Air Accident Investigation Unit (Belgium)
City Atrium
Rue du Progrès 56
1210 Brussels

Safety Investigation Report

ACCIDENT
JMB AIRCRAFT / AVEKO VL3-B
AT VELAINES (CELLES)
ON 8 SEPTEMBER 2015

Ref.:
AAIU-2015-AII-10

Issue date:
17 November 2016

Status:
Final – Revision 1

TABLE OF CONTENTS

FOREWORD

This report is a technical document that reflects the views of the investigation team on the circumstances that led to the accident.

In accordance with Annex 13 of the Convention on International Civil Aviation and EU Regulation 996/2010, it is not the purpose of aircraft accident investigation to apportion blame or liability. The sole objective of the investigation and the Final Report is the determination of the causes, and to define recommendations in order to prevent future accidents and incidents.

In particular, Article 17-3 of the EU regulation EU 996/2010 stipulates that the safety recommendations made in this report do not constitute any suspicion of guilt or responsibility in the accident.

The investigation was conducted by the AAIU(Be).

The report was compiled by Henri Metillon and was published under the authority of the Chief Investigator L. Blendeman.

SYMBOLS AND ABBREVIATIONS

’	Minute
°C	Degrees centigrade
AAIU(Be)	Air Accident Investigation Unit (Belgium)
AccRep	Accredited Representative of a State Investigation Unit
AGL	Above Ground Level
AMSL	Above Mean Sea Level
ATC	Air Traffic Control
BCAA	Belgian Civil Aviation Authority
CAVOK	Ceiling and Visibility OK
CG	Centre of Gravity
E	East
EASA	European Aviation Safety Agency
EBAM	Amougies airfield
EU	European Union
FH	Flight hour(s)
ft	Foot (Feet)
GA	General Aviation
GPS	Global Positioning System
ICAO	International Civil Aviation Organization
LAPL	Light Aircraft Pilot Licence
LH	Left hand
LOC-I	Loss of Control In-flight
m	Metre(s)
MTOW	Maximum Take-off Weight
N	North
PIC	Pilot in Command
PFM	Pilot’s Flight Manual
PPL	Private Pilot Licence
QNH	Pressure setting to indicate elevation above mean sea level
RH	Right hand
RPM	Revolutions per Minute
SN	Serial Number
SSR	Secondary surveillance radar
UTC	Universal Time Coordinated
VFR	Visual Flight Rules

TERMINOLOGY USED IN THIS REPORT

Safety factor: an event or condition that increases safety risk. In other words, it is something that, if it occurred in the future, would increase the likelihood of an occurrence, and/or the severity of the adverse consequences associated with an occurrence.

Contributing safety factor: a safety factor that, had it not occurred or existed at the time of an occurrence, then either:
(a) the occurrence would probably not have occurred; or
(b) the adverse consequences associated with the occurrence would probably not have occurred or have been as serious, or
(c) another contributing safety factor would probably not have occurred or existed.

Other safety factor: a safety factor identified during an occurrence investigation which did not meet the definition of contributing safety factor but was still considered to be important to communicate in an investigation report in the interests of improved transport safety.

Safety issue: a safety factor that
(a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and
(b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operational environment at a specific point in time.

Safety action: the steps taken or proposed to be taken by a person, organisation or agency on its own initiative in response to a safety issue.

Safety recommendation: A proposal by the accident investigation authority in response to a safety issue and based on information derived from the investigation, made with the intention of preventing accidents or incidents. When AAIU(Be) issues a safety recommendation to a person, organization, agency or Regulatory Authority, the person, organization, agency or Regulatory Authority concerned must provide a written response within 90 days. That response must indicate whether the recommendation is accepted, or must state any reasons for not accepting part or all of the recommendation, and must detail any proposed safety action to bring the recommendation into effect.

Safety message: An awareness which brings to attention the existence of a safety factor and the lessons learned. AAIU(Be) can distribute a safety message to a community (of pilots, instructors, examiners, ATC officers), an organization or an industry sector for it to consider a safety factor and take action where it believes it appropriate. There is no requirement for a formal response to a safety message, although AAIU(Be) will publish any response it receives.

AAIU-2015-AII-10

SYNOPSIS

Date and time: 8 September 2015 at about 12:00 UTC[1]

Aircraft: 'JMB Aircraft' (Construction AVEKO) model VL3-B, SN: 007

Accident location: N 50° 41' 13'' - E 003° 30' 39''. In a cultivated field 2,6 km NE of the village of Velaines (Celles). The crash site is located 12,5 km NE of Tournai and 6 km SSE from the Amougies airfield, Belgium.

Aircraft owner[2]: JMB SPRL

Type of flight: General aviation – Local flight

Phase of flight: En route - Manoeuvring

Persons on board: 2

Injuries: 2 fatal

Abstract:

After a navigation flight, the aircraft returned to the EBAV airfield, and flew further on.
Witnesses report seeing the aircraft flying "up and down" before spinning to the ground and crashing.

Occurrence type: Loss of Control–Inflight (LOC–I)

Cause(s):

The cause of the accident is a loss of control during an intentional manoeuvre, ending in a spin. The exact manoeuvre could not be determined with certainty, however it is likely that the pilot was conducting a 'power on' stall exercise or an aerobatic manoeuvre such as a 'zero-G' manoeuvre, a wingover or a lazy eight.

Contributing safety factors:
The decision by an inexperienced pilot to perform non-basic flight manoeuvres without the support of an instructor.

1 Note about the time: For the purpose of this report, time will be indicated in UTC, unless otherwise specified
2 The managers of the 'JMB SPRL' company are the managers of the airfield, of the flight school of Amougies and also of the company 'JMB Aircraft s.r.o.' for the current production of VL3 in the Czech Republic.

Other safety factors identified during the investigation:

- Failure of the shoulder harness.
  Although the failure of the shoulder harness attachment likely did not make a difference to the pilot's chances of survival, the possibility exists that the same failure would reduce the chance of survival in circumstances such as colliding with an obstacle when performing a forced landing at a comparable (rather limited) horizontal speed.
- Misleading placards.
  A placard fixed on the instruments board referred to an emergency parachute, although it was not installed. This could mislead the pilot in case of emergency, causing unnecessary distraction and waste of valuable time if the pilot tries to find an absent recovery parachute handle instead of trying to recover control.
- No stall warning system installed.
  This feature is absent of the vast majority of ultralight aeroplanes, although it could provide essential information to pilots when approaching a stall situation.

1 Factual information.

1.1 History of flight.

Two pilots who were friends, decided to perform a local flight. On 8 September 2015, they booked a VL3-B ultralight aeroplane from their school/club based at the EBAM airfield

The aeroplane took off from EBAM airfield at about 10:43. At 10:44:37, the aeroplane briefly appeared on the radar (Altitude 700 ft). At 10:48:21 it appeared again at 700 ft when climbing eastwards in direction of Geraardsbergen. Subsequently the aeroplane proceeded northward to Gent before coming back to Ronse and thereafter to the airfield of Amougies. Most of this part of the flight was performed at an altitude between 1300 ft and 2000 ft.

At 11:40:17, the aeroplane disappeared from the radar screen when flying at 600 ft in the vicinity of the Amougies airfield. Approximately at that time, witnesses standing on the airfield saw the aeroplane performing 2 or 3 touch-and-go landings before it flew away in a southerly direction, outside their view.

Thereafter, the aeroplane was seen by other witnesses in the vicinity of the village of Velaines, 6 km south of the airfield.
A passer-by stated that he saw the aeroplane over 5 to 10 minutes making several “up and down” manoeuvres.
Just before the accident, another witness saw the aeroplane flying horizontally after which it took a significant climbing attitude. The climb, with power on, lasted a few seconds up to a maximum height. About at that moment, the witness heard a sudden reduction of engine noise and saw the aeroplane falling, spinning around the vertical axis with the wings remaining horizontal. The aeroplane disappeared behind a bunch of trees and the witness further heard a brief noise corresponding to the impact with the ground.
Two other persons witnessed only the end part of the flight. They stated that they saw the aeroplane spinning before hitting the ground. One witness pointed out that the aeroplane, while spinning, took a nose down attitude shortly before hitting the ground on a cultivated field. The two occupants died upon impact.

