Federal Public Service
Mobility and Transport
Air Accident Investigation Unit

**Air Accident Investigation Unit
(Belgium)**
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1210 Brussels*

Safety Investigation Report

Ref. AAIU-2014-16
Issue date: 7 June 2016
Status: Final

SYNOPSIS

Classification:	Accident
Level of investigation:	Standard
Date and time:	26 July 2014 at 18:06 UTC
Aircraft:	Hot Air Balloon - Libert L3400
Owner:	Private
Accident location:	Football field in Eeklo
Type of flight:	General Aviation - Airshow
Phase:	Take-off
Persons on board:	One pilot, one pax
Injuries:	None

Abstract

During the 29th 'Meetjeslandse Balloonmeeting', an hot air balloon hit a light pole on the launch area during take-off. No one got injured.

Occurrence type:

Collision with obstacle(s) during take-off and landing (CTOL)

Cause:

The exact reason for the unexpected change in take-off direction could not be determined but was highly probably due to turbulence caused by surface obstacles. A contributing factor is that the hot air balloon was taking-off too close to the light pole, making it impossible to perform any recovery action.

FACTUAL INORMATION

History of the flight

During the weekend of 26-27 July 2014, the 29th 'Meetjeslandse Balloonmeeting' took place. This is a two-day event on which on several moments tens of hot air balloons are launched from the terrains of the communal sports site of the city of Eeklo. On Saturday evening a 'hare and hound competition' was organised. This is a game were one hot air balloon, the hare, takes off before the others from the same launch area. After its landing, a target is displayed upwind within 10 meters of the touch down point. The competitors, the hounds, have to attempt to drop a marker as close as possible to the target. There were 39 participating balloons. Because the terrains are too small of size to inflate all the hot air balloons at the same time, the launch was organised in two shifts. The very first balloon took off at 17:45 UTC.

The concerned balloon was planned in the second shift and was appointed a launch location on the second football field, approximately 20-25 metres from a light pole. The envelope was inflated downwind of the prevailing wind direction of 300-320 degrees. Trial balloons (also called pibals) as well as the preceding hot air balloons all took off in more or less the predicted direction. When the envelope was lifted by the heated air, the pilot and his son (which would be the only occupants) embarked the basket, which was still hold down by 3 additional crew members and a tether connected to a car. Once one of the assistant launch masters showed a green sign, the crew members released their hold, the pilot pulled the quick release and the balloon started his ascent. It immediately drifted in an eastern direction instead of the expected south-eastern. After just a couple of seconds, the envelope touched the light pole and began to slow down. The envelope was ripped open by the light socket and very quick began to deflate while still climbing due to the inertia. Eventually the balloon was arrested by the horizontal load tapes wrapped around the socket. When the envelope was deflated further, the basket fell some meters back down but kept hanging by the load tapes. The pilot put out the burner flame, shut off the gas bottles and disconnected the gas supply lines. As due to the weight, the pole began to keel over, the pilot took the drop line, bound it firmly around the pole and threw the other end down so that people on the ground could counteract the bending by pulling on the line. The rescue services arrived at the scene to free the pilot and his son from the basket. No one got physically injured but the son was taken away to the hospital because of in a psychological shock. All the other flights were cancelled that day.

Pilot information

Age:	66 years old
Nationality:	Belgian
License:	Holder of a national Hot-air balloon license, first issued in 1986, last issued in 2014 and valid until 16 March 2015. Authorized for commercial flights. Medical certificate: class 2 valid up to 6 March 2015 LAPL valid up to 6 March 2016
Experience:	Total: 1365 take-offs and landings Last 3 months: 2 Last 6 months: 5 Participated all previous 28 editions of the 'Meetjeslandse balloonmeeting'

Aircraft information

The hot air balloon was registered in Belgium and held a Certificate of Airworthiness and a valid Airworthiness Review Certificate (ARC). The combination of the envelope, burner, basket and cylinders is certified by EASA since 17 October 2013 under type certificate date sheet EASA.BA.019.

