

Investigation Report

CX003-0/05
April 2006

Identification

Type of occurrence: Accident
Date: 2 June 2005
Location: Frankfurt-Sindlingen
Aircraft: Hot-air Airship
Manufacturer / Type: Lindstrand / LBL HS 110
Injuries to persons: No injuries
Damage: Aircraft severely damaged
Other damage: None
Information Source: Investigation by BFU



During this check the burner was activated several times for short periods to keep the envelope warm and a cold-air ventilator was used to maintain the required envelope pressure. When the Rotax engine had been started and the airship was ready for lift-off, there was a bang. The airship pilot felt a heavy push in the gondola and noticed that the envelope pressure had dropped considerably.

Factual information

History of the flight

At 18:20¹ hrs preparation work to fly an advertising promotion with a hot-air airship started in a meadow at Frankfurt-Sindlingen.

The newly manufactured envelope LBL HS-110 with a British registration was used. The envelope had last been used for a flight the day before and had been inflated without incident. After the rigging/inflating phase the airship pilot began to check the equipment.



The envelope had burst open vertically and horizontally on the left-hand side in the area of the empennage involving several panels. In addition the internal left ventilation hose was torn open. A large triangular opening had formed at the tail of the airship and within a short time volume and buoyancy

¹ Unless otherwise specified, all times are indicated in local time

of the envelope decreased considerably. There was no damage to persons or property beyond the severe damage to the aircraft.

Personnel information

The airship pilot held a pilot's licence Class 1 for hot-air airships and hot-air balloons. He had a total flight experience of 214 flight hours, of which 176 hours were on hot-air balloons and 38 hours on hot-air airships.

Aircraft information

Commissioning date of the hot-air airship Lindstrand LBL HS-110, MSN 546 was 1 June 2005. The aircraft was operated under British registry and in the process of changing owners during re-entry into service. Prior to the construction of the new envelope, the hot-air airship had approximately 148 operating hours. The new envelope was to comply with the approval type design.

Meteorological information

At the time of the accident visual meteorological conditions with 7/8 stratocumulus at approximately 3,000 ft prevailed. Wind velocity 210°, 4 kt. There were no special meteorological conditions.

Wreckage and impact information

In the area of the left-hand empennage, the envelope had been torn open vertically over seven panels and horizontally over two panels.



The vertical rip involving seven panels was located in the section in which the left-hand fin was incorporated. The horizontal rip was above the left-hand fin. Both rips ran along the load tapes. The seams themselves were intact.



The ventilation hose was torn open along the seam to the left-hand fin over a length of more than 2 meters.

Comparison of the new envelope with the former envelope of the same type revealed repositioned eyelets for control lines and insufficiently interlinked load tapes.

The overall sewing of the envelope material showed distinct deficiencies.



The ends of several horizontally sewn panels did not match precisely.

Constructional differences existed on the air supply system which led to changes in the fresh air and pressure supply within the envelope.

The pressure in the envelope and the empennage added significantly to the strain of the structure. However, a statement regarding rate of airflow and

pressure characteristic related to power input of the equipment used can not be made. It was tried to rig/inflate the envelope in order to reproduce pressure ratios but without success due to the high degree of damage the envelope had suffered.

The transfer valves in the old envelope had been locked by means of single-tensioned rubber ropes. The valves of the new envelope had been double-tensioned over the same length. The pilot had no option to adjust tension by means of an adjustment device.

The envelope temperature indicator was inoperable due to a missing temperature transmitter. According to the airship flight manual the maximum allowable envelope pressure is 20 mm/Ws. The envelope pressure gauge's scale was in Inch and had no markings for the operating areas prescribed in the airship flight manual.

Fire

Investigation of the envelope showed no traces of fire or traces of an uncontrolled deflagration of propane gas on the fabric parts.

Analysis

The airship pilot was sufficiently qualified to conduct the flight. The flight experience on hot-air airships was low, total flight experience on hot-air balloons and airships was sufficient and showed a good level of training.