The accident occurred in a class G uncontrolled airspace extending from the ground to 4500 ft. Witnesses did not make particular comments about the altitude, saying that the aeroplane was not flying particularly high or low.

1.2 Injuries to persons.

Injuries	Crew	Passenger	Others	Total
Fatal	2	0	0	2
Serious	0	0	0	0
Minor	0	0	0	0
None	0	0	0	0
Total	2	0	0	2

1.3 Damage to aircraft.

The aeroplane was destroyed; the fuselage was fractured on both sides near the centre of the wing, the engine compartment was severely damaged.

1.4 Other damage.

There was some minor impact damage to the surface of the cultivated (potato) field. The ground was contaminated by some fuel and engine oil.

1.5 Personnel information.

Both pilots were trained during the same period, in the same flight school by the same instructor and using the same aeroplane type VL3. Both men know each other well and had equivalent experience.

Left seat pilot: 53 years old. Licence (Ultralight aircraft flight authorisation) first issued on 15 April 2015. Licence valid up to 14 November 2015.
Experience: Total flight experience, gained exclusively on VL3 aeroplane: 74:58 FH, from which 36:52 FH as pilot in command. Experience since issuing of the licence: 17:00 FH, gained in 6 months.
Class 4 medical certificate issued on 21 November 2013. Valid up to 14 November 2015.
Radiotelephony privileges. English level 5 valid until 31 January 2021.

Based on different testimonies, the pilot was eager to expand his flying skills, including aerobatic manoeuvres. The owner of another type of ultralight aircraft based at another airfield stated that he flew with the accident pilot one month before the accident. During this flight, the accident pilot (sitting on the right), impressed by the roll characteristics of the aeroplane, requested to make a barrel roll (a corkscrew). The owner, surprised by the proposal and no longer feeling comfortable, denied the request.. After the accident he heard from other sources that the accident pilot was eager to know more about aerobatics.

Right seat pilot: 45 years old. Licence (Ultralight aircraft flight authorisation) first issued on 15 April 2015. Licence valid up to 18 September 2015.
Experience: Total flight experience, gained exclusively on VL3 aeroplane: 87:37 FH, from which 35:50 FH as pilot in command. Experience since issuing of the licence: 13:33 FH, gained in 6 months.
Class 4 medical certificate issued on 9 October 2013. Valid up to 18 September 2015.
Radiotelephony privileges. English level 5 valid until 30 April 2021.

1.6 Aircraft information.

The AVEKO VL3 is a Czech ultralight aeroplane, designed by the engineering company ‘Vanessa Air s.r.o.’ and initially produced by ‘Aveko s.r.o.’ of Brno. The aeroplanes were supplied as complete, ready-to-fly ULM’s.
The ULM features a cantilever low-wing, in a two-seat side-by-side configuration with dual flight controls, fixed or retractable tricycle landing gear and a 4-stroke piston engine in tractor configuration. The aircraft is made of composite materials with an enclosed cockpit.

In 2012, the company 'JMB Aircraft s.r.o.' took over the production that continued in the same facility in the Czech republic. Reportedly, 100 aeroplanes had been produced by 'Aveko' and about 90 were manufactured by 'JMB Aircraft s.r.o.' since 2012 until June 2016.

General characteristics

- Crew: one
- Capacity: one passenger
- Length: 6,20 m
- Wingspan: 8,44 m
- Height: 2,05 m
- Wing area: 9,77 m^2
- Empty weight: 285 kg
- Gross weight: 450 kg (or 472,5 kg if parachute equipped)
- Fuel tanks capacity: 90 or 120 litres
- Power plant: Rotax 912ULS four cylinder, liquid and air-cooled, four stroke aircraft engine, 75 kW (100 hp)
- Maximum speed (IAS): 305 km/h (165 kt)
- Cruising speed (IAS): 250 km/h (135 kt)
- Stall speed (IAS): 53 km/h (29 kt)
- Never exceed speed (IAS): 305 km/h (165 kt)
- Rate of climb: 6 m/s (1200 ft/min)

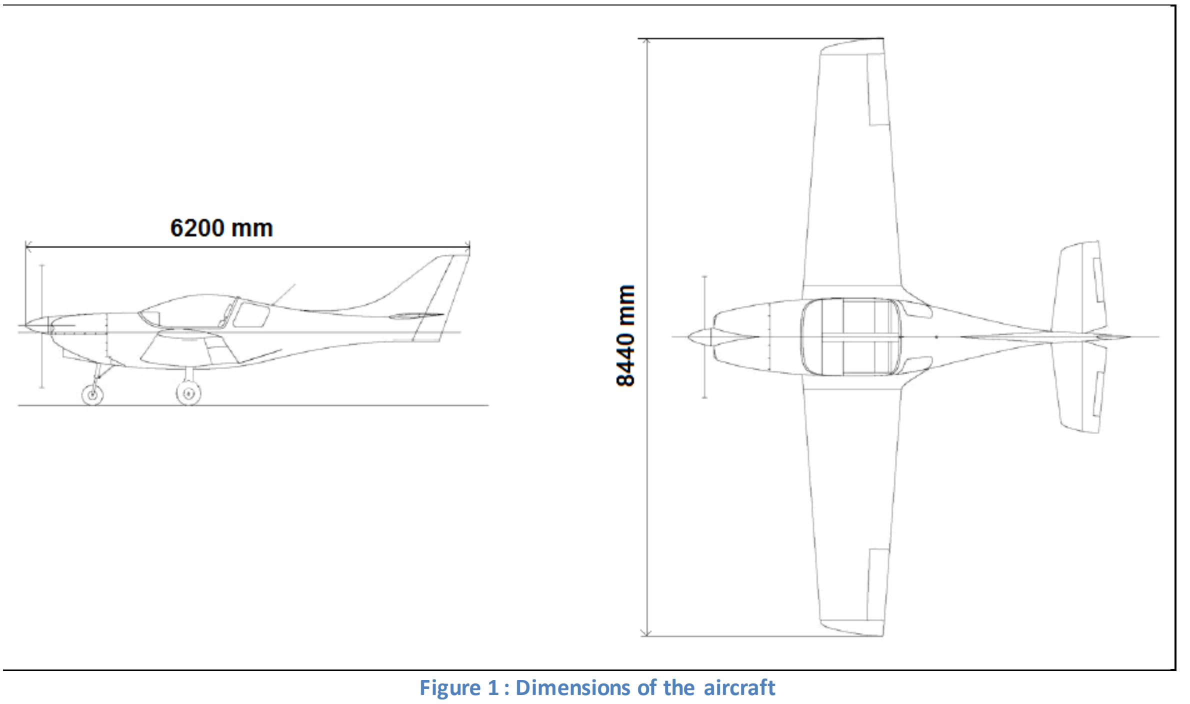

Figure 1 : Dimensions of the aircraft

Approved manoeuvres

The flight manual states in the section 'Limitations', § 2.8 'Approved manoeuvres' that the aeroplane is approved in the normal category. The only manoeuvres allowed are 'Steep turns not exceeding 60° bank'. Moreover, there is a warning note in this chapter stating that "Aerobatics[3], intentional spins and stalls are prohibited"

The section 'Emergency procedures', § 3.7 'Recovery from unintentional spin' states that the aeroplane has no tendency of spontaneous uncontrollable spin entry if normal pilot techniques are used. This chapter provides a recovery procedure should this situation occur. There is also a warning note stating 'Intentional spins are prohibited'.

Characteristics of the accident aeroplane

The accident aeroplane was manufactured by AVEKO s.r.o. in 2006 and was first registered and operated in Czech Republic.
After being cancelled from the Czech register on 24 November 2014 it was registered in Belgium on 30 January 2015. The Belgian registration documents delivered by BCAA show it was identified in Belgium as 'JMB AIRCRAFT' model VL3-B, SN: 007.

