Short summary of the occurrence

The 83-years-old owner of this ultralight aircraft started take-off from the turf strip 20 of Esztergom airfield at 14:41 on 30 November 2020, with the intention to do a local practice flight. After covering a distance of ca. 520 metres, the nose wheel of the aircraft separated from the strut, the aircraft tipped over around its lateral axis and after a few metres of sliding, came to rest on its back. The pilot suffered minor injuries, but the aircraft was substantially damaged.

The Investigating Committee of Transportation Safety Bureau (hereinafter referred to as "IC") identified human factors in flight preparation and subsequent pilot errors in the attempted take-off as causes of the accident.

The IC found no circumstance which would warrant for a safety recommendation, because the accident could have been avoided by observing relevant rules and regulations.

Factual Information

Occurrence category:	Accident			
Date of occurrence:	30 November 2020, 14:42 LT[1]			
Location of occurrence:	Esztergom Airfield (LHEM) (47°45',48 N; 18°43',80 E)			
Type and registration of aircraft:	Pipistrel Virus 912, 35-12 (not in valid registration in Hungary)			
Year of manufacture, serial number:	2011, S/N 408V912			
Type and number of engines:	Single, Rotax 912, S/N 912 67770185			
Validity of liability insurance:	No valid liability insurance			
Purpose of flight:	Non-commercial (private, local)			
People involved in the accident	**Crew**		**Passenger**	**Other**
Number:	1		0	0
Injured:	1, minor injury		-	-
Damage to property:	**Aircraft:** Substantially damaged **3rd party:** No damage			
Licence and ratings of PIC:	No valid rating			
Medical certificate of PIC:	No valid medical certificate			
Age and citizenship of PIC:	83 years old, Hungarian			
Flight experience of PIC:	**Total**	**On the type**	**Last 90 days**	**Last 7 days**
Flying hours:	523	340	9	2
Sources of information:	Reports, on-site investigation and additional site inspection, pilot interview, GPS data, weather data from OMSZ (National Meteorological Service), consultation with the Hungarian representative of Pipistrel, examination of other aircraft of the same model and consultation with their pilots, bench testing of air filters			

[1] *Local Time*

History of the Flight

In the early afternoon of 20 November 2020, the owner of the aircraft set off for a local private VFR[2] flight from Esztergom airfield. In preparation for his flight, rather than obtaining a meteorological forecast he settled for his general observation and personal perception. He pulled the aircraft out of the hangar and performed his routine walk-around checks, finding everything in working order. He started the engine outside the hangar and taxied to runway 20. Without stopping at the holding point he started to accelerate for take-off. According to his account, he felt the acceleration was slower than expected (he cannot recall the exact speed figures because, as he said, he never watches the gauges during take-off). Besides sluggish acceleration, the pilot also perceived the aircraft's reluctance to lift off, so he decided to abort the take-off. As he recalls, he closed the throttle, but finding the aircraft's deceleration insufficient and below expected, he engaged in intensive toe braking. As shown in *Figure 1**Hiba! A hivatkozási forrás nem található.***, his track during the take-off run was characterised by an increasing deviation to the left off the runway centreline. During the first 200-or-so metres, which was less than half of the full take-off run, the deviation angle increased from a few degrees to as much as 12 degrees. At the peak of acceleration the speed of the aircraft, as recorded by the onboard GPS, reached 91 kph or more. Based on the low sampling frequency of the GPS, this value could still be increasing past the last point of sampling before the ground speed actually started to drop. Owing to the hard braking at high speed, the nose wheel sunk in the uneven ground and the bolts at the lower end of the nose strut snapped while the nose wheel fork separated from the assembly. With the bare nose strut burying in the soil, the aircraft tipped over and inverted, came to a skidding halt with its air brakes extended.

