Investigation report No. 1835 on the accident to the tethered balloon HiFlyer on 23 July 2004 in Lucerne

According to Art. 11 of the decree on „special category aircraft“, tethered balloons require approval by the FOCA which defines licensing standards and operational requirements. Tethered balloons do not require to be registered. The AAIB has no obligation to investigate accidents concerning tethered balloons (Art. 2 of VFU). The General Secretariat of the Federal Department of Environment, Transport, Energy and Communications however requested the AAIB to make their expertise available for this investigation. The AAIB has complied with this request.

Aircraft Accident Investigation Bureau

Investigation report

This report has been prepared solely for the purpose of accident prevention. The legal assessment of accident causes and circumstances is no concern of the accident investigation (Art. 24 of the Air Navigation Law)

Owner:	Verein Verkehrshaus der Schweiz (VHS), Lidostrasse 5, CH-6006 Lucerne
Operator:	Verein Verkehrshaus der Schweiz (VHS), Lidostrasse 5, CH-6006 Lucerne
Tethered balloon type:	HiFlyer LBL 575 Type: HF 021 Vol. 5790 m^3
Country of origine:	United Kingdom (UK)
Registration:	None
Location:	Lucerne, Lidostrasse 5, Verkehrshaus der Schweiz
Date and time:	23 July 2004, 14:34 LT (UTC + 2)

General

Brief description

On 23 July 2004, a group of 24 Indian tourists, accompanied by a balloon pilot[1], ascended in a tethered balloon (HiFlyer) in order to enjoy the view over Lucerne and its environs.

During the ascent, at a height of approximately 40 m, the balloon pilot noticed an indicated wind of 18 kt and initiated the descent. Shortly afterwards, the HiFlyer encountered strong gusts of wind and was displaced laterally (side drift) on the winch cable[2]. In the process, the balloon's gondola, in an inclined position, came into contact with various parts of buildings and a tree. As a result of the drift down and the subsequent abrupt tensioning of the winch cable, during the ensuing short ascent the winch cable cut through the inner octagonal gondola structure and a floor panel in the walkway was torn away. One tourist fell through the resulting opening in the floor after she had attempted, briefly and unsuccessfully, to hang on. After approximately 20 minutes, it was possible to bring the HiFlyer back down to earth with the remaining occupants and secure the vessel.

The tourist who fell suffered fatal injuries, 10 people were in some cases seriously injured and 14 people were uninjured. The gondola of the HiFlyer was badly damaged and nearby buildings suffered considerable damage.

[1] Balloon pilot is an internal VHS term for the operator of the tethered ballon

[2] The cable between the winch on the ground and the balloon system is termed the winch cable.

Investigation

The accident took place on 23 July 2004 at 14:34 LT. Notification was received at the Aircraft Accident Investigation Bureau (AAIB) at 15:30 LT. The investigation was opened in cooperation with the Lucerne cantonal police on the same day at 18:45 LT at the scene of the accident.

The accident is attributable to the fact that on the occasion of an ascent in conditions with excessively high wind speeds and in an overloaded condition the gondola of the HiFlyer tethered balloon was damaged by the winch cable in such a way that a passenger fell to earth out of the balloon, suffering fatal injuries. Several passengers were injured.

The investigation determined the following causal factors for the accident:

- the crew's decision to carry out two extra trips, despite perceptibly critical weather conditions
- the crew carried out the ascent with too small amount of free lift.

The following factors contributed to the development of the accident:

- though the MeteoSchweiz wind warning had arrived by fax at the operations centre, it was not brought to the attention of the balloon pilots.
- the storm warning light at the Lido was blinking, however it could not be recognised by the crew. Two other storm warning lights were activated and would have been visible.

0. Description and operation of the tethered balloon

0.1 Description of the tethered balloon

The tethered balloon, called the HiFlyer, is considered as a system in the following description. This consists of four subsystems (cf. Annexes 1.1, 1.2, 1.3 and 1.4):

- the balloon system
- the gondola system
- the winch system
- the control system

0.1.1 The balloon system

The balloon system uses helium as a lift-generating gas. The volume of the envelope is divided by a membrane into the load-bearing section filled with helium and an air-filled ballonet (cf. Annex 1.4). The latter allows compensation of fluctuations in the volume of helium. A pressure-controlled ballonet fan ensures that the spherical shape is maintained, at an overpressure of the order of 14 mm column of water (equivalent to approximately 1.4 hPa). The balloon has a diameter of 22.28 m with a volume (incl. the ballonet) of 5790 m^3. The full ballonet has a volume of 1150 m^3. The helium pressure and temperature values as well as the ballonet air pressure and temperature are acquired and displayed on the gondola control panel. A pressure relief valve on top of the helium section, which opens at 40 mm column of water, prevents the envelope from bursting.

The net transfers lift forces via the net bridle to the load ring. A polar rope and several mooring lines allow high or low anchoring at the separate anchoring winches on the ground (cf. Annexes 1.1 and 1.3).

The balloon is equipped with interior lighting, external position lights and a lightning-rod.

The balloon system functions as follows: The helium in the balloon envelope is less dense than air and generates a total lifting force. This total lifting force minus the weight of the balloon, gondola and occupants and the weight of the fully extended winch cable results in a residual lifting force. In the HiFlyer manuals, this residual lifting force is termed the free lift. In order to keep the winch cable taut and the balloon as near as possible to vertically above the platform, the necessary free lift must be increased if the wind speed increases (cf. 0.2.2 and 1.18.3.1). The free lift is measured by the load cell, which is positioned between the winch cable and the load ring (cf. Annex 1.2).

0.1.2 The gondola system

The gondola system consists of an octagonal stainless steel structure. It includes a walkway 80 cm wide and two doors, which open inwards. These doors can be operated from inside or outside. The control panel and the battery are located in the access area. The winch cable runs from the load ring through the open centre of the gondola to the winch on the ground. The gondola system enables up to 30 people to be ascended to a height of 140 m (cf. Annex 1.2).

0.1.3 The winch system

The winch system consists of the load cell, the winch cable, the cable guide unit, the cable drum, the gearbox, the main motor, the auxiliary motor and the emergency power unit. The winch cable consists of 34 x 7 steel wires and is wound to produce minimum rotation under load. The diameter of the cable is 22 mm. It is 180 m long and the minimum ultimate load of a new cable is 42.3 t. The cable drum has a diameter of 1.5 m. The cable is wound in a single layer. One side of the drum is equipped with a disc brake (cf. Annex 10). The emergency power unit powers the winch in the event of a power failure.

0.1.4 The control system

The HiFlyer's winch system is usually controlled from the control panel in the gondola via a radio link. A second control panel (the ground station) enables it to be controlled from the platform. The main controls are in the pit next to the winch.

From the control panel in the gondola (the operator station), it is possible to control ascents and descents and read off, among other things, various pressure values, temperatures, the height, wind speeds and the available free lift.

From the ground station on the platform, priority control over the winch can be exercised and the 'up', 'stop' and 'down' functions can be operated.

From the main controls it is possible on the one hand to operate the winch and on the other to reset alarm signals which have been triggered, e.g. the alarm for an extreme winch cable deflection angle. The monitoring functions, which in addition to the inclined position of the winch cable include, among other things, the correct cable guidance, are displayed on a screen.

0.2 Operation of the tethered balloon

0.2.1 Application and authorisation

On 07.10.1997, the Verkehrshaus der Schweiz (VHS) informed the Federal Office for Civil Aviation (FOCA) that it wished to offer its visitors a special attraction. The VHS asked the FOCA "what conditions imposed by FOCA, if any, would have to be met" in order to operate a tethered balloon.

The FOCA provided five responses to this request. One of these stated that the tethered balloon system was regulated in the decree on "special category aircraft" (VLK, SR 748.941). Another reply stated that this device did not have to be registered according to the decree.

On 16.10.1997, the FOCA referred to the legal situation. In a memorandum covering 11 questions of a technical and insurance-related nature, the FOCA requested additional information from the manufacturer of the tethered balloon system. In a letter dated 30 June 1998 the manufacturer answered these questions and appended a HiFlyer system failure mode analysis (cf. Annex 15). This analysis concerned the gas balloon and the corresponding winch.

In relation to question 7 concerning cable breaks, the manufacturer made the following comments: "*The HiFlyer is built with the cable as the strongest component and we consider a cable break unlikely and do not consider the fly-away case as realistic. Consequently, we do not specify a balloon licence as a pre-requisite for the on-board operator. However, we consider a training programme is necessary*

for the operator, which we will carry out on site. We feel, however that a Balloon Pilot's Licence is a great help as the operator's primary safety task will be to identify bad weather."

The FOCA informed the VHS by fax on 17 June 1998 about an operating permit and answered those questions which were still outstanding, such as liability insurance.

On 28.09.2000, the Director of the VHS submitted the application for authorisation to the FOCA in accordance with art. 11 VLK, attaching the corresponding documentation.

The authorisation dated 9 October 2000 included the following conditions:

"*The tethered balloon must not be operated negligently or carelessly in a manner which endangers the lives or property of third parties. Incidents accompanied by injury to persons or material damage in connection with the operation of the balloon must be notified to the FOCA immediately.*

The tethered balloon must be operated in accordance with the Operations Manual and maintained in accordance with the manufacturer's Maintenance Manual. The operating personnel must be trained in accordance with the Training Manual issued by the manufacturer.

Lighting according to para. 2 of Annex 4 of the Decree on Aircraft Transport Rules (VVR, SR 748.121.11) must be available for ascents at night".

0.2.2 Operations manual

Among other things, the operations manual specifies the following limit values:

2.1 The balloon must not be operated in the vicinity of thunderstorms, or weather of great instability.

2.18.1 Operating free lift limits – The operating free lift limit is the free lift measured when the gondola is loaded with passengers at its maximum ride height.

The minimum allowable operating free lift varies with the peak indicated wind speed at maximum ride height.

Increased free lift is required at increased wind speed to reduce the balloon side drift.

Peak wind speed Knots	*Minimum Operating Free Lift Tons*
0 – 5	*0.90*
5 – 10	*1.20*
10 – 15	*1.60*
15 – 20	*2.20*
20 – 25	*2.80*

Passenger payload must be calculated to minimum operating free lift limitations as above.

Increased wind speed encountered during operations will require a reduced passenger load.

0.2.3 Crew training

In a memorandum dated 16.10.1997, the FOCA asked the HiFlyer manufacturer 11 specific questions. With regard to training (question 1), the manufacturer stated the following, among other things: ...."*We supply the entire system as a package, install it and train the client's personnel.*" (cf. Annex 17)

For the operation of the HiFlyer, the VHS put together a team of about 9 members. The manufacturer provided the initial training for the team members and issued appropriate certificates.

The manufacturer envisaged the following training and designed the training programme as follows:

Training

Lindstrand engineers will commence training on-site immediately upon arrival in the form of hands-on and formal classroom training to include written and oral tests pass before our engineers will leave the site.

Level 1 (Bronze)

A level 1 operator should be proficient in:

- *HiFlyer system configuration and terminology*
- *Tethered helium balloon theory and principles, windspeed, free lift and passengers calculation*
- *Balloon mooring and unmooring procedures*
- *Balloon and winch operating procedures*
- *Gondola and winch control panels*
- *Control panel monitoring*
- *Daily inspection and log panels*
- *Test ride and data recording*
- *Free lift and passenger loading*
- *Passengers handling distribution and information*

Level 2 (Silver)

A level 2 operator should be proficient in:

- *Level 1 (as above)*
- *Site preparation and safety*
- *Equipment monitoring, maintenance and repairs*
- *Generator operating procedures*
- *Weather forecasting and local assessment and awareness*
- *Inspection and maintenance procedures*
- *Ride operation decisions within limitations*
- *Ride safety decision*
- *Crew information, training and supervision*
- *Crew duty allocation*

- *Emergency recovery procedures*
- *Emergency services liaison*
- *Document signing and record keeping*

0.2.4 Organisation of operations at the VHS

The responsibilities and duties of the different team members who were responsible for operation of the tethered balloon were defined by the VHS in the following documents on the basis of the manufacturer's recommendation:

1. Duty specification of the team leader as manager of the Hiflyer attraction, training level 1 and 2 (cf. Annex 12.2)
2. Duty specification of the balloon pilot with supervisory function, training levels 1 and 2
3. Duty specification for balloon pilots, training level 1

The team leader's work was subdivided as follows:

20 % VHS caretaker

10% team leader

70% supervisor and balloon pilot

According to the duty specification, one balloon pilot and one balloon pilot with supervisory function are required for every ascent.

These duty specifications also document the measures which are necessary before an ascent. Among other things, before the first ascent, a fax containing the weather forecast for ballon operations must be called from MeteoSchweiz. And, if the weather conditions for operations are not clearly apparent, the crew has to take additional steps to clarify the situation.

In addition, a "daily log for pilots" must be completed (cf. Annex 2).

1. Factual information

1.1 Prior history and history of the ascent

1.1.1 Prior history

On the days prior to the accident, no deficiencies were established concerning operation of the HiFlyer.

On the day of the accident, as prescribed, the daily balloon and winch inspections were completed as per the checklists (LBL-TA2 and LBL-TA3) by a supervisor and the weather forecast was studied. Then a test ride was carried out and documented in writing in the corresponding log (LBL-TA1) (cf. Annexes 3.1, 3.2 and 3.3).

Meteoschweiz faxed notification to the HiFlyer team of a weather situation which as early as the morning indicated showers and thunderstorms as hazards for the whole day (cf. Annexes 4.1 and 4.2).

After the test ride, which took place at 10:30 LT, eight ascents with a total of 119 passengers were carried out (cf. Annex 2).

The rides were carried out alternately by a balloon pilot with supervisory function and a female balloon pilot. According to their own statements, they were both aware of the weather conditions communicated by MeteoSchweiz.

The seventh ascent at 14:00 LT was carried out by the female balloon pilot. At that time the supervisor noted that it was cloudy and "*a bit black*" in the direction of Emmen. According to his observations, there was no wind. He went into the operations office and issued instructions that the employees present should inform him immediately of any incoming storm warning.

From the log for 23 July it was apparent that during the test ride and the eight passenger rides wind speeds of max. 9 kt were recorded.

The eighth and ninth ascents were envisaged for an group of Indian tourists. They were unannounced to the supervisor. For the eighth ascent at 14:20 LT, the supervisor disembarked two passengers, as the necessary free lift was no longer guaranteed. On this ride a height of 140 metres was reached. Since the passengers were pressed for time, the balloon remained at this height for only one minute. On this ride a free lift of 760 kp at a wind speed of 8 kt was recorded. This ride was carried out by the supervisor.

The brief period of calm before the ninth ascent, i.e. the one involving the accident, appeared suspicious to the supervisor. He informed the female balloon pilot that he would "*take this last trip up till there's any wind*". According to the female balloon pilot, the weather was getting worse. She estimated the wind speed at about 10 kt. The supervisor agreed with her that she should bring him back from the ground station. According to his statements, he was expecting that this ride would probably have to be aborted.

1.1.2 History of the ascent

The ascent involved in the accident lifted-off at approximately 14:30 LT. After lifting off, the balloon climbed to about 40 metres. The supervisor suddenly noted wind speeds of 18 kt. He immediately stopped the balloon and initiated the descent. He instructed the balloon pilot at the ground station by radio to retrieve the balloon; she confirmed this. She pressed the stop button and then the button for landing. She realised that she was not able to bring the balloon back in this way and alerted her manager, the team leader. Between the alert by the female balloon pilot and the team leader's intervention, 2-3 minute elapsed, in his estimation. The team leader took over control and briefly allowed the balloon to climb. He then tried to retrieve the balloon. He instructed the female balloon pilot to keep the people on the ground well away.

During this phase a massive wind surge caught the balloon. It was displaced laterally (side drift) and went out of control. The supervisor instructed the passengers in English to hold tight and sit on the floor of the gondola.

The tethered balloon then struck the roof of a hall. In the process a number of roof gutters were damaged. Then the winch's main motor stalled and an alarm sounded.

This alarm was the result of a monitoring function which had tripped. After verifying the reason for the alarm, the team leader instructed a colleague to check the monitoring function of the inclination sensors on the winch and to release the winch for further operation by means of a reset. In this way it was possible to continue retrieving the balloon.

The winch cable repeatedly slacked and the gondola impacted 8 to 10 times on a roof, a tree and a sunblind.

As a result of the considerable lateral displacement of the tethered balloon, the winch cable ripped through a tube of the octagonal structure of the gondola, tearing away a floor panel in the walkway. A passenger fell through the opening which was made and suffered fatal injuries. The supervisor noticed that two thirds of the diameter of the winch cable had sheared through.

Under the prevailing circumstances, to avoid worse injuries to passengers, the team leader did not want to retract the balloon more quickly. The winch cable, ballon structure and passengers may be exposed to a great stain in case of wind gusts combined with a slack cable. The balloon landed on the platform after 20 to 30 minutes.

10 people were in some cases seriously injured and 14 people were uninjured.

Coordinates of the landing site: 668 150 / 211 750 435 m/ASL

1.2 Injuries to persons

	Crew	Passengers	Third parties
Fatally injured	---	1	---
Seriously injured	---	10	---
Slightly injured or uninjured	1	13	---

1.3 Damage to the HiFlyer

The HiFlyer gondola was seriously damaged. The inner octagonal structure was broken. In the process a floor panel in the passenger area was ripped out. The winch cable was seriously damaged. (cf. Annexes 5, 11)

1.4 Material damage to third parties

Major damage to buildings occurred, such as torn-off gutters, damaged tile roofs, smashed sunblind. (cf. Annex 6)

1.5 Personnel information

1.5.1 Balloon pilot and supervisor

Swiss citizen, born 1953

Licence:	Not required in Switzerland according to the FOCA
Pilot training:	None
Certificate:	*HiFlyer Training Certificate Level 1*
	Issued by: *Balloons Lindstrand, November 2000, Certificate No. 044, approved by: HiFlyer Engineer*

	Was trained by VHS employees to *Level 2* (Supervisor)[3], June 2001
Ratings:	See 0.2.3, Crew training
Last medical examination:	None and not required
Specialist experience:	Joined the team in November 2000. Did not keep a personal logbook; this was not required. Specialist experience amounts to ca. 1580 h

1.5.2 Balloon pilot

Swiss citizen, born 1975

Licence:	Not required in Switzerland according to the FOCA
Pilot training:	None
Certificate:	None, was trained by the team leader of the HiFlyer group[3]
Ratings:	None
Last medical examination:	None and not required
Specialist experience:	118,5 h

1.5.3 Team leader

Swiss citizen, born 1953

Licence:	Not required in Switzerland according to the FOCA
Pilot training:	None
Certificate:	*HiFlyer Training Certificate Level 2* Issued by: *Balloons Lindstrand, October 2000, Certificate No. 036, approved by: HiFlyer Engineer*
Ratings:	See 0.2.3, crew training
Last medical examination:	None and not required
Specialist experience:	Joined the team in October 2000.

1.5.4 Passengers

Twenty-four passengers were in the balloon gondola on the ride involved in the accident.

[3] See under section 2.4, Operational aspects

1.6 Information on the HiFlyer system

1.6.1 HiFlyer

Type:	HiFlyer LBL 575
Characteristics:	Tethered helium balloon
Year of construction	2000
Serial number	HF 021
Missions:	11 593 ascents
Empty weight of the gondola/balloon system:	2248 kp
Weight of the winch cable:	2.4 kp per metre, i.e. 340 kp for 140 metres

1.6.2 Winch

Manufacturer: David Brown, Huddersfield, England

- Transmission of main force

  Main motor with operating brake -> Gearbox -> Drum (diameter. 1500 mm) with guide groove, single-layer winding, one side of flange with disc brake (safety brake), drum shaft with overspeed monitoring -> Cable winding system -> Pivoting head.

- Transmission of auxiliary force

  As for main force, but auxiliary motor-drive directly on opposite side of the main motor transmission shaft.

- Control panel and sensors in the winch pit (cf. Annex 10)

  These cover operating and safety functions such as:

  Final balloon position up/down - overspeed – winding problem – inclination angle of cable – clutch disengaged/engaged, main brake on/off, cable guide unit, winch cut-off in event of pronounced cable strokes.

- Ground station on platform

  From the second control panel (ground station), priority control over the winch can be exercised, with ‘up’, ‘stop’ and ‘down’ functions.

1.6.3 Winch Cable

Manufacturer Certex Ltd. Wakefield

Designation: 22MM DF 34 x 7 WSC 1960 BT RHL

Diameter 22 mm – Length 180 m – guaranteed ultimate load 42.3 t, equivalent to 42 300 kp (415 kN) – mass 2.4 kg/metre.

The winch cable was inspected on 5 June 2002. For results, see 1.16.1

1.6.4 Load cell

The load cell is installed between the end of the cable and the balloon and provides a display on the gondola control panel of the free lift available at any time.

1.7 Meteorological information

Annex 4.2 shows the MeteoSchweiz weather report, which was sent to the balloon pilots by fax.

1.7.1 Description of the weather situation

The pressure contrasts over central Europe were only slight. Mild, humid air was flowing towards the Alps in a southwesterly upper air current. Several centres of thunderstorm activity formed in Switzerland during the course of the day. One of these centres was slowly passing over the canton of Lucerne in an easterly/north-easterly direction. At 14:35 LT the thunderstorm cell was located on a line from Aarau to Lucerne (cf. Annexes 7.1, 7.2).

Between 14:30 LT and 14:40 LT at the Lucerne measuring station, the air flowing radially from the thunderstorm near the ground gave rise to sudden gusts of 20 kt (37 km/h).

Between 14:40 LT and 15:00 LT the on moving thunderstorm cell caused peak gusts of 29 kt (54 km/h) at the Cham measuring station.

1.7.2 Storm warning

MeteoSchweiz issues storm warnings for the Swiss lakes. A distinction is made between two warning stages (translation of the original MeteoSchweiz text):

Cautionary report: A cautionary report is issued when peak gusts of at least 25 knots (6 Beaufort) are possible.

Storm warning: A storm warning is issued when peak gusts of at least 25 knots (6 Beaufort) are expected with a high degree of probability.

In practice, cautionary reports are issued predominantly in the case of isolated thunderstorms and storm warnings in the case of cold fronts and squall fronts.

On the day in question, at 13:51 LT, MeteoSchweiz issued a cautionary report for the Lucerne region (cf. Annexes 8.1, 8.2 and 8.3).

Wind measurements at the Lucerne automatic station (approx. 3 km WSW of the site of the accident)[4]

[4] The measured values relate to the last 10 minutes before the observation time

		Avg. wind		Peak gusts	
Time (LT)	Direction	kt	km/h	kt	km/h
13:00	170°	6.6	12.2	11.1	20.5
13:10	157°	5.4	10.1	8.7	16.2
13:20	178°	5.4	10.1	8.5	15.8
13:30	170°	5.2	9.7	8.0	14.8
13:40	166°	4.1	7.6	8.4	15.5
13:50	155°	3.3	6.1	6.8	12.6
14:00	176°	2.9	5.4	5.2	9.7
14:10	187°	3.1	5.8	5.6	10.4
14:20	189°	2.5	4.7	6.0	11.2
14:30	209°	1.9	3.6	4.9	9.0
14:40	284°	7.8	14.4	20.0	37.1
14:50	319°	6.2	11.5	17.7	32.8
15:00	315°	5.2	9.7	14.0	25.9

The following peak gusts were measured at the Cham automatic station:

Time (LT)	Direction	kt	km/h
14:50	252°	29.2	54.0
15:00	240°	29.5	54.7

1.7.3 Weather according to witness statements

Witness 1: VHS employee, location: Rigihof. *"At the time in question I noticed storm clouds gathering in the direction of the city.*"

Witness 2: VHS employee, location: reception office. *"It was clear that bad weather was approaching. There was a light wind when the balloon took off. It had not yet rained.*"

Witness 3: VHS employee, location: Lido green, bather. *"I went to swim and was completely surprised when it suddenly began to rain. When it began to rain I got dressed; this took about a minute. During this time the wind got up and was gusting,*"

Witness 4: VHS employee, location: Rigihof. *"We saw that there was going to be a thunderstorm. We expected it to start raining shortly and got ready to retract the sunblinds. Suddenly a strong wind started blowing and the napkins flew off the table.*"

Witness 5: not a VHS employee, location: approx. 200 m from the balloon platform. *"At this time (the time of the accident) there was a strong wind and lightning. At this time it was raining very little, only a few drops were falling.*"

Witness 6: VHS visitor, location: HiFlyer enclosure. *"At the time the balloon was lifting off, there was no wind. Then the balloon ascended to about 50 or 60 metres. Suddenly there was a strong wind and it pushed the balloon over the Rigihof restaurant.*"

1.8 Aids to navigation

Not present and not involved.

1.9 Communications

Communications between the gondola and the ground station were carried out using radio or mobile telephones.

There is no recording of the conversations.

