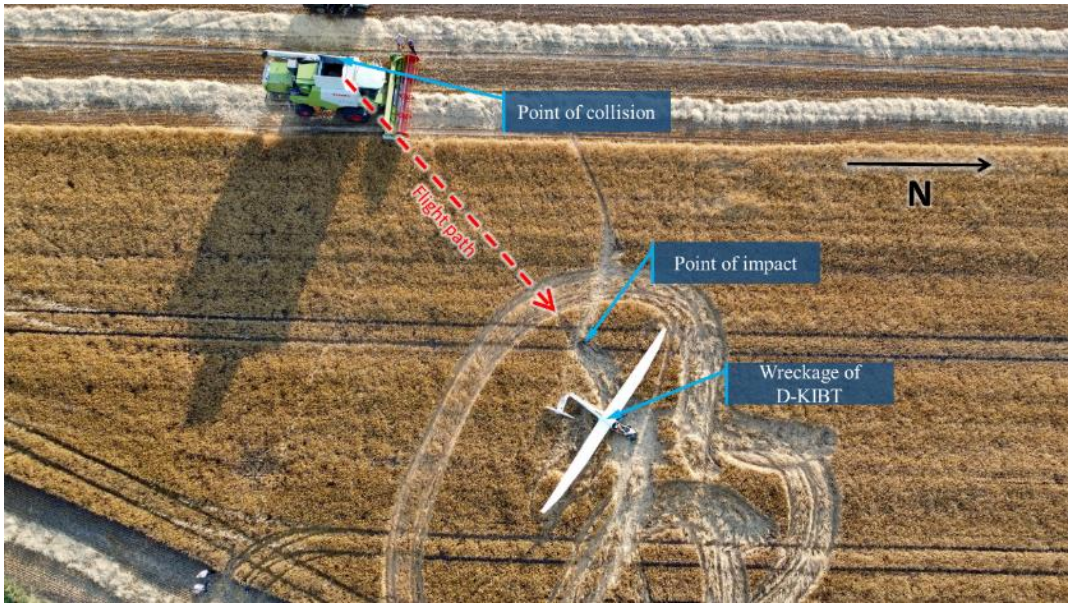


Figure 12: Crash site

1.13. Medical and Pathological Information

There was no indication of any physiological factor or other impediments affecting the Pilot's capacity or capabilities.

1.14. Fire

There was no fire.

1.15. Survival Aspects

It is not mandatory to equip this aircraft with an emergency location transmitter.

Bács-Kiskun County Rescue Service was notified by the driver of the harvester right after the accident, at 17:10. The paramedics of the National Ambulance Service arrived at the site. The Pilot was subsequently airlifted to Kecskemét County Hospital.

1.16. Tests and Research

The IC carried out a supplementary inspection on 14 July, 2021 with the participation of a maintenance engineer assigned by the Pilot, a number of police investigators and their appointed forensic expert.

In the course of the inspection no indication was found concerning any failure of a structural or flight control element prior to the accident with effect to the outcome of the event.

The fuel tank was found three quarters full and the fuel pump in standard working order. No indication was found pointing to a fuel system failure or any component thereof to contribute to an engine power loss.

Upon reconnecting the batteries the sustainer engine stow and deploy system was tested and passed as operational, working smoothly both ways. The position of the controls and switches provided insufficient evidence to determine whether the engine bay doors found ajar and the engine partially stowed was either caused by a structural hull deformation on impact or an incomplete stowing sequence aborted by the Pilot on collision with the harvester.

On removal of the engine it became apparent that the locking nut on the front decompression valve was missing and the decompression valve on the rear cylinder had run loose. The valve stem threads were intact on both valves, the rear valve could be tightened. No damage was found on the valve sealing surfaces. The spark plug in the rear cylinder was partially fouled, indicative of insufficient fuel burn. Spark testing this plug still yielded a passing result.

During extension and retraction tests engine deployment took 10 seconds and stowing was clocked at 9 seconds on average.

1.17. Organizational and Management Information

There were no organisational aspects affecting the event.

