

**ACCIDENT**

<b>Aircraft Type and Registration:</b>	Cameron Z-350 Balloon, G-CCSA	
<b>No &amp; Type of Engines:</b>	Burners: Quad Shadow CB 2256-2	
<b>Year of Manufacture:</b>	2004	
<b>Date &amp; Time (UTC):</b>	10 May 2006 at 1947 hrs	
<b>Location:</b>	Talywain, Pontypool, Wales	
<b>Type of Flight:</b>	Public Transport (Passenger)	
<b>Persons on Board:</b>	Crew - 1	Passengers - 14
<b>Injuries:</b>	Crew - 1 (Serious)	Passengers - 1 (Serious) 13 (Minor)
<b>Nature of Damage:</b>	Damage to basket	
<b>Commander's Licence:</b>	Commercial Pilot's Licence (Balloons)	
<b>Commander's Age:</b>	50 years	
<b>Commander's Flying Experience:</b>	1,133 hours (963 on type) Last 90 days - 12 hours Last 28 days - 12 hours	
<b>Information Source:</b>	AAIB Field Investigation	

**Synopsis**

Although the forecast included a 30% probability of thunderstorms, the local weather conditions were fine when the balloon launched from a field outside the town of Monmouth. About 40 minutes into the flight some of the occupants of the balloon basket observed lightning to the south and east. Approximately 15 minutes later, prompted by the sound of thunder, the pilot made an approach to land in the area that he had previously selected for the end of the flight. This approach was abandoned because of fluctuating winds and the presence of wires across the landing path. Another attempt to land was aborted before the pilot made an emergency landing in gusty wind conditions onto uneven ground. During the hard landing the pilot and one passenger received

serious injuries and the other 13 passengers sustained minor injuries. Following the accident the operator reviewed their decision-making procedures prior to take off. Two recommendations regarding the operator's procedures and safety equipment have been made.

**History of the flight**

The balloon took off from a field next to the town of Monmouth at 1830 hrs. The pilot reported that the meteorological forecast had predicted a 30% probability of thunderstorms in the area but that the sky was clear with no thunderstorms visible when they took off. During the journey to the launch site he had discussed the weather with the operator's chief pilot, who was

watching its development on weather radar imagery on the Met Office's website and, on arrival at the launch site, the pilot decided that the flight would go ahead. It was planned to last one hour and the wind velocity was such that he expected to land in the vicinity of Betts Newydd, which is 9 nm to the west-south-west of Monmouth and 5 nm to the north-east of Pontypool.

The pilot told the passengers that there were storms in the vicinity of Swindon and Swansea but they all remembered the weather being fine when they took off. About 40 minutes into the flight some of the passengers recalled seeing lightning to the south, in the direction of the Bristol Channel, and to the east.

The flight was reported to have been uneventful for the first 55 minutes and the pilot then made an approach to land in a position 1 nm to the west-south-west of Betts Newydd. Afterwards, he recollects that he had been prompted to make preparations for this attempt to land, which included briefing the passengers, when he heard the sound of thunder. During the approach the wind veered and increased and the balloon became more difficult to control. In addition, there were power cables ahead, across the balloon's intended track, so the pilot aborted the landing and initiated a climb. Some of the passengers reported that during the climbout the balloon basket clipped the tops of some trees.

Over the next 15 minutes the weather conditions deteriorated rapidly. The pilot made another attempt to land but, again, had to abort it because of rapid changes in the wind direction and more power cables. By this stage the balloon had reached the northern end of Pontypool, the wind was very gusty. There was a steep ridge of hills ahead, over which the pilot was concerned that the wind might increase still further. Consequently, he decided to make an emergency landing on uneven land on the north-west side of Pontypool.

The pilot instructed the passengers to adopt the landing position, which involved sitting on their bench seats holding on to a rope handle, with their heads back against the side of the basket and nothing around their necks. He recalled the final part of the approach being made in very turbulent conditions, at a speed of 15 to 20 kt across the ground. The balloon's burners were used to control the rate of descent, which the pilot reported as being between 300 and 400 fpm. Just prior to the landing the balloon basket struck a tree and one of its branches struck a passenger, causing a laceration above his left eye. The basket then landed hard on uneven ground, rolled on to its side and was dragged across the surface on to more level ground before stopping. The passengers remained in the basket, which was damaged, but were in distress.