Airframe:

○ Manufacturer:	AVEKO s.r.o. (This aircraft was registered as 'JMB Aircraft')
○ Model:	VL3-B
○ Serial number:	007
○ Built year:	2006
○ Certificate of registration:	N° 6735, delivered by the Belgian CAA
○ Permit to flight for ULM:	Delivered by BCAA on 2 February 2015
○ Aeroplane total time:	381:44 FH (= hour meter readings)
○ Empty weight :	282 kg
○ Empty weight C.G. position :	242 mm (19,9 % MAC)
○ Position (arm) of the pilots:	682 mm
○ Position (arm) of the fuel tank:	215 mm
○ Operating C.G. position :	260 mm – 433 mm (21 – 35 % MAC)
○ Fuel tanks capacity:	90 litres

Engine:

○ Manufacturer:	Rotax
○ Type:	912ULS
○ Serial number:	5646398
○ Total time:	381:44 FH (= hour meter readings)

Propeller:

○ Manufacturer:	Peszke
○ Type:	170/1950
○ Serial number:	197/2014
○ Total time:	Unknown

3 "Aerobatic flight" means manoeuvres intentionally performed by an aircraft involving an abrupt change in its attitude, an abnormal attitude, or an abnormal variation in speed, not necessary for normal flight or for instruction for licences or ratings other than aerobatic rating.

Stall speed

The stall speeds for different flaps positions are prescribed in the flight manual.
VL3's are not equipped with a stall warning device.

Stall	Flaps position	Engine Power	Stalling Speed IAS [km/h]	Stalling Speed CAS [km/h]
Wing level stall	RETRACTED	idling	75	82
	"TAKE-OFF"	idling	65	73
	"LANDING"	idling	55	65

Figure 2 : Extract of Flight Manual § 5 « Performance »

Airspeed indicator:

Figure 3 : Accident aeroplane airspeed indicator

- The airspeed is indicated in kilometres per hour (km/h).
- The outer diameter circle starts at 60 km/h up to 210 km/h and then continues on the inner circular arc ending at 400 km/h.
- The white arc starts at 55 km/h (Stall speed in landing configuration, Vso), ending at 120 km/h (Vfe).
- The green arc starts at 75 km/h up to 210 km/h (Max structural cruising speed, Vno).
- The yellow arc extend from 210 km/h up to 305 km/h where a red radial segment indicates the Vne.

The radial segment at 110 km/h was likely installed by an instructor for the purpose of flight instruction. All the other VL3 aeroplanes of the flight school were later verified and the radial segment was removed when necessary.

Fuel on board when the accident occurred

The last full tank refuelling (= 90 l) was performed before the first flight on the day before the accident. That day, another pilot flew two times totalizing 3h02 (Hour meter[4] readings at the end of the day 380h23). From the hour meter readings when the accident occurred (381h44) it can be deducted that:

- The engine ran 1h21 during the accident flight, including the running time before the take-off.
- The total engine running time from the last refuelling to the accident was 4h23.
- Based on an average fuel consumption of about 15 litres per hour, the remaining fuel quantity when the accident occurred would have been about 23 litres (≈16,5 kg).

4 The hour meter is electrically activated through an engine oil pressure switch, meaning it records the engine running time, including the engine warm up and the time necessary for taxying.

- The distribution of this fuel quantity between both fuel tanks could not be determined.

Weight & Balance calculation
The weight and balance had been established on the basis on the following data:
- Empty weight: 282 kg
- Empty weight CG position: 246 mm (19,9 % MAC)
- Total weight of both pilots: 155,5 kg
- Estimated weight of baggage and documents: 2 kg
- Estimated fuel quantity: 23 litres =>16,5 kg

	kgs	Arm (mm)	Moment
Empty weight	282	246	69372
Pilot and copilot	155,5	682	106051
Baggage and documents	2	1467	2934
Fuel (about 23 litres)	16,5	215	3547,5
Total	456	398,9	181904,5
		32,3% MAC	

Figure 4: W&B calculation

Based on the above data, the calculated weight and balance when the accident occurred was determined to be 456 kg, with the C.G. position at 398,9 mm from the wing leading edge (≈32.3% MAC).

Ballistic Recovery System
Although an emergency parachute was not installed, an operating instruction *'To activate parachute, pull handle'* was permanently marked on the instrument panel. When asked about this issue, the person responsible for the current production of VL3 stated that all VL3 produced feature the same marking, regardless of whether an emergency parachute is actually installed or not. However, a very small number of VL3's are not equipped with an emergency parachute.

Flight manual
The aeroplane was provided with a specific Flight manual dated 22 February 2008.

1.7 Meteorological conditions.

Based on the EBCI and EBBR Metar at 11:50 and 12:20: Temperature: 15°/16° C, Dew point: 10° C, Wind direction between 40° and 70°; Velocity 3 to 9 kt, Visibility +10 km and QNH: 1027 hPa.

1.8 Aids to navigation.

A TRIG mode S transponder was installed in the dash board. This transponder had never been encoded to identify the aeroplane. Despite this, the 57 minute long navigation flight from Amougies until back to Amougies could be reconstructed with the support of Belgocontrol.

At about 11:40, meaning approximately 20 minutes before the crash, the aeroplane disappeared from the secondary surveillance radar (SSR) when flying at 600 ft in the vicinity of the airfield. For the remainder of the flight, no radar information was available.