1.18. Additional Information

1.18.1. Rules Specific to Sailplane Operation

Section *'SAO.GEN.155 Documents, manuals and information to be carried'* of the regulation for the operation of sailplanes[6] states that the AFM, or equivalent document(s) shall be carried on each flight as original or copies.

Section '*SAO.GEN.130 Responsibilities of the pilot-in-command'* stipulates that the pilot-in-command shall record utilisation data and all known or suspected defects in the sailplane

[6] Commission Implementing Regulation (EU) 2018/1976 of 14 December 2018 laying down detailed rules for the operation of sailplanes pursuant to Regulation (EU) 2018/1139 of the European Parliament and of the Council

at the termination of the flight, or series of flights, in the aircraft technical log or journey log.

1.18.2. Mandatory Documents to Carry during Flight

Section SFCL.045 of the relevant legislation[6] lists the documents that are mandatory to carry on board when exercising the privileges of an SPL licence: a valid SPL; a valid medical certificate; a personal photo identification document; sufficient logbook data to demonstrate compliance with the requirements of this Annex.

The specified documents may be retained at the airfield for flights that remain within the sight of the airfield.

1.18.3. Flight Time Logging

Section FCL.050 of Commission Regulation (EU) No 1178/2011 of 3 November 2011 laying down technical requirements and administrative procedures related to civil aviation aircrew pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council states that *"The pilot shall keep a reliable record of the details of all flights flown in a form and manner established by the competent authority."* FCL.050 of "*The Acceptable Means of Compliance and Guidance Material to Commission Regulation (EU) No 1178/2011 of 3 November 2011 laying down technical requirements and administrative procedures related to civil aviation aircrew pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council*" requires holders of a pilot licence to record details of all flights flown. Flight crew logbook entries should be made as soon as practicable after any flight undertaken. All entries in the logbook should be made in ink or indelible pencil.

Section 10.1 of the Maintenance Manual for the powered sailplane model Discus bT details the logging in time of service, subpart b) states that *„the time in service of the engine of this powered sailplane must also be entered in its log book. Recording the engine time is either by (1) making a note on every flight of the time the engine was used, or (2) by calculating the engine time as follows: when refuelling the tank, the amount of fuel consumed is converted to engine time (minutes) with the aid of conversion factors…"*

1.18.4. Pilot Interview

During his interview with the IC the Pilot stated the following.

- He started the competition event well rested and did not feel tired after 4 hours of flight;
- He usually documents his flights at the end of each year;
- He trusts his aircraft's sustainer engine, because it has always started up without fail, therefore he usually starts to deploy the engine at about 200 m AGL;
- *"I have established this 200-meter engine deployment routine because this is what everyone else does , at about 200 meters, this is what I hear from everyone I asked";*
- *"I always keep an eye out for suitable landing spots well in advance, higher than 200 meters, just like I did this time… I pick out a spot to land in case the engine wouldn't kick in";*
- *"You cannot land with the engine deployed, it gets torn off on touchdown, it must be proper stowed";*
- *"The aircraft manual does not recommend landing with the engine extended";*
- He had out landings with D-KIBT before, when he deliberately did not use the engine;

- Once on a competition event he was able to break off in a thermal from 70 meters AGL without having to deploy the engine;
- This is his first glider with an engine, beforehand he flew regular gliders, he has experience in landing out;
- He says it takes 4 to 5 seconds to both deploy and stow the sustainer engine respectively;
- He purchased the D-KIBT 5 years ago;
- The aircraft and the engine were both well maintained;
- Annual maintenance can only be performed by a mechanic;
- The mechanic has a to-do list and checks the manufacturer's website as well to carry out the maintenance job, as is their (the mechanic's) responsibility;
- The engine only has a 6 to 8 page long document describing the maintenance to be done every 5 years, it does not have a manual;
- A mechanic from the German authority comes to Hungary every year to check that the maintenance has been properly carried out and issues the airworthiness certificate as a result of the review;
- The AFM of the aircraft is misplaced, he does not know where it may be, he may not have received it on purchase with the aircraft. The AFM was later found by the Pilot and was handed over to the IC;
- To stow the engine the speed has to be less than 90 km/h, or the propeller will not stop turning;
- The documents of the aircraft are in German. He does speak German, however, it is not a requirement in his opinion;
- Deployment and stow testing the engine before flight is not part of the walkaround requirements.

