ÚZPLN

AIR ACCIDENTS
INVESTIGATION INSTITUTE
Beranových 130
199 01 PRAGUE 99

CZ-20-0419

FINAL REPORT

**Investigation of causes of an accident
of the BB42Z hot-air balloon
registration mark OE-RAP
in the field near the village of Ostřetice (north-eastern part of ATZ LKKT)
on 27 July 2020**

Prague
November 2021

Contents

Abbreviations Used

Ac	Altocumulus
ACC	Air Control Centre
AGL	Above ground level
ATZ	Aerodrome traffic zone
CAMO	Continuing Airworthiness Management Organisation
Cb	Cumulonimbus
Ci	Cirrus
Cs	Cirrostratus
Cu	Cumulus
E	East
FAA	Federal Aviation Administration
FAR	Federal Aviation Requirements
FL	Flight level
FRS	Fire Rescue Service
LKKT	Public domestic airport Klatovy
MLW, MLM	Minimum landing weight
MSL	Mean sea level
N	North
NIL	None
PAR	Paradrop qualification
RADIO	Service providing information about known air traffic
ERS	Emergency Rescue Service
ATCS	Air traffic control service
CEST	Central European Summer Time
SERA	Standardised European Rules of the Air
SSR	Secondary Surveillance Radar
UTC	Coordinated Universal Time
AAII	Air Accidents Investigation Institute
VFR	Visual Flight Rules
VRB	Variable

Used Units

ft	Foot (unit of length – 0,3048 m)
hPa	Hectopascal (unit of atmospheric pressure)
kt	Knot (unit of speed – 1.852 $km.h^{-1}$)
MHz	Megahertz

A) Introduction

Operator:	Natural person
Aircraft manufacturer:	Balóny Kubíček, s.r.o.
Aircraft type:	hot-air balloon BB42Z
Registration mark:	OE-RAP
Location of incident:	in the field near the village of Ostřetice (north-eastern part of ATZ LKKT)
Event date and time:	27 July 2020 at 18:05 UTC (times of witnesses' testimonies are CEST)

B) Synopsis

On 27 July 2020, the AAII was notified of an accident of the BB42Z hot-air balloon in the north-eastern part of ATZ LKKT. The pilot of the balloon (foreign national) was carrying out a parachuting flight as part of an organised parachuting operation at the LKKT. Once the preparation for flight was completed and parachutists instructed, the pilot and five parachutists embarked the balloon basket. At the altitude of approx. 1,800 m AGL, while the balloon was descending, all the parachutists made a jump at the same time as instructed by the pilot. The unloaded balloon started ascending extremely and then the entire envelope collapsed. The balloon became uncontrollable and was free falling to the ground.

The balloon (both the envelope and the basket) was damaged during the critical phase of the flight, which occurred after parachutists had jumped out and the balloon hit hard to the ground. The pilot sustained serious injuries when the basket hit the ground and was transported to hospital. A patrol of the Police of the Czech Republic arrived at the accident scene and documented the balloon's condition and accident site. On the next day, the AAII Commission initiated the investigation of an air accident.

The cause of the accident was investigated by the Commission comprised of:

Investigator-in-charge:	Ing. Josef Bejdák
Commission members:	Ing. Zdeněk Formánek

The Final Report was issued by:

AIR ACCIDENTS INVESTIGATION INSTITUTE
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199 01 PRAGUE 9

On 24 11. 2021

This Final Report consists of the following main parts:

1 Factual Information

1.1.1 Circumstances Preceding the Event Flight

The circumstances preceding the critical flight were described by the pilot and parachutists in their statements.

1.1.1.1 Statement of the pilot

In his testimony about preparation for flight, the pilot said exactly: *"I have been flying with the balloon for three years, and I have performed some 190 flights. I arrived in Klatovy on Friday. I flew with the balloon in Klatovy twice before the flight on Monday night. Balloon inflation and flight preparation were trouble-free. From the technical point of view, the balloon was in good order. I have already dispatched parachutists in the past, last year it was fifteen times. On Monday evening, 27 July 2020, I took five parachutists on board. I briefed them completely, instructed them how to embark the balloon, what to hold on to, what not to touch, and how to stand in the basket. Before they stepped into the balloon basket, I told them to check their harnesses so that they wouldn't become trapped and to look around what to hold on to. I further advised them that I would switch off the burners before the parachute drop and they should jump only at my command and land safely where the conditions were good."*

1.1.1.2 Statements of parachutists

As regards the course of the balloon flight and parachute drop, all the parachutists agreed that prior to entering the balloon basket at LKKT, the balloon pilot explained to them how to embark the basket, what to hold on to, what not to touch, and how to stand in the basket. He also explained to them how to stand on the basket rim before the jump and that he himself would issue the command for all of them to jump at the same time.

1.1.2 Critical flight phase

The critical flight phase was described based on the pilot's, parachutists', and accidental witnesses' testimonies.

