MINISTRY FOR
INNOVATION AND TECHNOLOGY
TRANSPORTATION SAFETY BUREAU

FINAL REPORT

2014-080-4P

Serious incident

Sofia

8 March 2014

Beechcraft A-36

HA-ARB

The sole objective of the technical investigation is to reveal the causes and circumstances of aviation accidents and incidents, to initiate the necessary technical measures and to make recommendations in order to prevent similar cases in the future. It is not the purpose of this activity to apportion blame or liability.

NOTE: This document is the translation of the Hungarian version of the final report. Although efforts have been made to translate it as accurately as possible, discrepancies may occur. In this case, the Hungarian is the authentic, official version.

General information

This investigation has been carried out by Transportation Safety Bureau on the basis of

- Regulation (EU) No 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC,
- Act XCVII of 1995 on aviation,
- Annex 13 identified in the Appendix of Act XLVI. of 2007 on the declaration of the annexes to the Convention on International Civil Aviation signed in Chicago on 7th December 1944,
- Act CLXXXIV of 2005 on the technical investigation of aviation, railway and marine accidents and incidents (hereinafter referred to as: Kbvt.),
- Decree No. 123/2005. (XII. 29.) GKM on the rules of safety investigation of aviation accidents, incidents and other occurrences
- NFM Regulation 70/2015 (XII.1) on technical investigation of aviation accidents and incidents, as well as on detailed investigation for operators,
- or, in absence of other related regulation of the Kbvt., the Transportation Safety Bureau of Hungary conducted the investigation in accordance with Act CXL of 2004.

The competence of the Transportation Safety Bureau of Hungary is based on Government Decree № 278/2006 (XII. 23.), and, as from 01 September 2016, on Government Decree № 230/2016. (VII.29.) 23) on assignment of a transportation safety body and on the dissolution of Transportation Safety Bureau with legal succession.

Pursuant to the aforesaid laws

- The Transportation Safety Bureau of Hungary shall investigate aviation accidents and serious aviation incidents.
- The Transportation Safety Bureau of Hungary may investigate aviation accidents and incidents which – in its judgement – could have led to more accidents with more serious consequences in other circumstances.
- The Transportation Safety Bureau of Hungary is independent of any person or entity which may have interests conflicting with the tasks of the investigating body.
- In addition to the aforementioned laws, the ICAO Doc 9756 and the ICAO DOC 6920 Manual of Aircraft Accident Investigation are also applicable.
- This Report shall not be binding, nor shall an appeal be lodged against it.
- The original version of this Report was written in the Hungarian language.

Incompatibility did not stand against the members of the IC. The persons participating in the technical investigation did not act as experts in other procedures concerning the same case and shall not do so in the future.

The IC shall safekeep the data having come to their knowledge in the course of the technical investigation. Furthermore, the IC shall not be obliged to make the data – regarding which the owner of the data could have refused its disclosure pursuant to the relevant act – available for other authorities.

This Final Report

was based on the draft report prepared by the IC and sent to all affected parties (as specified by the relevant regulation) for comments.

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Definitions and abbreviations

FL	*Flight Level (1 FL = 100 ft = 30.5 m)*
IC	*Investigating Committee*
ICAO	*International Civil Aviation Organization*
ICAO Annex 13	*An international agreement on the regulation of the investigation of aviation accidents and incidents (an appendix the ICAO Convention)*
Kbvt.	*Act CLXXXIV of 2005 on the technical investigation of aviation, railway and marine accidents and incidents*
LBSF	*ICAO code of the international airport of Sofia*
LHKK	*ICAO code of the airport of Kiskunlacháza*
LHTL	*ICAO code of the airport of Tököl*
LT	*Local Time*
MAYDAY	*A radio communication expression to declare an emergency situation*
MET	*Ministry of Economy and Transport*
MIT	*Ministry for Innovation and Technology*
NTA AA	*National Transport Authority Aviation Authority (till 31 12 2016) (Hungary)*
NVFR	*Night Visual Flight Rules*
PPL (A)	*Private Pilot Licence (Aircraft)*
SEP	*Single Engine Piston*
TSB	*Transportation Safety Bureau of Hungary*
UTC	*Coordinated Universal Time*