1.18.5. Discus bT Engine Operation

AFM 4.5.3: *"The power plant should only be extended and started where there is a suitable landing terrain within gliding range. Below 300 m AGL starting procedures are to be avoided so as to have a safe height left for planning the approach pattern should the engine fail to run."*

"The loss of height, from the moment of extending the engine until it runs, is approx. 50-60 m."

AFM 4.5.4.: "*On approach it should be taken into account that the performance has deteriorated due to the extended stopped engine."*

AFM 4.5.5. b) *"Landing the "Discus bT" with its powerplant extended is performed in the same manner as with the power plant retracted (ignition to be switched "OFF")."*

1.18.6. Discus bT Operation

The aircraft was under a Pilot-owner maintenance scheme[7] at the time of the accident. The Pilot provided an AMP for the IC, dated 11 March, 2016. A more up-to-date version was not available.

[7] Based on M.A.803 point of Commission regulation (EU) No 1321/2014 of 26 November 2014 on the continuing airworthiness of aircraft and aeronautical products, parts and appliances, and on the approval of organisations and personnel involved in these tasks

The AFM and associated documents provide a detailed description of the daily, hourly and annual inspections of the aircraft and its sustainer engine. According to section 4.3 of the AFM the condition and operation of the decompression valve shall be checked before the first flight of the day.

The Aircraft Maintenance Manual lists the documents that contain the maintenance instructions for parts installed from various manufacturers.

According to Section 5 of the Engine Maintenance Manual, the engine should be inspected annually or after every 25 hours of operation (whichever occurs first).

The Manual for Engine 2350 specifies the following procedures:

*"**4. Operating manual***

In order to have best engine performance available, it is absolutely necessary to follow the following instructions:

Before starting the engine

- *Daily check done?*
- *Check fuel level in tank*
- *Airbleed fuel lines. Gently squeeze hand pump and at the same time press on carburetor diaphragm. To do this use a pin and push through the small hole in the carburetor chamber covers until fuel is injected. Listen if fuel is injected.*

5. Maintenance manual

- *…*
- *Every 12 months or 25 operating hours, whatever comes first, check the following points in addition to the daily checks:*
  - *fuel lines*
  - *All wiring, exhaust system and spark plugs*
  - *Clean engine*
  - *Disassemble, wash and check the decompression – valves*
- *Special examination after 5 years. This check can be carried out by the manufacturer or a certified maintenance organisation or a certified maintenance person.*
- *Special examination after 200 operating hours. This check has to be done by the manufacturer.*
- *Special examination after shock-loading. This check has to be carried out by the manufacturer or an approved maintenance facility.*
- *Conservation and storage: If an engine is not used for 2 months or more, the following work must be done:*
  - *Empty fuel system*
  - *Inject approx. 5 ccm of 2-stroke oil into each inlet manifold. Turn the engine over by hand 10 times. Make sure, ignition is in "Off" position and compression release valves are open.*
  - *Cover intake and exhaust openings. "*

There are also items in the propeller maintenance manual that must be completed daily; yearly, or after every 25 hours of operation, whichever occurs first; and after maximum 200 hrs of operation.

The AMP made by the Pilot does not include the annual maintenance steps for either the engine or the propeller, as required by the manufacturer's instructions.

1.18.7. Aircraft Maintenance and Airworthiness Review

The owner shall be responsible for the continuing airworthiness of the aircraft, and for the Aircraft Maintenance Program, if he/she declares it in accordance with section ML.A.302 (b) (1) of Regulation (EU) No 1321/2014, and shall contain a signed statement by which the owner declares that this is the AMP for the particular aircraft registration and that he is fully responsible for its content and, in particular, for any deviations from the design approval holders recommendations;

The same regulation (c) (9) stipulates that the aircraft maintenance program shall be reviewed at least annually in order to assess its effectiveness, and this review shall be performed, alternatively. This may be done by the organization maintaining the continuing airworthiness of the aircraft – which was not the case for the aircraft involved in the accident – or in conjunction with the airworthiness review of the aircraft by the person who performs such an airworthiness review.