1.10 Site of the HiFlyer installation

In a letter dated 20.10 1999, the VHS informed the manufacturer of the planned location and at the same time asked about any restrictions. Among other things, the VHS also indicated a planned building of the Rigihof restaurant, which might make it necessary to move the planned platform site by 2.5 m (See Annex 9). The manufacturer answered in a letter dated 25.10.1999: *"We can solve that.*"

1.11 Records of trips

All trips were recorded in the so-called Pilots' Log (*Tagslogblatt für Piloten*). It was used to record the relevant data and passenger numbers (cf. Annex 2).

From the pilot' log sheets it is apparent that on average two to five trips each day were made in an overloaded condition, i.e. the free lift required according to the OM was not complied with.

For the planning of an ascent, in accordance with the operations manual, the balloon pilot used the maximum wind measured on a height of 140 m during the previous ascent.

If the wind speeds measured during the actual ascent are taken for a verification of the planning, one realises that between 1 April and 23 July 2004, out of a total of 1448 trips, about 24% were carried out in an overloaded condition (cf. Annex 16).

A study of the records of the ascents showed that no incidents requiring notification occurred.

1.12 Information on the wreck

- The stainless steel outer gondola structure exhibited various traces of contact due to scraping on the tile roof and contact with a tree. On the inner side there were traces of contact and indentations due to multiple impacts of the winch cable.
- A steel tube of the inner octagonal frame was ripped through and a floor panel in the passenger area was missing (cf. Annex 5).
- The winch cable was extensively damaged and the outer strands were splayed.
- The black safety net on the inner side of the walkway had a round hole at the top approximately 30 cm in diameter.
- The plastic sheet was loosened on the inside of the break through.

- The envelope of the balloon was undamaged.
- The battery in the gondola, which supplied the control panel with electrical power, was no longer connected to the latter. The control data were therefore no longer displayed.

1.13 Medical and pathological information

1.13.1 The fatally injured passenger

The fatally injured person suffered her injuries during the fall onto the metal roof. These injuries caused her immediate death. The post-mortem on 23.07.04 at 18:20 LT indicated a basal skull fracture and a cervical vertebra fracture, which severed the medulla oblongata (respiratory centre) causing immediate death. It was not possible to survive this injury. The injuries to the other parts of the body were not fatal.

1.13.2 Other injured passengers

The other occupants suffered injuries ranging from slight to moderately severe, caused by repeated impacts of the balloon gondola which was swinging back and forth.

1.13.3 Balloon pilot

In the case of the balloon pilot (supervisor), the IRM found small quantities of benzodiazepine, in particular Temesta (tranquilizer), both in the blood (sampled 23.07. 20:00 LT) and in the urine (sampled 24.07. 03.00 LT).

In the personal interview, the balloon pilot stated that both the Temesta and the painkiller (evidence of paracetamol in the urine) had not been taken until after the accident. The alcohol and drugs tests produced negative results.

1.14 Fire

Fire did not break out.

1.15 Survival aspects

The passenger who fell from the gondola of the balloon had no possibility of survival.

1.16 Tests and research

1.16.1 Inspection of the winch cable before the accident

On VHS' initiative, an inspection of the winch cable was performed by the IKSS (Interkantonales Konkordat für Seilbahnen und Skilifte) inspection agency on 5 June 2002. According to the section "cable condition" the following was found:

"At the test length 5-153 m there was a normal noise level. At the cable section 0-5 m, which is located directly below the balloon attachment, four major deflections were noted at test length 2 m. The visual inspection showed that at these points individual wire strands had frayed and some were sheared through. The cause of

this is the cable rubbing on the balloon basket, especially when the wind displaces the cable laterally or as a result of load shifting by the balloon pilots. In order to prevent further damage, appropriate plastic guides have been fitted in the mean-time."

In accordance with the measures proposed by the IKSS, this section of cable was removed on 20 January 2003 and a new cable head was founded.

1.16.2 Ultimate load test on the winch cable after the accident

After 4 years and just under 12,000 ascents the winch cable (excluding the greatly damaged zone some 3 – 5 m below the balloon) had an ultimate load of 480 kN. The guaranteed ultimate load is 415 kN.

The ultimate load of the damaged zone of the winch cable was 6.62 t (65 kN) (cf. Annex 11).

1.16.3 Lift forces

During the test ride on the morning of the accident, a free lift of 2560 kp was measured at a height of 140 m. Taking in account the weight of the balloon, the gondola, the winch cable and the balloon pilot, it was possible to establish a total lift of 5225 kp.

On the eighth ascent a free lift of 760 kp was measured. With the 24 occupants recorded in the daily log (19 + 4 passengers plus 1 pilot), one can calculate a total lift of 5196 kp for this trip. This trip was overloaded by 6 occupants.

If one assumes a total lift of 5225 kp (test ride value) for the planning for the ninth trip (the one involved in the accident), then one obtains a free lift of 712 kp with 25 occupants. However, given the prevailing wind speed, the required free lift would have been 1200 kp. Therefore, the trip had been planned with an excess of six occupants.

Indian tourists exclusively were on board during the eighth and ninth ascents. The assumed average weight of 77 kp per occupant would be close to the upper limit for the calculations in the following table.

1	Test ride at 10:30 LT	Ascent No. 8 planning	Ascent No. 8 at 14:20 LT	Accident trip planning	Accident trip at 14:35 LT
Wind speed:	2 kt	4 kt	6 kt	6 kt	18 kt
Weight of gondola and balloon envelope:	2248 kp	2248 kp	2248 kp	2248 kp	2248 kp
Weight of the winch cable:	340 kp (140 m)	340 kp (140 m)	340 kp (140 m)	340 kp (140 m)	97 kp (40 m)
Weight of the occupants:	77 kp (1)	1848 kp (24)	1848 kp (24)	1925 kp (25)	1925 kp (25)
Free lift:	2560 kp	789 kp	760 kp	712 kp	955 kp
Total lift:	5225 kp	5225 kp	5196 kp	5225 kp	5225 kp
Required free lift (acc. to OM):	900 kp	900 kp	1200 kp	1200 kp	2200 kp
Maximum permissible number of occupants:	22	22	18	19	9

kp = 9.80665 N (corresponds to ~1 daN)

1.17 Information on the organisation and management of the Verkehrshaus Schweiz (VHS)

The VHS is managed by a director. Departmental managers run different divisions. “Attractions” come under the “Operations” division. The HiFlyer is one of these attractions. The organisation chart is shown in Annex 12.1.

The HiFlyer crew consisted of a team leader plus six other supervisor pilots and three balloon pilots. For a normal working day, the minimum crew was one supervisor pilot and one balloon pilot, as was the case on the day of the accident. The team leader drew up a monthly duty allocation schedule. He had the training of a supervisor pilot but also performed other duties within the company.

1.18 Additional information

1.18.1 Licensing and supervision in other countries

The German authorities have issued regulations and licensing conditions (cf. Annex 13).

There are no regulations in France and Austria. Operations are governed by special licences.

The British CAA, the US FAA and the Swedish LFV have classified the HiFlyer as an attraction. The CAA and the FAA did not wish to be involved in the certification process.

The Swedish LFV has delegated licensing of the balloon envelope to a sub-contract authority.

In Great Britain, certification is handled by the Health and Safety Executive (HSE) certification authority. The investigation also found that on 11 April 2001 an additional Independent Design Review *Balloon Ride Winch* had been carried out in England by an independent institute. This was required by the British certification authority, the British Health and Safety Executive.

In the United States the certification authority is the same one which certifies attractions (e.g. big wheels). In Florida, certification is delegated to the agricultural department.

In the course of the investigation of this accident, the investigator did not establish how operations in the different countries are supervised – with the exception of Germany.

1.18.2 Relevant points for risk analysis

The HiFlyer manufacturer's system failure mode analysis (cf. Annex 15) was complemented by the following analyses and measures:

1.18.2.1 Winch failure

For total winch failure, e.g. failure of the transmission gear, a concept has been worked out which is practised every year with the fire brigade of the city of Lucerne. This enables the tethered balloon to be retracted in an emergency. An auxiliary cable is carried in the balloon on every trip. One end of the auxiliary cable is secured to the balloon gondola. In the event of total failure of the normal equipment this cable is lowered and secured to a rescue cable. This cable is then pulled into the balloon gondola using the auxiliary cable and secured to the gondola's main attachment, the load ring. The balloon is then brought back down, via a pulley, using a truck.

1.18.2.2 Cable break

The balloon is equipped with an automatic pressure relief valve. This can also be opened manually by the pilot using electrical controls. This would enables the pilot to reduce the balloon's rate of climb if the winch cable breaks.

The valve cannot be opened if there is an electrical power failure. In the current configuration, the balloon pilot has no mechanical system, e.g. a cable allowing him to open the valve.

Two scenarios have been elaborated for the maximum and minimum commercial load (cf. Annexes 14.1 and 14.2).

Both scenarios assume isothermal and adiabatic cooling of the helium. In the case of isothermal cooling it is assumed that the helium in the rising balloon is always at the same temperature as the ambient air. In the case of adiabatic cooling it is assumed that there is no heat exchange with the ambient air.

In reality, the actual processes lie between these two physical states.

The two worst case scenarios are described below:

Case 1: maximum load 30 persons @ 77 kg, with winch cable break at the winch. For a cable length of 140 metres, the winch cable weighs 340 kp. This results in a total load of 2650 kp. Lift-off at 450 m/ASL and no pilot intervention by opening the electrical valve after the cable breaks.

In the case of isothermal cooling, the balloon climbs to approximately 2400 m/ASL and then descends towards the ground. As soon as about 16 metres of cable are lying on the ground, the balloon stabilises at approx. 574 m/ASL, i.e. 124 m above the ground without landing, as long as the pilot does not operate the valve to reduce the free lift.

In the case of the adiabatic process, the balloon climbs to 2330 m/ASL and without pilot intervention stabilises at an altitude of 1940 m/ASL.

Case 2: minimum commercial load. Five persons and winch cable break on the balloon side. It is assumed that it is not economical to ascend with less than four passengers and the pilot. This produces a total load of 385 kp.

In the case of isothermal cooling, the balloon climbs to 8000 m/ASL and then lands after approx. 50 minutes with a rate of descent of approx. 2.3 m/sec.

In the case of adiabatic cooling, the balloon climbs to approx. 7800 m/ASL and without pilot intervention stabilises around an altitude of 7500 m/ASL.

1.18.2.3 Failure of the pressure relief valve in the helium section

1.18.2.3.1 Failure of the pressure relief valve in a normal ascent.

Under normal circumstances the preasure relief valve does not operate during an ascent to 140 m above ground level, because the air ballonet compensates for the resulting overpressure.

1.18.2.3.2 Failure of the pressure relief valve in the event of a winch cable break

If the winch cable breaks, the balloon climbs at an average rate of approx. 37 m/sec. This is with the minimum commercial load. At such rates of climb, it is assumed that the pilot would not be able to operate the electrical valve control system in a timely manner.

Given that at lift-off there is already an overpressure of 40 mm column of water (392 N/m2, eqivalent to 3.92 hPa) and that lift-off takes place at about 500 m above sea level, with the valve closed the envelope tears at a height between 1000 and 1430 m above sea level.

If the load is increased, the rate of climb is reduced. This increases the probability that the balloon pilot can intervene, as long as the valve can be opened using the electrical control system.

It should be noted that the above scenario describes a combined risk, i.e. the failure of two independent functions occurs virtually simultaneously.

1.18.2.4 Failure of the air pressure valve in the ballonet

1.18.2.4.1 The air pressure valve remains closed

The fan will bring the air pressure in the ballonet to 8 mm column of water; at this pressure the fan switches off.

1.18.2.4.2 The air pressure valve remains open

The spherical shape of the balloon is not maintained. The balloon's air resistance is increased.

The result is that the permissible wind speed values are reduced.

1.18.2.5 The fan does not work

Same result as para. 1.18.2.4.2

1.18.2.6 The fan remains switched on

The air pressure rises to 14 mm column of water and the ballonet pressure valve opens. If the ballonet pressure valve remains closed and the fan increases pressure in the helium section to 40 mm column of water, the helium relief valve opens.

It should be noted that the above scenario describes a combined risk, i.e. the failure of two independent functions occurs virtually simultaneously.

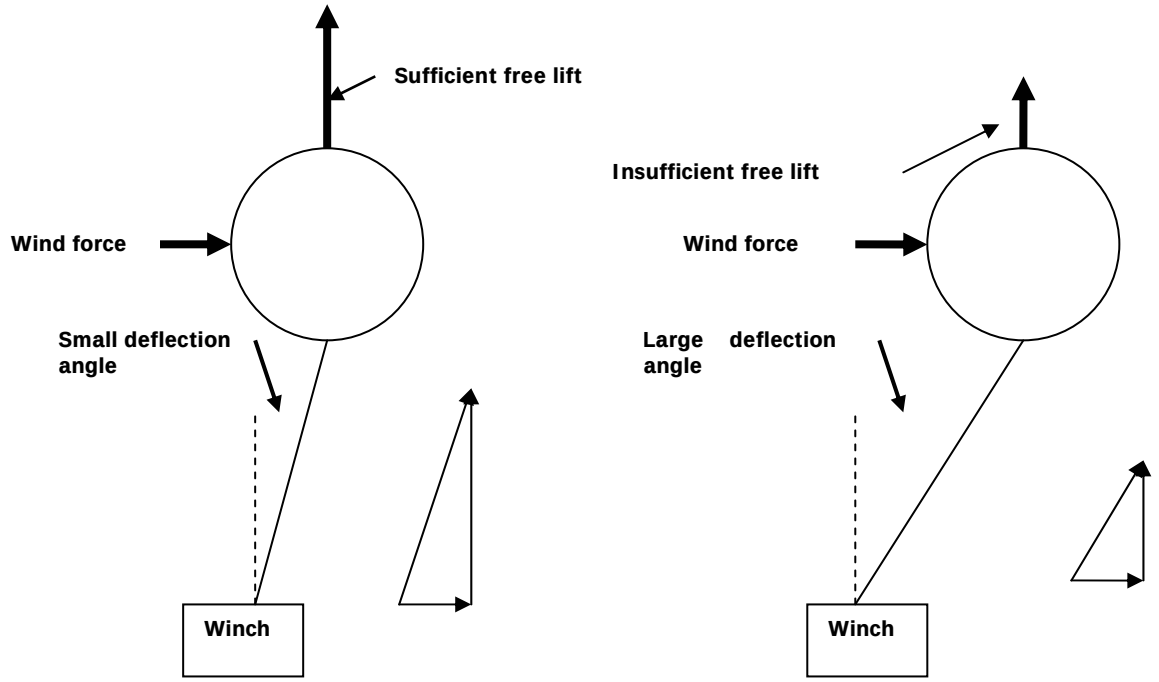
1.18.3 Winch cable deflection angle due to a side wind

At a deflection angle of approx. 32° against the vertical the winch cable makes contact with the inner octagonal structure of the gondola.

1.18.3.1 Winch cable deflection angle as a function of wind speeds and lifts

The manufacturer assumes laminal wind for an ascent. He does, however not allow ascents in the vicinity of thunderstorms or unstable weather conditions.

A cable length of 140 metres was assumed for the balloon deflection calculations. The following sketches show that for the same wind speed the deflection angle is dependent on the free lift:



The following table shows the resulting deflection angles at maximum allowable wind speeds and required minimum operating free lift:

Peak wind speed [kt]	Minimum operating free lift [tonnes]	Deflection angle [degrees]
0 - 5	0.9	0 - 2
5 - 10	1.2	1.3 - 5.3
10 - 15	1.6	3.6 - 8.1
15 - 20	2.2	5.5 – 9.7
20 - 25	2.8	7.4 – 11.5

2. Analysis

2.1 General aspects

According to Art. 11 of the decree on „special category aircraft“, tethered balloons require an approval by the FOCA which defines licensing standards and operational requirements.

2.2 Technical aspects

The winch operated correctly during the trip involved in the accident.

The HiFlyer system was maintained and serviced by the operator as prescribed by the manufacturer

In the event of low mooring the distance between the balloon envelope and the adjacent Rigihof comes to about 2.5 metres. This distance appears small but was stated to be sufficient by the manufacturer.

There are no indications that anything would not have functioned technically during operation within the parameters laid down by the manufacturer.

2.3 Risk of a cable break

As mentioned in para. 0.2.1, the manufacturer considers a scenario with a free ascent resulting from a cable break as unrealistic.

The manufacturer’s failure mode analysis mentions certain risks of the cable breaking, but does not address the following risks:

The damage to the cable which occurred during the ascent involved in the accident as well as the damage found on the occasion of the inspection by the IKSS on 05 June 2000 indicate that the balloon with passengers on board could have become separated from the winch (cable break). Closer attention must be paid to this scenario.

At the time of the ascent involved in the accident, which was carried out with insufficient free lift, gusty wind conditions prevailed. This caused the gondola and balloon to make dynamic movements and led, at a cable length of 40 m, to much greater deflection angles of the winch cable than would have occurred in the case

of a laminar flow. These gusty wind conditions had been notified by Meteo-Schweiz.

Although it seldom happens that unforeseen strong winds occur, such a phenomenon should not have fatful consequences for passengers.

The design of the gondola construction should prevent the cable and gondola from being damaged to such an extent that passenger safety is no longer guaranteed.

It is questionable whether the pilot's possibilities of intervention using the electrical control system are sufficient after a winch cable break. Opening the pressure relief valve on the helium side can indeed prevent the balloon envelope from bursting. However, the extent to which the rate of ascent can be controlled using the electrical controls and the height attained can be limited, and whether the HiFlyer can therefore achieve a controlled landing, should be examined as an additional item in the failure mode analysis.

The possibility of additional, mechanical-manual operation of the helium valve, which would permit the pilot to retain control over the ascent after a winch cable break and therefore increase safety, should be investigated.

A further risk of damage to the winch cable exists because of the insufficient separation between the balloon site and the surrounding buildings.

2.4 Operational aspects

The HiFlyer is a craft that demands appropriate training of operators in meteorological knowledge and decision-making besides the operation of the system.

Contrary to the manufacturers' instructions (cf. para 0. 2.3) the supervisor was trained to Level 2 and the balloon pilot to Level 1 not by the manufacturer but by the HiFlyer team leader (cf. para 1.5.1).

It is not unusual for the manufacturer to provide initial training to a company's instructors and for the latter to pass on their knowledge in their organisation. Such instructors, however, are authorised to do so by the manufacturer by means of a licence; this was not the case with the team leader.

On the day of the accident the crew were informed in the morning by a fax received from MeteoSchweiz that on that day thunderstorms with storm gusts were to be expected. Immediately before the ascent involved in the accident the crew had noticed the approach of a thunderstorm and had taken into account the possible increase in risk. It was decided that the supervisor pilot should conduct the next ride. Actions were agreed in case that the wind would increase markedly. Despite the wind warnings the ascent was planned and carried out in an noticably overloaded condition.

Since it was known that high wind speeds were predicted, the free lift would have had to be increased by reducing the number of passengers.

During his interrogation, one crew member stated that he himself had experienced wind speeds of 30 kt without anything happening. Such wind speeds are outside the permitted values.

The investigation showed that between 1 April and 23 July 2004, about 25% out of a total of 1448 trips took place in an overloaded condition (cf. para. 1.11).

Such a high number of trips in overloaded condition can no longer be explained by unexpectedly occurring wind speeds. However, if this were to be the explanation,

the applied planning procedure would be unsuitable or the number of passengers would have to be systematically reduced.

The comment by the IKSS inspection agency, two years before the accident, that even then the winch cable had been damaged by contact with the gondola must have made the HiFlyer crews and company management aware of the problem of overloaded ascents at higher wind speeds.

A better understanding of the effects of the weather and of balloon physics might possibly have prevented trips being carried out outside the limits.

Level 1 balloon pilot training did not include any meteorological training. The balloon pilot was not trained by the manufacturer.

The Level 2 training by the manufacturer does include training in meteorology, including an introduction to the specific local features of the weather. The supervisor pilot was not trained by the manufacturer.

The balloon is not licensed for trips in unstable weather conditions, i.e. in gusting winds or in the vicinity of thunderstorms.

A storm warning light, like the one installed at the nearby Lake of Lucerne (*Vierwaldstättersee*), was not present on the platform. Such a warning would have assisted the crew in their decision before the ascent.

Despite the situation described above, the crew were motivated to go ahead with the extra ride with the group that had travelled from India.

3. Conclusions

3.1 Findings

Technical aspects:

- There were no indications of pre-existing technical defects in the HiFlyer system.
- The daily inspections and the periodic inspections were carried out and documented according to the regulations.
- On the occasion of an earlier inspection of the winch cable a defect was found which might have been attributable to operation at high wind speeds or insufficient free lift.

Operational aspects:

- Operation of the HiFlyer was authorised by the FOCA subject to conditions.
- Contrary to the HiFlyer manufacturers' stipulations, not all members of the team were trained by the latter.
- The team members' obligations were governed by duty specifications.
- There were indications that even before the accident, ascents had been carried out outside the permissible wind speeds.
- Between 1 April and 23 July 2004 some 24% of all ascents were made in an overloaded condition.

- There was no wind warning lights in the vicinity of the HiFlyer site, such as the one installed at the Lido.
- The location of the HiFlyer platform close to buildings must be described as sub-optimal.

Sequence of the ascent:

- The condition that a supervisor pilot must be present at each ascent was fulfilled in the case of the ascent involved in the accident.
- There are no indications that the supervisor pilot, who was at the controls during the ascent involved in the accident, was in poor health.
- The ascent was made in a clearly overloaded condition.
- The HiFlyer crew had knowledge of the weather situation and must have considered the possibility of experiencing gusts of wind.
- During the accident, the winch cable was so badly damaged that there was a risk of the cable breaking.
- During the ascent, a floor panel became detached. One person fell to the ground and suffered fatal injuries.
- The on-board battery was no longer connected to the balloon controls. The supervisor pilot therefore no longer had any possibility of intervening.

3.2 Causes

The accident is attributable to the fact that on the occasion of an ascent in conditions with excessively high wind speeds and in an overloaded condition the gondola of the HiFlyer tethered balloon was damaged by the winch cable in such a way that a passenger fell to earth out of the balloon, suffering fatal injuries. Several passengers were injured.

The investigation determined the following causal factors for the accident:

- the crew's decision to carry out two extra trips, despite perceptibly critical weather conditions
- the crew carried out the ascent with too small amount of free lift.

The following factors contributed to the development of the accident:

- though the MeteoSchweiz wind warning had arrived by fax at the operations centre, it was not brought to the attention of the balloon pilots.
- the storm warning light at the Lido was blinking, however it could not be recognised by the crew. Two other storm warning lights were activated and would have been visible.

4. Safety recommendations

No. 333: It should be considered how commercial tethered balloon operations should be regulated in the future. Particularly, conditions for licensing and supervision should be defined in a clear manner.

No. 334: It is recommended that the VHS consider the installation of a storm warning light in the vicinity of the HiFlyer platform. This should illuminate at the same time as the light at the Lido.

No. 335: It is recommended that the VHS consider the installation of an anemometer at a higher location, e.g. on a building. A corresponding display on the platform would enable the HiFlyer crew to obtain a better impression of the prevailing wind.

No. 336: It is recommended that the balloon pilots and supervisor pilots hold a balloon pilot licence (*Ballonfahrerausweis*).

No. 337: It is recommended that the professional training of the balloon pilots be provided by the manufacturer. If the company's own instructors are used, these would have to be licensed by the manufacturer.

No. 338: It is recommended that the manufacturer of the HiFlyer check and improve the fixing of the floor panels in the gondola. In addition measures which reduce the risk of injury to passengers (e.g. cushioning) should be investigated.

No. 339: It is recommended that the manufacturer of the HiFlyer fit damping elements to the gondola and/or the winch cable in order to minimise the risk of damage to the cable at extreme angles of deflection.

No. 340: It is recommended that the manufacturer of the HiFlyer improve the electrical connection of the on-board battery to make an inadvertent interruption in power improbable.

No. 341: It is recommended that the manufacturer of the HiFlyer consider the development of an electronic overload warning which is also perceivable to passengers. This would have to incorporate the planned height of the ascent and the prevailing wind (recommendation 3) into the calculation.

No. 342: It is recommended that the manufacturer of the HiFlyer include the risk of a winch cable break into the HiFlyer failure mode analysis.

No. 343: It is recommended that the manufacturer of the HiFlyer examine the controllability of the HiFlyer in the event of a winch cable break. In particular, the electrical control system must be examined with reference to possible high rates of ascent or expected maximum heights. In the process, consideration should also be given to alternative control aids, such as the use of a mechanical-manual control feature, for example.

No. 344: The manufacturer of the HiFlyer should check whether subdividing the walkway into several sections would be appropriate. This would be designed to prevent the centre of gravity from shifting outside the permissible limits if passengers move about in the event of panic.