Introduction

Occurrence category		Serious incident
Aircraft	Manufacturer	Beechcraft
	Type	A-36 Bonanza (Figure 2)
	Registration sign	HA-ARB
	Operator	JetStream Kft
Occurrence	Date and time	8 March 2014,13:15 UTC
	Location	LBSF Bulgaria (Figure 1)
Number of people who died / were severely injured in the accident:		0 / 0
Extent of damage of the aircraft involved in the occurrence:		Slightly damaged

Any clock-time indicated in this report is given in Coordinated Universal Time (UTC).

Figure 1: Location of the occurrence in Bulgaria.

Reports and notifications

The occurrence was reported to the dispatcher of TSB by Ministry of Transport of Bulgaria on 12 March 2014, on 10:34.

Investigation Committee

The Head of TSB assigned the following investigating committee (hereinafter referred to as IC) to the investigation of the case:

Investigator-in-charge	**Endre Szilágyi**	Investigator
Member	**György Háy**	Investigator

Endre Szilágyi Government Official's employment by TSB was terminated during the investigation, therefore György Háy was assigned as Investigator-in-Charge and Gábor Torvaji, Investigator, was assigned as Member by the head of TSB.

Overview of the investigation process

As the occurrence took place abroad, the investigation falls within the competence of the local accident investigation body, according to ICAO Annex 13. But, because the aircraft returned to Hungary on the same day, the Bulgarian investigation authority requested TSB Hungary to perform the investigation.

The IC contacted the Bulgarian investigating body, asked for and received data relating to the course and circumstances of the occurrence. The IC received records of radio communication between the aircraft and the air traffic management service of the airport, as well as the flight paths recorded by the radar. In addition, the IC obtained a statement of the representative of the operator of an airliner staying near the scene, relating to the weather conditions experienced there (icing).

On 14 Mar 2014, the IC interviewed the pilot of the aircraft involved and a passenger who had been on-board, as witnesses. The IC inspected the aircraft at Kiskunlacháza Airport (LHKK). Photographs were taken of the aircraft and the documents, and measurements were also performed.

The IC revisited the airport (LHKK) on 25 03 2014, inspecting the operation of the autopilot, measuring the force required for automatic shut-off and assessing the state of the operating mechanism.

The IC summarised and analysed the information gathered, and drew conclusions of it.

Short summary of the occurrence

The aircraft took off at Tököl, Hungary, and was heading to Sofia, Bulgaria. It had one pilot, three passengers and two buckets of paint (20 litres each) on board. When approaching the destination, the pilot contacted the air traffic management service of Sofia Airport, and approached the airport according to the procedure communicated by them. During descent to the appropriate level, the aircraft had to break through a thin cloud layer in which the pilot experienced strong icing. This phenomenon was also confirmed by the flight crew of an airliner flying nearby. Upon getting out of the cloud, the aircraft began unexpected vertical oscillation. When at the top of an oscillation wave, the pilot gave a firm push to the elevator, and at the same time, he also disengaged the autopilot which had been in control of the aircraft till then. Then the nose of the aircraft dropped, and the aircraft began to fall almost vertically, which the pilot was only able to stop by great effort. In the meantime, he gave MAYDAY distress call. After returning to the normal flight attitude and speed, the extraordinary forces were gone, and the aircraft was easy to control again. Then the pilot cancelled the emergency situation initiated using the MAYDAY distress call. The pilot suspected autopilot malfunction. The IC inspected the operation of the autopilot during the visits. Taking all circumstances into account, the IC concluded that the incident was caused not by autopilot malfunction but by the combined effect of meteorological conditions and human factors.

Figure 2: The aircraft involved in the occurrence

1. Factual information

1.1. History of the flight

The pilot started to fly solo the aircraft owned by him after a few hours of acclimatisation flight during which the use of the autopilot was also demonstrated in practice.