In his testimony about the critical part of the flight, the pilot said exactly: *"The flight up to the altitude of 2,200 meters was carried out without any deficiencies. After that, I started descending down to the altitude of approx. 1,800 meters. The parachutists jumped at my command all at the same time. At first, after the jump, the balloon was ascending, but then began descending. The parachute on top of the balloon seemed to be pulled into the balloon and immediately then the envelope deflated. I was trying to set the burners on full flame, but when the envelope deflated fully, I couldn't do anything and just attempted to survive the impact. After crashing into the ground, I crawled out of the basket and some people found me ten minutes later."*

In their testimonies, the parachutists said unanimously: *"The balloon was ascending smoothly from the airport. As there was a parachuting traffic above the airport, the pilot let the balloon fly a little farther away from the airport. When we reached the altitude of 2,200 meters above the ground, the pilot instructed us all to climb onto the basket rim. He then started descending with the balloon and after a while he instructed us to jump out. We all jumped at once. We were free falling after the drop. (Two names) opened their parachutes at 1,500 metres, the others at 1,300 metres. (Two names) landed at the airport, others landed in the field near the crossroads north of Ostřetice. During the jump, we were paying no attention to the balloon and didn't see what happened to it. We learned everything no sooner than at the airport."*

1.1.3 Witness statements

Witness No. 1 was observing the balloon fall from Ostravská street in Klatovy and briefly stated in his testimony: *"I only saw the textile part of the balloon going flat and crashing to the ground at high speed."*

Witness No. 2 was another person at the aeromodelling airport near Bolešiny and said exactly in his testimony: *"I saw a balloon departing from the Klatovy-Chaloupky airport between 19:15 and 19:30. Now and then, I had a look at the balloon and parachutists jumping from a powered aircraft. Last time I noticed the balloon was shortly before 8 p.m., then I had a phonecall. While I was making a call, I overhead somebody shouting that the balloon was falling down. I interrupted the call and turned on my camera to film the fall until the balloon disappeared behind the horizon. Then we called 158 emergency line immediately."*

Fig. 1 – Condition of the envelope at the beginning and at the end of a videofootage lasting 36 seconds, taken by an accidental observer.

Witness No. 3 was observing the flight of the balloon from his place of residence in Mlýnské Struhadlo and, among other things, said in his testimony: *"I noticed a balloon flying towards us from Klatovy, and it was not low. I watched it fly. It was flying smoothly as no wind was blowing here at that time. All of a sudden, from my perspective, the balloon tilted to the left, remained tilted for a few seconds, and then returned to the original state. However, its shape*

was not round any more, it was deformed like a bitten apple. Immediately, the balloon deflated to the shape of a cigar and was slowly falling to the ground. I took my binoculars and continued to watch it. The balloon was falling smoothly, was not swagging, and after a while, it disappeared behind the horizon."

Witness No. 4 observed the balloon from Petrovice and briefly stated in his testimony: *"The balloon was flying from the direction of Klatovy. All of a sudden, it seemed as if tailwind blew to it. The textile part of the balloon was squeezed and deflated. Subsequently, the balloon crashed from the sky to the ground in a few seconds."*

Witness No. 5 observed the balloon from his garden in Ostřetice and, among other things, briefly stated in his testimony: *"I saw a blue balloon flying high from Klatovy – Chaloupky towards Újezdec. I then paid no more attention to it. At about eight p.m., my daughter was shouting that there were parachutists dropping down from the balloon. When I looked towards the balloon, it was already somewhere above the crossroads to Újezdec. I saw three parachutists and a balloon in the sky, but the balloon was deflated and was free falling down to the ground. Parachutists landed on a meadow not far behind the village, at the crossroads to Předslav. The falling balloon disappeared behind the horizon. I immediately jumped in my car and drove to the place of impact of the balloon. I saw the balloon lying in a wheat field, some 100 metres from the road to Petrovičky, near the crossroads to Újezdec. I pulled up my car on the right shoulder and ran to the balloon. I was on the spot some five minutes after I had seen the balloon falling. There have already been two men and one woman by the balloon. The balloon pilot was lying on his back in front of the balloon, at times holding his head and then his belly. Otherwise, he did not move at all. He was conscious and communicated in German. We smelt gas so we moved the part of the balloon that was lying over the frame of the basket and checked the valves on three gas cylinders. One valve was closed and two were partially opened so we closed them. Then we were waiting there for the arrival of an emergency team. First of all, a patrol from the police district department in Klatovy arrived at the spot, and at the same time, three women came to us from the road. One of them must have had a rescue backpack and started treating the pilot. They all spoke German. They gave him a neck collar and a drip feed. Once fire-fighters and the rescue team arrived, I went home."*

1.2 Injuries to Persons

Table 1: Number of injured persons

Injuries	Crew	Passengers	Other persons (inhabitants, etc.)
Fatal	0	0	0
Serious	1	0	0
Light/No injury	0/0	0/5	0/0

The pilot sustained serious injuries when the balloon hit the ground and was transported to hospital. None of the parachutists was injured during the accident.

1.3 Damage to Aircraft

The balloon was damaged during the critical phase of the flight, which occurred after parachutists had jumped out and the balloon hit hard the ground.

1.4 Other Damage

As the balloon was falling, it came into contact with grown wheat. The damage to wheat has not been claimed until this Final Report issuance.