General information

	Envelope	Basket	Burner	Fuel cylinders
Manufacturer	Ballons Libert	Cameron	Cameron	Cameron
Type	L3400	CB3278	CB2101-2	CB2990
Serial number	321 045	BH1141	B6358	
Weight	115 kg	70 kg	24 kg	Empty: 13 kg Full: 34 kg
Dimensions	Volume: 3380 m³ Height: 20.5 m Diameter: 19.4 m	1m40 x 1m10		Number: 5
Year of built	2008			
Flights	94			

The published maximal rate of climb is 3 m/s.

Load and lift

Item	Weight of unit (kg)	#	Weight (kg)
Envelope			115
Basket			70
Burner			24
Fuel cylinders	34	5	170
Crew + pax			178
		Total	557

The available lift can be calculated by using a chart in the flight manual. The calculated total lift available at cruise altitude of 1500 ft with a temperature on the ground of 24° C and a temperature within the envelope of 100°C is 0,237 kg/m³ x 3400 m³ (volume of envelope) = 805,8 kg. So this would have been the maximum allowed weight at take-off. The actual total weight at take-off was 557 kg, giving a margin of more than 248 kg or 2433 N net buoyancy force (when the balloon is heated to 100° C). Divided by the actual mass, this gives an initial acceleration of 4,36 m/s², hereby neglecting the air resistance.

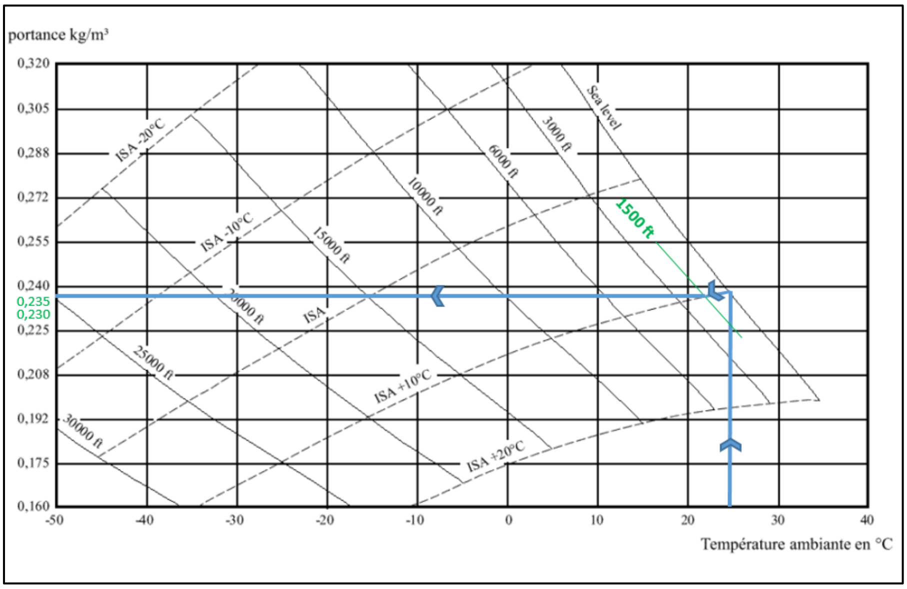

Figure 1: performance chart to calculate available lift

Internal temperature of the envelope

There's a note in the flight manual that states that the internal temperature of the envelope never may exceed 120°C. When the temperature reaches 126,7 °C, a melting link will melt and fall down to warn the pilot. In that case, he must immediately initiate a descent and land as soon as possible.

A so-called tempi-label or temperature indicator registers the reached temperature. If one of the indicated temperatures is reached, the corresponding window will immediately go into black.

Damage

The envelope of the balloon was torn open.