After take-off at Tököl (LHTL), the pilot intended to reach the destination airport LBSF (Sofia, Bulgaria) by VFR flight. The total weight of the pilot and the passenger sitting in the front right seat was 160 kg, the package placed between the first and the second rows of seats weighed 60 kg, the total weight of the passengers in the rear row was 150 kg, and the baggage placed in the cargo space was 45 kg (Figure 3). The flight was started with full fuel tanks. The pilot maintained the flight level (FL 110) with the engaged autopilot. After contacting the air traffic management at LBSF, they began to descend according to the information received, and during descent, they had to fly through a cloud layer. The pilot experienced severe icing while in the cloud, which was also confirmed by the flight crew of an airliner also heading to Sofia. Soon after getting out of the cloud causing icing, the aircraft began unexpected vertical oscillation. Upon effect of the unexpected situation, the pilot pushed the elevator forward firmly, making the aircraft start a descent, and he also pushed the disengage button of the autopilot at the same time. According to his report, he felt that the autopilot did not go off but it was turning the nose of the aircraft toward the ground with great force. Then he declared emergency situation by giving the MAYDAY distress call. Finally, at the cost of great effort, he was able to recover the aircraft from its fall at an altitude of 800 metres (above sea level), and then, after the speed returned to the normal value and he was able to control the aircraft again, he cancelled the emergency situation initiated using the MAYDAY distress call, and the aircraft landed safely at Sofia Airport (LBSF) which is situated at the altitude of 530 metres above sea level. As an effect of the loads appearing during the fall, the paint buckets carried without fastening or packaging opened and their contents contaminated the inside of the aircraft, which did not cause injury and did not affect the course of events.

1.2. Injuries to persons

Injuries	Crew		Passenger	Other
	Pilot	Flight attendant		
Fatal	0	0	0	0
Serious	0	0	0	0
Minor	0	0	0	
None	1	0	3	

1.3. Damage to aircraft

The aircraft was not damaged related to the occurrence, except for contamination with paint.

1.4. Other damage

The IC had got no information on other damage by the completion of the investigation.

1.5. Personnel information

1.5.1. Data of the pilot in command

Age, nationality, gender		43 years old, Hungarian, Male
Licence data	Type	PPL (A)
	Ratings	SEP (land), NVFR
Medical valid until		23 08 2014

1.6. Aircraft information

1.6.1. General information

Class	Fixed wing aircraft (MTOM < 5700kg)
Manufacturer	Beechcraft
Model	A-36 Bonanza
Year of manufacture	1988
Serial number	E2423
Nationality and registration marks	HA-ARB
State of registry	Hungary
Date of registry	11 July 2013
Name of the owner	private person
Name of the operator	JetStream Kft

1.6.2. Airworthiness Certificate

Airworthiness Certificate	Number	JS-E-04/2012
	Date of issue	14 05 2009
	Valid until	Until withdrawal
	Restrictions	None

Airworthiness Review Certificate	Number	J-SE-04/2012
	Date of issue	09 May 2009
	Valid until	09 May 2014
	Date of latest review	09 May 2013

1.6.3. Engines

The engine had no effect on the course of events, therefore its data needs no detailed analysis.

1.6.4. Propellers

The propeller had no effect on the course of events, therefore its data needs no detailed analysis.