1.5 Personnel Information

1.5.1 Pilot

1.5.1.1 Personal data:

- Male, aged 32 years,
- Valid class 2 medical certificate,
- valid pilot license for free balloons,
- valid licence of the aeronautical mobile service radio operator.

1.5.1.2 Flying experience

The pilot obtained his pilot license for free balloons on 13 March 2017. According to the records in the flight logbook, the pilot flew a total of 148 h 07 min on all types of balloons and performed 183 take-offs. In 2020, he flew approx. 22 hours with the balloon in question.

1.5.2 Parachutists

Five experienced parachutists of C class or higher made a jump from the balloon. Three of them made a jump from a balloon for the first time. The Police of the Czech Republic weighed the parachutists, including their parachutes and equipment. Weighing protocol was compiled and signed by the parachutists.

1.6 Aircraft Information

1.6.1 General specifications of the balloon

The BB42Z balloon is an aircraft consisting of an envelope with a volume of 4,200 m^3, burners, fuel bottles, and a basket with a capacity of 7 persons (1 pilot and 6 passengers). It is authorised by the European Union Aviation Safety Agency in compliance with FAR Part 31.

1.6.2 General Characteristics

1.6.2.1 Balloon envelope

- Material: polyester
- Volume: 4,200 m^3
- Height: 21 m
- Balloon equator diameter: 20 m
- Envelope weight: 167 kg
- Parachute valve type: Smart Vent

1.6.3 Operation of the damaged balloon

On 11 October 2017, the balloon was sold to the current owner and operator. On 14 February 2018, it was recorded in the Register of Österreichischer Aero Club-FAA under the OE-RAP registration mark, and on 6 April 2018, Austro Control GmbH issued a certificate of airworthiness. For the whole period of operation, the balloon condition was annually reviewed. On 25 January 2020, an annual inspection was performed, when 274 h 48 min

had been flown. The date of the last full review was 10 July 2020, when 298 h 25 min had been flown. The balloon configuration was normal, the balloon was in good condition and duly maintained.

- Balloon envelope type: BB42Z
- Registration mark: OE-RAP
- Manufacturer: Balóny Kubíček spol. s r.o.
- Serial number: 771
- Year of manufacture: 06/2010
- Maximum take-off weight: 1,410 kg
- Minimum landing weight: 630 kg
- Carrying capacity of the balloon basket 980 kg
- Hours flown: 299 hrs 55 min (as at 12 July 2020)
- Total number of take-offs: 183 (as at 12 July 2020)
- Liability insurance: valid
- Certificate of airworthiness inspection: valid

1.6.3.1 Balloon basket

- Type: Cameron 120
- Serial number: BH-434
- Material: wood, rattan, leather
- Width: 125 cm
- Length: 180 cm
- Weight: 105 kg
- Carrying capacity: 980 kg
- Maximum number of persons: Pilot + 6

1.6.3.2 Fuel bottles and burners

- Fuel bottles – number/type/material: 2/Cameron/stainless steel
- Fuel bottles – number/type/material: 1/Worthington/aluminium
- Empty/full weight: 58,5 kg / 188 kg
- Burners – type/weight: Cameron MK 4 double/26 kg

1.6.4 Determination of the maximum carrying capacity of the balloon

The maximum permissible carrying capacity of the balloon depends on the volume of the envelope, the altitude of the flight, and the surrounding air temperature. When determining the maximum carrying capacity of the balloon, the calculation was done in accordance with the Flight Manual and using the Carrying Capacity Chart and Table. The benchmark conditions for determining the maximum carrying capacity of the balloon included the planned flight altitude of 2,600 m MSL and the calculated temperature of 15.9 °C. For such conditions, the total permissible carrying capacity is 893 kg.

1.6.3.3 Calculation of the pre-flight weight of the balloon

Table 2: Calculation of the total pre-flight weight of the balloon

Balloon envelope weight	167 kg
Balloon basket weight	105 kg
Pilot's weight	85 kg
Parachutists' weight	440 kg
Weight of burners and hoses	26 kg
Weight of fuel bottles and fuel	188 kg
Equipment weight	10 kg
Total pre-flight weight of the balloon	1,021 kg
Total permissible carrying capacity of the balloon was exceeded by (1,021–893 kg)	128 kg

Under the given conditions, the permissible carrying capacity of the balloon was exceeded by 128 kg.

1.6.3.4 Calculation of the minimum weight of the hot-air balloon

According to the Flight Manual, the minimum landing weight of the balloon was 630 kg.

Table 3: Calculation of the total landing weight of the balloon

Balloon envelope weight	167 kg
Balloon basket weight	105 kg
Pilot's weight	85 kg
Parachutists' weight	0 kg
Weight of burners and hoses	26 kg
Weight of fuel bottles and fuel	118 kg
Equipment weight	10 kg
Total landing weight of the balloon	511 kg
The minimum landing weight of the balloon was not observed by (630–511 kg)	119 kg

The minimum landing weight of the balloon was not observed by 119 kg.

1.7 Meteorological Information

The analysis of the meteorological situation at 18:00 is based on an expert estimate of probable weather at the place of air accident made by the CHMI for the day of 27 July 2020.

