The original of the Final Report was issued in the Slovak language.
In case of inconsistency original version in Slovak language is applicable.

MINISTRY OF TRANSPORT, CONSTRUCTION
AND REGIONAL DEVELOPMENT
OF THE SLOVAK REPUBLIC

Aviation and Maritime Investigation Authority
Námestie slobody 6, P.O.BOX 100
810 05 Bratislava 15

F I N A L R E P O R T

on investigation of accident

of aircraft types **L-410UVP, L-410MA**

Registration numbers: **OM-ODQ, OM-SAB**

Reg. No.: SKA2015005

The investigation of occurrence has been conducted pursuant to Art. 18 of the Act No. 143/1998 on Civil Aviation (Civil Aviation Act) and on Amendment of Certain Acts and in accordance with the Regulation (EU) No. 996/2010 of the European Parliament and of the Council on investigation and prevention of civil aviation accidents and incidents, governing the investigation of civil aviation accidents and incidents.

The final report is issued in accordance with the Regulation L 13 that is the application of the provisions of ANNEX 13 Aircraft Accident and Incident Investigation to the Convention on International Civil Aviation.

The exclusive aim of investigation is to establish causes of accident, incident and to prevent their occurrence, but not to refer to any fault or liability of persons.

This final report, its individual parts or other documents related to the investigation of occurrence in question have an informative character and can only be used as recommendation for the implementation of measures to prevent occurrence of other accidents and incidents with similar causes.

Used abbreviations

ATPL(A)	Airline transport pilot licence (aeroplane)
CPL(A)	Commercial pilot licence (aeroplane)
FI(A)	Flight instructor (aeroplane)
FIC	Flight Information Center
FL	Flight level
IR	Instrument rating
LPS SR, š.p.	Letové prevádzkové služby Slovenskej republiky, štátny podnik
LZDB	Abbreviation in the ICAO code for the airport Slávnica
MEP(L)	Multi engine piston (land)
MTOW	Maximum takeoff weight
QFE	Atmospheric pressure (Q) at Field Elevation
SEP(L)	Single engine piston (land)
TMG	Touring motor glider
TRI(MPA)	Type Rating Instructor (Multi Pilot Aeroplanes)
TRI(SPA)	Type Rating Instructor (Single Pilot Aeroplanes)
UTC	Co-ordinated Universal Time
VFR	Visual Flight Rules

A. INTRODUCTION

Operator / Owner:	DUBNICA AIR, s.r.o.
Type of operation:	airdrops
Types of aircraft:	L-410UVP, L-410MA

Registration number:	OM-ODQ, OM-SAB
Takeoff site:	LZDB
Flight phase:	parachute descent climb
Place of accident:	Červený Kameň
Date and time of accident:	20.08.2015, 07:21

Note: All time data in this report are stated in the UTC time.

B. INFORMATIVE SUMMARY

On 20.08.2015, at 07:13, the pilots of aircraft L-410MA and L-410UVP, registration No.OM-SAB and OM-ODQ, respectively, took off from the airport LZDB for planned descent of 34 parachutists.

The pilots performed the take-off individually, with the aircraft OM-SAB starting first, followed by the aircraft OM-ODQ. After the take-off the aircraft climbed independently up to FL140 (4000 m). During the climbing flight, in altitude of 1300-1400 m, QFE of the airport LZDB, the aircraft approached and came into contact with each other, which caused their damage and unmanoeuvrability. Both aircraft started to rotate and fell to the ground. From the total number of 34 parachutists, 32 succeeded to timely leave the aircraft.

However, one parachutist from aircraft OM-SAB landed on the ground without the main parachute canopy and died on impact. Also both crew members of aircraft OM-SAB were killed by impact with the ground and subsequent fire.

Two parachutists from aircraft OM-ODQ did not leave the aircraft and died on impact of the aircraft with the ground, together with two crew members.

The following commission was appointed for investigation of the accident:

Ing. Zdeno BIELIK	– chairman of the investigation commission
Ing. Juraj GYENES	– member of the investigation commission
Lic. Jaroslava MIČEKOVÁ	– member of the investigation commission
Jaroslav JUSZCZUK	– member of the investigation commission

The report is issued by:
Aviation and Maritime Investigation Authority
of the Ministry of Transport, Construction and Regional Development of the Slovak Republic

C. MAIN PART OF REPORT

1. FACTUAL INFORMATION

2. ANALYSES

3. CONCLUSIONS

4. SAFETY RECOMMENDATIONS

1. FACTUAL INFORMATION

1.1 History of the flight

The aircraft started from the airport LZDB individually at 07:13. They climbed to the airdrop altitude of 4000 m individually, although the flight was performed in a formation from the perspective of the air traffic control, and the communication between the commander of aircraft OM-SAB and FIC was maintained in this spirit.