The AMP references an AFM version validated 8/01/2011, which corresponds to the 8th edition, but in the Aircraft Airworthiness Review Report an AFM version 3 is cited, the same version that was handed over by the owner during the inspection. This version was published on 24/08/1994.

The airworthiness review of 12 January 2021 was performed by an employee of a Slovak CAO accepted by the German authorities. Julbach, the municipality where the review was allegedly done according to the documentation could either be in Germany or Austria, which is neither indicated in the document, nor is this city listed in the CAE document of the CAO as an approved location. Neither the Slovak aviation authority nor the Pilot was able to present the review's Work Order Form. In the Pilot's account the review took place in Hungary.

The airworthiness review certificate issued contains several contradicting entries. In the airworthiness review authority's opinion the administration errors did not affect the issuance of the airworthiness certificate.

1.18.8. Harvester

The agricultural equipment involved in the accident was a Claas Tucano 440 combine harvester, its dimensions with open grain hold doors are shown in *Figure 13*.

Figure 13: Claas Tucano 440 harvester (source: https://app.claas.com)

1.19. Useful or Effective Investigation Techniques

The investigation did not require techniques different from the conventional approach.

2. Analysis

Although engine issues also contributed to the accident, the IC found human factor as the root cause of the accident. Sustainer engine failure or loss of power must not directly and unavoidably result in a hull loss and severe personal injury; especially in terms of a high performance glider aircraft.

As apparent from this accident, in a non-standard situation even an experienced pilot can get confused and mess up his prioritisation and situational awareness.

Figure 14: The dimensions of the landing site available

Figure 15: Aerial view of the accident site

2.1. Sustainer Engine

Although not each and every element in the cause of events could be pinpointed beyond doubt, the Pilot's report along with logger data and supplementary site inspection findings all suggest that the Pilot had initiated the engine stow sequence before the crash, which was interrupted by the collision or immediately before it.

It was determined during the supplementary site inspection that engine power loss was caused by the loosening of the compression release valve (1.16).

The IC assessed previous flight data preserved in the logger memory (1.11) and analysed engine noise level signals. These data show that from 29 March 2020 onward there is a distinct dropping tendency in engine noise levels. The IC opines a direct relation between engine noise level and performance, and the analysed data show a continuously decreasing engine noise throughout the examined period. The IC believes that a properly performed daily inspection any time during the period in question, done as described in and mandated by the AFM (1.18.6), would have revealed the engine issues early enough through the discovery of the missing locking nut, and the unusual status of the spring and spring plate as shown in *Figure 16*.

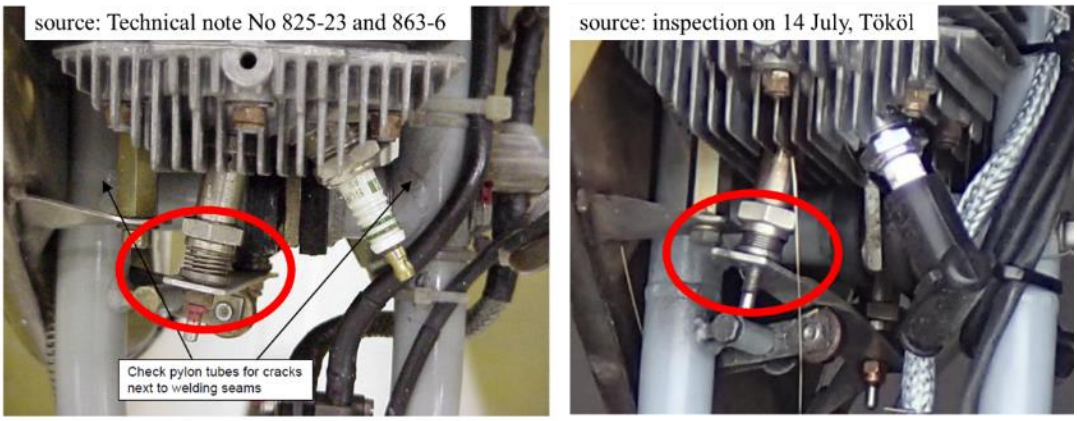


Figure 16: The missing decompressor valve nut

It is particularly important for the operator of an aircraft in Pilot-owner maintenance scheme to have all the aircraft documentation at hand and have an up-to-date working knowledge of the contents thereof – even more so with no other responsible entity to take care of the duties and obligations of continuing airworthiness management than themselves.