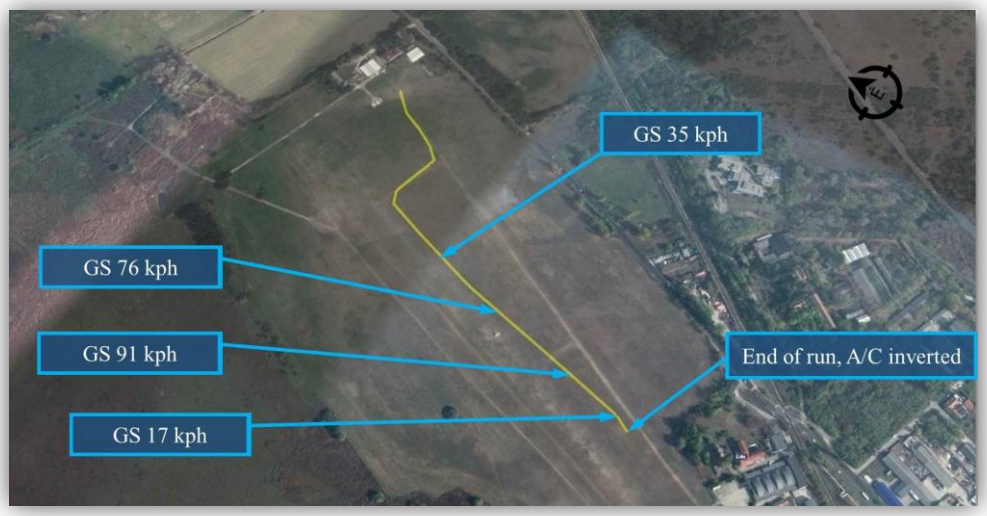


Figure 1. - Acceleration track and speeds as recorded by the on-board GPS (GS: ground speed, 'É' represents North in the compass rose)

The pilot sustained a ca. 10-cm long cut across his scalp.

Location and Wreckage Information

Figure 2. - The aircraft on its back with bent spoilers

While the grass surface of Esztergom airfield's single strip is not ideally smooth, it is suitable for light sport aircraft take-off and landing. The IC inspected the strip surface along the take-off run and found no surface anomalies that alone could cause the aircraft to tip over.

The damage sustained by the aircraft is comprised of separation of the nose wheel, destruction of both propeller blades and the spinner, breach of the nacelle and the hull along the tail section and the fuselage. The damage to the airbrake's spoilers mounted on the upper surface of the wings support that they were in the open position during the impact. With the aircraft tipping over, the airbrakes got caught in the soil and being bent forward during the skid, provided further traction to stop the aircraft (*Figure 2*).

During the investigation of the scene and the additional survey, the IC recorded the following deviations from the procedures listed in the Aircraft Flight Manual: the spring-loaded elevator trim had been set in the full forward posi-

[2] *Visual Flight Rules*

tion; the GRS[3] safety pin, as well as the Pitot tube cover had not been removed. During his interview conducted in the course of the supplementary inspection, the pilot stated that he had replaced the Pitot tube cover right after the accident.

Pilot

The pilot of the aircraft was 83 years old at the time of the event. In April 2010, at the age of 72, he obtained a ULA2 pilot certificate, which entitled him to fly ultralight aircraft (including the aircraft model involved in the event) according to the legislation in effect at that time. Six years later, as part of an alignment process with then-relevant EU legislation, Section 143(1) of the Ministry of National Development (NFM) Decree № 53/2016. (XII. 16.) mandated a specific licence for the aircraft category concerned and granted a grace period of 3 years for the pilots concerned to obtain such licences. As the pilot involved in the accident had failed to obtain a new and valid licence during the 3-year transition period, his right to fly LSA-class aircraft – or in his case, any aircraft –, had ceased as of 16 March 2020.

His Class 2 medical certificate that he obtained along with his original ULA2 pilot certificate on 07 December 2009 expired on 24 November 2010, and had not been renewed ever since.

In his account the pilot stated that on the day of the accident he made all preparations and duties regarding the flight ahead according to his usual routine. He recounts that during these duties he never uses any checklist and does everything by heart, according to his experience and acquired patterns that he had developed over the years. During the interviews, the IC managed to establish that over time this pilot had settled into his own-developed, individual routine, in which he replaced the guidelines set forth in the Flight Manual with his own. This individual routine that he crafted is often in contradiction with the official rules and regulations, especially those concerning the use of trim, propeller pitch settings and tasks relating to the use of the rescue parachute system. This individualist approach of his is also reflected in carrying out maintenance tasks (as discussed in section '*Maintenance'* below).

Aircraft

The accident aircraft is an ultralight shoulder-wing two-seater with a wing span of 12.5 metres. The hull is a carbon fibre/aramid/Kevlar, composite cast, self-supporting shell structure. The undercarriage is non-retractable tricycle-system, the engine is a 73.5 kW Rotax 912 UL engine with a two-blade variable pitch propeller. This agile and versatile ultralight aircraft displays outstanding flight characteristics and a full glass cockpit. The wings' camber can be set in four stages (-5°, 0°, +9° and +20°) by full-length flaperons. Speed and descent rate may be adjusted by airbrakes/spoilers mounted on top of the wings. According to the manufacturer's recommendation, "when the aircraft is not in use, the airbrake handle is recommended to be left hanging freely in an unlocked, unsprung position, in order to minimize the fatigue of the springs of the mechanism". The following chart includes the significant speeds and selected performance parameters.