Just before the collision the commander of OM-SAB communicated with FIC regarding the operation of airborne responder, which did not transmit correct data at that time and the aircraft was not displayed on the monitor of FIC. After activation of the second responder set the flight data started to be displayed on the monitor of FIC correctly.

During solution of the situation with displaying on the radar of aircraft straight climbing to the drop altitude the aircraft OM-ODQ approached the aircraft OM-SAB from behind from the right side to a close formation and both aircraft came into contact in altitude of 1300 -1400 m, at 07:21. Just before the contact the parachutists in aircraft OM-ODQ suddenly felt negative G-load, which lifted them from their seats. Afterwards they felt and heard an impact.

In the contact the right wing of aircraft OM-SAB first damaged the roller door of aircraft OM-ODQ. In the following movement its rear part, in the direction from the door to the tail, got so severely damaged that the tail of the aircraft, together with horizontal and vertical surfaces, came off and the aircraft OM-ODQ became unmanoeuvrable.

In the next contact of aircraft parts the right side of horizontal tail surfaces of aircraft OM-SAB was damaged and the separated tail section of aircraft OM-ODQ then came into contact with the balance aileron of aircraft OM-SAB, which broke off. The aircraft OM-SAB became unmanoeuvrable and started to stall in a complicated rotational movement. In the final phase of the stall it rotated around all three axes and after the impact with the ground it caught fire. Seventeen parachutists from aircraft OM-SAB could leave the aircraft, but one of them landed without main parachute canopy and dies on impact with the ground.

The aircraft OM-ODQ without tail stalled in a flat spin. Fifteen parachutists from aircraft OM-ODQ left the aircraft one by one. Two of them, probably due to injuries suffered on board the aircraft during the action of heavy centrifugal forces, could not jump from the rotating aircraft and died, together with the crew, on impact with the ground.

Daytime: day
Flight rules: VFR

1.2 Injuries to persons

Injury	Crew	Parachutists	Other persons
Fatal	4	3	-
Serious	-	-	-
Minor	-	7	-
None	-	24	-

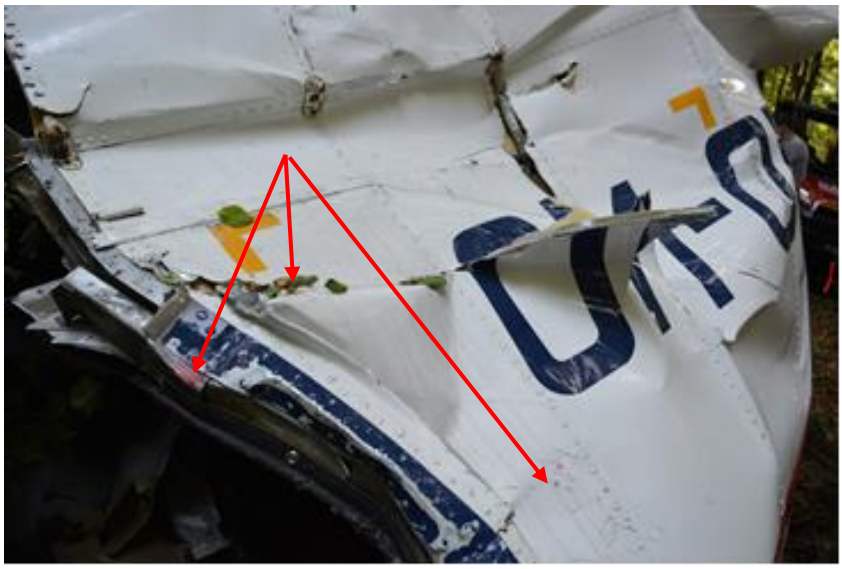
1.3 Damage to aircraft

The aircraft were destroyed in the accident.

Wreckage of aircraft OM-ODQ:

Traces left by aircraft OM-SAB on the separated tail of OM-ODQ

Separated tail of OM-ODQ near the 24th partition



Traces of red colour on OM-ODQ from the wingtip arc of OM-SAB

Wreckage of aircraft OM-SAB:

Balance aileron of the right wing of OM-SAB with traces from black tail leading edge of OM-ODQ

Damaged part of the right horizontal tail surface of OM-SAB from separated tail of OM-ODQ

1.4 **Other damage**

No circumstances with potential claims for compensation of other damage toward a third party were notified to the Aviation and Maritime Investigation Authority.