2.2. Documentation of Flight Hours, Maintenance and Airworthiness

The IC established that there were no 2021 flight entries either in the Pilot Logbook or in the Aircraft Logbook. This incomplete keeping of records is not compliant with 178/2011 EU regulation (1.18.3). The Pilot's submitted written statement of his 2021 flights is in conflict with the Logger flight data. The IC discovered that the discrepancy amounting to 13 hours of flight time is very likely to be comprised of flights done in a competition event earlier in 2021. The matching duration of the flights seem to be supported by the daily task list published on the official competition website and it could well cover the difference in the Pilot's account and Logger flight data. Such cavalier flight time logging may also account for the difference between the Pilot's statement of 300 flight hours in this aircraft as opposed to his flight log records showing 181 hours in it altogether (1.18.3).

The IC wishes to point out that prompt and up-to-date flight time logging is not only mandated by relevant regulations, but is also a prerequisite of reliable drafting and scheduling of maintenance jobs. On a side note the IC also remarks that the Pilot's logbook format is not in compliance with the legislation effective since 2011.

The IC did not find the reason why the 2017 Airworthiness Review sticker in the Aircraft logbook is attached to a page listing 2018 flights only.

For the maintenance of non-commercially operated gliders the operator is not mandated to contract a CAMO or CAO. After purchase, owners may choose to go by the pilot-owner maintenance scheme and comply with the duties of continuous airworthiness themselves.

To do this, an Aircraft Maintenance Program is required, which is to be kept up-to-date by the owner, who is also required to declare that the given AMP is specific to their particular aircraft and they shall assume full responsibility concerning the content of the AMP document, in particular, for any deviations from the design approval holders recommendations. In the course of the investigation the Pilot did not submit any maintenance manuals or source documents that the AMP could be based on, so the IC could not determine which documents were the basis for the Pilot when creating the AFM for the aircraft.

In the case of a pilot-owner operation, the owner must ensure that the aircraft operation is backed up with up-to-date documentation including an AMP and all manuals, and that every AD and mandatory service bulletin is properly and timely implemented. If a maintenance job should include a task that the owner is not authorized to do, they must seek professional assistance and have that job performed by a licensed aircraft mechanic or by an approved organization. In such case the Pilot must provide a work order with the detailed work package and all the latest information required for the maintenance job (e.g. AMP). This simplified and more cost-effective maintenance scheme is based on owner awareness in terms of maintenance periods and requirements so operators can maintain their aircraft or have it maintained accordingly. The requirements for aircraft mechanics to obtain maintenance documentation and effective guidelines for each maintenance job – as referenced by the Pilot in 1.18.4 – only apply to contracted CAMO or CAO maintenance entities providing Continuous Airworthiness Management services.

The Engine Maintenance Manual mandates specific checks and maintenance actions. Depending on the nature of the job, these are categorised as daily, 5-hour, annual and 5-year maintenance jobs. According to the documents submitted to the IC the only maintenance actions ever done on the engine were two 5-year jobs in 2016 and 2021, respectively. Concluded on the basis of the submitted documentation and the Pilot's statement, the engine operating times – in contrast to the manuals (1.18.3) – were not recorded. Sidestepping the logging requirements the owner deprived himself of the very chance to effectively comply with prescribed maintenance obligations and perform periodic maintenance actions. The IC believes the accident was not directly caused by deficient maintenance, as this aircraft is capable of a safe landing on suitable terrain without a working engine. Ignoring maintenance requirements and lack of familiarity with the manuals, however, have been identified as contributory factors to engine failure.

The IC found the following discrepancies in the Airworthiness Review Certificate and the related documentation.