Mass and quantity data		**Performance data**	
Empty aircraft mass	289 kg	Stall speed (with flaps)	64 kph
Maximum take-off mass (MTOM)	472.5 kg	Stall speed (clean)	79 kph
Fuel capacity	2 x 50 l	Rotation speed (Vr)	60 kph
Maximum allowed fuel mass	76 kg	Take-off run	95 m

Table 1

Examination of the engine

On 08 January 2021, the IC took a supplementary site visit at Esztergom airfield, in the presence of the pilot/owner of the aircraft and the representative of Pipistrel Hungary, with the objective of, among others, identifying the possible cause of the power loss accounted for by the pilot. A subsequent workshop bench testing of the engine's air filters confirmed that the air flow rate of the tested air filters was not essentially lower than the flow rate achieved using OEM[4] air filters, and certainly within limits. The testing process and findings were recorded in a test report. The IC also looked into the possibility of lubrication flaws, which might result from the use on non-OEM aftermarket filter elements, but no such indications have been found.

[3] *Galaxy Rescue System: a rocket-powered emergency parachute system that, in case of a complete loss of control, is capable of bringing the entire aircraft down with minimal damage to the fuselage.*

[4] *Original Equipment Manufacturer*

The manufacturer of Rotax engines issued *Revision 1* of their Service Bulletin № SB-912-063R1 of 4 June 2013, with effect to a range of engines, including the one installed in the accident aircraft. In this revision the manufacturer warranted for a recommended replacement of the engine's fuel pump on account of its revised, 5-year longevity. The recommendations in this bulletin were not observed and the fuel pump was neither replaced in the course of the subsequent five-year periodic maintenance, nor any time afterwards. Theoretically speaking, a compromised fuel pump may intermittently carry a reduced amount of fuel, which might affect engine performance and cause a momentary lapse in RPM, as corroborated by Pipistrel Hungary's representative. The pilot did not experience such an engine stall; he only accounted for insufficient acceleration in general. The engine was running smoothly, and, according to GPS data, he was able to accelerate the aircraft on the ground to speeds higher than necessary for take-off. The IC found no signs of engine malfunction whatsoever.

Legal environment

Pursuant to Subsection 30, Section 2 of the Ministry of National Development (NFM) Decree № 21/2105 (V. 4.) supplemented by Point e) of Annex I to Regulation (EU) 2018/1139) and Subsection (1) Section 12 of Act XCVII of 1995 on air traffic, aircraft (including, among others, the ultralight category concerned) were subject to mandatory registration as of 1 January 2016, from which exemption was granted by National Transport Authority in the form of a 3-year grace period expiring on 1 January 2019. This practically means that the aircraft involved in the event, previously entitled to be flown with an identification marking (as opposed to today's mandatory registration marks) should have been registered by 1 January 2019 in order to maintain legal grounds of operation past this date. As this aircraft was never registered, all operations from 1 January 2019 and onward – including the date of the event – lacked mandated legal basis. A valid registration is also a prerequisite for taking out a liability insurance policy, as well as for maintaining a valid Maintenance Programme (MP) supervised by the authority as required by law. In lack thereof, the required continuous supervision of airworthiness could not be provided.

Aerodrome

Esztergom airfield (LHEM) is a Class IV, privately operated, non-public aerodrome, situated between the river Danube and the western foot of the Visegrád Mountains. Its 1000 by 30 m single grass airstrip is at 111 metres above MSL[5], oriented 02/20. Due to the vicinity of the state border and the adjacent historic city of Esztergom, there are several flight limitations in effect, none of which had any effect on the course of events leading to the accident.

Maintenance

The maintenance log of the aircraft concerned could not be located by the time the Final Report was published. Circumstantial information obtained and facts known to the IC, outline a casual maintenance pattern that can be characterised as more responsive than scheduled in nature. Throughout the years, maintenance actions were carried out on a needs basis by several individuals, including the owner. As a consequence, the manufacturer's required Maintenance Programme was not precisely followed. This general attitude was apparent by the missed replacement of the fuel pump as called for by Rotax in their 2013 service bulletin; the use of modified, oversized automotive parts instead of OEM parts, such as oil filters and air filter elements; and not least, the lack of an up-to-date Maintenance Log – or any, for that matter. A continuous Maintenance Programme, approved and supervised by the relevant authority, is required by law for every aircraft registered in Hungary. The lack of a legitimate Hungarian registration prevented the aircraft under review from having a valid, approved MP.