1.5 **Personnel information**

Crew of OM-SAB

Commander of aircraft

A national of the Slovak Republic, aged of 45 years, holder of the airline transport pilot licence ATPL(A) issued by the Civil Aviation Authority of the Slovak Republic on 5.04.2005.

Medical certificate of 1st class with marked validity until 10.12.2015.

Qualifications:

MEP(L)/IR	with marked validity until 30.11.2015
SEP(L)	with marked validity until 31.01.2016
L-410/IR	with marked validity until 31.03.2016
FI(A)	with marked validity until 28.02.2017
TMG	with marked validity until 30.09.2015
TRI(MPA) L-410	with marked validity until 31.08.2016
TRI(SPA)	
BE90/99/100/200	with marked validity until 31.08.2016
Z137T	with marked validity until 31.08.2015

Flying experience:

Total flight hours	8 404 h 55min / as at 08.08.2015

Co-pilot

A national of the Slovak Republic, aged of 36 years, holder of the commercial pilot licence CPL(A) issued by the Transport Authority of the Slovak Republic on 08.07.2015.

Medical certificate of 1st class with marked validity until 10.03.2016.

Qualifications:

L-410/IR	with marked validity until 31.07.2016
MEPL/IR	with marked validity until 30.04.2016
SEP(L)	with marked validity until 31.08.2017

Flying experience:

Total flight hours	235 h 22 min
of which in 2015	58 h 34 min

Crew of OM-ODQ

Commander of aircraft

A national of the Slovak Republic, aged of 45 years, holder of the airline transport pilot licence ATPL(A) issued by the Civil Aviation Authority of the Slovak Republic on 12.11.2002.

Medical certificate of 1st class with marked validity until 14.01.2016.

Qualifications:

FI(A)	with marked validity until 31.03.2017
L-410/IR	with marked validity until 31.08.2016
SEP(L)/IR	with marked validity until 31.10.2015
TMG	with marked validity until 30.11.2016
TRI(MPA) B737 300-900 FFS only	- with marked validity until 31.01.2018
TRI(SPA) C525	with marked validity until 31.03.2017
B737 300-900/IR	with marked validity until 31.05.2016
MEP(L)	with marked validity until 30.04.2016

Flying experience:

Total flight hours	10 625 h 13 min / k 18.08.2015

Co-pilot

A national of the Slovak Republic, aged of 45 years, holder of the commercial pilot licence CPL(A) issued by the Transport Authority of the Slovak Republic on 19.08.2013.

Medical certificate of 1st class with marked validity until 15.10.2015.

Qualifications:

L-410/IR CP	with marked validity until 31.10.2015
SEP(L)	with marked validity until 31.10.2015
MEPL	with marked validity until 31.10.2015

Flying experience: not determined.

1.6 **Aircraft information**

L-410UVP

Registration number:	**OM-ODQ**
Serial number:	841320
Manufacturer:	LET, a.s. Kunovice, Czech Republic
Total operating hours:	8021 h
Right-hand engine:	WALTER M601 D
Left-hand engine:	WALTER M601 D

The certificate of airworthiness No. 0612, issued by the Transport Authority of SR, date of issue 20.03.2008.

The certificate of airworthiness verification No. 0612/07 was issued on 16.04.2015 with marked validity until 17.04.2016.

Third-party insurance: Association of Underwriters-Lloyd´s Catlin Syndicate 2003 One Lime Street, London EC3M 7HA United Kingdom, valid from 12.03.2015 to 11.12.2016.

Based on the witness statements, results of examination of wreckage and records from aircraft documentation it is obvious that the condition of the aircraft before the accident and during the flight was not the cause of the accident. Both engines indicated normal operation until the moment of the accident.

The report on weight and centre of gravity of the aircraft indicates maximum permissible takeoff weight of 5700 kg.

After adding up individual weights	- basic weight of aircraft	3877.5 kg
	- fuel	320.0 kg
	- weight of crew + parachutists	1631.0 kg
Total weight of aircraft taking off		**5828.5 kg**

Maximum takeoff weight of aircraft was exceeded by 128.5 kg.