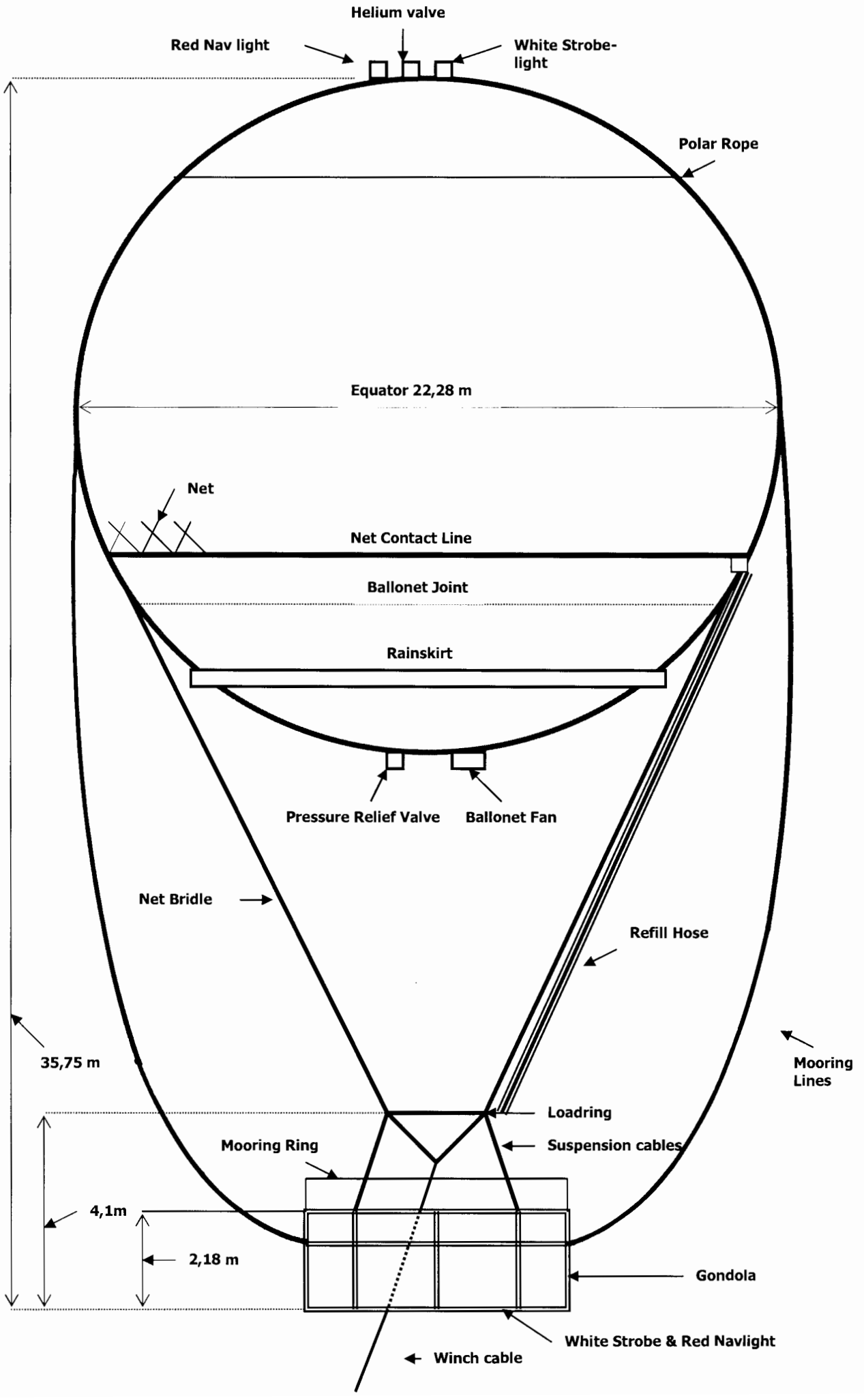
No. 345: It should be examined whether an ascent data logger should be installed to record the data over a specific period of time. In the case of the tethered balloon which is operated in Berlin (D), relevant data such as: free lift, helium pressure, wind speed, outside temperature, etc. are recorded over 24 months.

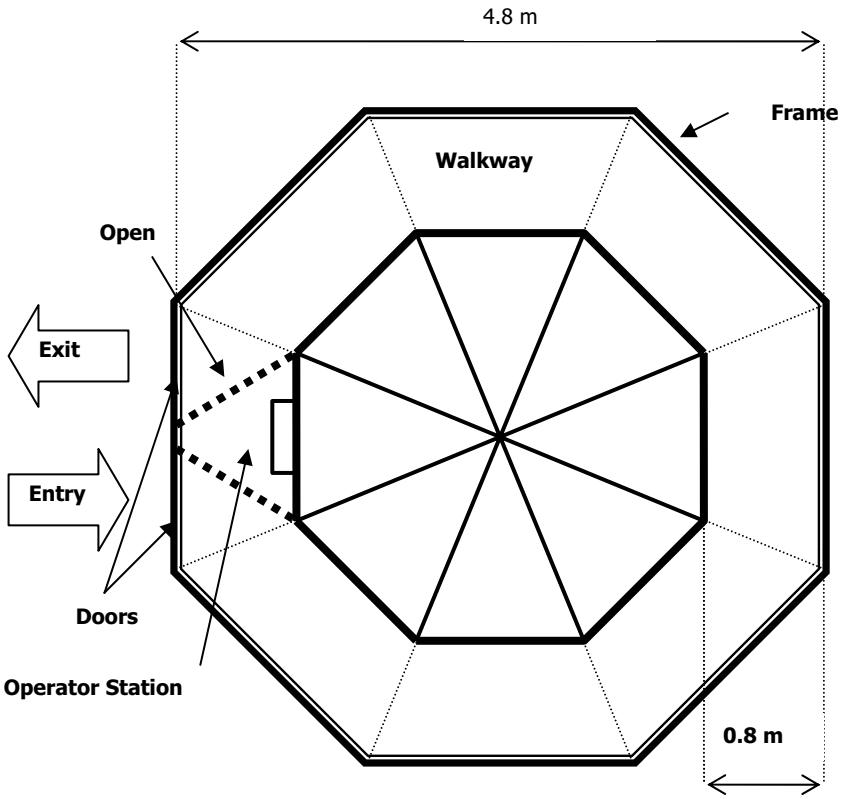
No. 346: If winter operations are envisaged, this must be included in a risk analyses (e.g. snow, icing, low temperatures for the electronics and lubricants).

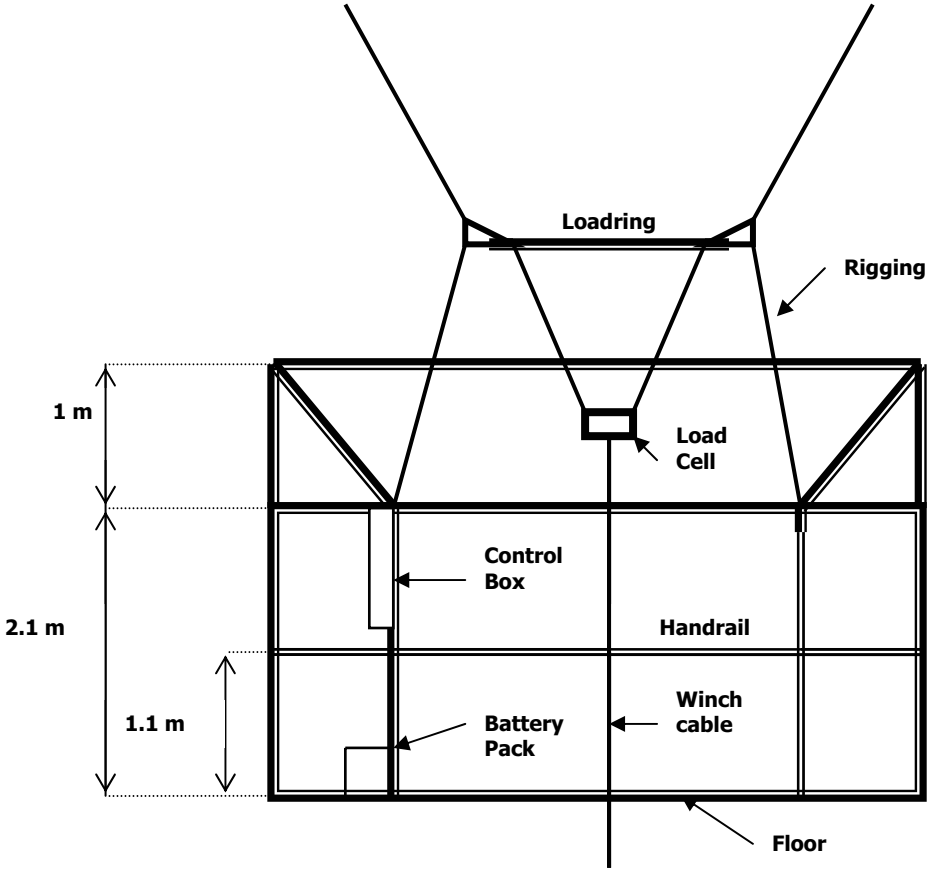
No. 347: The FOCA should check whether the strobe light system above the balloon and below the gondola is adequate to prevent collision with another flying object. If applicable, the installation of a transponder should be considered.

Berne, 24 February 2005 Aircraft Accident Investigation Bureau

This report has been prepared solely for the purpose of accident prevention. The legal assessment of accident causes and circumstances is no concern of the accident investigation (art. 24 of the Air Navigation Law)


Helium valve
Red Nav light
White Strobe-light
Polar Rope
Equator 22,28 m
Net
Net Contact Line
Ballonet Joint
Rainskirt
Pressure Relief Valve
Ballonet Fan
Net Bridle
Refill Hose
35,75 m
Mooring Lines
Loadring
Mooring Ring
Suspension cables
4,1m
2,18 m
Gondola
White Strobe & Red Navlight
Winch cable


4.8 m
Frame
Walkway
Open
Exit
Entry
Doors
Operator Station
0.8 m


Loadring
Rigging
1 m
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Handrail
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Pack
Winch
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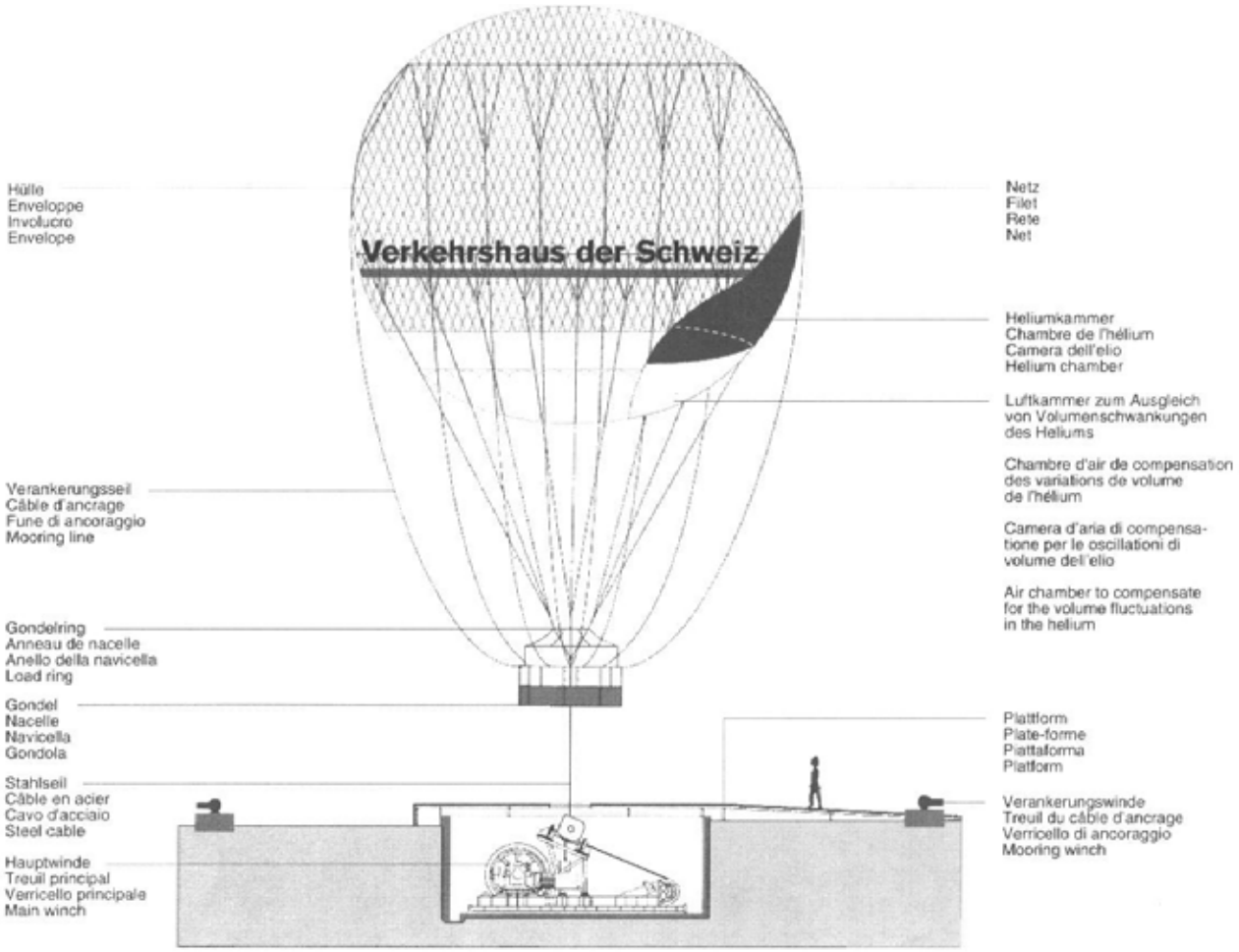
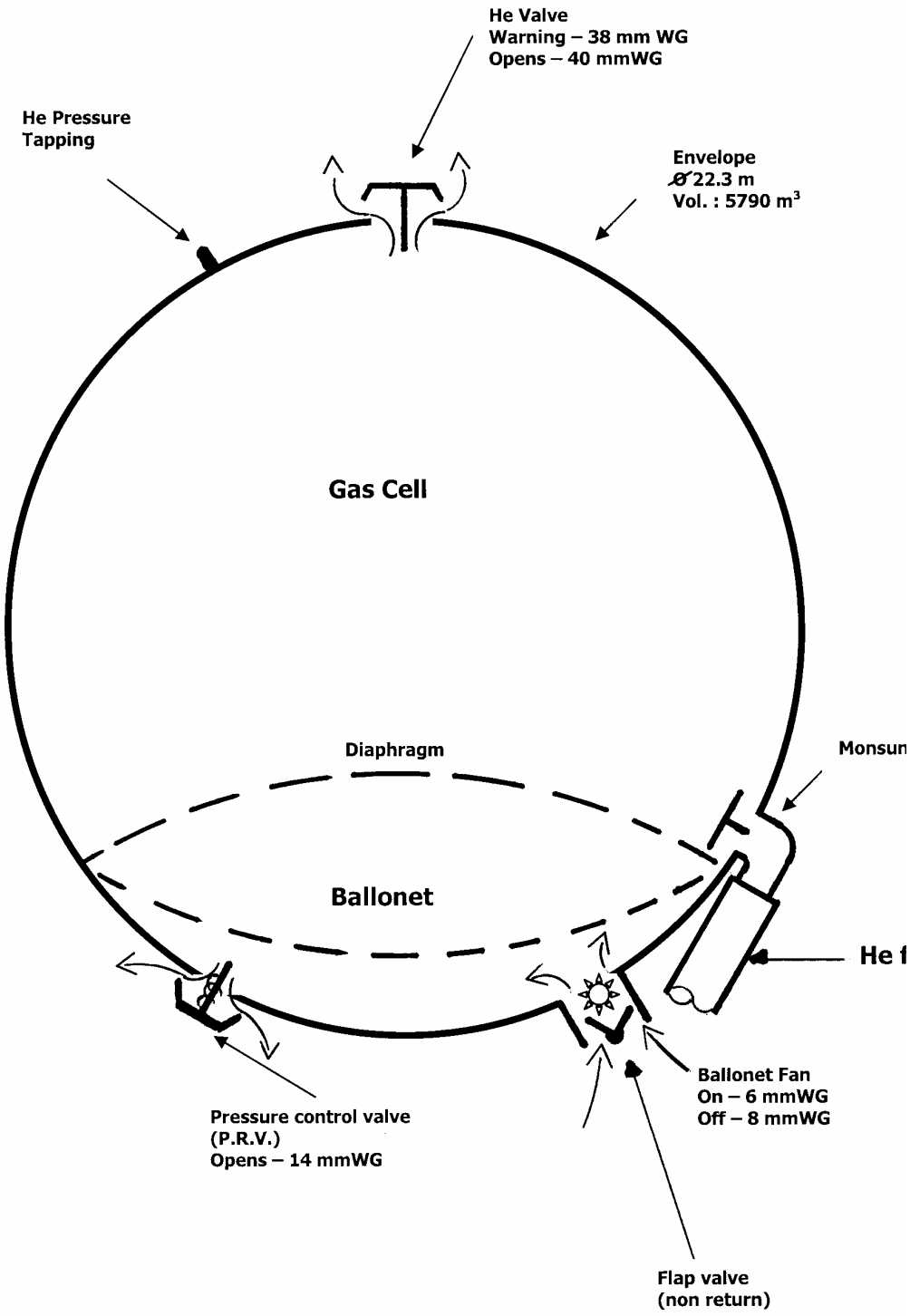


Technische Daten

Höhe insgesamt:	36 m
Durchmesser Hülle:	22,3 m
Volumen Hülle:	5790 m^3
Volumen Helium:	5215 m^3
Luftkammer (halbvoll):	575 m^3
Durchmesser Gondel:	5 m
Passagierkapazität:	max. 30 Personen
Durchmesser Stahlseil:	22 mm
Belastbarkeit Stahlseil:	50 Tonnen (Sicherheitsfaktor 10)
Aufstiegshöhe:	im Normalbetrieb 120 m, ausnahmsweise 140 m
Seilwinde:	elektrisch (Notstromaggregat als Reserve)
Zuggeschwindigkeit:	max. 40 m/min
Hersteller:	Lindstrand Balloons Ltd., Oswestry, England

Beilage 1.3



BALLOON PRESSURE CONTROL

TAGESLOGBLATT FUR PILOTE

Wochentag: Fr Datum: 23.07.2004 Crew: Fri / Kra

FLUG	Pax	Uhrzeit	HE Druck	BA Druck	Wind o. min/max		Wind u. min/max.		Freelift	B Volt	HE Temp	AM Temp	Vis. Pilot
											°C	°C	
TF	—	10.30	31.1	16.4	0	2	1	2	2.56	24	37.7	28.2	Fri
1	18	11.10	29.6	13.8	0	4	2	6	1.65	25	42.1	32.3	ekr
2	11	11.40	30.8	15.2	1	6	0	5	1.91	25	42.8	32.4	Fri
3	28	12.05	30.3	14.5	3	6	4	7	1.18	24.5	43.9	33.2	ekr
4	12	12.30	31.4	15.8	1	7	7	9	1.96	24.4	41.0	34.7	Fri
5	13	13.05	29.6	13.7	0	1	6	9	1.85	24.5	42.9	33.8	ekr
6	8	13.30	30.8	15.2	2	3	2	4	2.19	24.4	43.1	32.4	Fri
E 7	16	14.00	28.1	12.1	2	4	3	5	1.22	24.5	38.6	31.5	ekr
E 8+9	19	14.20	30.2	15.0	3	6	4	8	0.76	24.4	35.0	30.0	Fri
E 9	21												Fri
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Beilage 2

HIFLYER TECHNISCHES LOGBLATT (LBL-TA1)

LOGBLATT NR.:	
DATUM:	23.07.2004
ZEIT:	10.30

SEKTION 1 – INSPEKTIONEN VOR DEM FLUG

FORM LBL-TA2 (BALLON INSPEKTION)	OK / FEHLER	VISUM
FORM LBL TA3 (WINDEN INSPEKTION)	OK / FEHLER	VISUM

Sollte die Inspektion an irgendeiner Komponente fehlerhafte Resultate ergeben, muss der Defekt auf einem Schadensformular reportiert werden.

Die Arbeiten müssen unterbrochen werden bis der Defekt behoben ist

DEFEKT NR.	DEFEKT BEHOBEN	BESTÄTIGT (von supervisor)
	JA / NEIN	
	JA / NEIN	
	JA / NEIN	

HIFLYER BEREIT FÜR TESTFLUG	JA / ~~NEIN~~
UNTERSCHRIFT	

SEKTION 2 – FLUGBEDINGUNGEN

BODENBEOBACHTUNGEN

WIND

GESCHWINDIGKEIT	2 ktn
RICHTUNG	√W

DRUCK

HELIUMZELLE	29.7 Mm W.G
BALLONET	13.7 mm W.G

TEMPERATUR

HELIUMZELLE	37.7 °C
UMGEBUNG	26.6 °C

AUFTRIEB

UNBELADEN	3.√3 t

BATTERIEN

SPANNUNG	2√ Volts

WETTERPROGNOSE

ERHALTEN VON	FHA
ZEIT	06.20
GÜLTIG AB	06.30

AUF FLUGHÖHE

WIND

GESCHWINDIGKEIT	0 ktn
RICHTUNG	√W

DRUCK

HELIUMZELLE AUF 120m	31.7 mm W.G

TEMPERATUR

HELIUMZELLE	37.7 °C
UMGEBUNG	28.3 °C

AUFTRIEB

AUFGESTIEGEN	2.√6 t

BAROMETERDRUCK	— mbar

BEDINGUNGEN HEUTE INNERHALB DER BETRIEBSLIMITEN	JA / ~~NEIN~~
UNTERSCHRIFT	

Ich bin davon überzeugt dass der HiFlyer für seine heutigen Operationen bereit ist und erkläre, dass die Flugbedingungen innerhalb der vorgegebenen Limiten liegen, wie es im Operationshandbuch beschrieben wird (LBL TAOM).

MAX. ANZAHL PASSAGIERE PRO FLUG	22

SUPERVISOR UNTERSCHRIFT	

SEKTION 3 - BETRIEBSINFORMATION

3.1 FLUGINFORMATIONEN

ANZAHL FLÜGE (LETZTE SCHICHT)	
ZWISCHENTOTAL	

ANZAHL PASSAGIERE (LETZTE SCHICHT)	
ZWISCHENTOTAL	

3.2 HELIUM NACHFÜLLEN

HINZUGEFÜGTES HELIUM	m^3

AUFTRIEB VOR DEM AUFFÜLLEN	t
AUFTRIEB NACH DEM AUFFÜLLEN	t

LBL-TA3 FORMULAR FÜR DIE TÄGLICHE WINDEN-INSPEKTION

DATUM: 22.07 2004

	OK / FEHLER	DEFEKT NR.
Kabel		
Keine ausgefransten oder losen Drähte, speziell auf Abnutzung prüfen, sich Stück für Stück vom Schwenkkopf bis hinunter zur Winde vorarbeiten	✓	
Die gesamte auf der Windentrommel liegende Kabellänge überprüfen	✓	
Den Sitz des aufgerollten Kabels in den Rillen der Trommel vom Ende der Trommel bis über ihre ganze Fläche prüfen, auch den Sitz auf den Hilfsrollen	✓	
Hydraulik		
Die Bremsleitungen und das Antriebsaggregat für die Hydraulik auf Lecks überprüfen	✓	
Vor dem Anlassen des Hauptstroms prüfen, dass die Scheibenbremsen der Hauptverbindung gezogen sind. Bem.: Sind sie es nicht, können die Bremsflächen leicht bewegt werden.	✓	
Führrolle		
Die Kabelrille auf der Führrolle nach Schäden oder Einkerbungen absuchen. Es sollte keine Einkerbungen tiefer als 3mm (0.125 ")geben.	✓	
Startposition der Führrolle überprüfen. Die Seite der Scheibe sollte mit dem tieferen Begrenzungsschalter in Kontakt stehen, ihn aber nicht aktivieren.	✓	
Prüfen, ob das Gewinde der Führrolle genügend gefettet ist und nicht mit Split etc. beschmutzt ist	✓	
Das Gewinde der Führrolle testen indem man versucht, sie auf ihrer Achse hin und her zu schieben. Dies sollte nicht möglich sein.	✓	
Kabelführungsanlage		
Die Eingangsrollen auf Schäden oder Abnutzung prüfen. Wieder sollten dort keine Kerben tiefer als 3mm sein.	✓	
Die Bewegung der Kabelführungsanlage prüfen; die Bewegung sollte frei und leicht von der Hand gehen wenn das Gegengewicht von Seite zu Seite geschoben wird. Die beiden Deckungen sollten ohne Mühe vor und zurück bewegbar sein.	✓	
Die Ausgangsrollen auf die gleiche Weise wie die Eingangsrollen auf Schäden oder Abnutzung prüfen.	✓	
Generator		
Generator-Funktionscheck: Einschalten und drei Minuten laufen lassen.		
Gehäuse Kabelführungsanlage		
Kabelanordnung auf der Rolle kontrollieren	✓	
Windengehäuse		
Sicherstellen dass sich kein Wasser angesammelt hat	✓	
Sicherstellen dass sich keine losen Teile innerhalb des Windengehäuses befinden	✓	

INSPEKTION DURCHGEFÜHRT VON	
BESTÄTIGT VON (SUPERVISOR)	

LBL-TA2 FORMULAR FÜR DIE TÄGLICHE BALLON-INSPEKTION

DATUM: 23.07.2009

Die folgenden Systeminspektionen müssen täglich vor dem Beginn von Passagierfahrten durchgeführt werden.
Jedweicher Defekt muss mit einem Schadensformular reportiert werden (LBL-TA6)
Es dürfen keine Arbeiten beginnen solange der Defekt nicht behoben oder der HiFlyer nicht für betriebsbereit erklärt wurde.