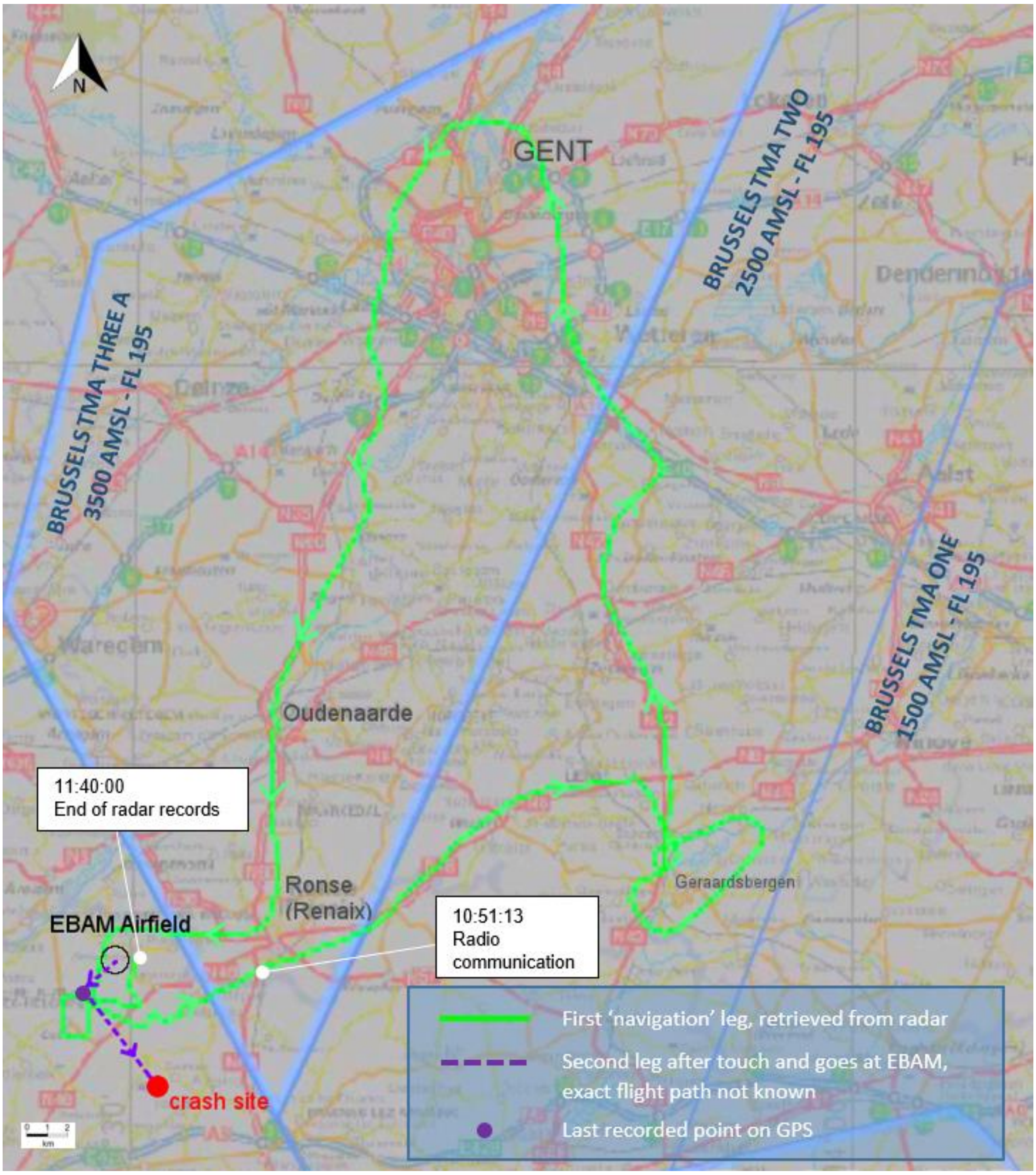

Figure 5 : Approximate navigation flight path

1.9 Communication.

The following radio communication was recorded between the aeroplane and Brussels Information' (FIC) shortly after the take-off when flying south of 'Ronse'. No other radio communication was held with Brussels Information.

Time	Aeroplane	Brussels Information
10:51:13	Brussels information, (Call sign)	
10:51:36	Brussels information, (Call sign)	(Call sign), Brussels information, goeiemiddag
	Goeiemiddag, VFR ****[5] Amougies to Amougies, via Geraardsbergen - Gent. Currently 1500 ft - 7000 under squawk, request Flight Information Service	(call sign), regional 1025, militaries are active and there is no traffic reported in the vicinity
	QNH 1025, (Call sign)	

1.10 Aerodrome information.

The airfield of Amougies EBAM is located N 50°44'22" – E 3°29'10", at 18 km south east of the city of Kortrijk and 16 km north east of Tournai.

The operator is private and the use of the airfield is subject to prior permission from the operator. The aerodrome is provided with basic radio information called 'Amougies Radio' on the frequency 119,750 MHz (Information only, no ATC).

The elevation is 49 ft (15 m) and it is equipped with two 18 m wide 610 m long grass runways oriented 105° / 285° (Runways designation are 11 / 29).

1.11 Flight recorders.

The aeroplane was not equipped with a flight recorder, nor was it a requirement.

A Garmin GPSMAP 695 was installed in the dashboard. This GPS turns ON when both the aeroplane master and avionics switches are switched ON and becomes automatically inoperative after 30 seconds when one of these switches is switched off. However, the pilot can select to feed the GPS from its own battery by operating a power button within the first 30 seconds.

Several flights were recorded under the 'Flight Log', including the flight performed on the day of the accident. However there were no 'track logs', showing details of the flight path.

[5] *** means unintelligible word(s)

On the day of the accident, 2 flights were recorded under the flight log. However, it shows only:

- the start and the end of the navigation flight from and to the airfield (57 minutes and 175.0 km)
- the last part of the flight starting from the airfield and ending 5 minutes later SW of the airfield, not at the place of the crash site. The distance travelled referred to (13.1 km) also does not correspond to the distance between the airfield and the crash site, which is about 6 km.

On the screens, straight black/white dotted lines don't represent the flight paths. This is simply a line linking the start and the end of the flight, representing nothing. The first screen shows the start and the end of the navigation flight, from and to the airfield. The second screen shows the start of the flight from the airfield ending at an undetermined place, which is not the crash site, SSW of the airfield.

When asked about the recording of the track log by the GPS, the owner of the aeroplane stated that it is likely that the record mode was set to 'OFF' a long time before the crash, which explains the lack of flight path data. This was confirmed by the 2 last pilots flying the day before and 2 days before the accident.

1.12 Wreckage and impact information.

When the investigators arrived at the crash site, the victims had already been removed from the wreckage. The rescue services stated they first disconnected the battery cables in order to mitigate the danger of post-crash fire. Subsequently, they cut most wires of the instruments and electrical equipment in order to move the entire dash board upwards to facilitate the recovery of the bodies.

Examination of the damage could determine that the aeroplane was destroyed essentially by a high vertical speed impact combined with a limited forward speed. Notwithstanding the shock, the wreckage did not disintegrate showing few separated parts excluding fragments of the canopy and of the engine cowling, the whole thing found in a circle of less than a 10 m diameter.

The impact left no trace of sliding on the ground, not even on the foliage of potato plants. The wreckage was found pointing NNE. The wings were in horizontal position. Because of the direction of the impact forces and the subsequent damage to the engine mount, the longitudinal axle of the engine was pointing slightly to the left with respect to the fuselage. The underside of the rudder was covered with soil and a corresponding impact with the ground was visible about 30 cm right of the rest position of the rudder. These 2 observations indicate that the fuselage turned further clockwise after the first impact and that the aircraft was in a right-hand spin. See Figure 6: Aerial view.

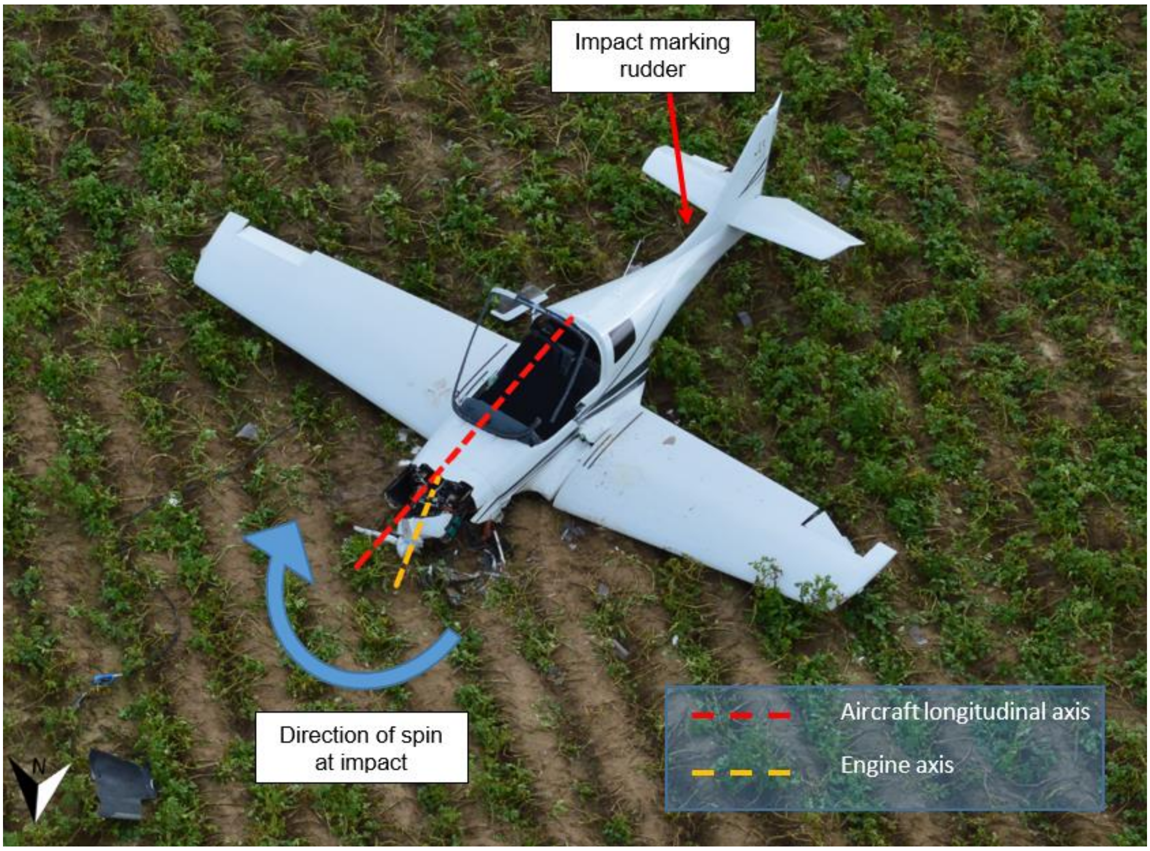

Figure 6: Aerial view

Examination of the fuselage frame at the receptacle of the canopy locking latch showed that the structure was ripped off at this place and that the latch and the handle had struck the roof of the fuselage about 15 cm rear of the frame.