Information on launch area

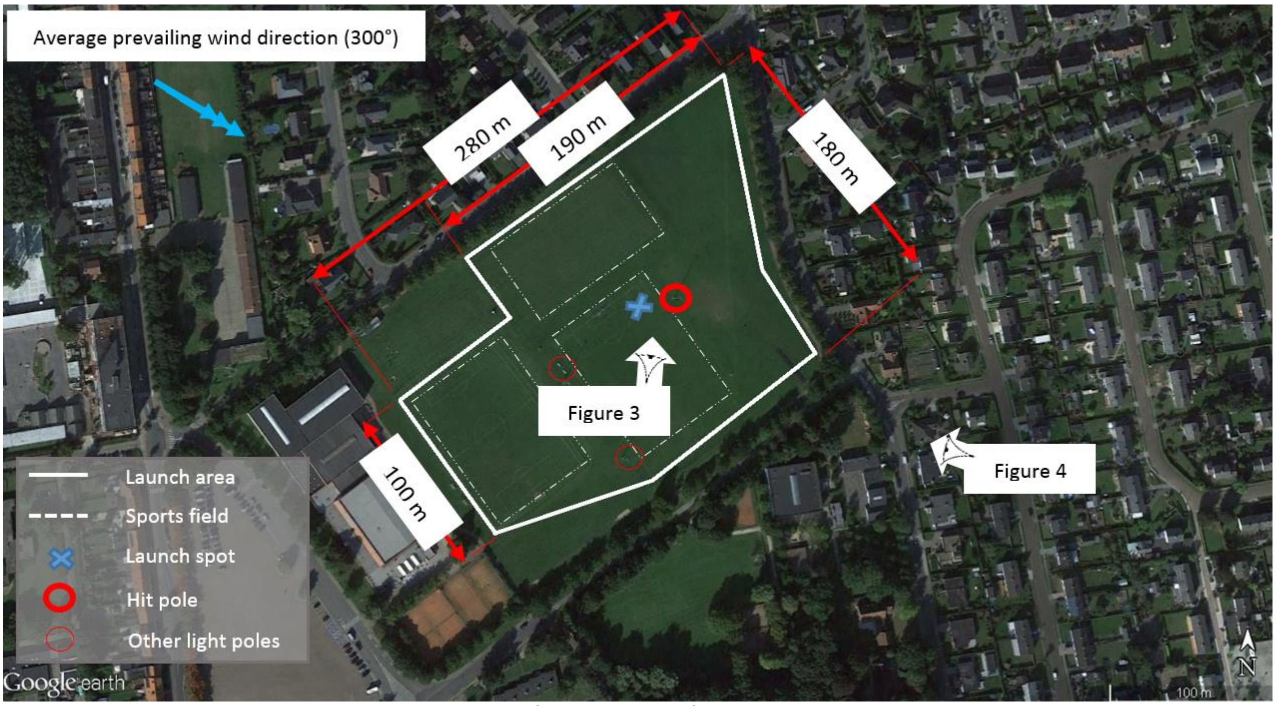

Figure 2: Launch area

The launch area consists of a grass ground, containing three sports fields, of the communal sports site in the built-up area of the city of Eeklo and is surrounded by trees. The white border on figure 2 shows the area that is used for the inflation and launching of the balloons. The remaining grass area is used for funfair, tents and a music stage.
One of the sports fields (a football pitch) has 3 light poles with a height of 19,5 m. For the first editions of the event, these poles were laid down. This is possible by means of an hinge system, used for repairing and replacing of the lights. However, in consultation with the balloon crews, the organisation decided to let the poles stand in the subsequent editions.
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Organisational information

Authorization

The 'Meetjeslandse balloonmeeting' has been organised since 1986 on the same location. The yearly authorization of the Belgian Civil Aviation Authority was obtained on 7 July 2014. This authorization contained several conditions including the following;

….
2. The prescriptions of CIR/GDF-07 edition 2 of 11 October 2011 are applicable.
3. It is prohibited to take-off with a surface wind speed of more than 10 kt.
….

The circular CIR/GDF-07 referred to details the conditions which must be fulfilled by the organisation of an hot air balloon meeting in Belgium. Some relevant extracts;

> **5.3**
>
> a) The launch area has to be selected so that for every take-off spot, taking into account the wind direction, wind speed and the existing obstacles, the free manned balloons sail with a minimum distance of 15 m from any obstacle during the take-off.
>
> **6.5 Launch master**
> **…**
> d) He takes into account the prevailing wind direction, wind speed and existing obstacles for the selection of the take-off spot so that the free manned balloons sail with a minimum distance of 15 metres from obstacles.

According to this circular, the organisation also has to appoint a person responsible for the meteo data. This person, who has to have professional experience as meteorologist, gets the latest meteorological observations and forecasts from the nearest weather station and briefs both the organisation and flight crews.