Weather and visibility conditions

The report issued for the time of the accident by OMSZ (National Meteorological Service) gives account of adequate VFR visibility, very light and variable north, north-easterly winds (360/0.4 m/s, 048/0.3 m/s, which can be regarded as wind calm in practical terms), and skies moderately/heavily obscured by high altitude clouds. Weather conditions were suitable for a local VFR flight as planned.

[5] *Mean Sea Level*

Analysis

For the intended flight, the pilot did not have a valid licence and a valid medical certificate (in fact, the latter had expired over 10 years prior). Generally speaking, practically every licence, rating and certificate to fly and operate the aircraft – including maintenance requirements – had, over the years, expired on the pilot/owner, or was never obtained to begin with. On the day neither his aircraft, nor the pilot had been legal to fly for rather a long time.

During maintenance, the owner used non-OEM replacement parts out of the manufacturer's specifications. Although the discovered modifications did not directly contribute to the accident, these incidentals reflect the owner's general attitude towards maintenance, operation and, by that, the overall prevailing operation culture.

In his account the pilot described his routine activity concerning pre-flight checks and overall preparation before flights as one carried out by heart – based on retained information and years of experience –, without the use of any written checklist, and heavily modified by his own perception and routine procedures he had settled into over the years.

During the pre-flight check, he missed to remove the GRS safety pin, and left the elevator trim in the full forward position, inadequate for take-off. During the on-site investigation the IC found the cover on the Pitot tube. In his subsequent explanation, the pilot stated to have replaced the cover on the Pitot-tube right after the accident. In the IC's view this scenario is not quite realistic and we assume that the removal of the cover before flight may have been missed altogether.

The IC think there is a logical connection between an attitude characterized by broad disregard for relevant rules and regulations, and poor planning combined with haphazard preflight preparations and inadequate flight performance resulting in an accident.

Analysis of flight data recorded by the onboard GPS system revealed the following facts. The total length of the take-off run was 530 metres in total. The aircraft reached VR[6], which is published in FM[7] as 60 kph, in a roll not longer than 190 metres[8]. Shortly after, the airspeed reached 64 kph, a safe minimum lift-off speed, which assures adequate lift to keep the aircraft airborne. Past this point the aircraft continued acceleration and not later than covering 270 metres from the beginning of the take-off roll, the ground speed reached 91 kph[9], which significantly exceeds the published 64 kph stall speed (*refer to Table 1*). Based on the above and considering the fact that the actual take-off mass was about 10% lower than MTOM, it is safe to say that the airspeed associated with adequate lift was readily available as early as covering the first third of the take-off run. Allowing for the low sampling frequency of the track recording, the above calculation can be considered rather conservative.

It appears rather probable that the airbrake handle released for storing – as recommended by the manufacturer – had not been stowed and secured prior to commencing operation that day. The IC studied the airbrake mechanism of several other aircraft of the same model and concluded that chances to inadvertently extend the locked and secured airbrake during tipping the aircraft over are next to zero. In fact, both the prolonged take-off run and the extended position of the airbrakes when the aircraft tipped over – which is a fact – suggest that the pilot had commenced take-off with an unlocked, even partially or fully open airbrakes. According to experience gathered from several pilots flying this model, a similar acceleration profile is characteristic of a take-off run performed with the airbrakes extended.

These pilots confirmed to the IC that they had tried taking off with open airbrakes. Making such a mistake may be attributed to the manufacturer's unconventional recommendation about the airbrakes/spoilers' unlocked position during hangar stowage. The above error can be trapped during the pre-flight checks by the use of a written checklist, which will explicitly call for the locking and securing of airbrakes prior commencing operation.