1.7.1 General Weather Information

The situation:	The weather over the territory of the Czech Republic was under the influence of a high-pressure area, and warm air started blowing into the Czech Republic from west to south-west.
Ground wind:	variable up to 3 kt, south-western 4–6 kt in the western part of the territory
Upper wind:	2,000 ft MSL VRB/8 kt, 5,000 ft MSL VRB/8 kt
Visibility:	over 10 km
Weather:	no precipitation during the day, scattered clouds to cloudy with occasional showers or thunderstorms

Cloudiness:	Development of convective clouds – unsteady convective stratification, convection limited by warm advection and low humidity in the middle layer, condensation level initially at FL 50, later at FL 70, upper convection level at FL 140
Turbulence:	NIL
Ice:	FL 120 – FL 130

1.7.2 Radar and satellite images

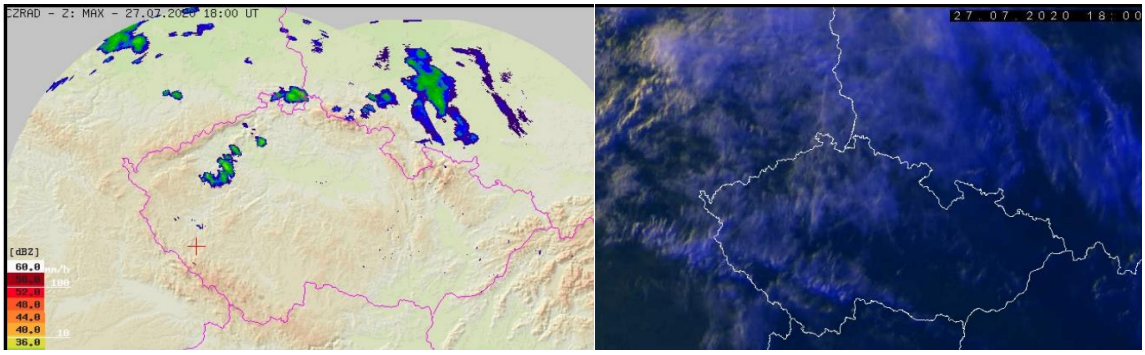


Fig. 2 – Radar and satellite images dated 27 July 2020. The red cross denotes the location of Klatovy.

1.7.3 Records from the automatic weather station in Klatovy

Fig. 3 – Snapshot from Klatovy webcam

In the area of balloon accident, some 3.5 km north-east from LKKT, at 18:00 UTC, mostly western to south-western wind was blowing at the speed of 2–3 $m \cdot s^{-1}$ and 4 $m \cdot s^{-1}$ at higher altitudes. Visibility was over 10 km (70 km observed at synoptic stations). There were no dangerous weather phenomena. The weather forecast for 18:00 UTC included no unfavourable conditions for ground wind or convection for balloon flying with convective cloud base at about 3 km. There were no clouds of Cu and Cb type, only middle-level Ac clouds and high-level Ci and Cs clouds. The measured temperature was about 25°C, later 23°C. Turbulence was not forecast.

1.8 Radio Navigational and Visual Aids

Visual aids at the LKKT corresponded to the airport category in line with L-14.

1.9 Communications

On the day of the air accident, the RADIO service at the LKKT was activated in compliance with the VFR Manual Czech Republic issued by the Flight Information Service of ŘLP ČR, s.p. The balloon pilot was communicating with the LKKT RADIO station on 122.210 MHz frequency.

1.10 Airport Information

The Klatovy airport is a public domestic airport. The airport reference point is located at the altitude of 396 m (1,299 ft). Its operability is VFR day/night. Parachuting activities are permitted. During parachuting operations, the data for known operations were provided on the frequency of 122.210 MHz KLATOVY RADIO.

1.11 Flight Recorders and Other Means of Recording

No logger, the record of which might be used in the flight analysis, was installed in the balloon.

The ACC summary display records did not show any indication of the position of the balloon concerned at the given place at that time. The balloon was not equipped with SSR transponder.

1.12 Wreckage and Impact Information

1.12.1 Wreckage and Impact Inspection

The balloon fell down on the field approx. 3.5 km north-east from the LKKT reference point. The place of accident was located in a wheat field about 100 m north of the road leading from Ostřetice to Petrovičky, approx. 300 m behind the crossroads to Újezdec in the direction of Petrovičky. For a precise location of the air accident see the below table.

Table 4: Place of balloon's impact

Geographical coordinates:	N 49°25´56.50´´
	E 013°22´12.32´´
Altitude:	451 m

Fig. 4 – Balloon at the place of the accident

1.12.2 Hot-air balloon inspection

1.12.2.1 Inspection at the accident site

The balloon was inspected at the accident site by a patrol of the Police of the Czech Republic. At the accident site, the basket of the balloon was found standing upright in a wheat field at the impact site, with no signs of damage. A portable radio transceiver, turned off at this time, and the pilot's black backpack were located near the basket. The fuel bottles attached to the basket on the inside were undamaged and their taps were closed. The metal structure above the basket holding the burners was partially damaged. The burners and half of the structure with the basket were covered by the balloon envelope which was spread in the direction from the nearby road down a gentle slope towards the village of Měcholupy. Upon superficial inspection of the balloon envelope no damage was found. When the envelope material was removed from the burners, they were inspected, and no damage was found on them. During the packing of the envelope, the parachute valve with the flap at the top of the balloon were inspected and the cords were found tangled. The balloon envelope was placed in the balloon basket and, together with the pilot's backpack and radio, was transported to Klatovy Airport to the hangar of Aircraft Service spol. s r.o.