Event briefing guide

A briefing guide is provided to all crews. This briefing guide contains a.o. the following instructions;

> ….
> After the briefing, the pilots have to monitor the messages broadcasted on aviation radio frequency 122.25
> …
> Quick release has always to be used.
> ….
> If you are ready to take off, you have to obtain a take-off clearance from the launch masters.
> Procedure: - you ask a launch master at your basket
> - wait for a green signal
> - when having green light, you immediately take-off and you climb to 1000ft
> ….

Meteorological information

The METAR's at 17:50 UTC issued by Belgocontrol were:

Weather station	Ostend (EBOS)	Brussels (EBBR)
Wind direction (°)	320	Variable between 270 and 340
Wind speed (kt)	6	8
QNH (hPa)	1014	1014
Temperature °C	24	24

The balloon bulletin issued on 14:30 UTC by Belgocontrol mentioned that is was partly cloudy to cloudy (cumulus and altocumulus) with in coastal area low clouds and misty. The overall forecasted wind at 18:00 UTC was 280-320°/05-07 kt.

The meteorologist appointed by the organisation got his information from the nearest weather station (Zelzate).
The last was check was done at 17:30 UTC which was 15 minutes before the first flight and 46 minutes before the accident. As both the observations and forecasts showed relative stable conditions, the launch masters as well as the flight crews were only briefed once about the weather.

	16:00 UTC	17:00 UTC	17:30 UTC
Wind direction (°)	310-330		300
Wind speed (kt)	6	8	8
QNH (hPa)	1014		1015

Flight recording

The balloon held a GPS with recording functions but was not (yet) activated. The accident was recorded by a video camera by someone of the public. However, the beginning of the launch itself was not filmed as the camera had just turned away to film another balloon. By superposing different shots the take-off path was reconstructed, see figure 3.
From the crew of the balloon that took off prior to the accident balloon, the Air Accident Investigation Unit received a picture showing the collision with the light pole.

Impact information

The envelope almost immediately hit the pole after take-off. Due to the mass it was containing, the pole bent a bit before it ripped open the envelope. It quickly began to deflate while still climbing due to the inertia. The basket slid upwards against the pole. Eventually the balloon was arrested by the horizontal load tapes wrapped around the socket. When the envelope was deflated further, the basket fell some meters back down but kept hanging by the load tapes.

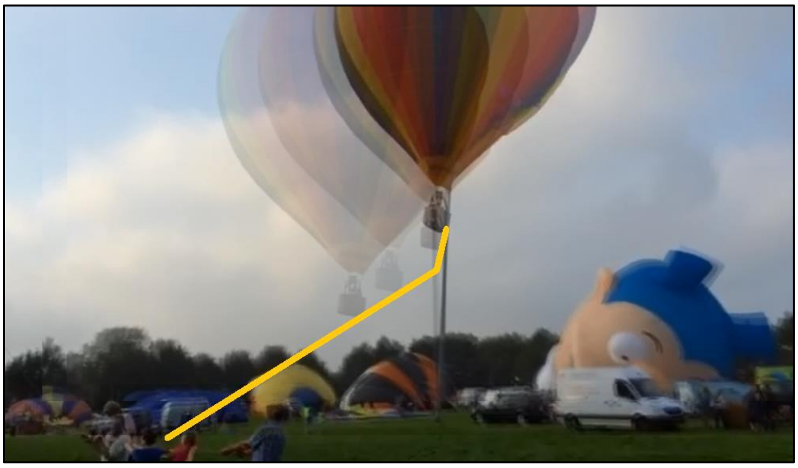

Figure 3: Reconstructed take-off path

Survivability

Due to the large form of the socket, the envelope kept hanging by its load tapes. The rescue services arrived quickly and could easily access the site and the accident spot.

ANALYSIS

Balloon and performance

The hot air balloon was airworthy. The actual take-off mass combined with the meteorological conditions should have allowed the balloon to take off at its maximum rate of climb of 3 m/s when heated up to 100° C. Just before the launch it can be seen on the footages that the balloon is held by 3 persons and a quick release cable while already getting some centimetres off the ground.

Launch spot

The pilot declared that the balloon was on a distance of 50 metres from the light pole. However, by analysing the video and pictures it was concluded that the basket was actually standing between 20-25 metres from the pole. This means that the envelope was on a distance of 10-15 m from the pole.