L-410MA

Registration No:	**OM-SAB**
Serial No:	750405
Manufacturer:	LET, a.s. Kunovice, Czech Republic
Total operating hours:	5618 h
Right-hand engine:	WALTER M601 D
Left-hand engine:	WALTER M601 D

The certificate of airworthiness verification No. 0675, issued by the Transport Authority of SR, date of issue 27.03.2008.

The certificate of airworthiness verification No. 0675/06 was issued on 16.04.2015 with marked validity until 17.04.2016.

Third-party insurance: Association of Underwriters-Lloyd´s Catlin Syndicate 2003 One Lime Street, London EC3M 7HA United Kingdom valid from 12.03.2015 to 11.12.2016.

Based on the witness statements, results of examination of wreckage and records from aircraft documentation it is obvious that the condition of the aircraft before the accident and during the flight was not the cause of the accident. Both engines indicated normal operation until the moment of the accident.

The report on weight and centre of gravity of the aircraft indicates maximum permissible takeoff weight of 5700 kg.

After adding up individual weights	- basic weight of aircraft	3770.5 kg
	- fuel	310.0 kg
	- weight of crew + parachutists	1768.0 kg
Total weight of aircraft taking off		**5848.5 kg**

Maximum takeoff weight of aircraft was exceeded by 148.5kg.

1.7 Meteorological situation

On 20.08.2015 at 07:00. in the cadastral area of Červený Kameň / airport Slávnica: half-covered sky, 3/8 – 4/8 of the sky was covered with clouds, of which 2/8 Stratocumulus with height of lower base 2000 m, 1/8 – 2/8 Altocumulus with height about 3000 m and 1/8 – 2/8 Cirrus clouds. Near the airport Slávnica, 10 m above ground level, weak north-east wind was blowing with average speed of 2 to 3 m/s and gusts up to 5 m/s. In the cadastral area of commune Červený Kameň (in the valley of Tovarský stream) weak north-west wind with speed of 1 m/s was blowing; in the other forested areas of the valley a dead wind prevailed. The air temperature was about 16°C, relative air humidity was 70%. The horizontal visibility achieved approximately 40 km.

1.8 Aids to navigation

Navigation device GARMIN GPSMAP 695 on board OM-ODQ – the flight recording function of the device was deactivated.

1.9 Communications

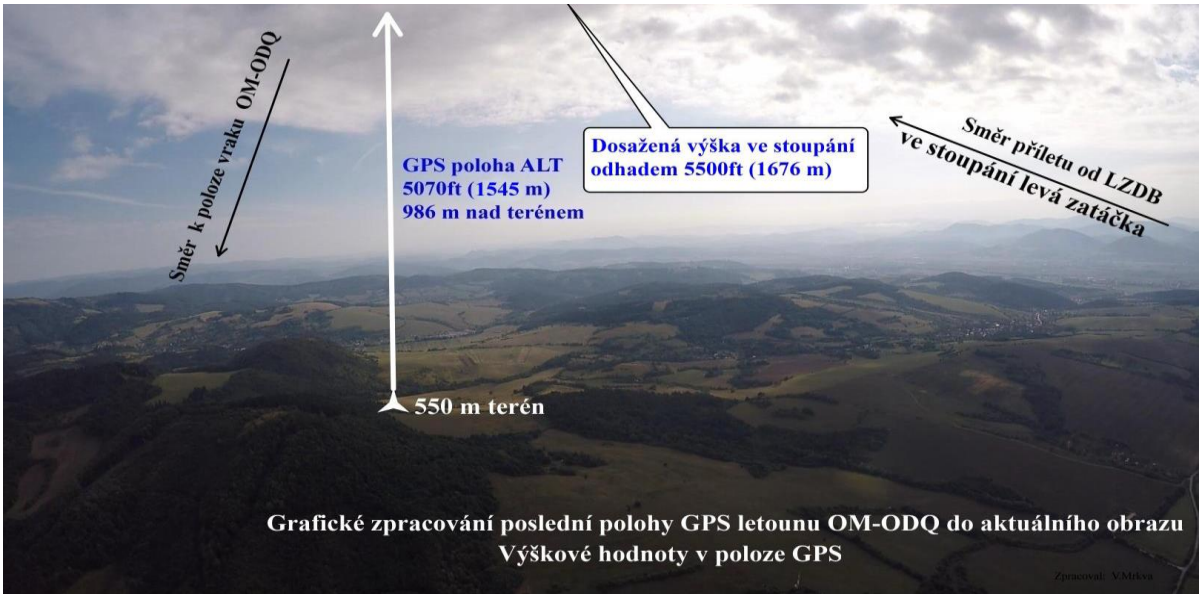
Aircraft were equipped by radio communication equipment allowing two-way radio communication with all air stations at every moment of the flight.