1.12.2.2 Inspection at the place of storage

The Commission carried out an inspection of the balloon at the place of storage in the hangar at LKKT.

A total of 5 panels near the parachute valve were damaged, 2 of which sustained extensive and serious damage. There were 7 burnt panels near the mouth. The red-and-white parachute valve control line had spontaneously released and was pulled high into the mouth of the envelope, where the anchor mechanism of the line lug became jammed in the pulley mechanism. This control line became entangled in the centring lines at the parachute valve anchorage area. The inner frame rigging of the burner was significantly deformed in the downward direction at the burner attachment point. All of the hitching fixtures on the sides

of the basket were damaged and items stored inside were thrown onto the basket floor. The wooden flooring was cracked in two places in the middle and also in the area under the fuel bottles.

Fig. 5 – The control lines, straps, and centring lines condition during the inspection of the hot-air balloon

1.13 Medical and Pathological Information

The operating patrol of the Police of the Czech Republic did not perform an indicative breath test for the presence of alcohol on the site due to the pilot's medical condition. The pilot suffered a severe spinal injury in the balloon crash. An alcohol test was performed on a sample of the pilot's blood taken in hospital with a negative result.

1.14 Fire

There was no fire of the envelope upon the balloon impact to the ground.

1.15 Search and Rescue

No search and rescue procedures were organised. The accident was reported to the Czech Police by accidental witnesses. Emergency Rescue Service and a Fire Brigade unit intervened at the scene. The pilot evacuated the balloon basket in his own strength.

1.16 Tests and Research

The subject of the technical inspection carried out by the specialists of Balóny Kubíček, s.r.o. was a professional assessment of the condition of the balloon after the air accident.

1.16.1 Inspection of the envelope pressurised with cold air

The envelope was pressurised with cold air and key structural components were inspected.

1.16.1.1 Steel support cables and carabiners

The steel cables were free of damage throughout their full length. The Stubai shackles and supporting carabiners were undamaged and all locks were functional.

1.16.1.2 Suspension straps and crown ring

The suspension straps were undamaged throughout their full length. The stitching of the suspension straps in the mouth as well as in the parachute valve was undamaged. The connection of the suspension straps to the steel cables was without damage. The crown ring in the parachute valve was not damaged.

1.16.1.3 Horizontal load tapes

The horizontal load tapes were undamaged throughout their full length. The tape from the filling mouth was in good condition, also around the burnt hole.

1.16.1.4 Fabrics

The fabric around the envelope mouth on vertical tapes Nos 14 and 15 was damaged by fire (nomex panel twice, PES panels/1 and 2 four times). A major damage to the fabric was located in the area of the centring cord loop sewing on 3 panels and in the area of the top license plate location on 1 panel. Several smaller holes were at a similar height of the envelope. One of the holes demonstrated temperature affected edges. The flap seal fabric was damaged in several places around the edge of the parachute valve. In one location, the auxiliary flap strap was torn out.

Fig. 6 – Detail of the fabric damage

1.16.1.5 Grab test

A grab test was performed on the fabric according to the technical manual (MM-B.3202 rev.5 ch.7. 17). The fabric was loaded up to 20 kg·2.5 cm^{-1} and no damage occurred (requirement of the MM=13 kg). The fabric demonstrated sufficient firmness.

1.16.1.6 Control cables and cords

The control cables, cords, straps, and pulley mechanism were tangled together. After untangling, all cords were undamaged, as were the pulleys and straps. The red control line remained undamaged throughout its full length. The end of the red-and-white rope was free of the rope clamp forming the lug. The cable clamp was pushed up higher on the cable and minor damage was found on the cable (core partially pulled out of the braid).

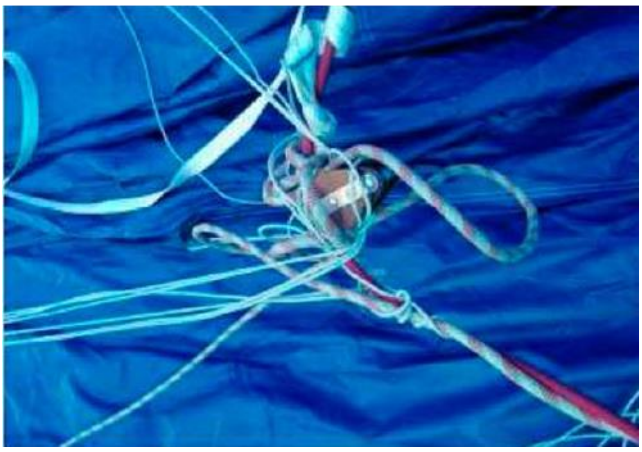


Fig. 7 – Entangled control cables and lines.

1.16.1.7 Thermal fuse

The thermal fuse was left hanging in the envelope. The envelope was not overheated.

Fig. 8 – Thermal fuse.