		OK / FEHLER	DEFEKT NR.
Inspektion der Ballonhülle	Feldstecher (7 x 50) benutzen, Hülle und Netz überprüfen		
Hülle	Kein Schaden	✓	
	Keine Deformation	✓	
Netz und Takelage	Netz liegt zentral auf Hülle	✓	
	Nicht verzerrt	✓	
	Keine gerissene Stränge	✓	
	Keine ausgefransten Zaumseile	✓	
Helium Nachfüllschlauch	Nicht beschädigt und an der Hülle angeschlossen	✓	
Takelage			
Lastenring	Keine Verdrehung / Verzerrung	✓	
Lastenring Takelage	Keine ausgefransten Leinen oder beschädigte Zwingen, intakte Metallringe	✓	
Ringschrauben	Mit Muttern festgemacht und mit Splint gesichert	✓	
Hauptverbindungen, Laschen	Festgemacht und verriegelt	✓	
Lastenvorrichtung	Verbindungen zu Hauptknoten und Schwenkkopf gesichert Anschluss Hauptleitungen , Funktion Messwerte auf der Schalttafel	✓	
Gondel			
Rahmen und Reling	Nach Verdrehungen und Schäden absuchen	✓	
Laschen	Zustand, Schweißnähte nach Brüchen absuchen	✓	
(Gondel/Leitungsbefestigungen)		✓	
Türen	Verzerrungen, Klinkenfunktion	✓	
PVC Abdeckungen	Zustand	✓	
	Keine Schnitte	✓	
	Keine fehlenden Ösen	✓	
	Schnürung intakt	✓	
Sicherheitsnetze	Keine gerissenen Stränge	✓	
	Schnürung intakt	✓	
Hauptwinde starten und die Gondel etwa 1.5m hoch steigen lassen Notfallknopf drücken um die Winde zu verriegeln und die Bremsen betätigen während die Unterseiten-Inspektion durchgeführt wird.			
Unterseite	Nach Verzerrungen / Schäden absuchen	✓	
Bodenplatten	Zustand und Sicherheit	✓	
Stossdämpfer	Intakt	✓	
Schalttafel für Ballonkontrolle			
Batterieladegerät	Ausschalten, Leitung zur Batteriebox trennen	✓	
Fernsteuerungsvorrichtung	An Bord und vollständig geladen	✓	
Batteriepack	In der Gondel an ihrem Platz angebracht	✓	
	Kontrolleitung angeschlossen	✓	
	genügend geladen	✓	
Heliumventil	Ventilschalter auf Automatic gesetzt	✓	
	Schalter für manuelle Steuerung auf „closed"	✓	
	Grünes Verriegelungslicht an	✓	
	Drucklimiten richtig gesetzt	✓	
Ballonetgebläse	Knopf für Gebläse auf Automatic	✓	
	Drucklimiten korrekt gesetzt	✓	
Schutzschalter	Alle ein, keine Fehlfunktionen	✓	
Verankerungsinstrumente	Temp.-Anzeige, Windgeschwindigkeit und Messwerte der Lastenvorrichtung funktionieren	✓	
Türen	Anzeigen funktionieren	✓	
Stecker / Verbindungen	Alle ordentlich platziert	✓	
Verankerungsausrüstung			
Spannsets	Auf extreme Ausfransung absuchen	✓	
	Schaden, Verzerrung, Abnutzung am Ratschenmechanismus	✓	
Karabiner	Schaden, Verzerrung, Abnutzung	✓	
Ankerpunkte	Vollständig befestigt	✓	
	Keine Schäden oder Verdrehungen	✓	

Inspektion durchgeführt von:	
Bestätigt von: (supervisor)	

28/07 2004 12:42 FAX 0413708027 VERKEHRSHAUS-DER-SCHWEIZ 001

****
*** JOURNAL ***
****

ANF.ZEIT	TEL/NAME	GEGENSTELLE	NR.	MODUS	S.	ERGEBNI
*17/07 09:32	METEO	0900554323	0027	ABRUFEMPFANG G3	1	OK 01'
			*5018			
*17/07 18:42	012650057		5019	AUTOMAT. EM G3	1	OK 01'
*17/07 21:26	012650031		5020	AUTOMAT. EM G3	1	OK 01'
*18/07 10:35	METEO	0900554323	0028	ABRUFEMPFANG G3	1	OK 01'
			*5021			
*19/07 07:07	METEO	0900554323	0029	ABRUFEMPFANG G3	1	OK 01'
			*5022			
*20/07 09:11	METEO	0900554323	0030	ABRUFEMPFANG G3	1	OK 01'
			*5023			
*20/07 17:16	COMUNOVA BUCHS	0628248758	0031	SENDEN ECM	1	OK 00'
*21/07 09:29	METEO	0900554323	0032	ABRUFEMPFANG G3	1	OK 01'
			*5024			
*22/07 00:40	012650059		5025	AUTOMAT. EM G3	1	OK 01'
*22/07 04:54	012650032		5026	AUTOMAT. EM G3	1	OK 01'
*22/07 09:06	METEO	0900554323	0033	ABRUFEMPFANG G3	1	OK 01'
			*5027			
/07 09:22	METEO	0900554323	0034	ABRUFEMPFANG G3	1	OK 01'
			*5028			
*23/07 09:34	012650031		5029	AUTOMAT. EM G3	1	OK 01
*23/07 09:35	012650057		5030	AUTOMAT. EM G3	1	OK 01
*23/07 13:53	012650030		5031	AUTOMAT. EM G3	1	OK 01
23/07 15:38	012650056		5032	AUTOMAT. EM G3	1	OK 01
24/07 02:21	012650060		5033	AUTOMAT. EM G3	1	OK 01
24/07 03:22	012650055		5034	AUTOMAT. EM G3	1	OK 01
27/07 10:23	STAMPFLI HEINZ A	0326133498	0035	SENDEN ECM	1	OK 00
28/07 12:09	METEO	0900554323	0036	ABRUFEMPFANG G3	1	OK 01
			*5035			

Wind für Ballon, Delta, Gleitschirm

Ausgabe vom 23 Juli 2004, 05.50 Uhr

MeteoSchweiz
Sign: kim

Messwerte von *MeteoSchweiz* von 5:20 h

Station	mittl Wind		Böen	TT	Höhe
Einheiten	Grd	Kt	Kt	Grd	m/M
Genève	280	2	9	20	420
Neuchâtel	40	1	6	19	485
Fahy	190	4	6	21	596
Möhlin	110	3	3	***	340
Rünenberg	360	0	0	21	610
Bern	220	2	4	19	565
Wynau	80	2	3	19	422
Buchs-Suhr	180	0	4	19	387
Zürich-SMA	90	0	1	20	556
Tänikon	230	2	4	18	536
Schaffhausen	210	1	3	19	437
Hüttingen	210	3	6	19	440
St. Gallen	170	4	5	20	779
Altdorf	120	3	11	20	449
Chur	10	1	5	19	555
St.Chrischona	110	7	8	23	742
Lägern	180	6	10	20	868
Uetliberg	210	4	7	22	1043
Bantiger	290	3	5	22	1125
Hörnli	200	11	17	19	1138
Napf	310	4	9	18	1406
Chasseral	210	25	30	16	1599
La Dôle	230	15	20	16	1670
Moléson	280	9	18	14	1972
Pilatus	280	10	11	13	2106
Gütsch	360	9	10	12	2287
Säntis	230	7	13	11	2490
Weissfluhjoch	340	20	29	9	2690
Eggishorn	250	6	9	9	2893
Jungfraujoch	320	5	17	4	3580

Ausgabe je um 4.00, 5.45, 10.30, 14.00, 16.30 Uhr

QNH - Luftdruck von 5:20 h

Genève	1021	hPa
Basel	1018	hPa
Zürich	1020	hPa
Stuttgart	1018	hPa
Milano	1017	hPa

Radiosonde Payerne 02 h

Höhe	Grd	Kt	TT	TP
Boden				
750 m				
1500 m				
2000 m				
3000 m				
4000 m				
5500 m				

Windvorhersage für 11 h

Region	1500 m	3000 m
Basel	270 / 15	250 / 20
Payerne	250 / 15	260 / 20
Zürich	260 / 20	250 / 20
Moléson	240 / 10	260 / 15
Napf	250 / 15	250 / 15
Säntis	270 / 10	250 / 20

Windentwicklung Mittelland in der Grundschicht.	variabel 2-5 kt. Im Laufe des Vormittags WSW 5-10 kt. In Schauer und Gewitternähe Sturmböen möglich!	
Thermik (zwischen 12^{00}-18^{00} Uhr) Cu/Sc Menge und Basis:	**Flachland:** mässig 2-4/8 Cu/Cb, 1500-2000 m + Ac/Cl	**Berge** (Alpennordrand) mässig 3-5/8 Cu/Cb, 2500-3000 m + Ac/Cl
Gefahren: Fronten/ Gewitter/ Turbulenz:	Anfangs Morgenthermik mit z.T. kräftigen Schauern/Gewittern. Dann Beruhigung und Übergang zu ziemlich sonnigem Wetter. Nachmittags wieder Schauer/Gewitter	
Besondere Hinweise / Talwind:	Bei Niederschlag tiefere Basis/red. Sicht	Talwind: 6-12 kt

Ballon-, Delta, Gleitschirmprognose (Fr. 2.00/Min) Fax 0900 162 323
Flugwetterprognose täglich 06.45 und 13.00 Uhr über Tonband (Fr. 1.00/Min.) Telefon 0900 162 121
Windprognose und Warnung auf Natel-Display (SMS): Übersicht auf Fax (Fr. 1.50/Min.) Fax 0900 162 234
Ballon-, Delta, Gleitschirmprognose auf Internet http://www.meteoschweiz.ch/de/Freizeit/Flugsport/IndexFlugsport.shtml
Hot Line für Hilfe bei Abrufproblemen täglich 00 - 24 Uhr Telefon 01 256 99 99

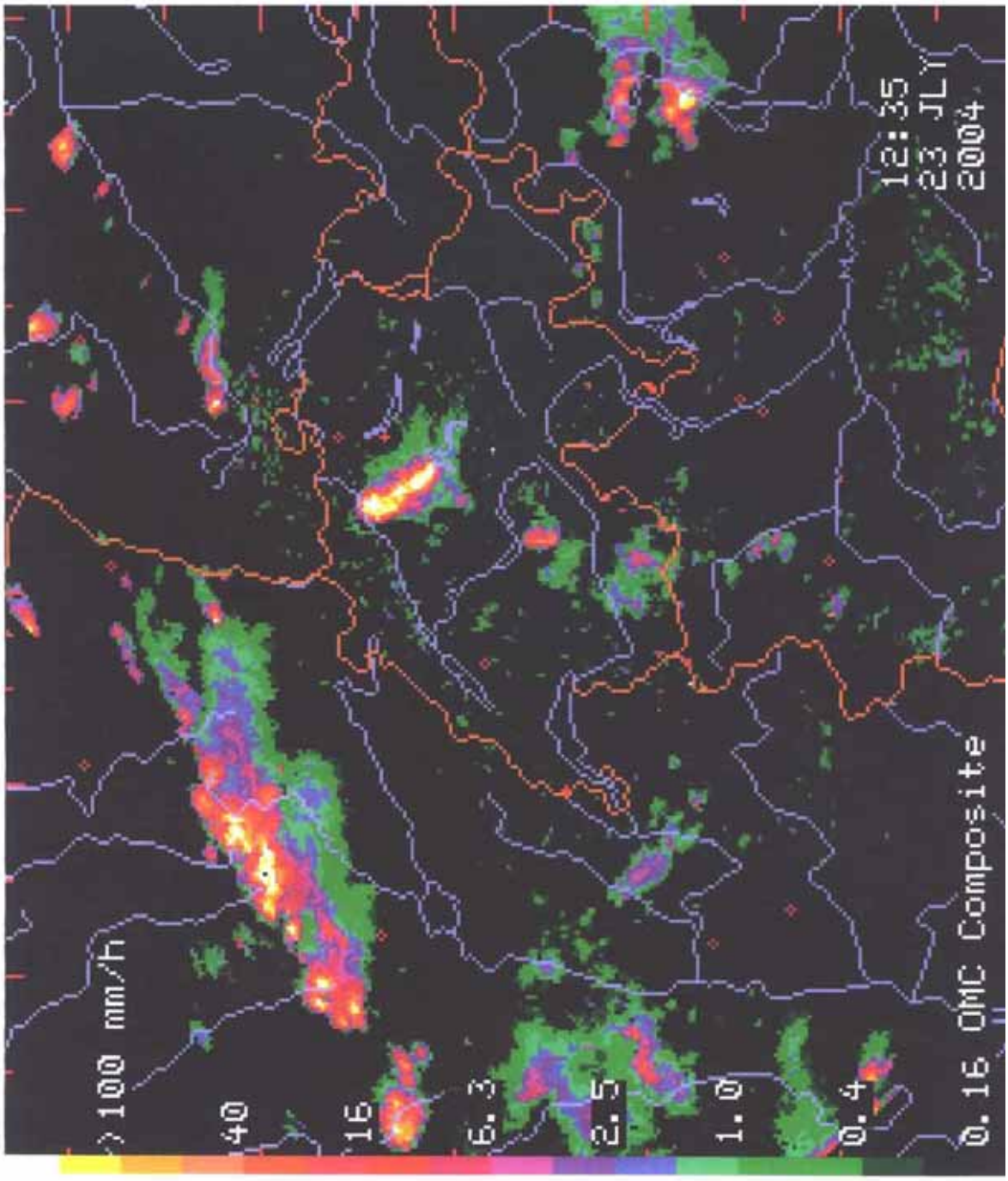
Anregungen und Kritik an: *MeteoSchweiz* Fax 01 256 95 55 E-Mail wetterdienst@meteoschweiz. ch


017207.jpg

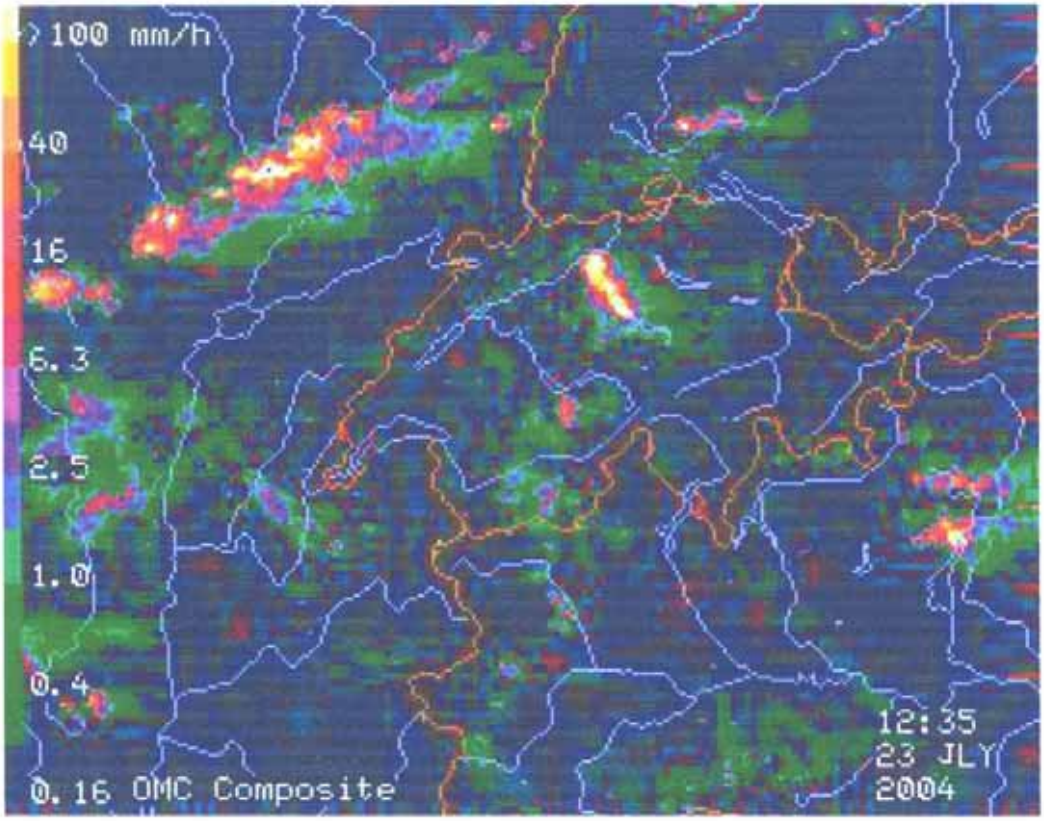

017225.jpg

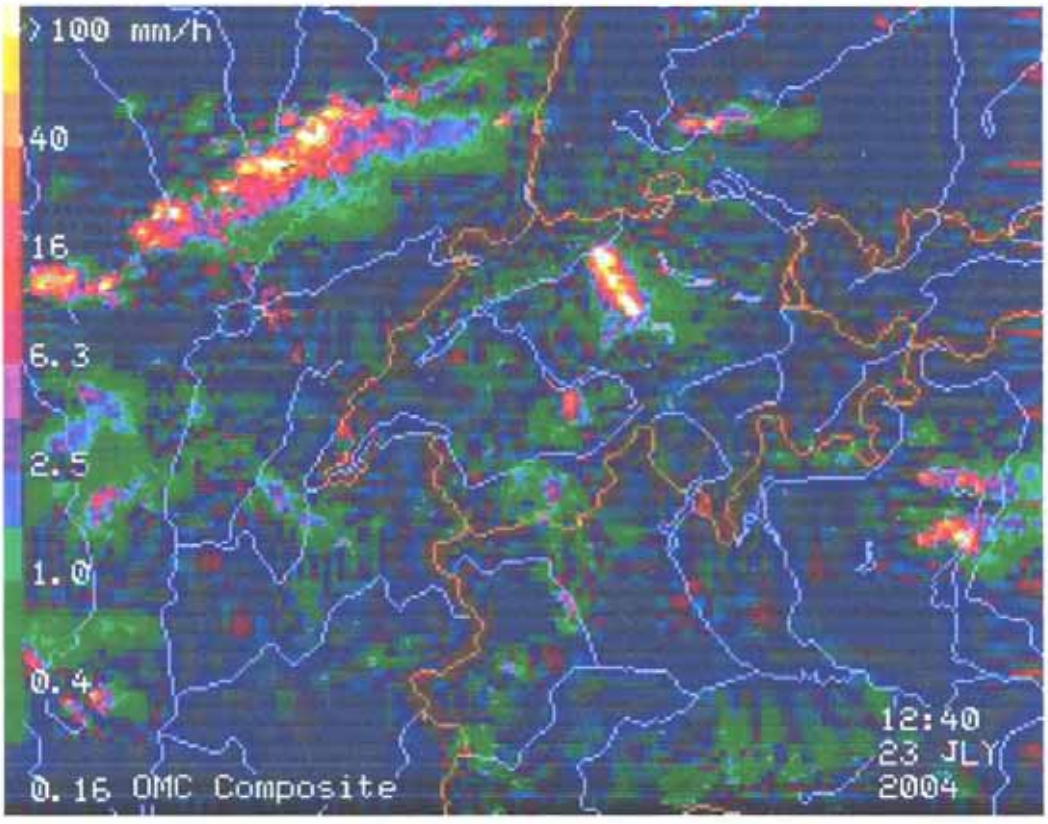
Beilage 6

Beilage 7.1



Radarbilder, 23. Juli 2004, 1235 + 1240 UTC





MeteoSchweiz

Windwarnung für die Region Luzern

Vorsichtsmeldung für die Region **Luzern**

ausgegeben am Freitag, 23. Juli 2004, 13:51 Uhr

Betroffene Seen/Flugplätze:

Vierwaldstättersee

Sarner- und Alpnachersee

Erwartete Windstärke:

25-33 Kt (46-61 km/h)

Erwartete Windrichtung:

Südwest

West

Weitere Hinweise:
Gewitterböen

Definition:
Vorsichtsmeldung: falls Windspitzen von 25 Kt oder mehr möglich sind.
Sturmwarnung: falls Windspitzen von 25 Kt oder mehr mit grosser Wahrscheinlichkeit zu erwarten sind.

KANTON LUZERN
Sicherheitsdepartement

Kantonspolizei Luzern
Wasserpolizei Luzern

Sturmwarndienst Vierwaldstättersee / Sempachersee

Bericht über Wetterwarnmeldungen / Nr. 54

A ***Eingang der Meldung*** Datum 23.07.04 Zeit 1351

Meldung von Meteo CH

B ***Inhalt der Meldung***

☐ Orientierung

☒ Vorsichtsmeldung

☐ Sturmwarnung

Entgegengenommen durch **XXXXXXX**

C ***Massnahmen***

Ein/Aus - Schaltzeiten der Warnleuchten	*Vorsicht*		*Sturm*	
	Ein	Aus	Ein	Aus
☒ Leuchte **Lido**	1403	1550h		
☒ Leuchte **Altstatt**	1403	1550h		
☒ Leuchte **Obermatt**	1403	1550h		
☐ Leuchte **Sursee**				
☐ Leuchte **Nottwil/Eggerswil**				