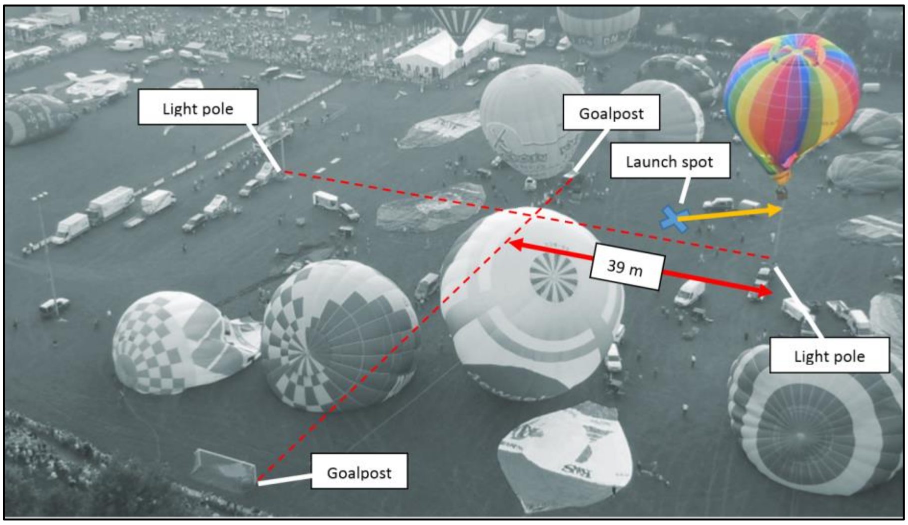

Figure 4: Aerial view of the launch area during the collision (taken from another balloon)

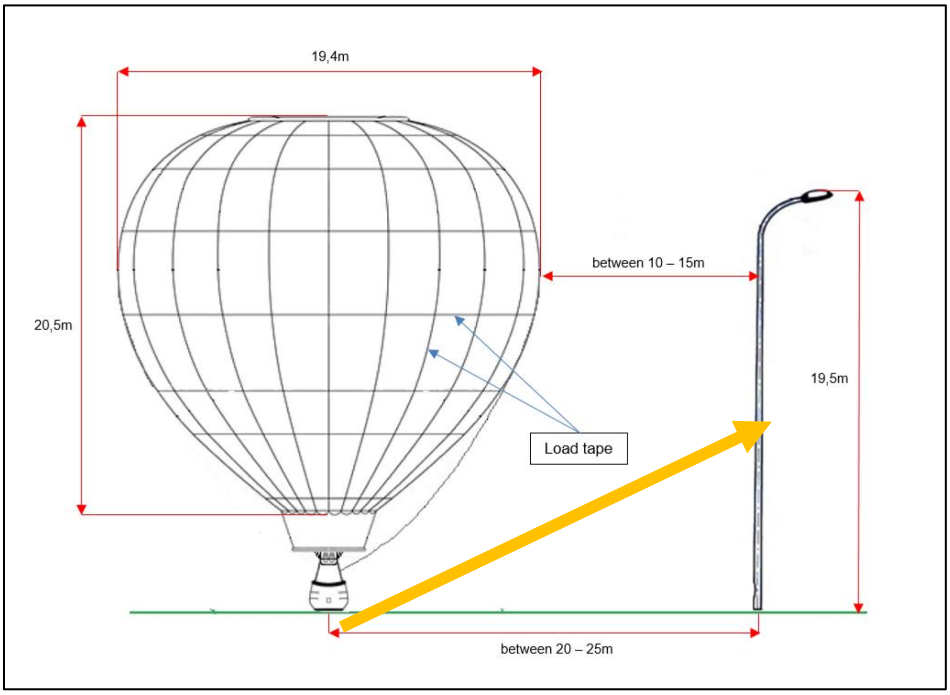

Figure 5: Sketch with relevant dimensions (not on scale)

Wind direction

The last measured prevailing wind direction was 300°, variable between 280-320° which means an expected take-off direction between 100 and 140°. This was confirmed by pibals and also the balloon that took off prior to the accident balloon followed the expected flight path.
However according to the pilot, and confirmed by the reconstruction on figure 6, the balloon immediately took a heading of 60-70°, which is about 60° clockwise from the expected direction.