1.16.1.8 Rotary valve

The rotary valve was not damaged. No damage was found on the fabric and the cord and cable system.

1.16.2 Inspection of the heated envelope

The functionality of the deflating system was tested after the air in the envelope was heated with the burner. The deflation system worked properly in all modes. Only a minor leak in the valve was observed, caused by damage to the fabric and the sealing valve strap.

The automatic return of the valve (also referred to as the valve panel/parachute valve/Smart Vent) was tested when the envelope was placed on the ground under low envelope pressure. The valve was repeatedly fully opened with a red-and-white cable and the automatic return to the opening was monitored. The valve returned back even upon the fifth opening. Only upon the sixth opening the valve panel did not return, when the envelope was almost pulled down to the ground. The correct functioning of the valve was verified even under low pressure in the envelope.

Fig. 9 – View of the deflation mechanism assembly inside the envelope

1.16.3 Inspection of the Cameron basket

A cursory inspection of the Cameron basket was performed. No identification plate was found. Serial number BH 434 was marked on the nozzle. The wooden flooring was cracked in two places in the centre and in the area under the fuel bottles. The upper frame of the basket was deformed. The manila at one of the nozzles was cracked. The APA rods were found with permanent deformation.

1.16.4 Fuel bottles

At the time of the inspection, the bottles had already been serviced. According to the CAMO representative, the bottles had been inspected and all valves and fuel gauges were in good order. Two bottles were found to have dents on the bottom collar.

1.16.5 Cameron burner

At the time of the inspection, the burner had already been serviced. According to the CAMO representative, the burner had been inspected and its operation was faultless. Only the deformed inner frame had been replaced.

1.17 Organisational and Management Information

1.17.1 Hot-air balloon operator

The hot-air balloon was owned and operated by a natural person. The balloon was used for recreational and sport flights.

1.17.2 Parachuting operation organiser

The parachute operation was organised at LKKT on 27 July 2020 by Pink Aviation Services GmbH.

1.18 Supplementary Information

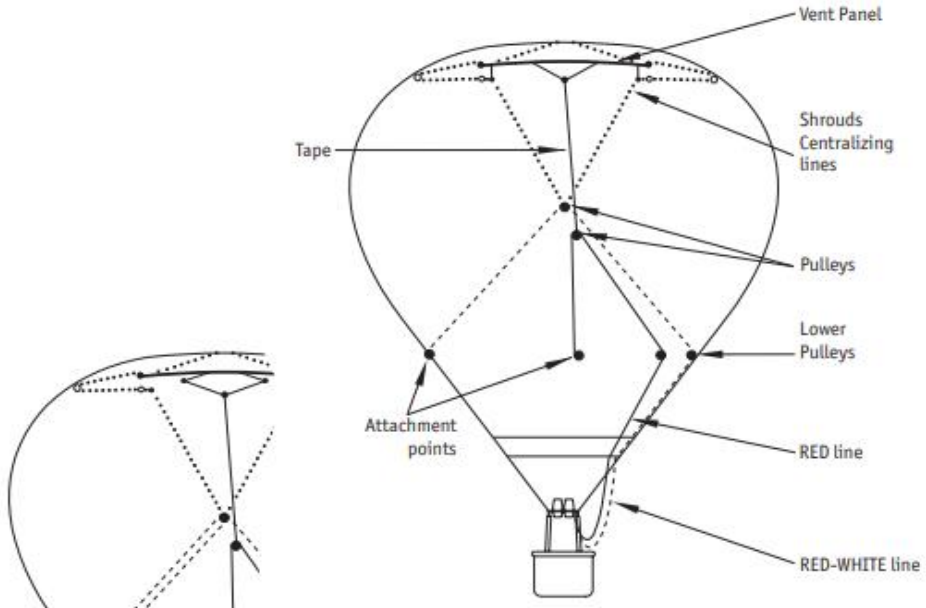
1.18.1 Hot-Air Balloon Flight Manual B.3102, Edition 3

1.18.1.1 Balloon controls

Kubíček BALLOONS www.kubicekballoons.cz

6.4.5 Smart Vent

The Smart Vent is a fast deflation system capable of two modes of venting, similar to a Slide Vent.
The activation lines and their operation is identical as the Slide Vent.



Smart Vent controls:

	Desired action	Control motion required
In-flight venting	Open Parachute mode	Pull and hold RED-WHITE line
	Close Parachute mode	Release RED-WHITE line - Parachute closes itself
Deflation	Open FD	Pull RED line
	Close FD	Pull RED-WHITE line

6-6 EDITION 3 revision 2, 10 January 2018

1.18.1.2 Parachutists' drop

4.4.10 Dropping of Parachutists

Conditions for parachuting:

- The maximum balloon take-off weight must not be exceeded.
- The weight of parachutists that are to jump and their equipment must be taken into account in the pre-flight planning to ensure the balloon remains within applicable limits during the entire flight (Minimum Landing Weight!)
- All applicable national regulations must be complied with.
- Free fall parachuting is only permitted. Static line releases must not be used.
- Maximum number of parachutists to be released at one time is one.

The pilot must react to a sudden drop of weight when the parachutists exit. To prevent the balloon from an excessive rise the parachute is to be opened. It is also possible to drop the parachutists with the balloon in a moderate descent. The recommended value is 1 m/s (200 ft/min).