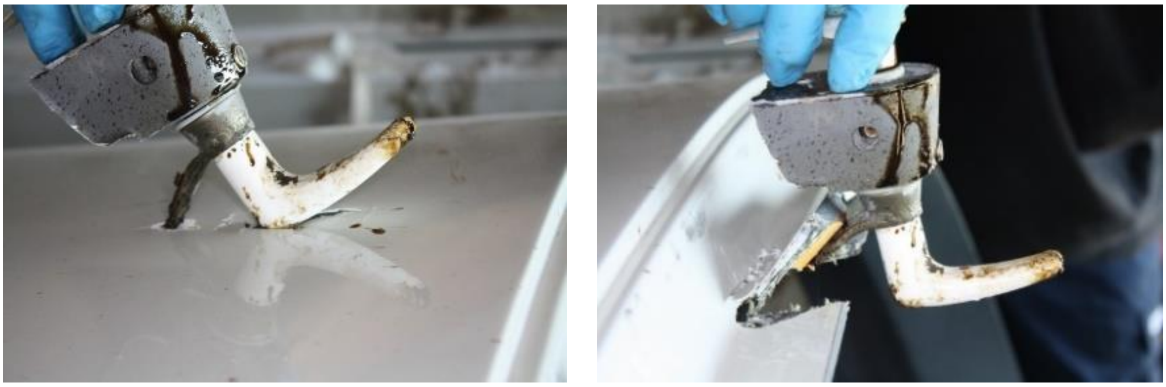

Figure 7: damage caused by the canopy locking latch

The engine cowlings, the underside of the engine and the engine mount were damaged due to the combination of a vertical impact force with a less important horizontal deceleration force.

One blade of the propeller was severed at the root while the 2 other blades were undamaged. The 3 landing gears legs, hidden by the fuselage and the wings lying on the ground, were folded up-and rearwards. The underside front section of the fuselage also showed significant damage, including visible deformation on the front cabin floor. By contrast, no obvious damage was visible aft of the rear cabin bulkhead.

Both fuselage sides show a vertical fracture starting approximately in the middle of the wing roots and ending at the opening of the canopy.

Lifting of the wreckage using a crane in order to facilitate the removal of the wing allowed the compression damage to be seen on the forwards front underside fuselage and also that the fuselage had lost all rigidity due to the both side vertical cracks.

Figure 8 : damage to the underside of the fuselage

Figure 9 : damage to the right side

After the removal of the wings, the observation of both fuselage side fractures showed that the fuselage had almost broken in two parts.

The skin of both wings was fractured in several places including the structural fuel tanks. There was no more fuel in the left wing fuel tank while the right one still contained some fuel and was leaking.

Flight controls:

- Elevator control was found in place and connected.
- Rudder control was found in place but very difficult to move due to the squeezing of the control cables. Later inspection demonstrated that both cables were connected and in good condition, from the rudder pedals to the rudder.
- Ailerons: The LH wing aileron articulations, found broken on the crash site, were examined. The aileron was still connected to the wing by its bellcrank. It was determined that no parts were missing and no trace of abnormal contact between the aileron and the wing structure, possibly caused by an inflight support failure or flutter, could be found. The RH aileron was still attached to the wing and in good condition. Both wing carbon rods connecting the aileron controls system to the fuselage side were found broken at each wing root. All other connections inside the wing structure were verified and found connected.
- The flaps were still attached to their respective wings.

Controls inside the cabin:

- Throttle control position: intermediate position between full and idle
- Fuel selector: left tank selected
- Choke control: full forwards
- Master switch ON
- Avionics switch ON

- Transponder OFF
- Radio ON
- Electrical fuel pump ON
- Navigation Lights ON
- Strobe Lights ON
- Elevator trim: Nose down
- Left pilot stick: undamaged
- Right pilot stick: undamaged excepted top cap removed
- Observation of the flaps lever system could determine that the flaps were in the retract position
- All flight control systems are connected and all damage found was related to the impact forces
- The head of both the ‘Charging’ and the ‘Battery’ automatic circuit breakers were missing from their respective holders

Engine:

- The underside of the engine was damaged by the ground impact.
- Several engine mount tubes were bent causing the nose of the engine to point upward.
- Both carburettors were found disconnected at the rubber connection between the carburettors and the intake pipe.
- Both carburettor float chambers were disassembled on the crash site in order to evaluate the fuel level and possible signs of contamination. Fuel level was normal and no contamination found.
- The fuel nozzles were further removed from both carburettors and were thoroughly examined: no contamination was found.
- The fuel strainer still contained fuel, it was at least ¾ full. Contamination by 2 small insects + other small contaminants were found upstream in the bowl. The filter element successfully played its role.
- All spark plugs were removed showing no anomaly except one spark plug located down in one cylinder head that exhibited carbon deposits likely originating from the combustion chamber. However this deposit on the external ring should not have prevented normal operation.
- The valve covers were removed showing that at least one rocker valve was moving at each of all 4 cylinders when rotating the propeller => the camshaft was properly connected to the crankshaft.
- The exhaust system was examined to verify that there was no obstruction preventing normal exhaust gas exit. No anomaly was found.
- The oil filter was opened in order to verify the presence of possible metallic contamination. No contamination was found.

1.13 Medical and pathological information.

The witnesses rushing to assist the victims stated that both occupants did not gave any sign of life. This was confirmed by the rescue services arriving shortly after. It is therefore almost certain that both occupants died upon impact.

No autopsy was performed. The injuries and their relationship to the impact and restraints are briefly described in 1.15 Survival aspects.

1.14 Fire.

The aeroplane did not catch fire.

1.15 Survival aspects.

When arriving at the crash site, the police and the rescue services found the two occupants still sitting inside the wreckage, secured by their safety belts except that the attachment of the left seat shoulder harness at the structure had been ripped off at the cabin rear bulkhead. The left seat headrest attachment also failed during the accident.

Figure 10: failed shoulder harness and headrest attachment

From the observation of the damage found to the wreckage it can be deducted that the vertical deceleration forces at impact were not survivable. There was no shock absorption provision in the seats to reduce the deceleration forces exerted on the crew and it could not be determined if it might have been helpful. Additionally, the occupants suffered other wounds (severe external haemorrhage) that could not be directly attributed to the vertical deceleration.
The pilot and the passenger wore their ventral safety belt and their shoulder harnesses. There are indications that the right seat occupant, held onto his seat by the shoulder harness, was wounded at the throat by the right hand shoulder harness belt.
The rupture of the pilot's shoulder harness was likely caused by the load exercised by the pilot's upper body inertia, directed forward in relation to a normal flight direction.

1.16 Tests and research.

Not applicable

1.17 Organizational and management information.

Not applicable

1.18 Additional information.

Transponder encoding
Normally, any mode S transponder installed in a Belgian registered aeroplane must be encoded following a unique alphanumeric number allowing the Air Navigation Service to identify the aeroplane (Cfr BCAA Circular Equip-10).
The investigation found that the mode S transponder was not encoded to match with the aeroplane.

Recording of the registration in the GPS
The GPS screen still mentioned the old Czech registration instead of the Belgian registration.

Aeroplane data plate
Similarly, the data plate of the aeroplane still mentioned the old Czech registration instead of the Belgian registration.