- The AFM presented by the Pilot was Version 3;
- The AMP is referenced to a later version of the AFM (Version 8);
- The AMP was not reviewed by the person who performed the Airworthiness Review (1.18.7);
- The annual maintenance work package does not match the maintenance action prescribed in section 5 of the Engine Maintenance Manual (Engine MM), because the former (as performed on 02 January 2021) only requires inspection and cleaning of the decompression valves, while the Engine MM mandates disassembly for testing;
- According to the Pilot's report, the review was carried out in Hungary by an employee of a Slovak CAO accredited by the German authorities. In contrast to this, the Airworthiness Review Report names Julbach as the location of the review, and the CAO specified in the documents is a CAO registered in Slovakia.

Although the revealed documentation inconsistencies have not directly affected the airworthiness of the aircraft or the course of the accident, they certainly give a hint about the owner’s approach concerning aircraft operation.

2.3. Human Factors

The IC believes that the Pilot, with his given background and experience, must have been able to accurately assess the risks associated with descending far below safe altitude for engine start.

From the interview with the Pilot and reviewing aircraft documentation the IC concluded that the Pilot had established his own ways and interpretation concerning maintenance provisions and logging pilot/aircraft flight time. Doing so he got accustomed to routinely deviate from relevant rules and regulations, which usually start by cutting corners, occasionally 'bending' the rules or making the odd minor deviation. Later on this approach would lead to engaging in high-risk deviations (such as low altitude engine start) on a regular basis. In lack of immediate repercussions these actions consolidate and soon enough, the Pilot will regularly adopt situations where standard safety barriers either disappear or are significantly compromised and the likelihood of an accident multiplies. This mindset will allow the Pilot to seek thermals or extend the engine at altitudes far lower than what is considered safe (1.18.4). In this accident the focus on chasing achievement in the competition was also contributing to his disregard of conventional aviation safety guidelines.

In years of experience flying the glider registered as D-KIBT, the Pilot had come to know this aircraft and its flight characteristics in and out. He also expressed to have acquired "*trust in the sustainer engine"* (1.18.4). In his first interview the Pilot stated not to have an AFM in his possession. Later on though, he managed to find the document (ver. 3) that he handed over to the IC. This might raise the question what source the Pilot's facts, knowledge and aircraft comprehension is based upon with a misplaced and out-of-date AFM.

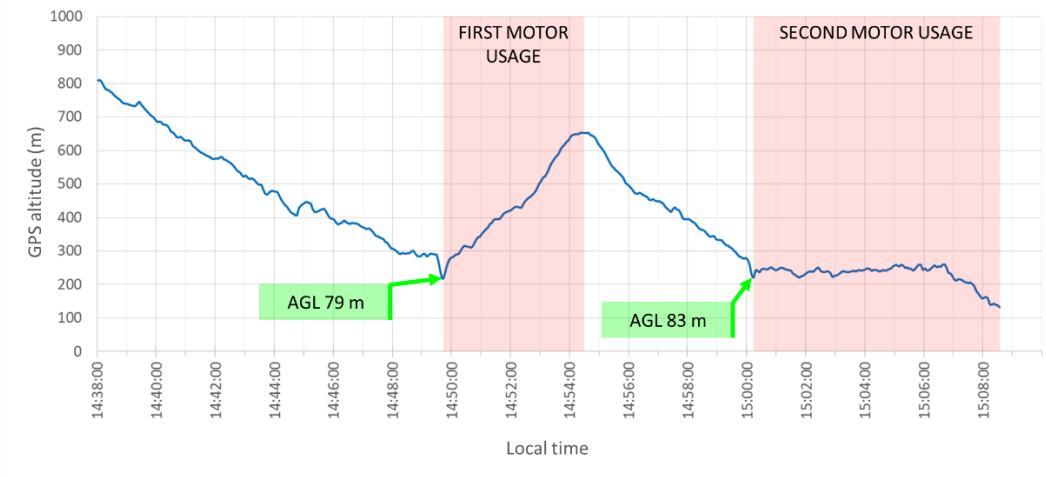


Figure 17: Altitude information for D-KIBT with highlighted motor usage information