D ***Weitermeldung***

Zeit: **Meldeempfänger:**

1408 Wasserpolizei Luzern (*Sommermonate Meldung an Pikettperson*) **XXXXX**

E ***Übermittlung des Formulars an Wapo Luzern nach Beendigung der Warnphase***

Datum: 23.07.04 Zeit: 1550

Übermittelt durch: **YYYYYY**

Verteiler

Ende der Windwarnung für die Region Luzern

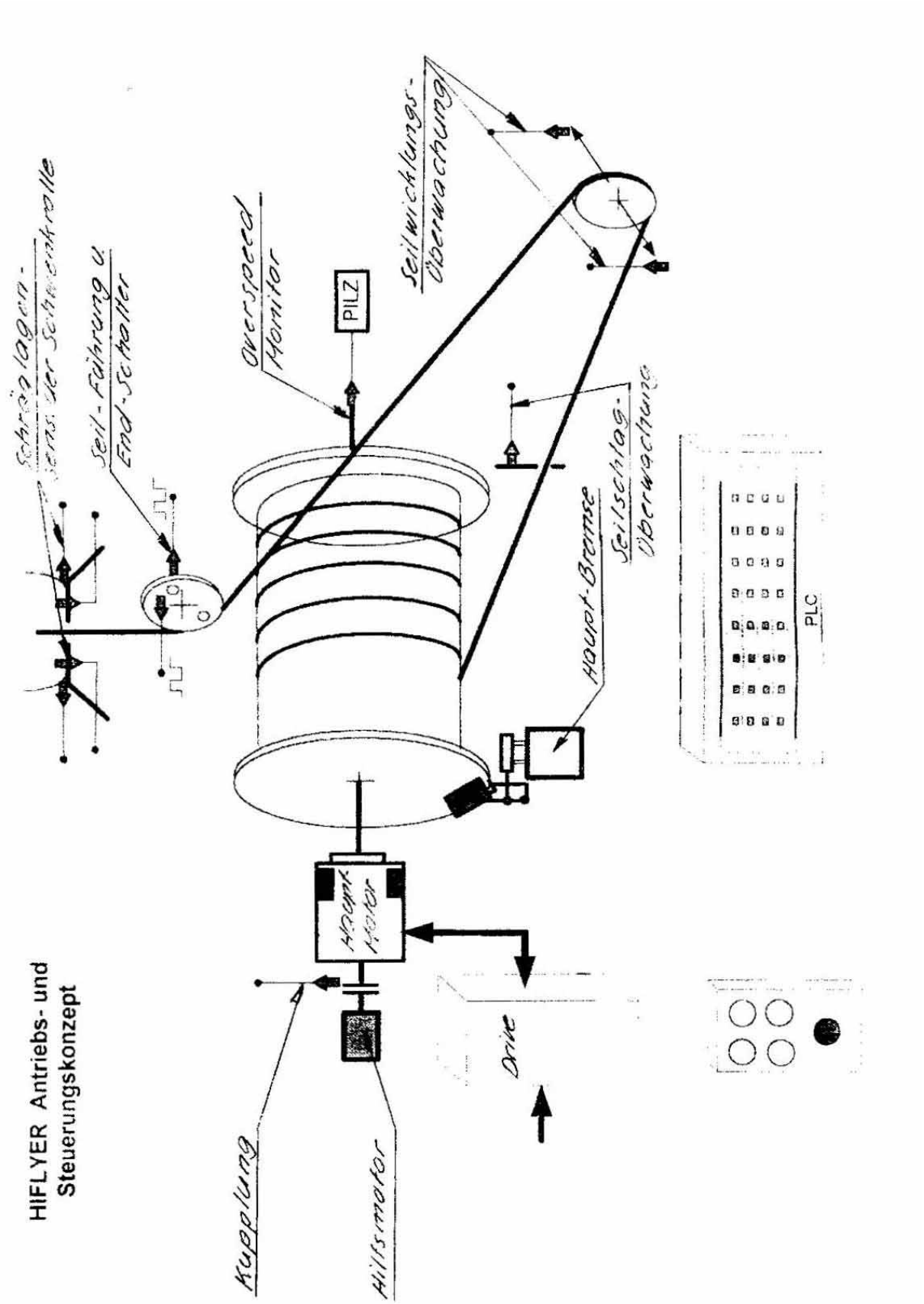
ausgegeben am 23.07.2004 15:40:05

Mit freundlichen Grüssen

Der Dienstmeteorologe

Beilage 9

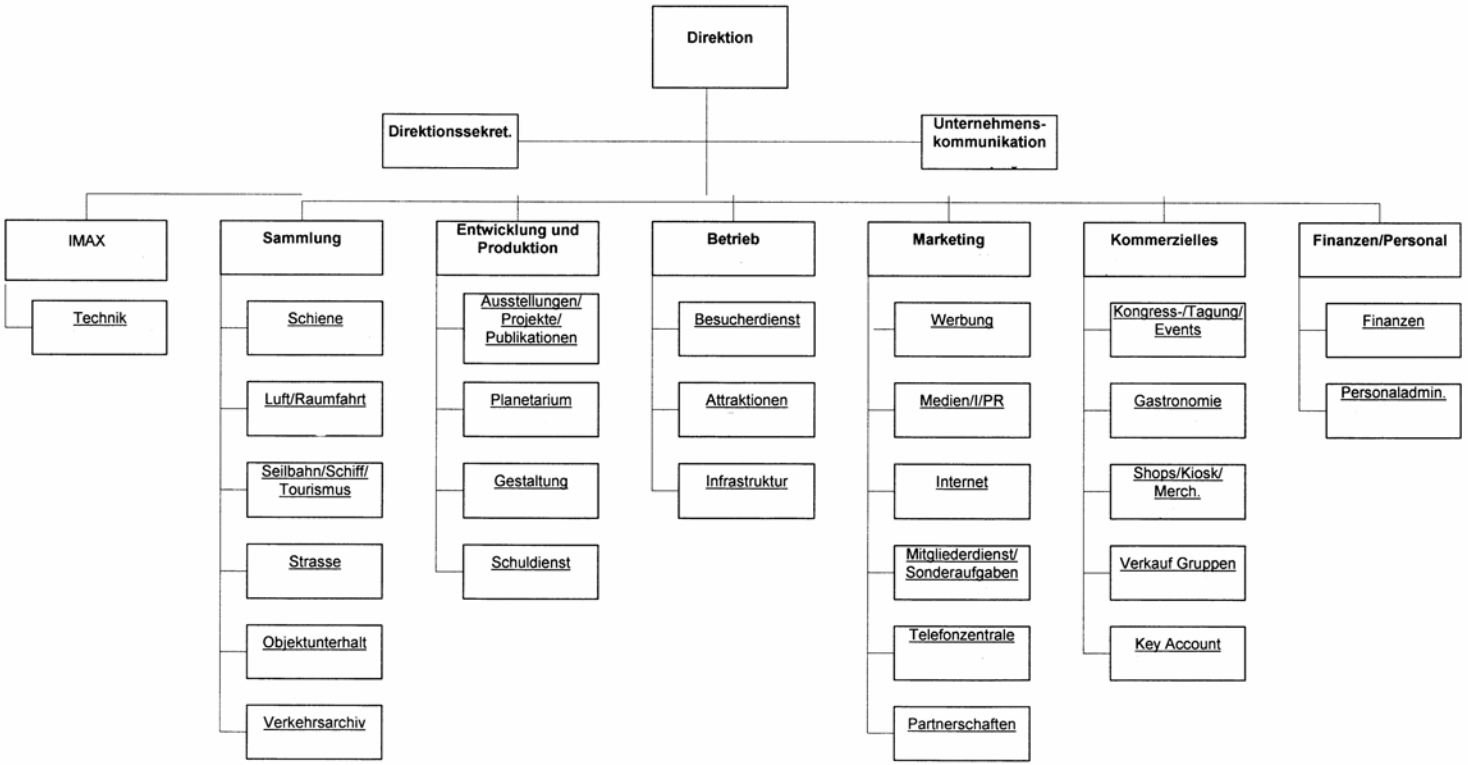

Heidenstrasse
Lidostrasse
Restaurant Rigihof
Standort des HiFlyer


HIFLYER Antriebs- und Steuerungskonzept
Schräglagen-
Seil-Führung u.
End-Schalter
Overspeed
Monitor
PILZ
Seilwicklungs-
Überwachung
Haupt-Bremse
Seilschlag-
Überwachung
PLC
Drive
Kupplung
Hilfsmotor

Strategieumsetzung: Organigramm neu

Organigramm VHS

1. Juni 2003



Pflichtenheft

Name:

Stelle:	**Teamleiter Hiflyer** /		**10%**
	Supervisor und Pilot (siehe Anhang 1)	**70%**	
	Hauswart (siehe Anhang 2)		**20 %**

1. Aufgaben und Verantwortung

Der Einsatzleiter steht im Mittelpunkt des täglichen Geschehens. Er ist verantwortlich für den reibungslosen Betrieb im Verkehrshaus. Er koordiniert, begleitet und betreut auch die Anlässe des Tagungszentrums und ist mindestens anwesend, solange sich Besucher oder Kunden im Verkehrshaus aufhalten. Im Tagesgeschäft trifft er die notwendigen Dispositionen für einen optimalen Personaleinsatz und Betrieb der Ausstellungen und Attraktionen und ist für einen hervorragenden Service gegenüber Besuchern und Kunden verantwortlich.
Er ist Anlaufs- und Koordinationsstelle bei Störungen aller Art sowie bei besonderen Vorkommnissen und Notfällen.

Als Teamchef ist er zudem verantwortlich für:

- vorausschauende Einsatz- / Personalplanung
- Koordination und Moderation der Teamsitzungen
- Bei Bedarf Koordination mit internen Abteilungen
- Budgetkontrolle Ausgaben/Einnahmen

2. Pflichten

- Gewährleistet in der Funktion als Teamleiter den reibungslosen Betrieb der Fesselballonanlage.
- Ist zuständig für die Koordination zwischen internen Schnittstellen.
- Ist verantwortlich für einen der Besucherfrequenz angepassten optimalen Personaleinsatz.
- Veranlasst Zusatzinformationen an Besucher und Kunden in besonderen Situationen.
- Überwacht und instruiert die für den Betrieb definierten Sicherheitsvorschriften
- Qualitätsstandards
- Führt die entsprechenden Checklisten und Rapporte gewissenhaft nach.
- Arbeitet bei Notfällen optimal mit dem Kadersupport zusammen und kennt die Notfallprozeduren

3. Besondere Pflichten

- Als Teamchef Hiflyer ist er zuständig für Information, Support, Coaching sowie Qualifikation der ihm unterstellten Mitarbeiter
- Sicherstellen des täglichen Betriebes inkl. Personenschutzes
- Steigerung der Betriebsqualität durch Schulung des Teams
- Planung und Koordination der Unterhalts und Revisionsarbeiten

4. Mitsprachemöglichkeiten

In allen Fragen den Verantwortungsbereich betreffend, insbesondere auch für Qualitätsstandards, Sicherheit, Aus- und Weiterbildungsmassnahmen und Besucherinformation

5. Organisatorische Beziehungen

Vorgesetzter:	Leiter Besucherservice
Stellvertreter:	Situativ nach Absprache
Unterstellte MA:	Hiflyer Crew
Rapporte:	HF Teamkoordination KT/ Gastro Koordination situativ Infrastrukturmeeting situativ

6. Kompetenzen

Unterschrift:

Einkaufskompetenzen:

Spesenregelung: nach Aufwand

Lohnfestlegung für Mitarbeiter: Vorschläge an Vorgesetzten

7. Spezielles

Dieses Pflichtenheft wird jährlich überprüft und eventuellen Änderungen angepasst.

Verkehrshaus der Schweiz

Abteilungsleiter	Stelleninhaber
.....	.....

Direktion

.....

Airworthiness Requirements for Manned Tethered Gas Balloons for Passenger Transport

References:

- Announcement: NfL II - 99/97
- Publication in Bundesanzeiger: BAnz. page 10 469, No. 152
- Effective date: 17. August 1997
- Amendments: none

Translation has been done by best knowledge and judgement. In any case the officially published text in German language is authoritative

FOREWORD

1. Subject

The LFGB are confined to technical stipulations. As far as the procedures and conditions for type investigation and certification are concerned, it is thus necessary to refer to the relevant provisions in the Luftverkehrsgesetz (Air Navigation Act) and the associated ordinances.

2. Numbering system

In the numbering system used, a paragraph number is assigned to each independent requirement. The numbering system as well as the subdivision into the subparts

A - General

B - Flight Requirements

C - Strength

D - Design and Construction

E - Equipment

F - Operating limitations and information

comply with the system of other airworthiness requirements.

3. Units

In the LFFB, the SI-units and the units derived thereof are used.

4. Notification

This ordinance has been notified under the No. 1996/419/D according to the directives 83/189/EEC, 88/182/EEC and 94/10/EC concerning an information procedure in the field of standards and technical regulations.

5. Equivalence clause

For aeronautical equipment which has already been certified in accordance with foreign airworthiness requirements, §4 of the Prüfordnung für Luftfahrtgerät (Testing Regulations for Aeronautical Products) continues to be valid unrestrictedly.

Lufttüchtigkeitsforderungen für gefesselte Gasballone zum Personentransport (LFFB)

Referenzen:

- Bekanntmachung: NfL II - 99/97
- Veröffentlichung im Bundesanzeiger: BAnz. Seite 10 469, Nr. 152
- inkraftgetreten: 17. August 1997
- Änderungen: nein

VORWORT

1. Gegenstand

Die LFFB beschränken sich auf technische Festlegungen. Hinsichtlich der Verfahrensweise und Voraussetzungen für die Musterprüfung und -zulassung bedarf es daher der Heranziehung der einschlägigen Bestimmungen im Luftverkehrsgesetz und dazu erlassener Verordnungen.

2. Numerierungssystem

In dem verwendeten Numerierungssystem ist jeder eigenständigen Forderung eine eigene Paragraphennummer zugeteilt. Die Numerierung wie auch die Einteilung in die Abschnitte

A - Allgemeines,

B - Betriebsverhalten,

C - Festigkeit,

D - Gestaltung und Bauausführung,

E - Ausrüstung,

F - Betriebsgrenzen und -angaben

entspricht dem Vorbild anderer Bauvorschriften.

3. Einheiten

In den LFFB werden die SI-Einheiten und die davon abgeleiteten Einheiten benutzt.

4. Notifizierung

Diese Durchführungsverordnung wurde unter der Nr. 1996/419/D entsprechend den Richtlinien 83/189/EWG, 88/182/EWG und 94/10/EG über ein Informationsverfahrens auf dem Gebiet der Normen und technischen Vorschriften notifiziert.

5. Gleichwertigkeitsklausel

Für Luftfahrtgerät, welches bereits nach ausländischen Lufttüchtigkeitsforderungen zugelassen wurde, gilt weiterhin §4 der Prüfordnung für Luftfahrtgerät uneingeschränkt.

CONTENT

INHALT

SUBPART A - GENERAL

1 Applicability

(a) These airworthiness standards are requirements for the issue of type certificates and changes to type certificates for manned tethered gas balloons used up to 150 m above ground.

(b) Definition of terms used:

(1) A tethered gas balloon is a balloon that is continuously anchored to the ground during operation.

(2) *(reserved)*

(3) The envelope of the balloon exclusively contains helium as lifting gas.

(4) The gondola is used to accommodate the balloon occupants.

(5) The tether system includes all components affected by forces resulting from tethering.

(6) The suspension system includes all components affected by forces resulting from the loading by the gondola.

(7) The maximum design mass is the largest operational mass of the balloon without taking into account the mass of the gas enclosed by the envelope.

(c) The balloon type or modification of the type is approved on application if these requirements are entirely satisfied or if it is shown that the equivalent level of safety is achieved where one or more of these requirements are not satisfied. A decision is made by the Luftfahrt-Bundesamt in doubtful cases.

SUBPART B - PERFORMANCE

14 Mass limits

(a) The mass range over which the balloon can be operated safely shall be defined.

(b) The maximum mass is the highest mass at which compliance with each applicable requirement of these Airworthiness Requirements is shown. The maximum mass shall be established so that it is not more than

(1) The maximum mass selected by the applicant;

(2) The design maximum mass, which is the highest mass at which compliance with each applicable load case of these Airworthiness Requirements is shown in regard to strength.

16 Empty mass

The empty mass is to be determined by weighing after removing all easily removable parts of the

ABSCHNITT A - ALLGEMEINES

1 Anwendbarkeit

(a) Diese Lufttüchtigkeitsforderungen sind Anforderungen für die Erteilung der Musterzulassung und Änderung der Musterzulassung von gefesselten Gasballonen für den Personentransport bis 150 m über Grund.

(b) Definition verwendeter Begriffe

(1) Der gefesselte Gasballon ist ein Ballon, der während des Betriebes ständig mit dem Erdboden verankert ist.

(2) *(reserviert)*

(3) Die Hülle des Ballons enthält als tragkrafterzeugendes Gas ausschliesslich Helium.

(4) Die Gondel dient zur Aufnahme der Balloninsassen.

(5) Das Fesselsystem sind sämtliche Bauteile, in denen Kräfte aus der Fesselung wirken.

(6) Das Aufhängesystem sind sämtliche Bauteile, in denen Kräfte durch die Belastung der Gondel wirken.

(7) Die Entwurfs-Höchstmasse ist die größte Betriebsmasse des Ballons ohne Berücksichtigung der von der Hülle umschlossenen Gasmasse.

(c) Das Muster oder die Änderung des Musters des Ballons wird auf Antrag zugelassen, wenn diese Forderungen vollständig erfüllt sind, oder wenn bei Nichterfüllung einer oder mehrerer Forderungen ein Nachweis erbracht wird, der ein gleichwertiges Sicherheitsniveau ergibt. In Zweifelsfällen entscheidet das Luftfahrt-Bundesamt.

ABSCHNITT B - BETRIEBSVERHALTEN

14 Massegrenzen

(a) Der Massebereich, in dem der Ballon sicher betrieben werden kann, muß festgelegt werden.

(b) Die Höchstmasse ist die größte Masse, für die Erfüllung jeder anwendbaren Forderung dieser Lufttüchtigkeitsforderungen nachgewiesen wird. Die Höchstmasse muß so festgelegt werden, daß sie nicht größer ist als

(1) die vom Antragsteller gewählte Höchstmasse;

(2) die Entwurfs-Höchstmasse; das ist die größte Masse, für die Erfüllung jedes anwendbaren Lastfalls dieser Lufttüchtigkeitsforderungen im Hinblick auf die Festigkeit nachgewiesen wird.

16 Leermasse

Die Leermasse ist nach Entfernen aller leicht entfembarer Teile der Ausrüstung durch Wägung zu ermit-

equipment. The lifting gas is not part of the empty mass.

20 Controllability

The applicant shall show - normally by demonstration with a balloon of the type for which certification is requested - that the balloon is safely controllable and manoeuvrable during takeoff, ascent, descent and landing without requiring exceptional skill.

SUBPART C - STRENGTH

21 Loads

Strength requirements are specified in terms of limit loads (that are the maximum loads to be expected in service) and ultimate loads (that are limit loads multiplied by the prescribed factors of safety). Unless otherwise specified, all prescribed loads are "limit loads".

22 Rigging case

The strength requirements shall include consideration of the rigging case, the loads occurring in service shall be determined and the parts and components under particular stress shall be designed in accordance with their designated use and dimensioned such as not to fail under recurrent loads.

23 Ascent factor

The strength of the anchorage on the envelope and on the ground and of the tether cable shall be established at the maximum possible static lift for the forces of gravity that occur when ascending. In the fully ascended state, the tether system is to be designed for at least twice this value for any sudden increase in the cable load as a result of maximum deceleration if no other value is established. The additional loads are to be compensated by the forces of gravity.

24 Gust load factor

The load factor under the effect of gusts is to be determined and arranged in accordance with the operating conditions of the balloon.

25 Factors of safety

(a) Except as specified in paragraphs (b) and (c) of this section, the factor of safety is 1.5.

(b) A factor of safety of at least 5 must be used in envelope design (factor of safety of 5 or more) to absorb the gas pressure, superimposed - where relevant - by the maximum strain caused by the tether system. The selected factor shall be applied to

teln. Das tragkrafterzeugende Gas ist nicht Teil der Leermasse.

20 Steuerbarkeit

Der Antragsteller muß durch Demonstration mit einem Ballon von dem Muster, für das die Zulassung gewünscht wird nachweisen, daß der Ballon in allen Betriebsphasen einschließlich Auflassen und Einholen bei jeder im Flughandbuch angegebenen Windgeschwindigkeit sicher beherrschbar und steuerbar ist, ohne es dazu außergewöhnlicher Geschicklichkeit bedarf.

ABSCHNITT C - FESTIGKEIT

21 Lasten

Die Anforderungen an die Festigkeit ergeben sich aus der Festlegung von sicheren Lasten (das sind die höchsten im Betrieb erwarteten Lasten) und Bruchlasten (das sind die mit den vorgeschriebenen Sicherheitszahlen multiplizierten sicheren Lasten). Wenn nicht anders angegeben, sind vorgeschriebene Lasten "sichere Lasten".

22 Aufrüstfall

Bei den Festigkeitsanforderungen muß der Aufrüstfall mitbetrachtet, die vorkommenden Lasten bestimmt und die besonders beanspruchten Teile zweckentsprechend gestaltet und so ausreichend dimensioniert werden, daß sie bei wiederkehrender Beanspruchung nicht versagen.

23 Hochlaßvielfaches

Die Festigkeit der Verankerung an der Hülle und am Boden sowie das Fesselseil muß bei maximal möglichem statischen Auftrieb für die auftretenden Massenkräfte beim Hochlassen nachgewiesen werden. Im aufgelassenen Zustand ist das Fesselsystem für ein plötzliches Ansteigen der Seillast infolge maximaler Verzögerung mindestens auf den 2-fachen Wert zu bemessen, wenn keine anderer Wert nachgewiesen wird. Die zusätzlichen Lasten sind durch Massenkräfte auszugleichen.

23 Böenlastvielfaches

Das Lastvielfache unter Böeneinwirkung ist entsprechend den Einsatzbedingungen des Ballons zu ermitteln und anzusetzen.

25 Sicherheitszahlen

(a) Wo nicht gemäß den Festlegungen unter nachfolgend (b) und (c) höhere Sicherheitszahlen verlangt werden, ist als Sicherheitszahl 1,5 einzusetzen.

(b) Für die Bemessung der Hülle zum Aufnehmen des Gasdrucks, überlagert, soweit zutreffend, mit der maximalen Beanspruchung aus dem Fesselsystem, ist eine mindestens 5-fache Sicherheit (Sicherheitszahl gleich 5 oder größer) vorzusehen.

the more critical conditions - the maximum operating pressure or a developing stress condition.

(c) Components made of fibre material of the device that supports the suspended load must have a factor of safety of at least 3.5 (factor of safety equal to or greater than 3.5).

(d) Regardless of the materials used, the load-bearing connections of the suspension and rigging system shall be designed so that failure of any single component will not jeopardize safety of flight and that total failure is extremely remote.

Interpretative material for paragraph 25(c) and (d):

(i) For metallic cable connections in the rigging system, the factor of safety (including the fitting factor prescribed in 43) must at least be 2.5 (factor of safety of 2.5 or more).

(ii) The individual structural elements in the suspension system shall be dimensioned and configured or duplicated so that failure does not cause any uncontrollable operating condition. The individual structural elements of the suspension system shall be dimensioned and configured or duplicated so that failure cannot cause any uncontrollable operating state. The factors of safety for cables are to be referred to the weakest part, e.g. end connections, knots, deflection pulleys or other types of cable installation that reduce its breaking strength.

(e) For design purposes, an occupant mass of at least 77 kg (170 pounds) shall be assumed.

27 Strength and proof of strength

(a) The structure shall be able to support limit loads without permanent deformation or other effects that impair strength occurring. If the distribution resp. size of the external loads and the internal forces is modified significantly by deformation or load or wind pressure, this shall be taken into account.

(b) The structure shall be able to support ultimate loads without failure for at least three seconds in a static breaking test. Proof of compliance with the strength requirements shall cover the balloon's entire operating range. Proof by calculation can only be accepted for those types of construction where it has been demonstrated by experience that such calculation gives reliable results. Load tests shall be performed in all other

Die gewählte Sicherheitszahl ist dabei auf die kritischen Bedingungen -den höchsten Betriebsdruck oder einen sich einstellenden Spannungszustand- anzuwenden.

(c) Aus Fasermaterial bestehende Komponenten der die aufgehängte Last tragenden Einrichtung müssen mindestens 3,5-fache Sicherheit aufweisen (Sicherheitszahl gleich 3,5 oder größer).

(d) Unabhängig von den eingesetzten Materialien sind die tragenden Verbindungen des Aufhänge- und Festigkeitssystems so ausreichend zu bemessen, daß das Versagen eines einzelnen Baugliedes die Sicherheit des Betriebs nicht gefährdet und ein Gesamtversagen äußerst unwahrscheinlich ist.

Erläuterungen zu Nummer 25(c) und (d):

(i) Für metallische Seilverbindungen sollte ein Sicherheitsvielfaches (einschließlich des in 43 vorgeschriebenen Beschlagvielfachen) von mindestens 2,5 in Ansatz gebracht werden (Sicherheitszahl gleich 2,5 oder größer).

(ii) Die einzelnen Bauglieder des Aufhängesystems sollten so bemessen und so angeordnet oder gedoppelt sein, daß das Versagen keinen unkontrollierbaren Betriebszustand hervorruft. Die Sicherheitszahlen für Seile sind auf den schwächsten Teil zu beziehen, z.B. Endverbindungen, Knoten, Umlenkung, oder sonstige, die Bruchfestigkeit herabsetzende Einbauarten des Seil.

(e) Für die Bemessung muß eine Insassenmasse von mindestens 77 kg je Person angenommen werden.

27 Festigkeit und Festigkeitsnachweis

(a) Der Festigkeitsverband muß imstande sein, die sicheren Lasten aufzunehmen, ohne daß bleibende Verformungen oder sonstige festigkeitsbeeinträchtigende Wirkungen auftreten. Wenn die Verteilung bzw. Größe der äußeren Lasten und der inneren Kräfte durch Verformungen oder Last oder Winddruck wesentlich geändert wird, muß dies berücksichtigt werden.

(b) Der Festigkeitsverband muß imstande sein, Bruchlasten mindestens drei Sekunden lang in einem statischen Bruchversuch zu ertragen, ohne daß ein Versagen auftritt. Der Nachweis der Erfüllung der Festigkeitsforderungen muß den gesamten Betriebsbereich des Ballons abdecken. Rechnerische Nachweise können dabei nur für solche Bauweisen anerkannt werden, für die aufgrund von Erfahrungen erwiesen ist, daß die Berechnung zuverlässige Ergebnisse liefert. In allen anderen Fällen müssen

cases.

(1) In the case of a netless balloon, proof of strength shall also make allowance for the tear growth of the envelope after it has been damaged in order to prevent the occurrence of a tear of a hazardous size.

(2) Load tests for the envelope can be performed on portions of the envelope provided the dimensions of these portions are sufficiently large to include critical construction and design details such as transitions between different materials, load attachment points, seams, etc.

(c) The gondola shall be of a generally robust design and afford the occupants adequate protection during a hard landing. Its design is to be selected so that all loads that occur only result in elastic deformation of the gondola. Shatterproofness is to be regarded as essential integral part of the protection of occupants.

SUBPART D - DESIGN AND CONSTRUCTION

31 General

The suitability and reliability of design features and of components and parts of the balloon that bear on safety shall be established by tests and analysis.

33 Materials

(a) The suitability and durability of all materials used shall be established on the basis of experience or tests. The materials for load-bearing parts shall conform to approved descriptions and data (specifications) that will ensure that the design strength data used do not fall short of the required values.

Interpretative material for paragraph 33(a):

(i) Approved specifications in the sense of these requirements are German and foreign aeronautical standards (e.g. MIL, LN), European standards (EN), International standards (ISO), DIN-Standards and in particular cases also manufacturer's standards.

(ii) Commercial grade materials and semi-finished products may be used if design calculations do not exploit more than 75 percent of the nominal strength of the material.

(iii) In order to comply with these requirements, it is permissible to rely on recommended inspections.

(b) The strength properties of the materials used shall be based on enough tests so as to establish design values on a statistical basis.

Belastungsversuche durchgeführt werden.

(1) Bei einem netzlosen Ballon muß zusätzlich das Weiterreißen der Hülle nach einer Beschädigung im Festigkeitsnachweis berücksichtigt sein, um die Entstehung eines Risses gefährlichen Ausmaßes zu verhindern.