Figure 6: Take-off path (orange) compared with average wind direction (300°)

Speeds

As the take-off was not completely recorded on video camera and the envelope almost immediately hit the pole, thereby decelerating the complete assembly, the initial rate of climb and prevailing wind speed can't be determined with absolute accuracy. The speeds calculated from the video are about 1 m/s in the vertical and 3 m/s (= +- 6 kt) in the horizontal direction.

The prevailing wind was a sea (also called onshore) breeze coming from the Northwest. The characteristics are that it is a gentle wind that is caused by unequal heating and cooling of adjacent land and sea surfaces and blows from the sea to the land. It only develops when there are weak general wind circulations.

The wind direction and speed in the weather forecasts of Belgocontrol are always an average of 10 minutes. Because of the existing buildings, trees,.. the lower layers of the atmosphere are turbulent which makes it impossible to predict the wind with an accuracy of 1 knot and even 5 degrees. The forecaster can only modify the TAF's if the wind direction changes with 60° or more and with which the average wind speed has to be 10 kt or more.

The already airborne pilots didn't notice any sudden change in wind direction. Therefore the reason of the deviation is highly probably due to the surface properties; the line of trees in combination with inflated balloons still on ground could have caused (temporary) some light wake turbulence.

Recovery action

As this flight path was not expected and the envelope already touched the light pole after some seconds, it was impossible for the pilot to react in time by heating the envelope in order to increase the rate of climb.

CONCLUSIONS

Findings

- The balloon was airworthy and its load was within limits
- The balloon (equator of the envelope) was at the limit of the 15 metre distance from an obstacle as prescribed in circular CIR/GDF-07
- The balloon immediately took a heading of approximately 60 degrees clockwise from the expected flight path

Cause

The cause of the accident is an unexpected change of wind direction highly probably due to turbulence caused by the surface obstacles. A contributing factor is that the hot air balloon was taking-off too close to the light pole, making it impossible to perform any recovery action.

SAFETY ACTIONS AND RECOMMENDATIONS

Safety issue

There is too much reliance on the prevailing wind direction for the determination of the distance from obstacles. In case of a sudden change of wind direction, no margin is left to perform a recovery action.

Recommendation BE-2016-0023:
It is recommended that the organisation 'Meetjeslandse Balloonmeeting' instructs the flight crews to take-off from a launch spot with a distance from any obstacle of at least two times the height of that obstacle within 60 degrees left and right of the expected flight path, and this only as a bare minimum.

Safety issue

Because of the close presence of obstacles and other balloons, it is really important to take-off at the highest rate of climb possible in order to ensure a safe and expeditious clearance over and around all obstacles. This can be done using the 'weight off'[1] take-off procedure. Therefore;

Recommendation BE-2016-0024:
It is recommended that the organisation 'Meetjeslandse Balloonmeeting' revises its briefing guide by adding the instruction to use the 'weight off' take-off procedure.

For the above-stated reasons, to ensure that future hot air balloon events organised in Belgium will happen under safe circumstances;

Recommendation BE-2016-0025:
It is recommended that the BCAA revises the circular CIR/GDF-07 to add the following instructions;
- flight crews have to take off from a launch spot with a distance from any obstacle of 15m or at least two times the height of that obstacle (whichever is greater) within 60 degrees left and right of the expected flight path
- 'weight off' take-off procedure has to be used

About this report

As per Annex 13 and EU regulation EU 996/2010, each safety investigation shall be concluded with a report in a form appropriate to the type and seriousness of the accident and serious incident. For this occurrence, a limited-scope, fact-gathering investigation and analysis was conducted in order to produce a short summary report.
It is not the purpose of the Air Accident Investigation Unit to apportion blame or liability. The sole objective of the investigation and the reports produced is the determination of the causes, and, where appropriate define recommendations in order to prevent future accidents and incidents.

[1] Weight off: A procedure used to launch the balloon when a rapid rate of climb is needed because of wind and obstacles. The basket is held to the surface by tether and by additional weight of crewmembers until sufficient heat can be generated by the burner assembly into the envelope to attain the maximum ascent rate possible. This also allows to control direction away from objects before letting it go. When this necessary heat has been generated, the tether is released and the pilot clearly instructs the ground crew members to release their hold by shouting "weight off!" ("(laat) los!" in Dutch, "lâche!" in French).