While in the AFL engine deployment is not recommended below 300 m AGL, preceding the event the Pilot first deployed the aircraft's engine 3 km north of Harta at 128 m AGL and started climb on engine power from approx. 80 m AGL (*Figure 17*). In 4 minutes after engine start a loss of power occurred, so the Pilot shut down and retracted the engine at 500 m AGL. This altitude would have given him sufficient time and latitude to pick a suitable landing spot, line up and land safely, never having to use the engine again. The Pilot despite opted for continuing gliding northbound. At 17:00, 3 km east of Dunaegyháza at 139 m AGL he extended the engine again and started it up. As he recalls, after a few seconds of normal the engine lost power again. On his limited power the Pilot continued level flight in a northerly direction, maintaining altitudes between 90 and 130 m AGL. 5 minutes later, reaching SE of Apostag, he started spiralling left at 120 m AGL to find lift in a thermal. His efforts to gain altitude were unsuccessful and soon enough he found himself as low as

25 m AGL overhead the accident site (*Figure 18*), in a gruelling situation where safe standard approach for landing was not achievable any more.

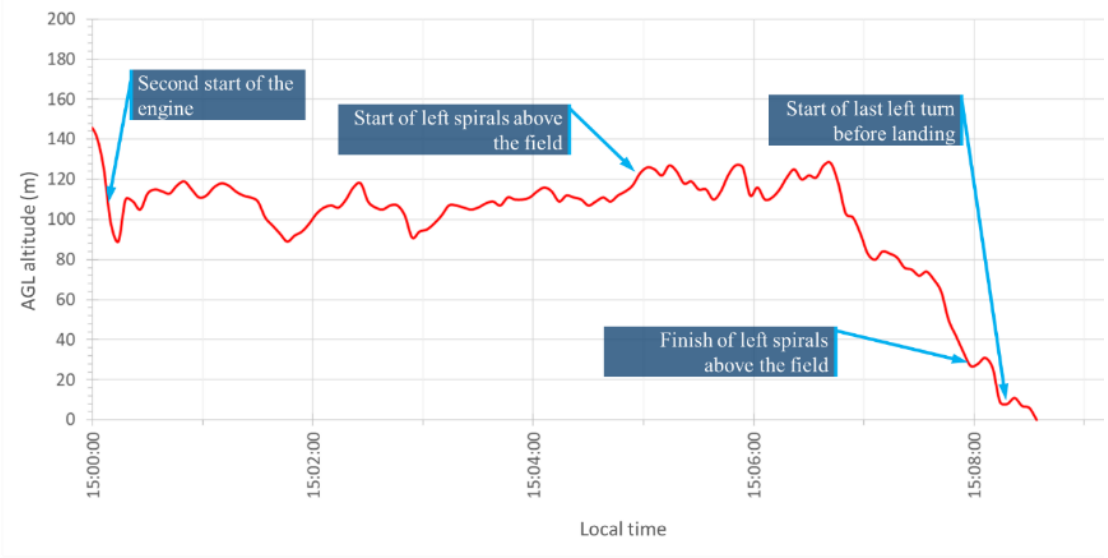


Figure 18: Altitude information for the last 8 minutes of the flight

The investigation failed to disclose the Pilot's reasons for attempting to start his limping engine at very low altitude rather than concentrate on executing a safe landing.

As the Pilot reported to have arrived well rested for the championship event and he did not feel tired having flown for 4 hours, the IC found no reason to expect fatigue as a contributory factor in the chain of events or in the Pilot's decision making process.

Considering the Sun's position along with weather and environmental aspects (detailed in *1.7*), the IC determined that none of these factors could impede the Pilot's visual perception of the harvester or restrain him in his pilot function flying the aircraft.