The airship had a British registration and had passed its annual inspection. It was in the process of changing owners and was to fly commercial advertising promotions. The hot-air airship was not registered with a commercial operator.

Comparison of the airship envelope with the former envelope of the same type revealed considerable constructional differences leading to distinct changes in technical in-service loads. The structure was overstressed particularly by the excessive pressure generated in the envelope and the empennage. As a result the envelope and the ventilation hose ruptured. The sequence of damage events could not be identified clearly.

Comparison of the envelope design under evaluation showed that the former envelope of the same type was inflated by a funnel-shaped, more than 2 m high opening in the ventilation hose. In the accident envelope no "funnel" had been installed during manufacture, only a small amount of

air was able to pass from the hose system into the envelope. This was possible through a small vent of approximately 40 cm instead of a funnel-shaped, more than 2 m high opening as in the other envelopes. With the fan running at full load, this change to the air supply of the airship envelope obviously resulted in very high internal pressure in the aft portion of the airship. Due to the small opening in the hose the fresh air supply was low.

Caused by the modified ventilation system and with the high pressure relief valves set too tight the pressure values in the envelope increased. These pressure values could not be counterbalanced sufficiently by the air extraction rate. The pilot's statements show that these high pressure relief valves discharged significantly less air than the valves of other envelopes.

According to the pilot's estimation there were significant differences in the control of the aircraft during the flight the day before also due to the changing pressure ratios.

Investigation of the airship envelope showed that the rip in the envelope started in the area of the eyelet for control line for the left-hand control cable.



The actual positions of the eyelets in the load tape were less than optimal in view of the loads which occur in service. The load tape did not form a closed loop around the envelope but had gaps at each of the four eyelets for control lines.



Conclusions

The flight accident is to be attributed to the fact that after the rigging the envelope pressure in the empennage increased too much resulting in a structural failure of the envelope involving several meters of fabric with rips running in horizontal and vertical direction.

The inadequate processing of the envelope and non-conformance with the type design during manufacture had contributed to the structural failure.

Due to the incorrect instrumentation the pilot was not in a position to assess with sufficient certainty the limit values of the envelope air temperature and the envelope pressure when putting the aircraft into service.

Investigator in charge	Stahlkopf
Assistance	Bleienheuft

Because the envelope expanded due to the internal pressure but the load tape running around the envelope did not a very high tensile stress occurred in the area of the eyelets of the discontinuous circumferential load tapes and this caused the fabric to tear. On other eyelets, the fabric showed clear signs of high tensile stress in the run-up to tearing.

The structural strength of the airship envelope had been considerably degraded caused by the unsatisfactory sewing of the airship envelope during manufacture, the discontinuous circumferential load tapes and the inadequate positioning of the eyelets. Structural failure after extended time in service or exposure to high in-service loads was thus to be expected.

The production deficiencies of the sewing could have been noticed by the manufacturer had he done a routine test.

The envelope pressure indicator installed had an Inch scale and no colour markings. The pilot had no sufficient option to recognize the allowable operating ranges without further conversion.

As the envelope temperature indicator was inoperable and a reliable control of the operating pressure in the envelope was not sufficiently possible, the limit values for pressure and temperature could not be adequately monitored by the pilot.

The investigation has been conducted in compliance with the law relating to the Investigation of Accidents and Incidents associated with the Operation of Civil Aircraft (Flugunfall-Untersuchungsgesetz - FIUUG) dated 26 August 1998. Danach ist das alleinige Ziel der Untersuchung die Verhütung künftiger Unfälle und Störungen. Die Untersuchung dient nicht der Feststellung des Verschuldens, der Haftung oder von Ansprüchen.

mail: box@bfu-web.de
<http://www.bfu-web.de>
 Tel: 0 531 35 48 0
 Fax: 0 531 35 48 246

Editor/Distributor:
 Bundesstelle für
 Flugunfalluntersuchung
 Hermann-Blenk-Str. 16
 38108 Braunschweig