Dropping procedure:

Preparation	Parachutists sit on the basket top rim
Unobstructed exit	Parachutists are well free from control lines, fuel hoses or any other equipment
Airspace check	Airspace under the basket is free from any air traffic
Dropping	Parachutists leave the basket after the agreed pilot's signal
Venting	Vent enough to prevent undesired climb

1.18.2 Aeronautical Regulations Rules of the Air L 2, Appendix N Rules for Parachuting Operation Flights

2.3 Only an aircraft approved for this purpose by the State of Registry may be used for parachute flights in accordance with the procedures and limitations specified in the flight manual.

2.4 The pilot in command of an airborne aircraft shall hold a PAR (para-aircraft) rating.

2.5 The flight crew shall be equipped with rescue parachutes which shall be properly attached to the body throughout the flight for ready use in an emergency and shall be properly briefed in advance on their use.

4.6 Duties of the parachuting guide or commander

One of the above stated functions is always designated for each parachute by the parachuting operation controller. If there are parachutists of category lower than 'C' in the drop team, a parachuting guide must be appointed from amongst the 'H' category parachutists. In other cases, a drop leader must be designated from among parachutists of at least category 'C' and above, the drop leader may make a jump themselves only if the drop leader is designated for the remaining parachutists of category 'C' and above. The parachuting guide or the commander shall be responsible for the activities of the parachutists on board the aircraft from the time they board until the last parachutist leaves the aircraft.

4.3 Duties of the parachuting operation controller.

4.3.1 The parachuting operation controller has overall responsibility for planning, organising, and conducting parachute jumps, designating other persons to provide for jumps and instruction, and assigning parachutists into individual operations. They are the only person authorised to communicate on behalf of the parachutists with the appropriate ATC/AFIS unit or known traffic information unit and with the commander of the parachute aircraft on the ground.

1.18.3 Commission Implementing Regulation (EU) No. 923/2012, Annex Commission Implementing Regulation (EU) No. 923/2012 of 26 September 2012 laying down the common rules of the air and operational provisions regarding services and procedures in air navigation.

Section 3: General rules and collision avoidance.

SERA. 3101 Negligent or reckless operation of aircraft

> *An aircraft shall not be operated in a negligent or reckless manner so as to endanger life or property of others.*

1.18.4 Additional questions for the balloon pilot.

The additional questions were sent to the pilot in writing, in German language. The pilot replied in writing in German. The translation is provided in the table below.

Otázka	Odpověď
Jakou měl balón rychlost klesání při výskoku prvního a posledního parašutisty?	5 m/sec.
Jakou měl balón výšku při výskoku prvního a posledního parašutisty?	2 500 m MSL.
Jakou rychlostí začal balon stoupat po výskoku parašutistů?	10 m/sec.
Kdy se otevřel paraventil? Jaká byla asi rychlost stoupání?	14 s. 5,3 m/sec.
Použil jste ovládání paraventilu po výskoku parašutistů?	Ne.
Jakou rychlostí jste dopadl na zem?	Cca 13 m/sec.
Měnila se rychlost klesání před dopadem (během posledních 500 metrů, bylo to měřitelné)?	Ano byla měřitelná.
V jaké výšce jste provedl výsadku?	2 500 m MSL.
Do jaké výšky vystoupal balón?	2 500 m MSL.
Použil jste hořák? Kolikrát?	Ano. Asi 2krát.
Byl jste schopen balon nějak řídit? Jak?	Ne.
Kolik hodin jste nalétal s tímto balonem?	Cca 100 hodin.
Kolik hodin jste nalétal s balóny typu Kubíček?	Cca 120 hodin.
Kolik hodin jste nalétal celkem?	Cca 170 hodin.
Kolik hodin jste nalétal tento rok?	40 hodin.
Jak dlouho létáte s balóny objemu 3 400 - 6 000 m^3?	3 roky.
Létáte i s balóny větších kubatur?	Nelétám.
Máte povolení pro obchodní lety s balónem?	Ano.
Jakou máte zkušenost s výsadky?	Provedl jsem cca 100 výsadkových letů.
Prošel jste nějakým školením pro výsadky?	Ano.
Byl jste poučen o českých podmínkách pro výsadky?	Ano.
Skočil jste sám někdy s padákem?	Ano. Mám cca 7 000 seskoků.
Jaká byla hmotnost balónu před a po výskoku parašutistů?	885 kg při startu. 510 kg při přistání.
Znáte termín MLM a MLW.	Ano.
Kolik je MLW pro tento balón?	630 kg.

2 Analyses.

Most of the facts pointing to the determination of the cause of the accident are derived from the evidence found on the damaged balloon, from the results of the detailed inspection of the accident site, from the statements of the pilot, the participants in the parachute drop, witnesses, mobile phone video footage, and expert reports.