1.19 Useful or effective investigation techniques

Not applicable

2 Analysis.

2.1 The wreckage

From the evidence found at the crash site and during the further inspection of the airframe and the engine it may be concluded that the airframe did not suffer any pre-impact damage that could have adversely influenced its controllability. In particular, the following was verified:

- Continuity of all flight control cables, rods, control links and bellcranks from the sticks and pedals to the attachment fittings at the controls. All the parts found damaged or separated during the inspection showed evidence of overload and deformation originating from the impact with the ground.
- No sign of in-flight break-up of the primary structure or controls was found. The left wing aileron that was the only control surface found separated (but still attached to the wing by the control connecting rod) did not show any trace of pre-impact separation.

Examination of the wreckage shows that the fuselage failed in compression causing the vertical ruptures at both sides of the fuselage. The pull-out of the canopy locking latch and its impact with the roof of the fuselage about 15 cm rear of its normal position is also proof that the structure of the cockpit (on which the canopy rests) deformed and bent at impact. This shows a significant temporary deformation of the fuselage at impact after which the cockpit structure recovered almost its normal shape when resting on the ground.

2.2 Shoulder harness attachment rupture

When asked about the structural resistance of the shoulder harness attachment points, the manager of the current production company of the VL3 (JMB Aircraft s.r.o.) stated that the earlier ‘Aveko’ production of VL3, including the accident aeroplane, already complied with the ultralight standards applicable in Czech Republic. However the current ‘JMB Aircraft s.r.o.’ production introduced a structural reinforcement by adding a layer of fiberglass at that place.

According to the current production manager of the VL3, the reinforcement was not retrofitted to the early production of the VL-3 aeroplane because the current production manager did not want to take any responsibility and/or give the impression he was responsible for the airworthiness of the early ‘Aveko’ production.

2.3 The engine stoppage

The damage to the propeller, limited to the spinner and to only one blade, suggests that the engine was stopped before impact. This is supported also by a witness stating that his attention was drawn by a significant engine noise reduction when seeing the aeroplane spinning.

Examination of the wreckage on the crash site and further thorough examination of the engine and the fuel system did not find any anomaly susceptible to explain a possible engine failure.

When asked about possible unintentional Rotax 912 engine shutdown, experienced pilots and engineers stated that this type of engine can brutally stop (almost without wind milling) when the main nozzles of the carburettors suck air instead of fuel. Moreover, the high compression version of the engine (the 100 HP version) is more sensitive to this phenomenon particularly when the airspeed is low. A possible cause of the engine stoppage could be that the aeroplane was temporarily submitted to negative G during the first phase of the loss of control causing the fuel in the carburettor float chambers to move upwards. This could have lead the carburettor main nozzles to suck air instead of fuel.

A second hypothesis could be that the fuel pumps (mechanical and electrical) might have sucked air into the selected fuel tank due to the significant nose up attitude taken by the aeroplane during the (possibly non-coordinated) climb, causing a temporary fuel exhaustion in the carburettors. A contributing factor of this scenario would have been that the 23 litres estimated remaining fuel quantity was not equally shared between both tanks, with possibly less than half the remaining quantity in the selected tank. Under these circumstances, the fuel feeding of the carburettors could have been regained during the spin or shortly after the impact with the action of the electrical fuel pump.

In summary, it is likely that the engine was in good working condition and stopped operating when submitted to the manoeuvre leading to an abnormal position of the fuel inside the carburettors' float chambers and/or in the fuel tanks.

2.4 Weight & Balance

The calculated W&B (456 kg and C.G. position at 398 mm) shows that the aeroplane was 6 kg overloaded (MTOW is 450 kg) but with the C.G. position within the limits.

Knowing that the same aeroplane, when equipped with a parachute accepts 472,5kg with the same operating C.G. position limits, it is unlikely that the slight overload may have played a role in this accident.

2.5 GPS and transponder

GPS Record mode setting
The GPS was recovered from the wreckage in an attempt to download the last flight path. Unfortunately this was not possible because its record mode selected OFF. When asked about the usual setting of the record mode of the GPS, the operator and the pilots flying the 2 last flights stated that the flight path record setting was rarely used.

Turning off the transponder and the GPS
On the one hand, the flight log of the GPS shows that 2 flights were recorded during the fatal flight, the first lasting 57 minutes and the second lasting only 5 minutes. In fact, there was only one flight this day, although interrupted by a few touch and goes at the airfield.
A possibility to explain the presence of 2 flight logs could be that during the navigation flight the pilot made a 'Direct to' order to the Amougies airfield which caused the GPS to view the arrival at the airfield as the end of the flight, automatically shutting off the ongoing log file and starting a new one.

On the other hand, after 57 minutes of flight visible on the radar, the radar could no longer detect the aeroplane (from 11:40 and on) meaning that transponder was switched off or there was no radar contact due to the too low altitude. A low altitude situation preventing the aeroplane being visible by the SSR occurred obviously at the beginning of the flight, before reaching the altitude of 600ft and also in the vicinity of the airfield at the end of the navigation flight when performing touch and goes.

It is thus highly probable that the transponder and the GPS were switched off at the same time, 5 minutes after the starting of the second log file of the day because both equipment were no longer necessary to the pilots intending to fly few kilometres from the airfield in a well-known area. Under these circumstances the 5 minute overtime recorded by the GPS and not by the transponder should correspond to the flight time at low altitude (less than 600 ft) in the vicinity of the airfield when the aeroplane was not visible by the SSR.

2.6 Aerobatics and stall training with ultralights

As a reminder, according to the regulation applicable in Belgium and in the vast majority of other countries ‘Aerobatic flight’ is not allowed with an ultralight aeroplane. Aerobatic is also in most cases not approved by the aeroplanes’ manufacturers and/or designers.

Following ICAO definitions, a stall is not considered as aerobatics, especially if it is conducted for the purpose of flight training. By extension, it would be safe to say that stall exercises performed during a refresher training or even during solo training flights would also not be considered as aerobatics provided it is approved by the aeroplane manufacturer and performed safely. Stall training in a controlled environment will help the pilot to gain, or later to maintain, adequate skill and the ability to recognize stall symptoms early.

Stall exercises are allowed by the Belgian ultralight regulations and by most aeroplanes’ manufacturers and/or designers. As a matter of fact, the ‘Royal Decree’ dated 25 May 1999 requires that a candidate for an ULM licence demonstrates during the skill test for a licence their ability to recognize and to control a straight stall (only for ULM, not for DPM aeroplane). There is no mention in the regulation of other types of stalls as ‘Power on stalls’ and ‘Turning flight stalls’ meaning that they are only allowed if they are authorized by the flight manual.

EASA Part FCL AMC[6] applicable to LAPL and PPL pilot licence (≠ ultralight pilot licence) suggests that during the skill test a candidate performs satisfactory:

- Clean stall and recover with power[7]
- Approach to stall descending turn with bank angle 20°, approach configuration
- Approach to stall in landing configuration

In fact, the ‘clean stall and recover with power’ does approximately correspond to the BCAA ultralight requirement as laid out in the Royal Decree (‘Abattée’ in French and ‘Overtrek’ in Dutch). The 2 other types of stall are difficult to be safely demonstrated and trained when the aeroplane is not equipped with a stall warning. When equipped with a stall warning, the impending stall demonstration stops when the stall warning announces the imminence of the stall.

The flight manual of the VL-3 states that Stalls are prohibited (see 2.8 hereunder)

In summary:

6. Acceptable Means of Compliance and Guidance Material to Commission Regulation (EU) No 1178/2011 of 3 November 2011.
7 ‘Clean’ means the configuration straight ahead and no flaps.

- Stalls aren't considered as aerobatic and are permitted by the BCAA ultralight regulation. However possible limitations as laid out in the flight manual must be adhered to.
- BCAA regulation for ultralight requires the student pilot to demonstrate his ability to perform only one type of stall: the 'Clean stall and recover with power'
- The lack of stall warning in most ultralight aeroplanes makes it difficult to achieve other approaches to stall trainings.
- Stalls are prohibited by the VL3 flight manual, more for a regulatory issue than an actual operational reason.