1.10 Aerodrome information

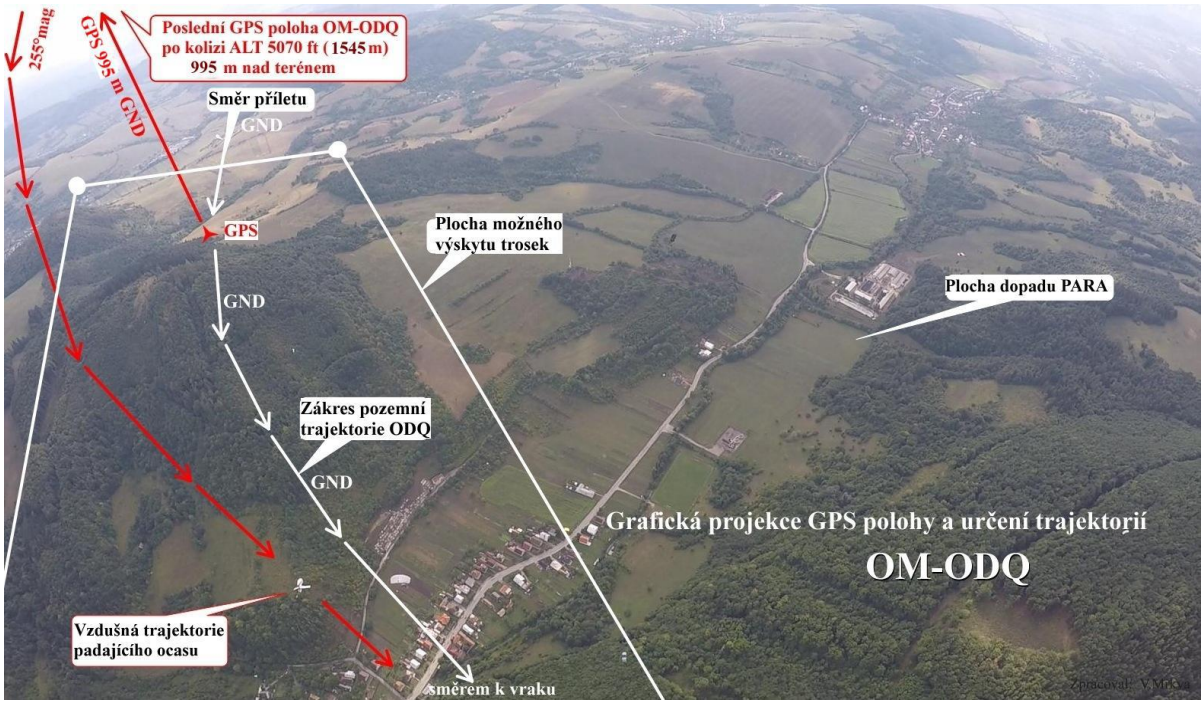
The airport LZDB is a public domestic aerodrome with irregular operation. The grassy runway 05/23 is used for the aircraft operation and was suitable for performance of the critical flight at the time of accident.

1.11 Flight recorders

Data from aircraft OM-ODQ, device GARMIN GP Smap 695, radar records from device LETVIS/LPS and records of communication with aircraft OM-SAB from LPS SR, š.p. were used for the evaluation of the flight.



Graphic representation of directions and trajectory related to the GPS fix in an overall picture of the occurrence



1.12 **Wreckage and impact information**

Coordinates of aircraft – L 410MA, OM-SAB
Cadastral area of commune Červený Kameň, local district Dubie
N 49°05´11,8´´ E 18°10´39,5´´

Coordinates of aircraft – L 410UVP, OM-ODQ
Cadastral area of commune Červený Kameň, local district Chotúč
N 49°04´57,0´´ E 18°11´01,0´´

1.13 **Medical and pathological information**

Pilots

A forensic examination was conducted – assessment of the pilots´ death related to the calculation of impact velocity, evaluation of special biochemical examinations, pilots´ health condition before the accident, detailed analysis of the mechanism of injuries caused by the ground impact of the aircraft.

From the forensic aspect, the pilot died of violent death due to accident causes, injuries to several vital organs and fractures of several bones of the scull, torso and extremities.