2.1 Crew

2.1.1 Pilot's Qualifications

The pilot was fit to fly and had the appropriate qualifications to fly a BB42Z type balloon, which he had retrained for in 2018. He is an experienced balloon pilot, having flown his own balloon without major break intervals and had experience of conducting parachute flights. He has flown at LKKT also in the past and is very familiar with the airport environment and specifics of the operation. Although he stated in his testimony that he had been trained in parachute procedures, he clearly did not comply with the requirements of the Aeronautical Regulation L 2, Appendix N-Rules for Parachuting Operation Flights. Considering the number of performed parachute jumps he stated, he is an experienced parachutist.

2.2 Flight Performance

The parachuting operation flight was recorded in the parachute drop controller's documentation. The arrangement with the controller was made only formally. Contrary to the balloon flight manual, the airdrop was planned as a group jump. The necessary calculations prior to the drop flight were not performed and the flight was probably based on experience from previous flights. This approach led to the total permissible carrying capacity of the balloon being exceeded and to deliberate non-compliance with the minimum landing weight of the balloon. The pilot was not equipped with a rescue parachute during the drop flight.

2.3 Critical Situation

After reaching an altitude of 2,200 m AGL, the pilot switched off the burners and started the balloon to descend using the parachute valve. The parachutists stood on the edge of the basket on his instruction. Critical situation occurred at approximately 1,800 m AGL, during the descent of the balloon, when, upon the pilot's instruction, all five parachutists simultaneously made a group jump, thereby reducing the weight of the balloon by 440 kg. The unloaded balloon immediately went into an extreme climb, which resulted in deformation of the upper part of the envelope, including the parachute valve. The red-and-white parachute valve control line was spontaneously released and pulled high into the mouth of the envelope where the anchor mechanism of the line log became jammed into the pulley mechanism. This control line became entangled in the centring cables at the anchorage area of the parachute valve. After the total collapse of the balloon envelope during the fall to the ground, the parachute valve control lines rotated violently. The balloon became uncontrollable and was free falling to the ground. Video footage taken by a casual observer shows that the balloon was falling at an estimated two to three times the vertical speed compared to the descent of parachutists on fully open sport parachutes.

2.4 Aircraft

No defects were noted in the maintenance logbook during the previous operation after the annual inspection. The weight was not within authorised limits. The total permissible carrying

capacity was exceeded by approximately 128 kg. The fact that the minimum landing weight was reduced by about 119 kg had a significant effect on the occurrence of the event. The balloon burners were operating normally during the flight and all controls were functional. The balloon envelope was damaged during the critical phase of the flight (after the parachute drop), and subsequently the basket during the hard impact into the ground. The technical inspection of the balloon showed that the discharge system worked correctly in all modes, both in the inflated heated envelope as well as under low pressure inside the envelope.

2.5 Weather Effects

The weather conditions were suitable for a VFR flight. The ground wind speed allowed for hot-air balloon take-offs and landings in accordance with the flight manual.

2.6 Parachuting operations organiser

The parachuting organiser held the parachuting operations with its own aircraft and was informed of the balloon flight by the pilot. The controller recorded the parachuting flight in his documentation, but only formally complied with the obligations prescribed by V-PARA-1 regulation and Aeronautical Regulations Rules of the Air L 2, Appendix N Rules for Parachuting Operation Flights.

3 Conclusions

During the investigation of the accident, the Commission came to the following conclusions.

3.1 Findings

The pilot:

- held a valid free balloon pilot licence;
- did not provide a record of training by a qualified person in performing balloon parachute drops;
- was medically fit;
- had a valid licence of the aeronautical mobile service radio operator,
- had extensive experience flying the type and flew without long break intervals;
- had experience in parachute drops from a balloon;
- had instructed the parachutists prior to flight;
- was not equipped with a rescue parachute during the drop flight;
- failed to prepare for the flight and calculate the permissible carrying capacity in accordance with the balloon flight manual;
- performed the actual parachute drop in non-compliance with the balloon flight manual and the applicable valid air regulations;
- completely lost control of the balloon after the drop.

Balloon:

- had a valid certificate of airworthiness inspection and was airworthy,
- had a valid liability insurance;
- the total permissible carrying capacity and the minimum landing weight were not within the authorised limits prescribed in the flight manual;

- the burners were operating normally until the critical phase of the flight and all controls were fully functional;
- the gas cylinders contained sufficient amount of fuel for the flight;
- the damage to the envelope was caused strictly after the drop;
- the damage to the balloon basket structure was caused by a hard impact to the ground;
- during the examination at the accident site and the subsequent technical inspection of the balloon, no facts indicating that the cause of the accident was a technical defect in the balloon were ascertained.

Meteorological situation:

- had no effect on the occurrence and progress of the air accident.

3.2 Causes

The cause of the accident was an incorrect execution of the parachutists' drop from the balloon basket when the minimum landing weight was not complied with, so the uncontrolled balloon went into an uncontrolled descent and hit hard to the ground.

4 Safety Recommendations

In view of the persisting practice in the performance of parachute drops from hot-air balloons, when after the parachutist leaves the basket, the requirement for a minimum landing weight is not observed and the flights cannot be performed in accordance with the flight manual, the Air Accidents Investigation Institute recommends to the Civil Aviation Authority:

Regarding the specific nature of balloon operations, consider the need to make amendments to Appendix N Rules for Parachuting Operation Flights of the Air Navigation Rules L 2.In

5 Annexes

NIL