During the landing the pilot sustained a broken ankle. He had difficulty walking and remained with the basket. Initially, he thought that he was the only one who was injured and that a few of the passengers were dazed and shaken. After being cleared to exit the basket, some of the passengers helped to gather in the balloon canopy, while others sat and then lay down. It was reported by some of the passengers that two of their number were rendered temporarily unconscious.

In the meantime, one of the passengers had called the emergency services. Their arrival, after about 10 minutes, coincided with a heavy downpour of rain and some of the passengers were taken to local houses for protection. Subsequently, the pilot and all of the passengers were taken to hospital for examination. One of the passengers had suffered cracked ribs and all the other passengers sustained a variety of neck and back strains and bruising. Also, a number of them complained of headaches following the accident.

Local residents, who had observed the balloon landing, were some of the first on the scene to assist the pilot and

passengers, before the emergency services were able to arrive. The retrieval crew were in the vicinity of the landing site, liaising with the land owners, and arrived at the scene very shortly after the emergency services.

The balloon was equipped with portable GPS navigational equipment but subsequent examination by the AAIB found no record of the flight in its memory.

### Weather

The investigation reviewed the Terminal Area Forecast (TAF) at 1520 hrs for Cardiff Airport, 25 nm to the south-west of the balloon's intended landing site. For the period from 1600 hrs on 10 May to 0100 hrs on 11 May it predicted a variable wind of 5 kt; 7,000 metres visibility; a few clouds with a base at 4,000 ft and temporary spells during the period with visibility in excess of 10 km and no cloud below 5,000 ft. This forecast was revised at 1805 hrs to include a 30% probability of a temporary change, between 1800 hrs and 2100 hrs, with thunderstorms and scattered cumulonimbus clouds with a base at 4,000 ft amsl. At 1819 hrs the TAF was amended once again, forecasting a temporary change between 1900 hrs and 2300 hrs with 4,000 metres visibility, thunderstorms and broken cumulonimbus clouds with a base at 3,500 ft amsl.

These TAFs reflected the forecasts at Bristol Airport, Bristol (Filton) and Gloucester Airport, which were to the south and east of the balloon's track. Bristol Airport's TAF was also changed at 1819 hrs, from a 30% probability of thunderstorms during the evening to temporary thunderstorms after 1900 hrs.

Uncertainty in forecasts is unavoidable, and it is often useful to provide a forecast in terms of a probability of occurrence, particularly when referring to significant phenomena such as thunderstorms. When there is a

probability of thunderstorms occurring, a 30% or 40% probability is used. If the probability is judged to be less than 30% it is not considered sufficiently significant to be included, and if the probability is 50% or more then is no longer considered to be a probability but is indicated by use of one of the change indicators 'BECMG' or 'TEMPO'.

Also during the investigation an aftercast was obtained from the Met Office. The synoptic situation at 1800 hrs on the evening of the accident showed a high pressure covering the British Isles with a thundery trough lying over South Wales and the Bristol area.

It was clear, from tephigrams and the general state of the atmosphere from surface charts, that significant instability was possible, with cumulonimbus cloud tops up to between 30,000 and 35,000 ft.

Recorded radar images, which indicate the presence of rain droplets in the atmosphere, showed a build-up of rain returns over South Wales from 1745 hrs onwards. The heaviest rain appears to have arrived in the Pontypool area between 1930 hrs and 2000 hrs and was, according to the colour of the returns, particularly heavy, possibly including hail.

Satellite imagery revealed that a number of convective cells were generated over South Wales during the early evening. Also, there was a large area of cumulonimbus cloud situated over Wiltshire at 1700 hrs, which moved west towards south Wales at 10-15 kt, possibly generating further cumulonimbus cells along its leading (western) edge by picking up moisture from the Bristol Channel.

Cumulonimbus cloud began to develop over South Wales and around the Bristol Channel/Severn estuary area during the period between 1700 hrs and 1800 hrs

and moved in a west-north-westerly direction towards the site of the accident. It is likely that cumulonimbus cloud was over, or very close to, the area of the accident at the time it occurred.

The aftercast estimated the surface visibility to be 10-15 km in haze and it was considered possible that, in the prevailing visibility, any cumulonimbus cloud would not have been seen until it was quite close to the observer.

The wind at 2,000 ft agl was estimated to be from 060° at 10 kt, veering to 110° at 10 kt; with the surface wind from 080° at 5 kt, veering to 110° at 10 kt. It was possible that in and near thunderstorms the surface wind was from the east-north-east at 15 to 20 kt, gusting to 30 kt.