Neither the external and internal inspection of a corpse, nor supplementary laboratory examinations of biological materials detected acute or chronic pathological changes, which could negatively influence attention and behaviour of the pilots at the time of accident or contribute to their death.

The examination of biological materials did not detect the presence of etylalcohol, standardly used painkillers, tranquillizers and sleeping drugs (analgesics, ataractics, barbiturates and benzodiazepines), or other psychoactive substances, narcotics and drugs, which could influence the thinking and behaviour of the pilots at the time of accident, or contribute to their death.

Parachutists

The forensic examination revealed that the two parachutists who died in OM-ODQ in the collision of both aircraft under the influence of violent centrifugal forces with changing intensity, had sustained injuries due to the uncoordined violent bumping of their bodies into the fixed parts of the aircraft interior, which made them unconscious. That is why both parachutists did not leave the aircraft with parachutes, but they stayed on board until the collision with the ground, which caused their killing.

None of the killed parachutists was under the influence of alcohol or other or other psychoactive substances, narcotics and drugs at the time of accident.

A forensic autopsy of the parachutist who landed without the main parachute canopy and dies on impact with the ground, was performed. The autopsy revealed that the parachutist had not sustained any severe injury in the aircraft. At the time of accident the parachutist was not under the influence of alcohol or other or other psychoactive substances, narcotics and drugs, which could have influenced his conduct.

1.14 **Fire**

Upon the impact of aircraft OM-SAB fire broke out, which was extinguished after the arrival of the members of the Fire Fighting and Rescue Corps. The fire destroyed a large part of the aircraft.

1.15 **Survival aspects**

After their collision the aircraft landed in a hardly-accessible forested terrain near the commune Červený Kameň in the district of Ilava. Three crews of the helicopter rescue service ATE which are equipped by rescue hoist for use in a hardly-accessible terrain, were sent to the place of accident. All three helicopters operated from the playground in Červený

Kameň. The members of the fire fighting and rescue corps were intervening on the site at that time.

Ambulances of fast medical help were intervening on the site of accident.

After the collision of the aircraft 32 parachutists left the aircrafts with parachutes. One of them was killed when landing without the main parachute canopy.

All persons who did not left the aircraft sustained fatal injuries when falling to the ground.

After the accident the rescued parachutists concentrated at the airport in Slávnica, where they received psychological help.

1.16 Tests and research

The experts examined the parachute equipment (main parachute type SABRE 170, reserve parachute type WP-175, body harness with a pack, device VIGIL II, analog altimeter-barometer SAPPHIRE calibrated to 4000m/360°) of the parachutist who jumped out of the aircraft OM-SAB, fell to the ground without main parachute canopy and died on impact.

The inspection of the harness and the place of impact revealed that the main parachute canopy had been released and landed undamaged 20-25 m away from the body of the parachutist. Its examination did not detect any damage. The parachute steering reins remained locked – they were not pulled out. The jettison gear release of the main parachute was partially pulled out.

The package of reserve parachute was open and the metal manual reserve-parachute release was fully retracted in the pocket, apparently unused. The reserve parachute cords were partially pulled out up to the last eyes, which closed the reserve parachute container with properly packed reserve parachute.

The experts evaluated the record from the automatic rescue/safety device VIGIL II, which serves for automatic opening of the parachute and works in three modes with adjustment of the activation height.

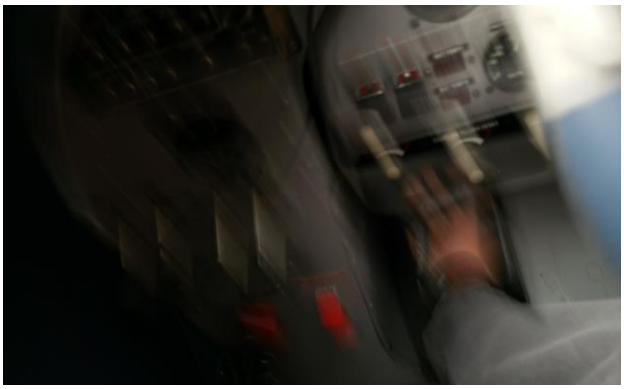
Operating modes:
PRO – activation height: 256 m (840 feet), descent rate: 35 m/s,
STUDENT - activation height: 317 m (1040 feet), descent rate: 20 m/s,
TANDEM - activation height: 622 m (2040 feet), descent rate: 35 m/s.