(2) Belastungsversuche für die Hülle können mit Teilen der Hülle durchgeführt werden, sofern die Abmessungen dieser Teile groß genug sind, um kritische Konstruktions- und Ausführdetails wie Werkstoffübergänge, Lastbefestigungspunkte, Nähte usw. zu enthalten.

(c) Die Gondel muß allgemein robust ausgeführt sein und den Insassen ausreichenden Schutz während einer harten Landung bieten. Die Konstruktion ist so zu wählen, daß alle auftretenden Belastungen die Gondel nur im elastischen Bereich verformen. Die Splittersicherheit ist ein wesentlicher Bestandteil des Insassenschutzes.

ABSCHNITT D - GESTALTUNG UND BAUAUSFÜHRUNG

31 Allgemeines

Die Eignung und Zuverlässigkeit von Entwurfsmerkmalen sowie von Teilen und Einzelbaugliedern des Ballons, die Sicherheit beeinflussen, muß durch Versuch oder Rechnung nachgewiesen werden.

33 Werkstoffe

(a) Eignung und Dauerhaftigkeit aller verwendeten Werkstoffe müssen aufgrund von Erfahrungen oder Untersuchungen erwiesen sein. Alle für beanspruchte Teile verwendeten Werkstoffe müssen anerkannten Beschreibungen und Festlegungen (Spezifikationen) entsprechen, die sicherstellen, daß die bei der Auslegung verwendeten Festigkeitswerte nicht unterschritten werden.

Erläuterungen zu Nummer 33 (a):

(i) Anerkannte Spezifikationen im Sinne dieser Vorschrift sind deutsche und ausländische Luftfahrtnormen (z.B. MIL, LN) Europäische Normen (EN), Internationale Normen (ISO), DIN-Normen und in besonderen Fällen auch Werksnormen.

(ii) Werkstoffe und Halbzeuge handelsüblicher Qualität können verwendet werden, wenn in den Ansätzen nicht über 75 Prozent der nominellen Werkstoffestigkeiten hinausgegangen wird.

(iii) Zur Erfüllung dieser Forderungen ist es zulässig, sich auf empfohlene Inspektionen zu stützen.

(b) Die Festigkeitseigenschaften der verwendeten Werkstoffe müssen durch genügend Versuche belegt sein, um so Rechenwerte auf statistischer Grundlage festlegen zu können.

35 Manufacturing processes

The methods of fabrication used shall produce consistently sound structures and connections. If a fabrication process requires close control to reach this objective, the process shall be performed in accordance with an approved process specification.

36 Stress concentrations

The structure shall - insofar as is feasible - be designed so that stress concentration in areas where normal operation may produce varying stress beyond the limit of fatigue are avoided.

37 Fastenings

Only bolts, pins, screws and rivets conforming to an approved specification may be used in the structure. This also applies to locking devices and methods. Unless it is shown that the installation is free from vibration and rotation, these pins and screws shall be secured. Self-locking nuts may not be used on bolts that are subject to rotation in service.

Interpretative material to for paragraph 37:

Approved specifications in the sense of these requirements are the standards listed in the Interpretative material to paragraph 33 (a).

39 Protection of parts

(a) Each part shall be suitably protected against deterioration or loss of strength in service due to weathering, corrosion, or other causes.

Interpretative material for paragraph 39(a):

To ensure the protection of parts, it is permissible to rely on recommended inspections (details in the Maintenance Manual).

(b) Cable joints between the envelope and basket consisting of steel cables shall be manufactured from a stainless material.

(c) The load-bearing parts of the gondola suspension system are to be designed and arranged so as to exclude the possibility of damage to them in normal service.

41 Inspection provisions

Parts that require regular inspection and maintenance shall be easily accessible.

42 Increased factors of safety

(a) Where no provision is made for duplication in the suspension or tether system, the factor of safety as per 25(c) is to be multiplied by the factor of 1.5.

(b) For all parts of the structure that are not

35 Herstellungsverfahren

Die angewendeten Herstellungsverfahren müssen durchgehend einwandfreie Strukturen und Verbindungen ergeben. Wenn Herstellungsvorgänge zu diesem Zwecke der genauen Überwachung bedürfen, müssen sie nach anerkannten Arbeitsvorschriften durchgeführt werden.

36 Spannungsanhäufungen

Der Festigkeitsverband muß - soweit durchführbar - so gestaltet sein, daß Stellen mit Spannungsanhäufungen, an denen im normalen Betrieb veränderliche, über der Ermüdungsgrenze liegende Spannungen auftreten können, vermieden werden.

37 Verbindungselemente

Im Festigkeitsverband verwendete Bolzen, Stifte, Schrauben und Niete müssen einer anerkannten Spezifikation entsprechen. Dies gilt auch für Sicherungsmittel und -verfahren. Außer es wird nachgewiesen, daß weder eine schwingende noch eine drehende Beanspruchung auftreten kann, müssen sämtliche Bolzen, Stifte und Schrauben gesichert sein. Für Bolzen, die im normalen Betrieb Drehbewegungen unterworfen sind, dürfen keine selbstsichernden Muttern verwendet werden.

Erläuterung zu Nummer 37:

Anerkannte Spezifikationen im Sinne dieser Vorschrift sind die in der Erläuterung zu Nummer 33(a) aufgeführten Normen.

39 Schutz der Bauteile

(a) Jedes Bauteil muß in geeigneter Weise gegen Verrottung oder Festigkeitsverlust durch Bewitterung, Korrosion oder andere Einflüsse geschützt werden.

Erläuterung zu Nummer 39(a):

Um den Schutz von Bauteilen zu gewährleisten, ist es zulässig sich auf empfohlene Inspektionen zu stützen. (Angaben im Wartungshandbuch)

(b) Aus Stahlseilen bestehende Seilverbindungen zwischen Hülle und Gondel müssen aus nichtrostendem Material hergestellt sein.

(c) Die tragenden Teile der Gondelaufhängung sind derart zu gestalten und anzuordnen, daß deren Beschädigung während des normalen Betriebes ausgeschlossen ist.

41 Vorkehrungen zur Überprüfung

Teile, die der regelmäßigen Kontrolle und Wartung bedürfen, müssen gut zugänglich sein.

42 Erhöhte Sicherheitszahlen

(a) Wo keine Doppelungen im Aufhänge- sowie im Fesselsystem vorgesehen sind, ist die Sicherheitszahl gemäß 25(c) mit dem Faktor 1,5 zu multiplizieren.

(b) Für alle Teile des Festigkeitsverbandes, die

covered by 43:

- the strength of which is uncertain, or;
- which may deteriorate in service before normal replacement to such an extent that the factors of safety as per 25 are not maintained, or;
- the strength of which is subject to considerable variability due to uncertainties in manufacturing processes or inspection methods

an increased safety factor shall be selected so that failure of the part due to insufficient strength is unlikely.

43 Bracing factor

(a) For all fittings, the strength of which is not proven by limit load and at ultimate load tests - and in fact simulating the actual stress conditions in the fitting and surrounding structure - a fitting factor of at least 1.15 must be used. This factor applies to all parts of the fitting, the means of attachment, and the bearing on the structural elements joined.

(b) Each part with an integral fitting shall be treated as a fitting up to the point where the section properties become typical of the member.

(c) The fitting factor need not be used if the joint design is made in accordance with approved practices and the safety of which is based on comprehensive test data.

44 Protection of envelope against tearing

In order to prevent tears propagating to a hazardous size, rip stops or other tear-prevention precautions shall be incorporated or taken.

Interpretative material for paragraph 44:

If the balloon is equipped with a net to put down the loads on the envelope, the net is regarded as a tear-prevention device.

49 Operator's control

(a) Each control shall operate easily, smoothly, and positively enough to allow proper performance of its functions. Controls shall be so arranged and identified to prevent confusions and subsequent inadvertent operations.

(b) Each control system and operating device shall be designed and installed in a manner that will prevent jamming, chafing, or unintended interference from passengers, luggage, or loose objects. The elements of the control system shall have design features or shall be distinctly and permanently

nicht durch Nummer 43 abgedeckt sind,

- deren Festigkeit aber ungewiß ist, oder
- die sich im Betrieb vor normalem Austausch soweit verschlechtern können, daß die Sicherheitszahlen gemäß Nummer 25 unterschritten werden, oder
- deren Festigkeit aufgrund von Unsicherheiten in den Herstellungs- oder Prüfverfahren erheblichen Streuungen unterliegen,

muß ein erhöhtes Sicherheitsvielfache so gewählt werden, daß der Ausfall des Teils durch ungenügende Festigkeit unwahrscheinlich ist.

43 Beschlagvielfaches

(a) Für alle Beschläge, deren Festigkeit nicht durch Belastungsversuche mit sicherer Last und mit Bruchlast -und zwar unter Nachahmung der wirklichen Beanspruchungsbedingungen in den Beschlägen und in ihrer Umgebung- nachgewiesen ist, muß ein Beschlagvielfaches von mindestens 1,15 angesetzt werden. Dieser Faktor ist für alle Teile des Beschlages, für alle Befestigungsmittel und für alle Lochleibungen in den miteinander verbundenen Baugliedern anzusetzen.

(b) Jedes Bauteil mit einem Integralbeschlag muß bis zu dem Punkt als Beschlag betrachtet werden, an dem der Querschnitt seine bauteiltypische Gestalt erreicht.

(c) Das Beschlagvielfache braucht nicht angesetzt zu werden, wenn es sich um Verbindungen handelt, die in ihrer Art einer anerkannten Ausführung entsprechen und deren Sicherheit durch umfassende Versuchsergebnisse belegt ist.

44 Rißsicherheit der Hülle

Um zu verhindern, daß sich Risse in einem gefährlichen Ausmaß ausbreiten können, müssen Rißstopper eingearbeitet oder sonstige rißhemmende Vorkehrungen getroffen sein.

Erläuterung zu Nummer 44:

Wenn der Ballon zum Absetzen der Lasten auf die Hülle mit einem Netz ausgerüstet ist, gilt das Netz als rißhemmende Vorrichtung.

49 Bedieneinrichtungen

(a) Jedes Bedienelement muß, um die ihm zugedachte Funktion erfüllen zu können, leicht ansprechen, leichtgängig sein und genügend Wirkung hervorrufen. Verwechslungen und Fehlbetätigungen müssen durch Anordnung und Kennzeichnung ausgeschlossen sein.

(b) Jede Bedienanlage und jeder Betätigungsmechanismus muß so ausgelegt und eingebaut sein, daß Klemmen, Scheuern oder ungewollte Einwirkung, sei es durch Balloninsassen, sei es durch Gepäck oder lose Gegenstände vermieden wird. Durch deutliche und dauerhafte Beschriftung der

marked to minimize the possibility of incorrect assembly that could result in failure of the control system.

(c) Each balloon shall be equipped so that the lifting gas can be released automatically and manually before the burst pressure is reached. The quantity of gas to be released shall be sufficient to prevent bursting. Opening of a valve shall be visually indicated to the pilot.

50 Precautions against loss of lifting gas

The balloon shall be designed so to exclude the possibility of loss of lifting gas likely to adversely affect safe operation taking into account wind pressure, temperature and fluctuations in air pressure over the permissible operating range.

51 Limiting of operating pressure

Each balloon shall be equipped so that lifting gas can be released automatically and manually before 1.15 times the maximum operating pressure is reached. The quantity of gas to be released shall be large enough to prevent a further increase in pressure. Opening of a valve shall be visually indicated to the pilot.

53 Protection against breaking away

Precautions are to be taken to prevent the balloon breaking away when tethered to the ground due to the effect of wind at each of the wind speeds stated in the Flight Manual.

55 Rapid deflation means

The envelope shall have a means allowing rapid deflation of the balloon after the landing. If a system other than a manually operated is used, the reliability of the system used shall be substantiated.

57 Operation of rapid deflation means

(a) If a rip cord is used for rapid deflation, it shall be designed and installed to preclude entanglement.

(b) The force required to operate the rapid deflation device shall be at least 110 N but shall not exceed 340 N.

(c) The device for operation of the fast deflation means shall be colored red, where it is operated by the pilot.

(d) The rip cord shall be long enough to allow an increase of at least 10 percent in the vertical dimension of the envelope.

einzelnen Teile einer Bedienanlage oder durch entsprechende Gestaltung muß die Möglichkeit eines falschen Zusammenbaus und dadurch bedingtes Versagen weitgehend ausgeschlossen sein.

(c) Jeder Ballon muß so ausgerüstet sein, daß vor Erreichen des Berstdruckes das Füllgas automatisch und per Handbedienung abgelassen werden kann. Die abzulassende Gasmenge muß so groß sein, daß ein Platzen verhindert wird. Das Öffnen eines Ventils muß dem Piloten optisch angezeigt werden.

50 Vorkehrungen gegen Traggasverlust

Der Ballon muß so beschaffen sein, daß ein den sicheren Betrieb beeinträchtigender Traggasverlust unter Berücksichtigung von Winddruck, Temperatur und Luftdruckschwankungen im zulässigen Betriebsbereich ausgeschlossen ist.

51 Begrenzung des Betriebsdrucks

Jeder Ballon muß so ausgerüstet sein, daß vor Erreichen des 1,15-fachen maximalem Betriebsdrucks das Füllgas automatisch und per Handbedienung abgelassen werden kann. Die abzulassende Gasmenge muß so groß sein, daß ein weiterer Druckanstieg verhindert wird. Das Öffnen eines Ventils muß dem Piloten optisch angezeigt werden.

53 Sicherung gegen Losreißen

Es sind Vorkehrungen zu treffen, damit sich der am Boden verankerte Ballon durch Windeinwirkung bei jeder im Flughandbuch angegebenen Windgeschwindigkeit nicht losreißen kann.

55 Schnellentleerung

Die Hülle muß über eine Einrichtung verfügen, die ein schnelles Entleeren des Ballons gestattet. Falls es sich hierbei um Einrichtungen handelt, die nicht handbetätigt sind, muß deren Zuverlässigkeit nachgewiesen werden.

57 Betätigung der Schnellentleerung

(a) Wenn zum Zwecke der Schnellentleerung eine Reißleine verwendet wird, muß diese so gestaltet und angeordnet sein, daß ein Verwickeln oder Verheddern ausgeschlossen ist.

(b) Die zum Betätigen der Schnellentleerung erforderliche Kraft muß mindestens 110 N und darf höchstens 340 N betragen.

(c) Die Bedieneinrichtung für die Schnellentleerung muß an der Stelle, an der sie vom Piloten betätigt wird, rot gefärbt und gegen unbeabsichtigte Betätigung geschützt sein.

(d) Die Reißleine muß lang genug sein, um bei einer Streckung der Hülle um 10 Prozent in vertikaler Richtung benutzbar zu bleiben.

59 Gondola

(a) The gondola may not rotate independently of the envelope.

(b) Hard or sharp-edged structural or equipment parts on which occupants might injure themselves shall be padded.

(c) Each occupant shall be able to hold onto the edge of the gondola or a holding grip shall be provided for each occupant.

(d) For each occupant, standing room of at least 0.3 m² shall be provided.

(e) The height of the gondola side wall on the inside shall be at least 1.10 m.

(f) The gondola doors shall comply with the following requirements:

(1) There shall be a device that closes the door and secures it during flight against unintentional opening by persons or as the result of a mechanical failure.

(2) The doors shall be capable of being opened from inside and outside

(3) Operation of the door opening device shall be simple and obvious.

(4) For doors that do not open inwards, precautions shall be taken to establish by visual examination whether the door is properly closed and locked.

(g) The gondola floor shall not project beyond the side walls.

60 Anchorage to the ground

(a) In service the balloon shall be securely and reliably anchored to the ground.

(b) If paragraph 60(a) is complied by a device to raise and lower the balloon (e.g. winch), the suitability, durability and reliability of the entire device shall be established.

Acceptable means of compliance for paragraph 60(b):

Compliance with the requirement of paragraph 60(b) can be shown by a certificate from an expert body. This certificate also contains the conditions for safe operation of the winch.

SUBPART E - EQUIPMENT

71 Function and installation

(a) Each item of the required equipment shall

(1) be of a kind and design appropriate to its intended function,

(2) if necessary, be labelled to identify it in accordance with its function or operating limits or any applicable combination of these factors,

59 Gondel

(a) Die Gondel darf sich nicht unabhängig von der Hülle drehen.

(b) Scharfkantige Bau- oder Ausrüstungsteile müssen gepolstert sein, damit sich die Insassen nicht verletzen können.

(c) Jeder Insasse muß sich am Gondelrand festhalten können oder es muß für jeden ein Haltegriff vorhanden sein.

(d) Für jeden Insassen muß eine Standfläche von mindestens 0,3 m² vorgesehen sein.

(e) Die Gondelwandhöhe auf der Innenseite muß mindestens 1,10 m betragen.

(f) Die Türen der Gondel müssen folgende Bedingungen erfüllen:

(1) Es muß eine Vorrichtung vorhanden sein, die Tür zu schließen und während der Fahrt gegen unbeabsichtigtes Öffnen durch Personen oder als Ergebnis eines mechanischen Versagens zu sichern.

(2) Die Tür muß von innen und außen zu öffnen sein.

(3) Die Betätigung der Vorrichtung zum Öffnen der Tür muß einfach und offenkundig sein.

(4) Für Türen, die nicht nach innen zu öffnen sind, müssen Vorkehrungen getroffen werden, durch Sichtprüfung festzustellen, ob die Tür ordnungsgemäß geschlossen und verriegelt ist.

(g) Der Gondelboden darf nicht über die äußeren Seitenwände überstehen.

60 Verankerung am Boden

(a) Der Ballon muß während des Betriebes fest und zuverlässig am Boden zu verankern sein.

(b) Soll Nummer 60(a) durch eine Vorrichtung zum Hochlassen und Einholen des Ballons (z.B. Winde) erfüllt werden, muß Eignung, Dauerhaftigkeit und Zuverlässigkeit der gesamten Vorrichtung nachgewiesen werden.

Annehmbares Nachweisverfahren zu Nummer 60(b):

Die Erfüllung der Forderung nach Nummer 60(b) kann durch Gutachten einer sachverständigen Stelle nachgewiesen werden. Dieses Gutachten enthält auch die Bedingungen für den sicheren Betrieb der Winde.

ABSCHNITT E - AUSRÜSTUNG

71 Funktion und Einbau

(a) Jedes Teil der geforderten Ausrüstung muß

(1) nach Art und Gestaltung der ihm zugedachten Funktion angemessen sein,

(2) wenn erforderlich, zu seiner Identifizierung, gemäß seiner Funktion oder seiner Betriebsgrenzen oder irgendwelcher anwendbarer Kombination dieser

(3) be installed according to limitations specified for that equipment, and

(4) function properly when installed.

Interpretative material for paragraph 71(a):

(1) Perfect operation shall not be adversely affected by icing, heavy rain or high air humidity.

(2) If air traffic control equipment instrumentation is installed, evidence shall be furnished that its operation is not adversely affected by the electrical system.

(b) Safe operation of the balloon shall not be endangered by instruments or other equipment or their effects on the balloon.

(c) The following instruments shall be installed:

(1) An envelope pressure gauge or an indicating instrument which displays the point at which the maximum permissible internal pressure is reached. If the maximum operating pressure is exceeded, the pilot shall be warned by an unmistakable signal.

(2) A temperature measuring device mounted on the highest point of the envelope.

(3) A wind velocity indicator mounted on the highest point of the envelope.

(4) A load cell between the tether cable and tethering device in order to monitor the tensile force in service.

73 Instrument marking

The following applies to all monitoring instruments:

(a) If the cover glass of the instrument is marked, adequate measures are to be taken to ensure that the cover glass remains in its correct position relative to the graduated dial.

(b) All markings shall be sufficiently wide and applied to ensure that they are easily and clearly readable by the crew.

(c) Ranges shall be identified as follows:

Normal operating range - green arc,
Caution area - yellow arc,
Permissible maximum or minimum value - red radial line.

75 Warning, caution, and advisory lights

If warning, caution or advisory lights are installed, these shall be:

(a) red, for warning lights (lights that indicate a hazard that demands immediate corrective action);

Faktoren beschriftet sein,

(3) gemäß den für diese Ausrüstung festgelegten Grenzen eingebaut sein, und

(4) im eingebauten Zustand einwandfrei arbeiten.

Erläuterungen zu Nummer 71(a):

(1) Die einwandfreie Funktion darf nicht durch Vereisung, starken Regen oder hohe Luftfeuchtigkeit beeinträchtigt werden.

(2) Wird Flugsicherungsausrüstungsgerät eingebaut, muß nachgewiesen werden, daß es durch die elektrische Anlage nicht in seiner Funktion beeinträchtigt wird.

(b) Geräte und andere Ausrüstungen dürfen weder für sich allein noch durch ihre Auswirkungen auf den Ballon dessen sicheren Betrieb gefährden.

(c) Folgende Geräte müssen eingebaut sein:

(1) Ein Hüllendruckmesser bzw. ein Anzeigegerät, das anzeigt, wenn der maximal zulässige Innendruck erreicht ist. Bei Überschreiten des maximalen Betriebsdrucks muß der Pilot durch ein unmißverständliches Signal gewarnt werden.

(2) Eine Temperaturmeßeinrichtung an der höchsten Stelle der Hülle.

(3) Ein Windgeschwindigkeitsmesser an der höchsten Stelle der Hülle.

(4) Ein Kraftmesser zwischen Fesselseil und Fesselvorrichtung zur Überwachung der Zugkraft während des Betriebs.

73 Gerätemarkierungen

Für alle Überwachungsgeräte gilt:

(a) Wenn Markierungen auf dem Deckglas des Gerätes angebracht werden, ist in ausreichender Weise dafür zu sorgen, daß das Deckglas seine richtige Lage gegenüber der Skalenscheibe beibehält.

(b) Alle Markierungen müssen breit genug und so angebracht sein, daß sie für die Besatzung leicht und deutlich erkennbar sind.

(c) Die Kennzeichnung der Bereiche ist folgendermaßen vorzunehmen,

Normaler Betriebsbereich - grüner Bogen,
Vorsichtsbereich - gelber Bogen,
zulässiger höchster oder niedrigster Wert - roter radialer Strich.

75 Warn-, Vorwarn- und Betriebsleuchten

Wenn Warn,- Vorwarn- oder Betriebsleuchten eingebaut sind, müssen sie

(a) rot sein, wenn es sich um Warnleuchten handelt (Leuchten, die eine Gefahr anzeigen, die eine sofortige Abhilfemaßnahme erfordert);

(b) yellow, for caution lights (lights that indicate the possible need for subsequent corrective action);

(c) green, for safe operation lights, and

(d) of any other colour, including white, for lights not described in paragraphs (a) through (c) of this paragraph, provided the colour differs sufficiently from the colours prescribed in paragraphs (a) through (c) to avoid possible confusion;

(e) visible under all likely lighting conditions in the cockpit.

SUBPART F - OPERATING LIMITS AND DETAILS

81 Operating instructions

FLIGHT MANUAL

(a) General. For each type of balloon, a Flight Manual shall be established and presented to the Luftfahrt-Bundesamt. A suitable place for its storage aboard the balloon shall be provided.

(b) Information in the Flight Manual and Approval. The Flight Manual shall contain all the information necessary for safe operation of the balloon as well as the operating limitations. This section of the manual requires approval. The necessary content of the Flight Manual includes:

(1) a description of the balloon and its technical equipment with explanatory sketches;

(2) specification of the permissible lifting gas;

(3) the operating limits as per 14, 20, 51, 53;

(4) emergency procedures.

(5) normal operating procedures.

INSTRUCTIONS FOR MAINTENANCE AND INSPECTION

(a) Maintenance Manual. For each type of balloon, a Maintenance Manual shall be established which contains all information necessary for the continued airworthiness of the balloon, in particular:

(1) a description of the systems including the assembly and disassembly instructions;

(2) inspection programmes with indication concerning the kind and scope of maintenance work (scheduled inspections);

(3) special inspection procedures, if required;

(4) details of repairs with reference to the degree of difficulty and resulting associated demands placed on the agency that performs repair (e.g. manufacturer only, licensed repair station holding appropriate permit, skilled person);

(b) gelb sein, wenn es sich um Vorwarnleuchten handelt (Leuchten, die mögliche Notwendigkeit einer späteren Abhilfemaßnahme anzeigen);

(c) grün sein, wenn es sich um Leuchten handelt, die sicheren Betrieb anzeigen; und

(d) von irgendeiner anderen Farbe, einschließlich weiß, sein, wenn es sich um Leuchten handelt, die nicht in den Absätzen (a) bis (c) beschrieben sind, vorausgesetzt, die Farbe unterscheidet sich ausreichend von den in Absatz (a) bis (c) aufgeführten, um eine mögliche Verwechslung auszuschließen;

(e) unter allen wahrscheinlichen Beleuchtungsbedingungen im Cockpit zu sehen sein.

ABSCHNITT F - BETRIEBSGRENZEN UND -ANGABEN

81 Betriebsanweisungen

FLUGHANDBUCH

(a) Allgemeines. Für jedes Ballonmuster muß ein Flughandbuch erstellt und dem Luftfahrt-Bundesamt vorgelegt werden. Für seine Unterbringung an Bord des Ballons ist ein geeigneter Platz vorzusehen.