2.7 Stall training of the accident pilots

During the training for the licence, performed with VL3 aeroplanes, the instructor demonstrated 'power off' straight stalls and gave the student pilots the chance to practice such impending stalls. Interview of the instructor concluded that no 'power-on stall' and no 'turning flight stall' exercises were performed. However, the 'power off' straight stall exercises were sufficient as a preparation for the future skill test.

The examiner who carried out the evaluation of both student pilots for the licence stated that both candidates were very well prepared. Amongst others, both candidates performed a satisfactory 'power off' straight stall during the examination.

About the stall to be conducted during the examination, the examiner stated that he was torn between two contradicting requirements;

- To fulfil the requirement for the candidate to be able to conduct a stall and
- To comply with the flight manual which prohibits stalls.

2.8 Flight manual

About the stalls

When asked about the rationale of the prohibition of stall, the manager of the current production of VL3 stated that aerobatics, stalls (unless they are performed as part of training) and intentional spin are not authorized by the ultralight regulation applicable in the Czech Republic where the VL3 was designed. The stall prohibition found in the flight manual would have its genesis in the ultralight regulation from Czech Republic, outside technical reasons specific to the aircraft design.

The Belgian Circular[8] Airworthiness N°12, requests the flight manual of ultralight aeroplanes to provide limited accurate information about the stall characteristics of the aeroplane;

- The stall speed in various configurations;
- The loss of altitude from the beginning of a straight stall until regaining level flight, and the maximum pitch angle below the horizon;
- The loss of altitude from the beginning of a turning flight stall until regaining level flight.

8 In particular, Annex N°2 to the Circular N°12 sets out a series of piece of information that should be provided in the flight manual. These requirements about the flight manual are based on the British Civil Airworthiness Requirements – Small light Aeroplane (BCAR Section S)

The VL3 flight manual displays the stall speed in various configurations of flaps. However, the other required information regarding the loss of altitude caused by stalls are missing.

As a consequence of the stall prohibtion mentioned in the flight manual, there is an apparent inadequacy using VL3 aeroplanes for initial training and skill tests during which the candidate must demonstrate their ability to recover from a stall.

Useful guidance, limitation and warnings about the stalls are regularly found in flight manual of general aviation aircraft, including of homebuilt design. An example of such information is displayed at the end of this report[9].

About the spin recovery procedure

When asked about the effectiveness of the spin recovery procedure, the manager of the current production of VL3 stated that spin tests were performed by the test pilot of AVEKO before starting the production. These tests resulted in the publication of the recovery procedure displayed in the flight manual. Reportedly, a limited number of experienced pilots also successfully tested the spin recovery technique.

Warning
Intentional spins are prohibited !

Should an inadvertent spin occur, the following recovery procedure should be used:

1. Throttle	-	retard to idle
2. Control stick	-	hold ailerons neutralized
3. Rudder pedals	-	apply full opposite rudder
4. Control stick	-	forward elevator control as required to break the spin
5. Rudder pedals	-	immediately after the stopping of a rotation neutralise the rudder
6. Recover from dive		

Figure 11 : Extract of flight manual chapter 3.7 'Recovery from unintentional spin'

Taking into account that a not properly recovered stall can induce a spin and that a spin, especially if unintentional and unexpected, needs much more altitude than a stall to recover, it is a safe practice to only perform stall exercises at an altitude sufficient to allow recovery from a spin.

In summary, practice stalls should only be performed at a safe altitude, sufficient to recover from a spin and only together with an experienced pilot able to recover from a spin.

9 An example of this information originating from the home built 'Glasair' aeroplane flight manual is enclosed at the end of this report.

2.9 Other accidents with VL3

From 8 major accidents found around the world, 5 were caused by a loss of control ending in a spin. These accidents do not include the accident concerned by the present investigation.

The proportion of fatal accidents caused by losses of control not only with VL3 but also with other high performance ultralight types seeks to show that there is a need to tackle this issue.

2.10 Probable scenario: the loss of control

Impact traces left on the ground as well as the damage to the wreckage, combined with the witness statements leaves no doubt as to the fact the aeroplane entered a spin up to the impact with the ground.

One witness stated he saw the aeroplane making “up and down” manoeuvres a few times in the 5 to 10 minutes before the accident. Repetitive manoeuvres over a certain period of time above the same area made this witness conclude they were intentional. The fact that the electrical fuel pump switch was found ‘ON can also be an indication of the intention of the pilot to perform manoeuvres.

Although this witness didn’t look precisely at the aeroplane when the loss of control occurred, it can be safely assumed that the manoeuvre ending with the loss of control was quite the same as those repeatedly observed.

The only witness who actually saw the end of the controlled flight and the loss of control stated that he saw the aeroplane taking a significant positive angle of climb up to a maximum height before it entered in a spin. The witness recalls also hearing a sudden engine noise reduction, however, he couldn’t remind the sequence of the spin entry and the engine noise change. Additionally, there is an offset between the sound and the sight.

Exercises of engine failure simulation could be disregarded because the witness heard the engine delivering power approximately up to the spin entry.

The VL3 like the majority of modern ultralights is not very noisy meaning that the engine noise is no more perceptible above an estimated altitude of 3000 ft to 4000 ft AGL. This can conclude that the altitude of the aeroplane when the loss of control occurred was likely below 3000 ft, which is compatible with the witnesses’ statements saying that the aeroplane was not flying particularly high or low.

Up and down manoeuvres are more likely to be a sign of ‘power on’ stall exercises, but may also be signs of aerobatics manoeuvres such as a zero-G manoeuvre, a wingover or a lazy eight. These types of exercise bear some similarities beginning with a horizontal flight followed by a power on climb, ending by a pitch down and a loss of height.

AAIU can therefore conclude that the pilot was likely performing ‘power on’ intentional stall exercises or maybe aerobatics manoeuvres when the last one had degenerated into an unintentional spin.

3 Conclusions.

3.1 Findings

- Both pilots were duly qualified and licenced for piloting ultralight aeroplanes.
- The left seat pilot got his ultralight licence 6 months before the accident and had limited experience flying ULMs (17:00 flight hours since the issuing of his licence). He conducted his training for licence on VL3 aeroplane.
- The right seat pilot got also his ultralight licence 6 months before the accident and had a little less experience flying ULMs than the other pilot. (13 flight hours since the issuance of his licence). He also conducted his training for licence on VL3 aeroplane.
- Both pilots possessed a valid class 4 medical certificate.
- There are indications that the left seat pilot wanted to improve his flight skills and showed interest several times in aerobatic manoeuvres.
- The investigation could not determine which of the two pilots were effectively in command at the time of the accident.
- The aeroplane was in an airworthy condition which means properly type accepted, registered and covered by a valid permit to fly.
- Thorough examination of the wreckage did not find any pre-impact anomaly to the structure, the flight controls or the propulsion system. No indications were found in the wreckage showing that the maintenance was not adequately performed.
- The weather conditions were acceptable for a local flight implying a good visibility and light wind.
- The aeroplane first performed a navigation flight ending by a few touch and goes at EBAM airfield before proceeding south of the airfield where it was seen performing what was perceived by witnesses as "aerobatics manoeuvres".
- The GPS 'Flight Track'" showed that the record mode of the flight track was set to off making it impossible to reconstruct the flight by means of the GPS.
- The transponder and the GPS were set to off at the end of the first part of the flight making it impossible to reconstruct the last part of the flight using the radar records.
- The aircraft entered into a spin and hit the ground in a potato field at low airspeed with a high rate of descent.
- The altitude of the aeroplane when the loss of control occurred could not be determined, however it is likely that there was not enough room to recover from a spin especially with a low experienced pilot flying.
- The airframe was extensively damaged. Amongst others, the airframe ruptured at the pilot's shoulder harness attachment at a place where the structure is systematically reinforced in the current JMB production of VL3. No information was released recommending a retrofit of the AVEKO production.
- Stalls with the VL3 aeroplane are prohibited by the flight manual further to the Czech Republic regulation where the aeroplane had been designed, unless it is performed as part of training.
- There is no guidance in the flight manual related to the performance of stalls resulting that in most cases stall exercises are omitted or are not sufficiently achieved during training for licence.
- As stall exercises are requested as part of the ultralight student pilot training and also during the skill test for a licence, there is an theoretical incompatibility using VL3 aeroplane for complete training for a licence and for the skill test.
- Although an emergency parachute was not installed in the aeroplane, an operating instruction suggesting that it was available was permanently marked on the dashboard.