Shots from the parachutists´ cameras and mobile telephones found on the site of accident were examined. From results of the expertise only shots from the mobile telephone of the commander of aircraft OM-ODQ (Figures 1-5) were conclusive.

Figure 1: Before the take-off, shot at 09:04:56

Figure 2: Close formation approach, shot at 09:20:31

Figure 3: Flight in close formation before collision, shot at 09:20:40



Figures 4-5: Fuzzy pictures, probably after a sudden violent manoeuvre, shot at 09:20:41 and 09:20:43, respectively.

The commission also received the camera recording from the camera operator, who initially was there to record the mass parachute descent. After leaving the aircraft, the camera operator made a recording of the crash of aircraft OM-ODQ, clearly showing the aircraft movement after the loss of the tail.

1.17 Organizational and management information

The flight operation was performed on the occasion of the all-Slovak concentration training of parachutists for training jumps of large formations, followed by a jump for the purpose of breaking the Slovak national record in a free-fall mass parachute descent “33- Way Slovakia 2015“.

The management of the parachute activity was performed in accordance with the Regulation for Performance of Sport Skydiving and Parachute Descents V-PARA-1 by the aeroclub in Dubnica.

The operator DUBNICA AIR, s.r.o. was a holder of valid license for performance of flights No. SK/041 issued by the Civil Aviation Authority of the Slovak Republic.

The flight was performed in accordance with aeronautical standards valid in the territory of the Slovak Republic and with local rules.

1.18 Additional information

According to statements of witnesses from both aircraft the commander of aircraft OM-ODQ was taking photos of the aircraft OM-SAB during flight in a tight formation. During the inspection on the site of accident the inspectors found a mobile telephone of the commander of aircraft OM-ODQ, from which they obtained photographs taken between the take-off and the moment just before the collision of both aircraft.

From the flight instruction it followed that before the flight the commander of aircraft OM-ODQ had decided to change the composition of the crew against the initial plan.

Before the flight there was a communication between the pilots, from which the witnesses understood that the aircraft would keep a distance of 100 m between each other during the flight.

The co-pilot of aircraft OM-ODQ recognised a problem, but he did not venture to oppose his more experienced colleague, who felt to be in a position of higher authority than that which resulted from his function on board. Later he did not attempt to intervene into the steering, which contributed to the rise of a dangerous situation with subsequent collision of aircraft.

1.19 **Useful or effective investigation techniques**

Standard investigation methods were used.

2. ANALYSIS

2.1. **Activity of crew**

Although, according to the witness statements, the pilots had agreed before the flight to keep a distance of 100 m between each other, the commander of aircraft OM-ODQ breached this agreement and took a position in the group, which was inadequate to the accomplished task, in the effort to get to the aircraft OM-SAB as close as possible. The collision was probably caused by the fact that, insteady of paying full attention to steering of the aircraft, the commander of aircraft OM-ODQ had been taking photos of the leading aircraft.

When taking photos the commander held a telephone in the shooting position in his left hand and steered the aircraft by his right hand. At that time the aircraft OM-ODQ was still climbing and approaching OM-SAB from the right side from below, with slight prevalence of forward speed, and probably got too close to the first aircraft with slight elevation. The co-pilot probably did not dare to timely intervene into steering of the aircraft or to warn the commander to avert the imminent threat of collision, maybe due to his exaggerated perception of authority of the aicraft commander.

In the phase of approaching the first aircraft, the manoeuvrability of OM-ODQ was influenced among others by the exceeded MTOW, which caused the higher inertia of the aircraft in maneouvring. After the commander of aircraft OM-ODQ realized that he got dangerously close to the leading aircraft OM-SAB, he quickly push control wheel and banked the aircraft to the right in the effort to increase the distance from the leading aircraft. Afterwards both aircraft came into mutual contact.

In the contact the right wing of aircraft OM-SAB first damaged the roller door of aircraft OM-ODQ in the upper section. In the following movement its rear part, in the direction from the door to the tail, got so severely damaged that the tail of the aircraft, together with horizontal and vertical surfaces, came off in the area of the 24th partition.

The separated tail section of aircraft OM-ODQ then came into contact with the balance aileron of aircraft OM-SAB, which broke off. In the next movement the separated tail damaged the right side of horizontal tail surfaces of aircraft OM-SAB.

Having damaged each other´s control elements, both aircraft stated to rotate and stall. The aircraft OM-ODQ without tail stalled in a flat spin, while the aircraft OM-SAB rotated around all three axes in the final flight phase.