(b) Angaben im Flughandbuch und Anerkennung. Das Flughandbuch muß alle für einen sicheren Betrieb des Ballons erforderlichen Angaben sowie die Betriebsgrenzen enthalten. Es bedarf für diesen Teil der Anerkennung. Zum notwendigen Inhalt des Flughandbuchs gehören:

(1) eine Beschreibung des Ballons und seiner technischen Einrichtungen mit erläuternden Skizzen;

(2) Angabe des zugelassenen Füllgases;

(3) die Betriebsgrenzen nach 14, 20, 51, 53;

(4) die Notverfahren;

(5) die normalen Betriebsverfahren

UNTERLAGEN FÜR DIE INSTANDHALTUNG UND NACHPRÜFUNG

(a) Wartungshandbuch. Für jedes Ballonmuster ist ein Wartungshandbuch zu erstellen, das alle erforderlichen Angaben zur Erhaltung der Lufttüchtigkeit des Ballons enthält, insbesondere:

(1) eine Beschreibung der Anlagen einschließlich der Ein- und Ausbauvorschriften;

(2) Inspektionsprogramme mit Angaben zu Art und Umfang der Wartungsarbeiten (planmäßige Kontrollen);

(3) besondere Prüfverfahren, falls diese erforderlich sind;

(4) Angaben für Reparaturen mit Hinweis auf den Schwierigkeitsgrad und daraus abzuleitende Erfordernisse hinsichtlich der durchführenden Stelle (z.B. nur Hersteller, Luftfahrttechnischer Betrieb mit entsprechender Berechtigung, sachkundige Person);

(5) advice on annual inspection with checklist of items to be checked;

(6) a summary of the materials used with procurement details and possible alternative materials.

(b) Parts list. For each type of balloon, a list shall be established covering all construction and equipment components and the assemblies. Individual parts shall be numbered so that they can be related to the different assemblies and that their number corresponds to the type plate of the assembly.

(5) Hinweise für die Jahresnachprüfung mit Klarliste der zu kontrollierenden Punkte;

(6) eine Übersicht der verwendeten Werkstoffe mit Bezugsnachweis und möglichen Ausweichwerkstoffen.

(b) Teilekatalog. Für jedes Ballonmuster ist eine Liste sämtlicher Bau- und Ausrüstungsteile sowie der Baugruppen zu erstellen. Einzelbauteile sind dabei so zu numerieren, daß die Zuordnung zu der jeweiligen Baugruppe deutlich wird und deren Numerierung wiederum mit dem Typenschild der Baugruppe übereinstimmt.

* * *

II - 70/00

Nachrichtliche Bekanntmachung der Grundsätze des Bundes und der Länder zur Erteilung von Erlaubnissen zum Auflassen von Fesselballonen gemäß § 16 Abs. 2 und 3 Luftverkehrs-Ordnung

In den nachstehenden Grundsätzen des Bundes und der Länder zur Erteilung von Erlaubnissen zum Auflassen von Fesselballonen gemäß § 16 Abs. 2 und 3 LuftVO sind die Bedingungen, Sicherheitsanforderungen und Auflagen zusammmengefasst, die von den örtlich zuständigen Luftfahrtbehörden der Länder bei der Erteilung von Erlaubnissen nach § 16 Abs. 2 und 3 LuftVO zu Grunde gelegt werden.

Die Bekanntmachung vom 06. Dezember 1999 - LR 17/60.05.05/8Va99 - (NfL II - 8/00) wird hiermit aufgehoben.

Diese Bekanntmachung tritt am 01. August 2000 in Kraft.

Bonn, den 7. Juli 2000
LS17/60.01.31/11Va00
Bundesministerium für Verkehr, Bau- und Wohnungswesen
Im Auftrag

Dr. Wittmann

Grundsätze des Bundes und der Länder zur Erteilung von Erlaubnissen zum Auflassen von Fesselballonen gemäß § 16 Abs. 2 und 3 LuftVO

1. Begriffsbestimmung

Ein Fesselballon ist ein mit Gas leichter als Luft oder mit Heißluft gefüllter Ballon, der - unabhängig von Ausmaßen und Masse der Ballonhülle - unmittelbar oder mittelbar mit dem Boden verankert ist.

2. Auflasshöhe und Auflassort

2.1 Die Auflasshöhe darf grundsätzlich 100 m über Grund nicht überschreiten; innerhalb von Tieffluggebieten, in denen militärische Tiefflüge bis 75 m über Grund stattfinden, darf sie 50 m über Grund nicht überschreiten. Für wissenschaftliche Untersuchungen und technische Zwecke kann im Einzelfall eine größere Auflasshöhe zugelassen werden.

2.2 Grundsätzlich ist vor Erteilung der Erlaubnis eine Stellungnahme des Luftwaffenamtes (LwA) einzuholen, ob an dem geplanten Auflassort aus gegebenem Anlass eine geringere Auflasshöhe geboten ist oder die Erlaubnis zu versagen ist.

Der Einholung einer Stellungnahme des LwA bedarf es nicht, wenn der Auflassort

- außerhalb geschlossener Ortschaften mit Auflasshöhen bis 30 m über Grund,
- innerhalb geschlossener Ortschaften mit Auflasshöhen bis 50 m über Grund,
- innerhalb geschlossener Ortschaften mit mehr als 100.000 Einwohnern mit Auflasshöhen bis 100 m über Grund,
- innerhalb von Kontrollzonen

liegt.

2.3 Die für die Flugsicherung zuständige Stelle (DFS) ist um Stellungnahme zu ersuchen, wenn kontrollierter Luftraum (z.B. innerhalb einer Kontrollzone) bzw. Flugplätze mit Luftraum F betroffen sind. Die DFS beteiligt ggf. das Amt für Flugsicherung der Bundeswehr.

2.4 Die örtlich zuständige Luftfahrtbehörde hat zudem in eigener Zuständigkeit zu prüfen, ob der Auflassort unter Berücksichtigung der vorgesehenen Auflasshöhe, der Lage zu Flugplätzen, Segelfluggeländen, Modellfluggeländen usw. geeignet ist.

3. Sicherheitsanforderungen

3.1 Verankerung und Halteseil des Fesselballons müssen ausreichend sicher sein, um ein Losreißen des Ballons zu verhindern.

3.2 Beträgt die Auflasshöhe des unbemannten Fesselballons mehr als 30 m und seine Gesamtmasse mehr als 1 kg, muss er im Falle des Losreißens folgende Forderungen erfüllen:

- Eine geeignete automatische Vorrichtung muss sicherstellen, dass ein Traggasventil derart betätigt wird, dass ein Sinkflug in überschaubarer Weise erfolgt (z. B. elektronischer Höhendruckschalter kombiniert mit Steiggeschwindigkeitsmessgerät).
- Das Fesselseil darf nur bis 50 % seiner Bruchkraft belastet werden. Bei höherer Belastung muss sich im Fesselsystem eine Sollbruchstelle derart öffnen, dass der Strömungswiderstand herabgesetzt wird (z. B. Fangseil am Bug).

Beträgt die Gesamtmasse des unbemannten Fesselballons mehr als 1 kg, die Auflasshöhe aber weniger als 30 m, kann er auch mit einem zweiten, separat verankerten Seil ausgerüstet sein, das im Falle des Losreißens des Ballons über entsprechende Vorrichtungen verfügt, die ein selbständiges Entleeren des Balloninhalts auslöst. Das Auflassen ist von sachkundigen Personen durchzuführen oder zu beaufsichtigen.

3.3 Fesselballone dürfen grundsätzlich nur von Sonnenaufgang bis Sonnenuntergang aufgelassen werden.

3.4 Der Auflassort muss zu öffentlichen Straßen, Wegen, Eisenbahnlinien, Überlandleitungen usw. einen ausreichenden Abstand haben, der unter Berücksichtigung von Umfang und Masse des Ballons sowie der örtlichen Gegebenheiten festzulegen ist.

3.5 Beträgt die Auflasshöhe außerorts mehr als 30 m oder innerorts mehr als 50 m über Grund, muss der Fesselballon in kontrastreicher Farbe ausgeführt sein (z. B. orange, weiß gemäß DIN 6171).

3.6 Der Betreiber des Fesselballons ist zu verpflichten:

- den Fesselballon einzuholen wenn

a) die Windgeschwindigkeit 10 kts übersteigt, sofern im Betriebshandbuch des Fesselballons keine Angaben dazu gemacht werden oder ein anders lautendes Gutachten eines Sachverständigen vorliegt,

b) die Sicht am Boden weniger als 5 km beträgt. Ausnahmen können nach den örtlichen Gegebenheiten im Einzelfall von der örtlich zuständigen Luftfahrtbehörde erteilt werden;

- die nächst erreichbare Flugverkehrskontrollstelle umgehend zu benachrichtigen, falls ein Fesselballon mit einer Gesamtmasse von mehr als 0,5 kg sich gelöst hat und unkontrolliert aufsteigt.

3.7 Weitere Sicherheitsvorkehrungen sind aufgrund besonderer örtlicher Verhältnisse, des verwendeten

Fesselballons oder der Art seines Betriebes von der örtlich zuständigen Luftfahrtbehörde festzulegen.

4. Haftpflichtversicherung

Der Halter des Fesselballons hat den Abschluss einer Haftpflichtversicherung nach den §§ 102 ff. der Luftverkehrs-Zulassungs-Ordnung nachzuweisen.

5. Veröffentlichung

Auflassort und -höhe sowie Auflasszeit des Fesselballons sind bei einer Auflasshöhe von mehr als 100 m stets sowie in den übrigen Fällen dann, wenn das LwA, die DFS oder die örtlich zuständige Luftfahrtbehörde eine Warnung der übrigen Luftfahrt für erforderlich halten, durch NOTAM und im VFR-Bulletin bekannt zu geben.

6. Zusätzliche Forderungen für bemannte gefesselte Ballone

6.1 Bemannte gefesselte Gasballone bedürfen der Musterzulassung, in der auch die Betriebsanweisungen festgelegt werden. Bei ausländischen Zulassungen empfiehlt es sich, beim Luftfahrt-Bundesamt eine Stellungnahme einzuholen und der Genehmigungsbehörde vorzulegen.

6.1.1 Besatzung

Die Besatzung muss aus

- mindestens einer sachkundigen und vom Betreiber eingewiesenen Person am Boden zum Einholen des bemannten gefesselten Gasballons,
- einem Erlaubnisinhaber PPL-D bestehen, wenn mehr als 4 Passagiere befördert werden können,
- zusätzlich mindestens einer sachkundigen und vom Betreiber eingewiesenen Person in der Gondel zur Betreuung der Passagiere, wenn sich mehr als 15 Passagiere an Bord der Gondel befinden.

6.1.2 Sprechfunkverbindung

Zwischen den Personen an Bord des bemannten gefesselten Gasballons und dem Bodenpersonal muss eine Verbindung durch Sprechfunk gewährleistet sein.

6.1.3 Haftpflichtversicherung

Der Halter eines bemannten gefesselten Gasballons hat vor Inbetriebnahme des Gerätes den Abschluss einer Haftpflichtversicherung gemäß § 37 LuftVG in Verbindung mit den §§ 102 ff. LuftVZO nachzuweisen.

7. Hinweis für Heißluftballone

Das Luftfahrt-Bundesamt hat bisher keine bemannten gefesselten Heißluftballone zugelassen. Die Musterzulassung der in der Bundesrepublik Deutschland zugelassenen Heißluftballone beinhaltet keinen Fesselbetrieb.

Sollten ausländische Musterzulassungen vorgelegt werden, ist sinngemäß nach den Regelungen dieser Richtlinie zu verfahren. Außerdem sollte bei Heißluftballonen eine Stellungnahme beim Luftfahrt-Bundesamt eingeholt und der Genehmigungsbehörde vorgelegt werden.

II - 71/00

Bekanntmachung über die Verlängerung der Jahresnachprüfung gem. § 15 Abs. 2 LuftGerPV

Entsprechend § 15 Abs. 2 der Verordnung zur Prüfung von Luftfahrtgerät (LuftGerPV) kann das Luftfahrt-Bundesamt u.a. für die umfassende Nachprüfung zur Feststellung, ob das Luftfahrtgerät noch lufttüchtig ist und den Angaben des zugehörigen Gerätekennblattes entspricht (Jahresnachprüfung), von den in § 15 Abs. 1 LuftGerPV gemachten Angaben im Einzelfall kurzfristige Verlängerungen gewähren.

Diese begründeten Einzelanträge zur Verlängerung der Jahresnachprüfung bitten wir an das

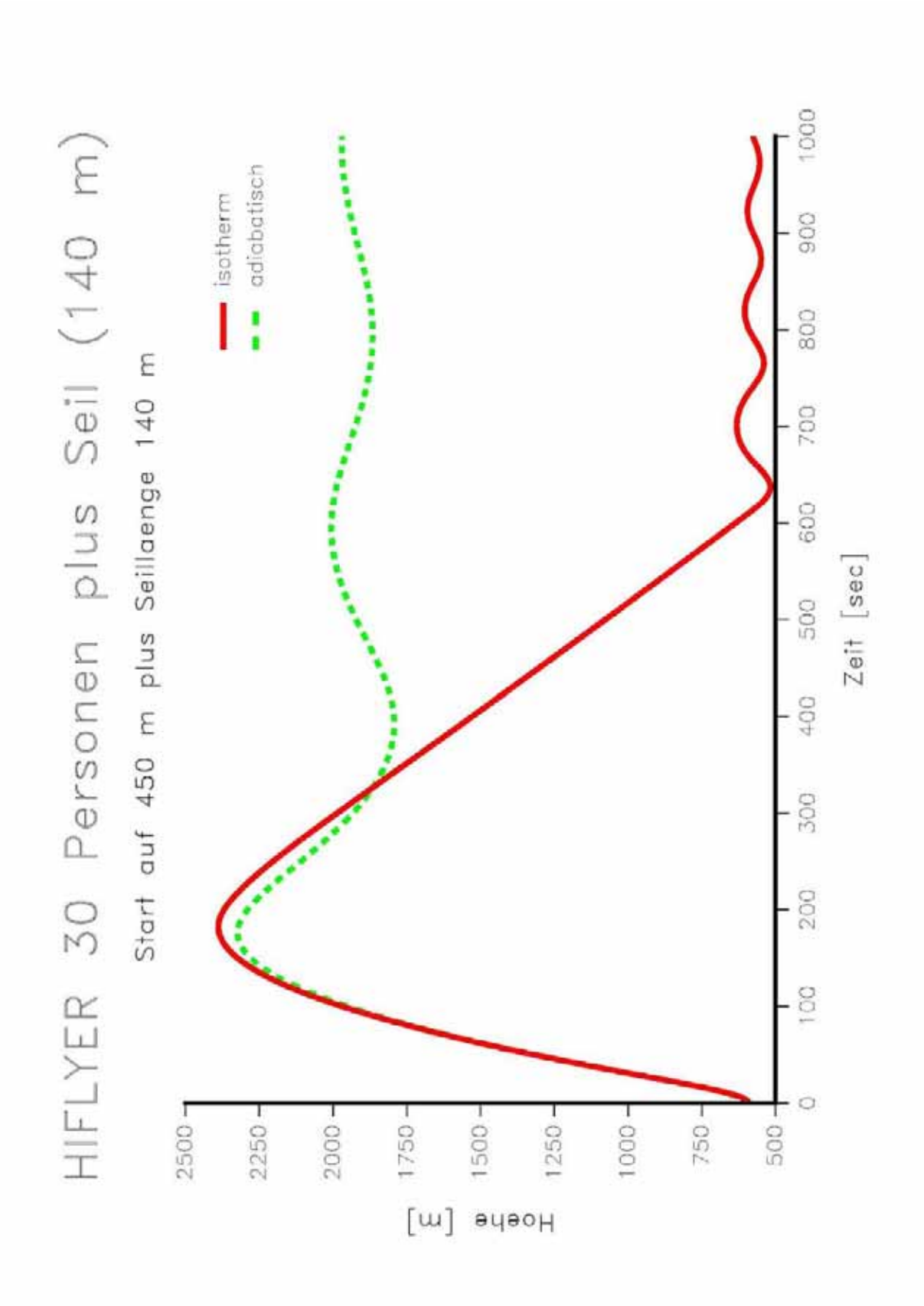
Luftfahrt-Bundesamt
Fachbereich B 2
Postfach 30 54

38020 Braunschweig
Fax 0531 23 55 762

zu richten.

Braunschweig, den 17.7.2000
B 2 - 300.31.5/00
Der Direktor des Luftfahrt-Bundesamtes
In Vertretung

Dr. L o h l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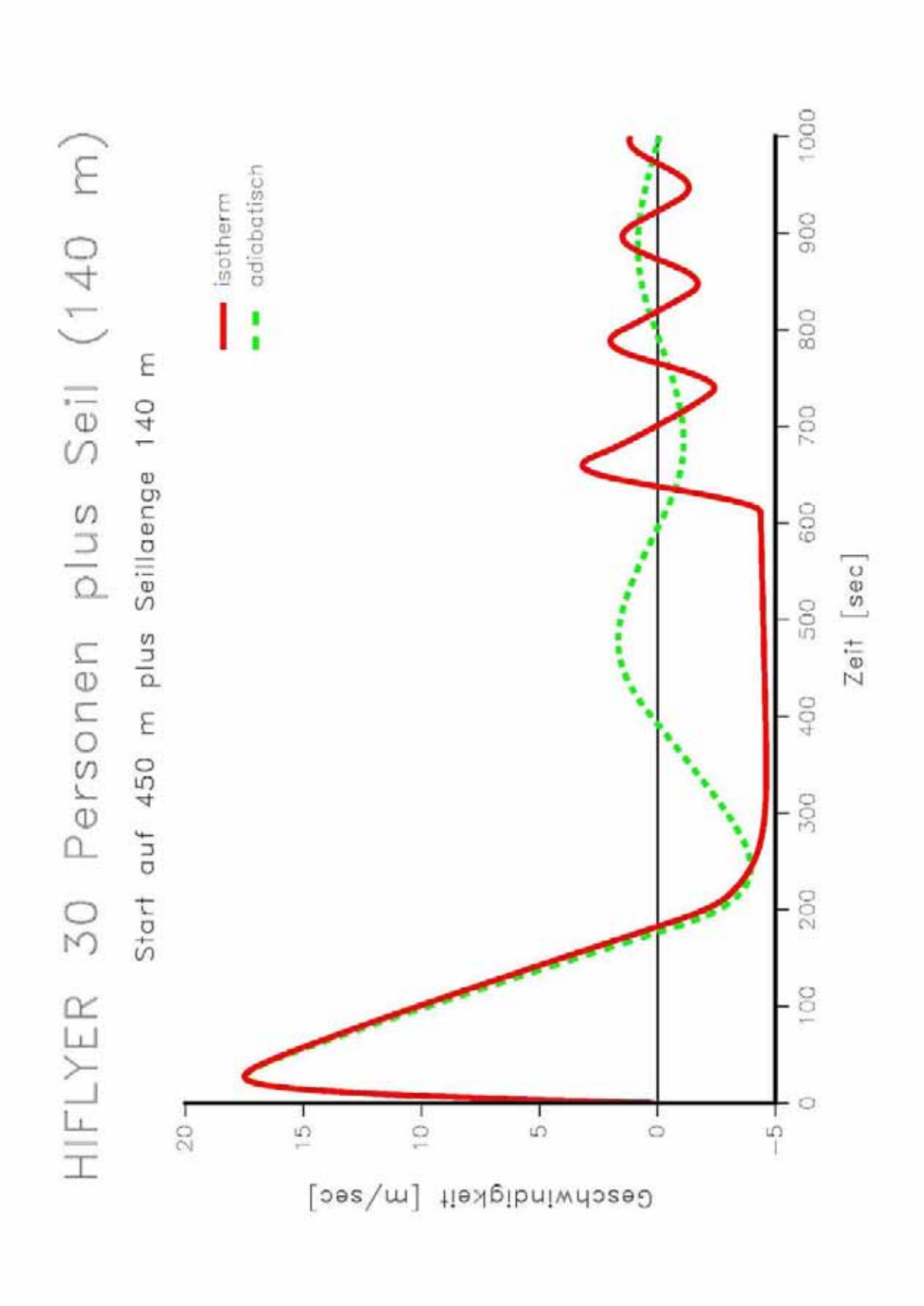
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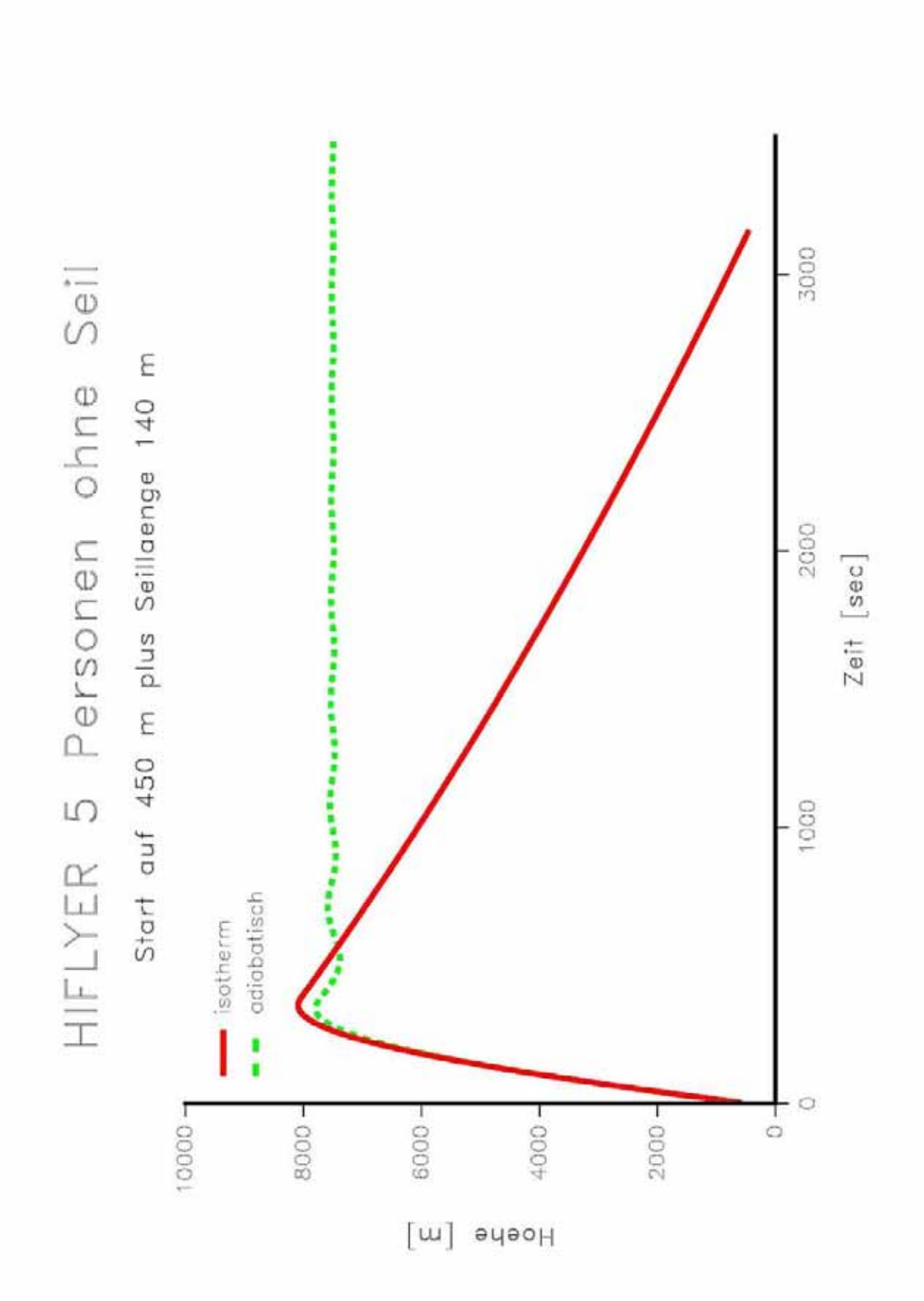
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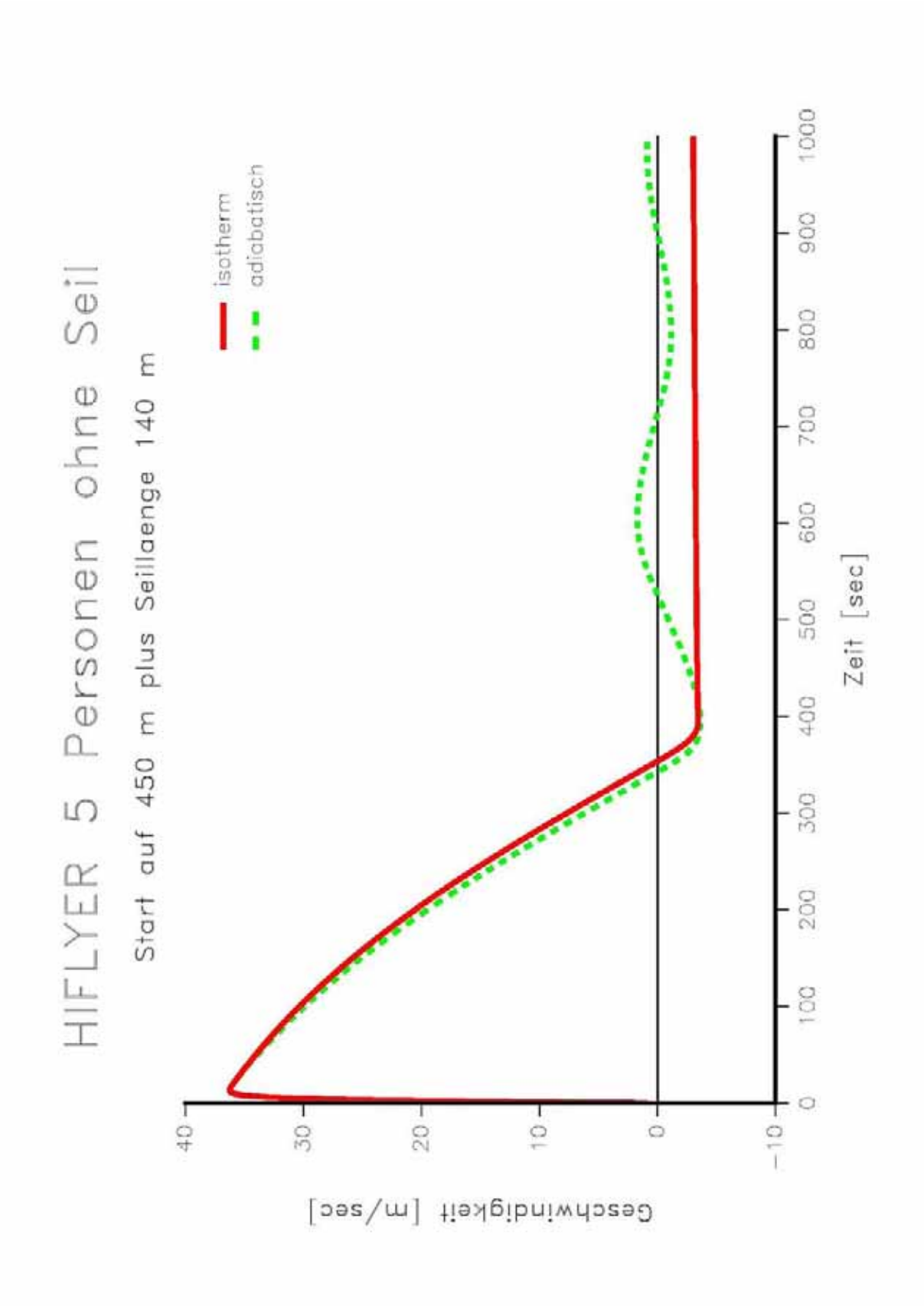
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HI FLYER SYSTEM FAILURE MODE ANALYSIS

INTRODUCTION

It is of interest to examine all causes of failure of the HiFlyer system and for each failure to establish the consequences with particular regard to passenger safety.