The full forward position of the elevator trim seems to explain the pilot's perception of a nose-heavy aircraft that is difficult to rotate and will be sluggish to get airborne. The spring-loaded elevator trim in a forward position exerts a forward acting force on the control stick, which might give the pilot the impression of a heavy nose and an aircraft reluctant to break off the ground in response to the usual amount of back pressure on the control stick. Trimming the elevator full forward allowed the aircraft to accelerate, without lifting off, to speeds much higher than usual. This 50

[6] *Rotation Speed – the speed calculated for the lifting off of the nose gear during the take-off run.*

[7] *Flight Manual – the official user's manual published by the manufacturer*

[8] *The GPS track is interpolated using data assigned to sample points recorded in regular intervals by a programmed algorithm. These data include geographical location, speed and height information, and are only available for these intermittent sampling points.*

[9] *Based on the relatively low speeds, the negligible wind speed at the time and the low density altitude of the airstrip, the recorded GPS speed, ground speed and the aircraft's actual airspeed will be considered identical.*

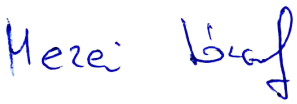
percent higher rolling speed also seems to explain the pilot's impression of insufficient deceleration when he aborted take-off. In addition, the much higher forces on the nose wheel coming from high ground speed and further aggravated by the additional dynamic load from the continuous forward pitching momentum, facilitated the nose wheel to catch and pushed its fork bolts to eventually give.

For reasons reviewed in section '*Aircraft'*, the IC ruled out engine malfunction as a cause of the accident.

Based on the above, the IC has concluded that the immediate root cause of the accident was human error. The actual pilot errors identified break down as follows: an insufficient level of professional awareness that roots from the pilot's cavalier approach toward flight planning, preparation and execution, as well as the established individual routine procedures that the pilot have settled into, replacing standard operation procedures over time. This approach had led to missed or botched check items and the pilot's failure to recognise and trap errors that necessarily followed – this is known as breached situational awareness, accompanied by his failure giving adequate and timely response to errors he identified (task saturation).

The high number of errors may, on the one hand, be attributed to the pilot's advanced age. On the other hand, the fact that he actually owned his aircraft enabled him to escape a number of ways an average pilot is exposed to supervision in a professional working environment. The pilot had certainly been aware of most of the instances he was "bending the rules", but most of these being of administrative nature, he chose to ignore the breaches and went flying anyway – especially in an environment where he was mostly independent of immediate supervision. In the course of long years of unsupervised flying without valid credentials (including a medical that was 10 years overdue), a valid MP and aircraft registration and so on, he had gotten accustomed to being able to go flying with apparently no adverse consequences, which tainted his motivation towards a law-abiding approach in general. In time, this lenient attitude may very well have extended to the actual rules of air and could have resulted in developing his individual set of rules that were quite often in direct contradiction to official rules and regulations. Random examples are the disregard of the manufacturer's specifications in the use of aftermarket, non-OEM parts or the conscious neglect in using written checklists. This complacent attitude can be identified as a secondary factor leading to the accident.

As the accident could have been avoided by observing relevant rules and regulations, the IC has not found grounds to issue a safety recommendation.



József Mezei
Investigator-in-Charge

Ákos Hanczár
IC Member

The sole objective of the safety investigation is to reveal the causes and circumstances of aviation accidents or incidents and to initiate the necessary safety measures, as well as make recommendations in order to prevent similar events in the future. Safety investigations shall not be conducted to apportion blame or liability by any means.

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 as referenced 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 (hereafter referred to as Kbvt.),
- NFM [10] Regulation 70/2015 (XII.1) on safety investigation of aviation accidents and incidents, as well as on detailed investigation for operators,
- Act CL of 2016 on General Public Administration Procedures in absence of contradictory regulation set forth in Kbvt.

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 Hungary shall investigate aviation accidents and serious incidents.
- Transportation Safety Bureau Hungary may investigate aviation and incidents which – in its judgement – could have led to more accidents with more serious consequences in other circumstances.
- Transportation Safety Bureau Hungary is independent of any person or entity which may have interests conflicting with the tasks of the investigating body.
- In addition to the aforementioned legislation, the ICAO Doc 9756 and the ICAO DOC 6920 Manual of Aircraft Accident Investigation also apply.
- This Report shall not be legally binding, nor shall an appeal be lodged against it.

There is no conflict of interest concerning the members of the IC. Persons participating in the safety investigation do not act as experts in other procedures concerning the same case and shall not do so in the future.

The IC shall retain the data and information obtained in the course of safety investigations. Furthermore, the IC shall not disclose for other authorities such data and information, whose holder would have been legally entitled to withhold them.

Copyright Notice

Translation

The present 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 is considered overriding.

[10] Ministry of National Development