The pilots of both aircrat tried to partially stabilize the stall by changing the engine thrust and adjusting the angle of propeller blades, in order to facilitate the evacuation of the aircraft for the parachutists, but this method was not very efficient due to the massive damage to the control elements of OM-SAB and the loss of tail surfaces of OM-ODQ.

2.2. **Activity of parachutists**

The manoeuvring by the pilot of OM-ODQ before the collision produced negative G-load in the first phase, which lifted the parachutists from their seats up to the ceiling. As the parachutists were did not expect this movement, were not fastened by belts and most of them had not their helmets on, some of them bumped their head or other part of their body against the ceiling or other parts of the aircraft interior. During this manoevre and later sudden rotational movements of both aircrafts the parachutists got bruised by mutual contact or contact with the interior parts mentioned above due to the action of centrifugal forces of different directions and intensities.

As a consequence of the hard blows described above two parachutists in the aircraft OM-ODQ fell unconscious and stayed in the aircraft until its collision with the ground.

The descent of parachutists from both damaged aircraft was very difficult on account of the severe damage caused to both aircraft. It is only thanks to their experiences and composure that the accident had not claimed more victims.

2.3. **Activity of parachutist killed in the accident**

From conclusions of examination of the parachute equipment and forensic autopsy of the killed parachutist is followed that the parachutist probably had not sustain any injury when falling on the floor in the aircraft. However, in the effort to get out of the aircraft, he pulled the jettison gear release of the main parachute out enough to release both cords from the securing reins of the three-ring system.

Moreover, he probably captured the Velcro fastener of the jettison gear release on the back side of the package between parachutes so unfortunately that, in his effort to get to the door and jump out, he did not notice the detached canopy of the main parachute.

After the jump in an altitude of 3000 feet / 914.4 m, 680 m above the point of landing (recorded by the device), he decided to use the main parachute because he had a sufficient height, and had been free-falling for at least 5s, increasing the distance between himself and the stalling aircraft and the other parachutists.

When he dropped away the pull-off parachute of the main parachute, this opened in an altitude of 1800 feet / 549 m, 314 m above the point of impact, but after its release the canopy flew away, because it had been previously detached from the body harness.

Due to the change of the centre of gravity the parachutist fell over his head and his descent rate increased very fast. Due to the lack of time he was unable to open the reserve parachute and fell to the ground at high vertical speed of 220 km/h measured by the device VIGIL ll.

3. C O N C L U S I O N S / CAUSE OF ACCIDENT

3.1 **Findings**

- The pilots had valid qualifications for making the critical flight.
- Before the flight the pilots agreed on the method of performance of the flight and on parameters for the parachute descent.
- On the basis of the autopsy report the aircraft OM-ODQ was steered by its commander.
- The crew of the first aircraft was not informed about the intention of the pilots to fly in a close formation.

- During the investigation the commission did not succeed to document the method and level of training of the aircraft crews in formation flying and to document the operating procedures for flying in formations.
- The aircraft were not equiped by a flight data recorder, therefore the analysis of the flight relies, as regards the flight parameters, on GPS data, witness statements, record from the mobile telephone and traces on the ground after the impact.
- Both aircraft had valid documentation and did not show any fault before the take-off and during the flight.
- Both aircraft fulfilled the conditions of airworthiness before the critical flight.
- Both aircraft performed the take-off with exceeded MTOW.
- The used parachute equipment fulfilled all prescribed technical and legislative requirements.
- The operator DUBNICA AIR, s.r.o. was a holder of valid licence for performance of flights.
- The parachute activity was in accordance with the Regulation for Performance ofSkydiving and Parachute Descents.

3.2 **Cause of accident**

- The main cause of the accident was that the commander of aircraft OM-ODQ had not paid full attention to the steering of the aircraft and had not mastered the flying technique.
- The immediate cause of the accident was the collision of the aircraft.

3.3 **Contributory factors:**

- Handling of a mobile telephone when steering the aircraft;
- Exceeded MTOW of aircraft OM-ODQ;
- Overestimation of own competence by the commander of aircraft OM-ODQ.

4. SAFETY RECOMMENDATIONS

On the basis of investigation of the accident of

Aircraft types **L-410UVP and L-410MA**
Registration No. **OM-ODQ and OM-SAB**
Date of accident: **20.08.2015**

We recommend the implementation of the following measures:

By the Slovak National Aeroclub

- To analyse the results of investigation of the accident with aviation personnel participating in the performance of formation skydiving.

Bratislava, 04.04.2016