3.2 Causes.

The cause of the accident is a loss of control during an intentional manoeuvre, ending in a spin. The exact manoeuvre could not be determined with certainty, however it is likely that the pilot in command was conducting a 'power on' stall exercise or an aerobatic manoeuvre such as a 'zero-G' manoeuvre, a wingover or a lazy eight.

<u>Contributing safety factors:</u>
The decision by an inexperienced pilot to perform non-basic flight manoeuvres without the support of an instructor.

<u>Other safety factors identified during the investigation:</u>

- Prohibition of stalls and lack of guidance in the Flight manual.
- Although the failure of the shoulder harness attachment likely did not make a difference to the pilot's chances of survival, the possibility exists that the same failure reduces the chances of survival in other circumstances. This could be for example the impact with an obstacle on the ground when performing a forced landing, at a comparable (rather limited) horizontal speed.
- The presence of a marking on the dashboard which can lead the pilot to mistakenly believe that the aeroplane is equipped with an emergency parachute. In case of emergency, this can cause unnecessary distraction and waste of valuable time if the pilot tries to find the lacking emergency parachute handle instead of trying to recover control.
- The lack of stall warning system, in the vast majority of ultralight aeroplanes, can prevent the pilot from realise an approaching stall situation early on.

4 Safety actions and recommendations.

4.1 Safety issue: Prohibition of stalls and lack of guidance in the Flight manual

The VL3 flight manual currently states that “stalls are prohibited”, generating confusion and misunderstanding among student pilots and instructors, with as a consequence that in most cases stall exercises are omitted or are not sufficiently achieved during training.

However, recognizing (approach to) stall conditions and practicing how to recover from it should be included in every student pilot’s training. This is in order to minimize the risk of inadvertent stalls and that stalling leads to a loss of control and ultimately an accident.

According to the current manufacturer ‘JMB Aircraft s.r.o.’, the VL3 had been intensively flight tested by the AVEKO test pilot before the start of the production. These tests concluded that the aeroplane type had an acceptable behaviour when conducting intentional stalls. Therefore:

Recommendation BE-2016-0007:
It is recommended that ‘JMB Aviation sprl’, the Belgian type authorization holder, in collaboration with ‘JMB Aircraft s.r.o’, the current production company and with the engineering company ‘Vanessa Air s.r.o.’ revises the flight manual by removing the prohibition of stalls and at the same time incorporates guidance on how to safely perform stall exercises. This safety information should cover amongst others:
- the conditions (minimum safe altitude, power setting, flap setting, etc)
- the risks (stall with power, inadvertent spin entry,..)
- the recovery actions

4.2 Safety issue: Inadequate marking indicating the presence of a recovery parachute

A minority number of VL3 is not equipped with a recovery parachute, but all instrument panels indicate the presence of this equipment regardless of whether it is installed or not. In case of emergency, this can cause unnecessary distraction and waste of valuable time if the pilot tries to find the lacking emergency parachute handle instead of fighting to recover control.

Recommendation: BE-2016-0008:
It is recommended that ‘JMB Aircraft s.r.o’, the current production company publishes an information bulletin to recommend all VL3 owners and operator to remove the marking about the emergency parachute on the dashboard when no emergency parachute is installed.

4.3 Safety issue: Possible shoulder harness attachment failure reducing the chance of survival in other accident scenarios .

No information was released aiming to reinforce the earlier produced aeroplane (up to SN:100) because the current production manager didn’t want to take any responsibility and/or give the impression he was responsible for the airworthiness of the ‘Aveko’ production.
AAIU(Be) believes that no one can blame the current production manager if he releases information likely to improve safety. Therefore:

Recommendation: BE-2016-0009:
It is recommended that 'JMB Aircraft s.r.o', the current production company publishes an information bulletin to inform the owners of the earlier production of VL3 (up to SN: 100) about the possibility of reinforcing the shoulder harness attachment structure. The information bulletin should include instructions on how to install the reinforcement.

4.4 Safety issue: The lack of a stall warning system in the vast majority of ultralight aeroplanes.

The vast majority of ultralight aeroplanes are not equipped with a stall warning device. This can in some cases prevent the pilot from early detection of an approaching stall situation which can lead to possible inadvertent loss of control.

Recommendation: BE-2016-0010:
It is recommended that the Belgian CAA, in collaboration with the BULMF, conducts research to assess the usefulness of a stall warning system in some categories of ultralight aeroplanes. Thereafter, if the study concludes that a stall warning will help reducing the risk of loss of control, it is recommended that the BCAA requires the installation of such an equipment in the type of ultralight where it had been deemed worthwhile.

5 Appendix

Example of POH warnings about stalls ('Glasair' aeroplane)

WARNING

Intentional spins are prohibited in the Glasair Super IIRG. We strongly recommend that stalls be practiced at least 4000 ft AGL. Be familiar with standard spin recovery procedures in the event of an inadvertent spin entry while practicing stalls.

Remember that an airplane can stall at any airspeed and attitude (high speed stalls) but the recovery is always the same: stick forward and add power. The rudder is effective in keeping the wings level throughout the stall.

Just prior to the stall, a moderate burble or airframe shake, induced by the stall strips at the wing root, will be felt. If the stick is held back, the shake will become more pronounced, followed by the nose dropping. To recover, move the stick forward and apply power. Keep the wings level, if necessary, with the rudder.

WARNING

Do not use the ailerons to keep the wings level in a stall as this will more easily cause a spin entry or aggravate spin recovery.

POWER OFF STALLS

When practicing power off stalls, hold the nose up in a slight climb attitude, gradually bringing the stick back as the speed bleeds off, until the plane begins to stall. Practice power off stalls at each flap setting to get the feel of the stall in each mode from fully retracted to fully extended flaps.

NOTE

If flaps are extended with the gear retracted, the gear warning horn will sound unless an override breaker has been installed in the gear warning circuit and the breaker is opened for practicing stalls.

With flaps applied, the plane feels more stabilized, the stall speed is lowered by a few knots, the actual point of the stall is a little more sudden, and the nose drops slightly lower. Because of the extra drag with the flaps lowered, the stall is more pronounced and there will be less time between the wing root buffet and the nose dropping. The stall with full flaps is still quite gentle and a quick recovery with minimal altitude loss is possible. Release back pressure on the stick, apply full power, stabilize the plane back into a climb and gently ease the flaps off.

POWER ON STALLS

Do not practice these types of stalls lower than 6000 ft AGL. Power on stalls are more pronounced or sudden because of the high angle of attack, but recovery is the same as with power off stalls: stick forward and add power. With power applied, the torque effects of the engine and propeller induce rolling and yawing forces during the stall. For this reason, a wing drop is more likely to occur in a power on stall.

WARNING

Power on stalls can more easily lead to a spin entry. Give yourself plenty of recovery room for safety in the event of an inadvertent spin. As the power is increased above 1800 rpm, a spin becomes more and more likely during power on stalls.

Federal Public Service
Mobility and Transport
Air Accident Investigation Unit

AAIU-2015-AII-10

AAIU-2015-AII-10

Air Accident Investigation Unit -
(Belgium)
City Atrium
Rue du Progrès 56
1210 Brussels

Phone: +32 2 277 44 33
Fax: +32 2 277 42 60

air-acc-investigation@mobilit.fgov.be
www.mobilit.belgium.be