The ‘Afternoon ballooning forecast - South-West’ for the period from midday to dusk was consistent with the general forecast and referred to isolated wind gusts of 30 kt in and near to thunderstorms.

The departure weather recorded by the pilot, based on an observation at 1750 hrs at Cardiff, indicated a surface wind from 080° at 5 kt, 10 km visibility, a few clouds at 3,400 ft and a temperature of 19°C.

Sunset at Cardiff, was at 1952 hrs.

### **Photographic evidence**

Photographs taken from the balloon basket during the flight reveal that for much of the flight the weather was fine and hazy. Two other photographs taken from a residential property in Pontypool shortly before the balloon landed, showed it beneath the western edge of cumulus type cloud in a position assessed as being over the north-western side of Pontypool.

### **Procedures and limitations**

#### *Weather and flight planning*

The operator’s Operations Manual states that:

*Before flying a balloon the captain shall satisfy himself that .... in the forecast wind conditions the balloon will reach an area suitable for landing within the planned flight time.*

and in APPENDIX Y it stipulates:

***Wind Speeds.*** Pilots are reminded they must not fly if the ground speed is expected to exceed 15 knots.

The Operations Manual also states that the CAA approved Flight Manual is part of the Operations Manual.

That approved Flight Manual specifies the following weather limitations:

1. *Balloon must not be flown free in surface winds greater than 15 knots (7.7m/sec).*
2. *The balloon must not be flown in meteorological conditions which could give rise to erratic winds and gusts of 10 knots (5.1m/sec) above the mean wind speed.*
3. *The balloon must not be flown if there is extensive thermal activity or any cumulonimbus (thunderstorm) activity.*

With regards to flight planning, the Flight Manual advises that the following should be considered;

***Severe weather*** A balloon flight should never be attempted around thunderstorm activity, ahead of approaching frontal systems or near severe weather of any kind.

and ....

**Wind Direction** *The wind direction should not carry the balloon into ..... areas unsuitable for landing (mountains, lakes or large built-up areas) unless sufficient fuel is carried to overfly such areas safely. The pilot should visually assess the weather both before take-off and during the flight and be prepared to modify flight plans accordingly.*

#### Landing site selection and procedures

On the subject of landing site selection, the Flight Manual states:

*For landing, a field must be chosen in the line of flight, containing a sufficiently large clear area in which to land the balloon. The intended landing area should be free of animals, crops, telephone wires and power cables, and there should be no high obstacles in the approach or overshoot. A larger landing area will be needed in stronger winds.*

The Flight Manual also contains a list of Pre-Landing Checks which includes repeating the landing part of the passenger briefing; that briefing having been given when the passengers first embark, before takeoff. For partitioned baskets, as in this case, the landing part of the briefing states:

*Before landing, stow all loose items, cameras etc. On landing face away from the direction of travel. Knees should be together and slightly bent. Push backwards against the leading edge of the passenger compartment. Hold on to the rope handles in front of you with both hands. After touchdown the basket may fall on its side and drag along the ground.*

*After landing do not leave the basket without the pilot's permission.*

*The passenger's landing position may be rehearsed before take-off to ensure that they are taking up the correct position. It is important that the passenger's knees are only slightly bent, and that they are not squatting or sitting on their heels.*

The Flight Manual Emergency Procedures contain guidance on **PREPARATION FOR A HARD LANDING**. It states:

*.... a weather emergency may cause a 'fast' landing where the speed is mostly horizontal....*

*In a fast landing the basket may tip forward violently on impact, tending to throw the occupants out. The occupants should adopt a low down position (knees well bent) with their back or shoulder pressed against the leading edge of the basket, head level with basket edge and rope handles or cylinder rims held firmly.*

#### Safety equipment and procedures

The Flight Manual states in its *Limitations* section:

*There must be at least one restraint, e.g. hand hold, for each basket occupant.*

Under the heading *Passenger Handling*, the Operations Manual states:

*Protective helmets must be provided for the use of passengers if it is likely that other than normal conditions could be encountered during the course of a flight, for example a landing on steep or rocky terrain or at a high ground speed.*

However, later in the Operations Manual a Notice to Pilots (APPENDIX Y) states:

**Protective Helmets.** *I do not consider that we fly over steep or rocky terrain or at high ground speeds. Protective Helmets are not issued by this company and flying over steep or rocky terrain or at high ground speeds is prohibited.*

The Manual specifies that the minimum equipment required to be carried for public transport includes a First Aid Kit. The Manual also stipulates that pilots must complete first aid training every three years and it advises that

*ground based personnel should have adequate training in first aid because, in the event of a serious accident, it is possible that the pilot may be incapacitated and the retrieve crew would be first to attend the scene.*

It was confirmed that the pilot had received his first aid training and that a first aid kit was carried in the balloon basket and in the retrieve vehicle.