METHOD

Each operational component within the system will be considered to have 'failed' or become non-operational in the most extreme form, and the consequences of the failure identified. The single failure cases are considered from the top of the system down to the bottom.

1) Helium Valve Failure

If the helium valve fails closed there is no loss of operational capability. The failure of the valve will be discovered during periodic maintenance checks. If the helium valve fails open then the loss of free lift will become quickly apparent and the gondola may be immediately recovered in the normal manner before the helium loss becomes hazardous, since the free lift is increased as the cable is winched onto the drum.

2) Split in the Gas Cell

During normal and all hazardous incorrect operational scenarios, the structural integrity of the envelope is protected by the presence of the helium valve automatic vent system. Information is constantly presented to the operator on the maximum measured helium pressure which provides an extra level of security, in association with the manual override helium vent facility.

If a split is caused by deliberate damage from the ground during flight the size of the hole would not permit a sufficiently high helium loss rate to cause a hazardous situation. The most obvious source of tear would be bullet holes. The presence of these holes would eventually be detected through increasing loss of free lift, if the operator was not aware of being shot at.

Accidental penetration of the envelope by larger objects is difficult to envisage as at all likely. The effects of accidental collision between other aircraft and the envelope and net of the HiFlyer system are difficult to quantify but may well be survivable if the loss of lift is the only consideration. However, more extreme consequences are likely resulting from the damaged aircraft causing collateral damage to the ground based systems. Standard

precautions have been taken to prevent collision between the HiFlyer and other aircraft with regard to operational notification and system illumination. The fact that the envelope is equipped with a net means that tears will not propagate in the envelope. This is well established through a long history of gas ballooning experience.

3) Split of the Ballonet

If the ballonet is split, however this occurs the consequential loss of envelope pressure would be noted at the control panel and the balloon would be recovered in the normal manner.

4) Break of any Single Net Element

The construction and attachment of the net to the load ring has a high level of redundancy. The minimum number of load paths is in the lower position of the net where there are eight attachments to the load ring. The maximum operational loads are easily supported by seven footropes. Emergency recovery procedures would be initiated.

5) Control Loom Severed

Total failure of the control loom or its total severing has no immediate impact on the ability of the HiFlyer to continue flying. If power is interrupted to the valve when the valve is fully open the emergency recovery procedure may be followed without hazardous loss of lift.

6) Ballonet Fan Failure

The operator will detect this failure by a drop in ballonet pressure but the fan does not start working at the pre-set pressure level. Loss of pressure has no immediately hazardous effects.

7) PRV Fail

Failure of the ballonet pressure relief valve has no deleterious effects on the system performance. The failure would be detected during routine maintenance checks.

8) Load Ring Failure

This failure is highly unlikely without massive physical damage which would be detected and corrected. However, were the ring to split this would have little immediate consequence. There are eight independent load paths through the load frame. Failure of the loadframe itself does not compromise the links between the balloon, gondola and winch. Similarly any failure of a welded attachment lug or suspension cable would not cause a hazardous situation since the remaining 7 lugs are more than capable of carrying the increased loads.

9) Gondola Failure

There is no single failure of the gondola structure which would cause a hazardous situation. The construction of the gondola provides multiple load paths.

10) Control Box Failure

It would be immediately apparent to the operator that there was a problem. Operations would not be affected and the balloon would be recovered in the normal manner for further investigation of the failure. Valve operation would still be possible due to emergency batteries being available for this function.

11) Power Pack Failure

The implications of power pack failure are the same as above for control box failure. A back-up power pack is supplied for immediate replacement.

12) Winch Cable Failure

A failure of the winch cable could only occur due to the following circumstance. Each of these will be considered individually.

a) Manufacturing Failure - this could result in a substandard winch cable being produced which would not have the ultimate strength required. However, this is prevented by the cable being supplied with a certificate of conformity and the cable undergoes a proof load test to 16 tonnes.

b) Maintenance - the design of the main winch drum makes constant monitoring of the winch cable very easy. Faults arising from service will always appear progressively allowing ample time for corrective measures to be taken. The techniques for maintenance of single wire systems are well known and have a very good reliability record.

c) Operator Error - if an operator selects the ascend button when already flying at the correct ride/altitude an alarm sounds and the ascend command is over-ridden. If an operator continues to winch in past the normal ending point then the load ring, net and envelope approach the winch. The control system is fitted with an immediate emergency stop, and independent micro switch stop. A rubber cone is fitted 700mm from the swivel at the upper end of the winch cable. If winching is continued this bumper causes the micro switch to stop the winch immediately.

d) Meteorological Effects - given the maximum breaking load of the cable a wind of 256 km/hr would be required to cause a tether failure. It is presumed that a wind of this severity would be well predicted and the complete system secured. The above wind speed is based on the following -

$$\text{Drag } (D) = C_D \tfrac{1}{2} \rho V^2 S$$

where the drag figure is equal to the horizontal component of the resolved maximum cable tension, ie if the balloon was operating at its maximum free lift this would give the following

$$\text{Drag} = (43200^2 - 3508^2)\ \tfrac{1}{2}$$

$$\text{Drag} = 43057 \text{ kg}$$

Therefore the windspeed that would create this tension figure would be

$$V = \frac{(43057 \times 9.81 \times 2)}{(1.225 \times 390 \times 0.35)}^{\frac{1}{2}}$$

$V = 71\ ms^{-1}$ or $V = 138$ knots
$V = 256$ km/hr

e) Aerial Collision - firstly it must be noted that there are no aircraft which can survive an aerial collision as noted earlier. However, the safety of the HiFlyer is such that aerial collisions with the cable would be unlikely to cause a failure of the cable.

i) Maximum altitude - the maximum ride altitude is just below 500 ft. It is widely accepted that 500 ft is the minimum altitude for aircraft over open country. However, the HiFlyer systems are more likely to be located in built up areas for increased passengers throughput and for greater scenic interest. In this situation the minimum altitude is more likely to be 1500 ft. This provides a large margin of safety.

ii) Aircraft collision - small aircraft are unlikely to cause a rise in cable tension sufficient to cause cable failure before the aircraft themselves are severely damaged. Propeller contact will always result in propeller damage with negligible damage being caused to the cable. If lighter parts of aircraft structure hit the cable it is likely that there will be little damage to the cable. Main fuselage contact with the cable will probably be survivable because the cable can deform and move with the aircraft and consequently will slide past the aircraft: This means a new section of cable is presented to the aircraft during contact.

iii) Rotorcraft collision - this would cause immediate separation of the rotorblades but some damage may be caused to the cable. Recovery of the gondola is probably possible provided the winch is still functional.

iv) Visibility - the balloon is a 22m diameter sphere which is clearly visible from a great distance. At night standard aviation anti-collision lights and navigation lights are fitted.

13) Sheave Block Failure

The worst case failure on the sheave block is mechanical failure leading to a cable jam. Whilst this is difficult to envisage happening the results of this failure would be immediately apparent when the next winch movement is required. If the winch is hauling in cable the tension in the cable between the main drum and the sheave block will quickly reach a maximum and cause the current overload protection circuits on the main drive motor to power down the main motor. If the cable is payed out the gondola will not move and the problem will be recognised and the winch stopped.

Recovery of the balloon may be achieved by using a twin snatch block method identified in the operations manual.

14) Intermediate Roller Failure

If, for any reason, the intermediate roller failed it is likely that the winch could still be used but that extreme wear would be caused to the intermediate roller due to the passage of the cable across the roller.

15) Main Drum Failure

The worst case scenario for the main drum is that the failure has caused the jamming of the main drum. If the cause of jamming cannot be removed the balloon will have to be recovered using the twin snatch block method.

16) Gearbox Failure

If the gearbox fails so that the main winch drum cannot be driven by either the main motor or the auxiliary motor then the balloon will have to be recovered as for a drum jamming. If the gearbox fails such that the main winch drum can free wheel then the calliper safety brakes can be applied which act directly on the main drum. If the brakes are not manually applied the overspeed sensor will apply the brakes automatically.

17) Drive Motor Failure

If the main drive motor jams solid mechanically then it can be declutched, the auxiliary motor may be engaged and the balloon recovered at a maximum speed of 4 m/min. If the power from the mains supply is interrupted then the auxiliary motor may also be supplied by an independent 5 KVA petrol generator set. If for any reason the generator set is not functioning the auxiliary drive motor also has the facility to be driven by handcrank which is attached to the motor driveshaft. If all of the above systems are non-operational the twin snatch block method may also be used.

18) Winch Control Panel Failure

A complete control panel failure will be quickly apparent due to the winch not responding to the next command input. The auxiliary drive motor and generator set are completely independent and can be brought on line to recover the balloon. If only the radio linked controller has failed then the auxiliary winch control panel can be used to control all aspects of the winch.

19) Total Electrical Power Failure

Realisation would be obvious due to winch not operating. Recovery of balloon is achieved with the auxiliary motor and petrol generator set.

20) Environmental Effects

a) Low Temperature - the balloon and valve are both tested down to -60^{0}C and will function at this level. Accumulation of ice on the balloon gradually reduces the available freelift. Thus provided the freelift remains at an acceptable level (see Operations Manual) there are no other adverse effects from exposure to low temperature.

b) High Temperature - the valve is tested to +40^{0}C and the balloon fabric retains its structural strength up to +60^{0}C. Regarding both temperature limitations a test flight is conducted each day to establish the correct systems operation. The ambient temperature is unlikely to change rapidly within a 15 minute period which is the normal balloon ride duration.

c) Heavy Rain - heavy rain is normally associated with the more extreme weather systems. These are predictable and the system should be moored securely prior to the arrival of the rain. However, if the balloon is caught out flying in heavy rain this does not have a hazardous effect. The freelift is reduced due to the fact that the envelope and net become waterlogged. If freelift is reduced below the recommended figure in the operations manual the ride can be completed. The winch system container is fitted with bilge pumps to remove any collected water.

d) Snow and Ice - as with heavy rain the meteorological forecast will give advanced warning of heavy snow. The accumulation of snow on the upper surface of the balloon gradually reduces the available freelift. There is adequate time to cease operations in an orderly fashion.

e) Extreme Wind - operational limitations on wind speed are given in the operations manual. The maximum speed is 24 knots. However, the balloon is capable of withstanding much higher speeds of up to 69 knots when secured by the low mooring system.

f) Lightning Damage - a lightening protection system is installed which consists of a collector rod on the apex of the balloon and a large cross sectional copper conductor which is fitted into the control loom. The conductor is connected into the winch cable which can comfortably handle the large voltages resulting from a lightning strike. This protection will prevent the lightning from damaging the balloon or harming any occupants of the gondola. The charge is dissipated into the ground through the winch. Recovery of the balloon can always be achieved with the auxiliary winch and generator set if any of the winch functions are disabled.

Zusammenfassung der Tageslogblätter

	Datum	max.Px	Fahrten	Px total	Überladen	E Fa Überl	E Total
Fr	23.07.2004	22	9	140	2	1	3
Do	22.07.2004	22	20	298	6	0	0
Mi	21.07.2004	18	17	272	1	0	0
Di	20.07.2004	12	9	146	3	0	0
Mo	19.07.2004	16>14	19	343	0	0	0
So	18.07.2004	22	17	231	1	0	0
Sa	17.07.2004	18	16	227	0	0	3
Fr	16.07.2004	22	18	200	2	1	1
Do	15.07.2004	21>20	17	274	0	0	3
Mi	14.07.2004	19>18	15	208	4	0	0
Di	13.07.2004	15<16	20	238	3	0	0
Mo	12.07.2004	20	13	221	3	0	0
So	11.07.2004	17<18	24	363	9	0	0
Sa	10.07.2004	(6)	10	94	6	0	0
Fr	09.07.2004						
Do	08.07.2004	18	11	193	3	0	0
18	07.07.2004	19>18	18	279	4	0	0
Di	06.07.2004	16	14	213	0	0	0
Mo	05.07.2004						
So	04.07.2004	23	14	186	1	1	2
Sa	03.07.2004						
Fr	02.07.2004	13>10	10	94	3	0	0
Do	01.07.2004						

Zusammenfassung der Tageslogblätter

	Datum	max.Px	Fahrten	Px total	Überladen	E Fa Überl	E Total
Mi	30.06.2004	23	15	139	0	0	0
Di	29.06.2004	20	22	244	5	3	5
Mo	28.06.2004	20	10	82	1	0	0
So	27.06.2004	22	17	218	2	1	4
Sa	26.06.2004	20	20	312	2	1	5
Fr	25.06.2004	10<12	21	254	8	4	8
Do	24.06.2004						
Mi	23.06.2004	5<10	2	15	2	0	0
Di	22.06.2004	22	22	321	3	0	0
Mo	21.06.2004	20	16	225	3	0	5
So	20.06.2004	16>11	16	220	4	0	0
Sa	19.06.2004						
Fr	18.06.2004	6<15	3	16	2	0	0
Do	17.06.2004	22	21	256	5	1	4
Mi	16.06.2004						
Di	15.06.2004	19	17	231	6	6	9
Mo	14.06.2004						
So	13.06.2004	20<21	16	259	1	0	3
Sa	12.06.2004	19>18	1	1	0	0	0
Fr	11.06.2004						
Do	10.06.2004	20<24	24	409	8	8	12
Mi	09.06.2004	23>22	19	141	2	0	0
Di	08.06.2004	23	19	233	1	1	7
Mo	07.06.2004	19	13	157	0	0	0
So	06.06.2004	15<20	21	284	8	4	6
Sa	05.06.2004	21	22	269	2	0	6
Fr	04.06.2004	21>19	15	176	0	0	6
Do	03.06.2004						
Mi	02.06.2004	20	6	88	0	0	0
Di	01.06.2004						

Zusammenfassung der Tageslogblätter

	Datum	max.Px	Fahrten	Px total	Überladen	E Fa Überl	E Total
Mo	31.05.2004	19>18	14	212	1	0	1
So	30.05.2004	20	21	394	8	4	8
Sa	29.05.2004	20	25	290	6	4	9
Fr	28.05.2004	22	19	265	6	5	8
Do	27.05.2004	22>20	22	272	5	3	7
Mi	26.05.2004	20	16	171	2	1	8
Di	25.05.2004	20	23	315	4	4	13
Mo	24.05.2004	16	16	186	2	2	6
So	23.05.2004	19<20	23	358	4	2	7
Sa	22.05.2004	18	25	277	9	5	16
Fr	21.05.2004						
Do	20.05.2004	22<24	34	594	18	13	16
Mi	19.05.2004	24	20	234	7	6	8
Di	18.05.2004	24	15	200	4	4	7
Mo	17.05.2004	20>17	19	306	9	9	13
So	16.05.2004	22	23	371	13	4	5
Sa	15.05.2004	20	26	394	6	5	13
Fr	14.05.2004	19<22	24	276	4	3	11
Do	13.05.2004	15	19	199	11	10	14
Mi	12.05.2004	20	17	223	6	6	10
Di	11.05.2004	22	13	163	4	2	4
Mo	10.05.2004	23	15	222	4	3	4
So	09.05.2004						
Sa	08.05.2004	19	1	17	1	0	0
Fr	07.05.2004	17	3	21	0	0	0
Do	06.05.2004						
Mi	05.05.2004						
Di	04.05.2004	20	15	197	3	3	6
Mo	03.05.2004	20<24	11	97	1	1	3
So	02.05.2004	21	23	351	9	7	11
Sa	01.05.2004						

Zusammenfassung der Tageslogblätter

	Datum	max.Px	Fahrten	Px total	Überladen	E Fa Überl	E Total
Fr	30.04.2004						
Do	29.04.2004	18	14	186	7	4	4
Mi	28.04.2004	18	14	169	7	3	4
Di	27.04.2004	21	13	132	3	0	0
Mo	26.04.2004	18>17	10	108	1	1	3
So	25.04.2004	13<14	2	19	1	0	0
Sa	24.04.2004	9<12	19	196	6	2	2
Fr	23.04.2004	16>18	11	148	3	0	0
Do	22.04.2004	17>18	17	265	2	2	2
Mi	21.04.2004	22<24	18	311	9	4	4
Di	20.04.2004	17	18	235	2	0	0
Mo	19.04.2004						
So	18.04.2004	17>15	18	363	9	0	0
Sa	17.04.2004	21	12	153	2	0	0
Fr	16.04.2004	21>20	16	284	8	0	0
Do	15.04.2004	20>18	14	260	8	0	0
Mi	14.04.2004	20	18	305	1	0	0
Di	13.04.2004	15	17	281	3	0	0
Mo	12.04.2004	15	16	237	6	0	0
So	11.04.2004	17>15	14	231	8	0	0
Sa	10.04.2004						
Fr	09.04.2004	10	7	79	3	0	0
Do	08.04.2004	16	6	70	1		
Mi	07.04.2004						
Di	06.04.2004						
Mo	05.04.2004						
So	04.04.2004	15	11	145	4		
Sa	03.04.2004	14>10	8	92	1		
Fr	02.04.2004	16	13	100	0		
Do	01.04.2004	22	11	89	1		

Swiss FOCA
Section FL

Memorandum

To: Swiss Transport Museum, Mr. P. Hauri

From Alex Husy, FOCA

Copies to: Lindstrand Balloons, Simon Forse

Date: 17.10.97

Subject: Swiss Approval (?) of LBL HiFlyer

Operation of tethered balloon systems in Switzerland

In order to get a clearer picture regarding the installation and operation of tethered balloon systems, the Swiss FOCA requires the following additional information:

1. What different size balloon systems does the manufacturer offer and are there any differences in certification and/or operating procedures?
2. Were any of these products certified by a local or foreign airworthiness authority or are there any ongoing certifications in process?
3. If yes, what kind of certificate was issued by these authorities?
4. If no, what other kind of approval (or similar) was given by airworthiness authorities?
5. If no, what other kind of approval (or similar) was given by other than airworthiness authorities?
6. What operating restrictions/limitations/procedures (except those contained in the manufacturer's operating manuals) are known to be in effect for the existing systems?
7. What kind of official "pilot" requirements were established by the authorities of those countries in which such systems are already operated? We are thinking of similar policies used for cable-operated ferries where the "captain" has to be able to safely land the ferry in case of rope breaks.
8. What were the requirements to be complied with for night operations?
9. Basically, is the tethered balloon system regarded more as an "aircraft" or a "ride attraction"? For airborne operations, is it considered to be an "aircraft" or an "aerial obstacle"?
10. What are the safety features built into the system? (We think here of rope breaks, severe gusts etc.)
11. What documentation (except promotional material) can be provided by the manufacturer? Does this paper cover installation and operational procedures.

ALEX HUSY

Lindstrand Balloons Ltd

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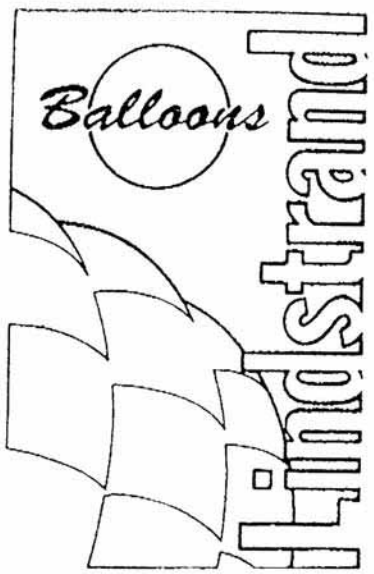

FAX

To: Peter Hauri
Swiss Transport Museum

From: Per Lindstrand

Date: 21 October 1997

Fax No: 00 41 41 370 61 68

Total no of pages (inc this page): 2

Dear Peter

LINDSTRAND HiFLYER

Thank you for your fax of today's date. I will, of course, bring complete documentation with me on Monday. Please let me answer Alex Husy's questions in the order they were asked:-

1) Lindstrand Balloons only offer one type of tethered aerostat which is called the "HiFlyer". This consists of a 5,750 m^3 envelope, an envelope net, a 30 people gondola, and a winch. We supply the entire system as a package, install it and train the client's personnel.
2) The British CAA, the US FAA and the Swedish LFV have all classified the HiFlyer as an amusement ride. The CAA and the FAA don't want to be involved in the certification process. The Swedish LFV certified the envelope as a sub-contract authority to the Civil Certification Authority SAQ. In England the certification authority is the Health and Safety Executive (HSE). In the United States the certification authority is the same as those who certify amusement rides and differs from State to State. In Florida, for example, the certification authority is the Department of Agriculture and in Las Vegas it is the Building Department.
3) The certificate issued is a permit to operate an amusement ride
4) See 2) and 3).
5) See 2) and 3).
6) The operating manual is the only restriction so far.

7) The HiFlyer is built with the cable as the strongest component and we consider a cable break unlikely and do not consider the fly-away case as realistic. Consequently, we do not specify a balloon licence as a pre-requisite for the on-board operator. However, we consider a training programme is necessary for the operator, which we will carry out on site. We feel, however, that a Balloon Pilot's Licence is a great help as the operator's primary safety task will be to identify bad weather.

8) The HiFlyer carries the same night lights as an aircraft, ie white and red lights, on top of the envelope and underneath the gondola. The tether cable carries no lights.

9) As regards operational restrictions, the HiFlyer is normally considered as an aircraft.

10) The HiFlyer is built never to leave the ground and we believe that the envelope would fail (not catastrophically) in the event of an extreme overload such as a hurricane. The use of an overstrong net will limit tear propagation and such result in a gentle descent. We now have two seasons of operational experience behind us and we have seen the HiFlyer hit by gusts of up to 67 miles an hour resulting in no damage to the system or injuries to the passengers. The maximum operating limit is a 25 knot wind speed. This limit is due to passenger comfort rather than structural reasons, ie at wind speeds above 25 knots the movement of the gondola could result in an uncomfortable ride for the passengers. There is a wind meter at the top of the envelope with a readout for the operator. If bad weather approaches, it only takes 3 minutes from top to bottom, ie 120 metres flying height down to the landing platform.

11) We supply an Operations Manual and a Maintenance Manual with every HiFlyer. These are standard documents and we also provide a training manual in conjunction with the client. This document is client specific.
For the certifying authority we will provide full drawings plus detailed stress analysis, in fact we will provide documentation very similar to the normal CAA certified products we manufacture.

Best regards

Per Lindstrand