In his interview the Pilot claimed that landing with deployed engine is prohibited by AFM provisions. In fact, the referenced manual does not contain such restriction. In view of the foregoing, the IC wishes to point out that lack of familiarity with the manufacturer's provisions and neglect in compliance with them will likely result in flawed decisions made by pilots who follow their own ways and make their own rules in aviation. The Pilot trusted his engine and its eventual failure – which he oddly disregarded, trying to start it up again – may have broken his focus and burden him mentally while flying the aircraft. The IC believes that knowledge about AFM provisions concerning approach and landing with deployed engine would have prevented the Pilot from trying to retract it during the final seconds just before landing on a plough field, which was otherwise large enough for the execution of a safe landing. Struggling with engine stowing just a few meters above ground in a turn during the approach, the Pilot was sadly falling behind in his situational awareness when all his mental capacity was required to actively manage the tasks in the landing sequence.

The Pilot's situational awareness was gradually deteriorating in the last 10 minutes before landing to a point where his mental saturation and flawed prioritization pattern resulted in loss of attention and a crash.

3. Conclusions

3.1. Findings

3.1.1. Aircraft

The aircraft was airworthy. (1.6; 2)

There were no indications concerning structural or flight control malfunctions affecting the course of events leading to the accident. (1.16; 2)

The sustainer engine malfunctioned. (1.1; 1.16; 2.1; 2.3)

The aircraft was substantially damaged. (1.3)

The aircraft had a valid Airworthiness Review Certificate. (1.6.2; 1.18.7; 2.2)

Based on its documentation the aircraft was equipped in accordance with relevant regulations and approved procedures, however the IC found deficiencies both in documentation and maintenance. (1.5.1; 1.18.1; 1.18.3; 1.18.4; 2.2; 2.3)

The aircraft logbook was not kept up-to-date and the engine time was not logged and documented in the logbook. (1.18.3; 1.18.4; 2.2; 2.3)

The investigation exposed administration deficiencies in the Airworthiness Review Report. (1.6.2; 1.18.7; 2.2)

3.1.2. Pilot

The Pilot was qualified to fly the aircraft and held valid documents at the time of the accident. He had experience to fly the assigned flight task. (1.5; 1.5.1; 2.3)

He did not have adequate knowledge of the operation of the aircraft concerned. (1.18.4; 1.18.6; 2.2; 2.3)

He was not fully aware of his responsibilities concerning continuing airworthiness. (1.18.4; 1.18.7; 2.2; 2.3)

3.1.3. Operation

The aircraft weight was within prescribed limits. (1.6.5)

The aircraft carried sufficient amount of fuel necessary for the flight. (1.16)

The flight took place in good visibility and in daylight conditions. (1.7)

3.1.4. Data Recorders

Air traffic control and their equipment was not involved. Flight data and voice recorders were not required for this aircraft. The logger used in the aircraft for competition task validation purposes was operational and its recorded data was used during the investigation. (1.11; 2.1; 2.2)

3.1.5. Medical Information

There was no indication of physiological factors or other impediments affecting the Pilot in his flying capacities. (1.13)

3.1.6. Survival Aspects

The Pilot sustained serious injuries from the accident. (1.2; 1.15)

3.2. Causes

As a result of the investigation the IC concluded that the root cause of the accident was the decrease in the Pilot's situational awareness resulting in flawed prioritization and inadequate mental assessment of the situation. (2; 2.3)

In addition to the above, the IC identified the following contributing factors associated with inadequate compliance with rules and regulations.

- Deficient knowledge of the aircraft concerned (AFM) (2.2; 2.3);
- The Pilot's own bespoke ways and adapted set of guidelines (2.3) that allow regular deviation from legal rules and regulations in effect (2.1; 2.2; 2.3).

4. Safety Recommendations

4.1. Actions Taken by the Operator/Authority During the Investigation

The IC of the TSB did not take safety measures in the course of investigation.

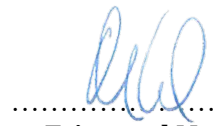
4.2. Interim Safety Recommendation(s)

The IC of the TSB found no grounds to issue a safety recommendation.

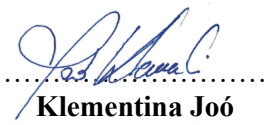
4.3. Concluding Safety Recommendation(s)

The IC of the TSB found no grounds to issue a safety recommendation.

Budapest, 07 March 2022



Zsigmond Nagy
Investigator-in-Charge



Klementina Joó
IC Member