#### Civil Aviation Authority advice

The UK CAA General Aviation Safety Sense Leaflet 16a, entitled *Balloon Airmanship Guide*, gives guidance on obtaining weather information and landing area planning. It states:

*Plan to land in an area which provides a choice of suitable sites. Avoid being committed to land in an area which does not offer any alternatives if an initial approach has to be abandoned.*

#### Fuel

The balloon departed with 148 kg of fuel, the amount specified in the operator's Operations Manual for a flight lasting one hour. This provided 30 minutes of reserve fuel.

#### Discussion

The balloon was beneath the western edge of a cumulonimbus cloud when it made an emergency landing. It was not possible to establish the balloon's ground speed or the surface wind velocity during the landing, but the weather forecast for the period indicated that the wind speed could gust to 30 kt in, and near to, thunderstorms.

The pilot had earlier made two attempts to land but was unable to do so due to obstacles and insufficient control of the balloon. The weather then deteriorated rapidly. The initial attempt was made in the vicinity of Betts Newydd, the planned landing area. As the balloon flew further west, the weather worsened and suitable landing sites did not present themselves as the balloon travelled over difficult landing terrain. When the pilot decided to make an emergency landing he was faced with a combination of a strong surface wind, which was probably in excess of the manufacturer's limiting surface wind for a landing, and an uneven landing surface. These conditions, which were not foreseen and fell outside the operator's operating limitations, fell within the criteria for passengers to wear protective helmets.

The meteorological aftercast reflected the conditions that the pilot observed before the balloon took off and during the first half of its flight. The aftercast also indicated that any cumulonimbus cloud would not have been visible until it was quite close to the observer.

However, there was evidence of developing convective cloud activity over South Wales on the radar imagery, which the operator reported having access to, in the 45 minutes before the balloon launched. There were also visible signs of thunderstorm activity to the south and east of the balloon about 15 minutes before the first attempt to land. The pilot recalled hearing the sound of thunder during that 15 minute period and that prompted him to prepare for a landing.

The advice in the Flight Manual, that

*the balloon must not be flown if there is extensive thermal activity or any cumulonimbus (thunderstorm) activity,*

arguably warranted a cancellation or a postponement of the flight on the basis of the weather radar imagery and the forecast. However, it was understandable that the balloon took off, in the light of the local conditions at Monmouth and bearing in mind that a 30% probability is the minimum level of probability that will be included on a TAF.

By the time the balloon was making its first approach to land, the combination of the wind and local obstructions was such that the pilot decided to abort the landing. Thereafter there was a lack of suitable landing sites and, ultimately, the pilot elected to make an emergency landing in unsuitable conditions.

The pilot's passenger briefings were appropriate. With bench seats fitted, the passengers' seating position was

the same for an emergency high speed landing as for a normal one. However, the provision of protective helmets was merited. Following the accident, the Civil Aviation Authority undertook to review the use of protective helmets in public transport balloons and, as an interim measure, to issue a Balloon Notice reiterating previously published advice regarding the provision of protective helmets for balloon flights over areas close to steep or rocky terrain. The Notice would also give greater guidance to operators on when helmets should be used.

Although first aid kits were provided, the pilot was incapacitated and the retrieve crew arrived after the emergency services, who administered first aid treatment before the pilot and passengers were taken to hospital. The proximity of the landing site to a residential area meant that local residents were some of the first to assist the occupants of the balloon in the immediate aftermath of the landing.

#### **Safety Recommendation 2006-132**

It is recommended that Ballooning Network Ltd review their procedures to ensure that suitable alternative landing areas are identified in their spheres of operation in the event that a planned landing area cannot be used.

#### **Safety Recommendation 2006-133**

It is recommended that Ballooning Network Ltd review their safety equipment, particularly with regards to the provision of protective helmets, to cater for possible emergencies