1.6.5. Aircraft loading data

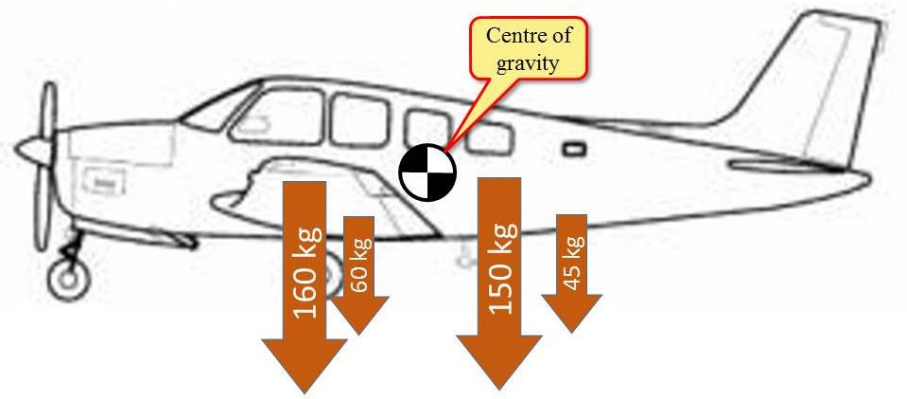

Figure 3: Payload distribution

Empty weight	1 104 kg
Fuel weight	~226 kg
Payload	415 kg
Take-off weight	1 745 kg (3 847 lb)
Maximum take-off weight	1 656 kg (3 651 lb)
Maximum landing weight	1 656 kg (3 651 lb)
Weight at the time of the occurrence	1 550 kg (3 417 lb)
Centre of gravity at take-off	219.0 cm (86.2 inch)
Centre of gravity at the time of the occurrence	222.5 cm (87.6 inch)
Centre of gravity limits with max. weight	205.7 – 222.8 cm (81.0 – 87.7 inch)

1.7. Meteorological information

The occurrence took place at daytime, in good visibility conditions, after breaking through a strongly icing, thin cloud layer.

1.8. Navigation aids

The navigation aids had no effect on the course of events therefore their data needs no detailed analysis.

1.9. Communications

At the time of the occurrence, the aircraft had continuous radio connection with the air traffic management service of Sofia Airport.

1.10. Aerodrome information

The aircraft took off at Tököl Airport (LHTL) on 08 March 2014.

The planned destination airport was Sofia (LBSF).

The parameters of the aerodromes had no effect on the occurrence therefore these parameters need no detailed analysis.

1.11. Data recorders

The aircraft had no data recorder in place; it is not required for the aircraft type affected.

1.12. Wreckage and impact information

There was no wreckage in connection with the occurrence.

1.13. Medical information

There was no evidence of any influence of physiological factors or other impediment on the capacity of the flight crew.

1.14. Fire

There was no fire in connection with the occurrence.

1.15. Survival aspects

No one was injured.

1.16. Tests and research

The IC revisited the LHKK airport on 25 03 2014 to inspect the operation of the autopilot, to measure the control force required for automatic shut-off, and to assess the state of the operating mechanism.

1.17. Organisational and management information

The affected organisations had no effect on the course of events therefore their data needs no detailed analysis.

1.18. Additional information

The autopilot is able to maintain the altitude and direction of the aircraft and the horizontal position of the wings. It can also perform a slight climb and descent. It maintains altitude on the basis of the barometric pressure measured, which is based on pressure of the air coming through the static inlets made at the side of the aircraft. Contrary to the pitot tube, the static inlets in this aircraft category are not equipped with heating to prevent icing.

1.19. Useful or effective investigation methods

The investigation required no non-standard methods.

2. Analysis

The IC finds it probable that the air inlet of the static pressure probe was partly blocked due to icing, which resulted in faulty and fluctuating altitude determination due to pressure fluctuation caused by turbulence. Attempting to follow the pressure altitude set, the autopilot started to steer the aircraft up- and downward on the basis of the changing air pressure measurements.

Similar to the pilot's activity, the autopilot also uses the trim to adjust level flight, in such manner that first the elevator is moved by a relatively stronger electromotor, and then, in order to spare this motor from continuous load, a smaller motor moves the balancing aerodynamic trim flap of the elevator until the force needed to provide sufficient travel of the elevator is gone. During take-off, the aircraft somewhat exceeded the maximum take-off weight, although its centre of gravity was inside the specified range (Figure 4). The fuel tanks are situated in front of the main spar inside the wings, so the mass of fuel creates a tilting torque (top heavy) during level flight, because it is situated in front of the centre of gravity. During flight, the centre of gravity of the aircraft shifted forward, due to gradual decrease of the mass of fuel. Supposing that 10 gallons of fuel was left, the location of the centre of gravity changed according to Figure 4.

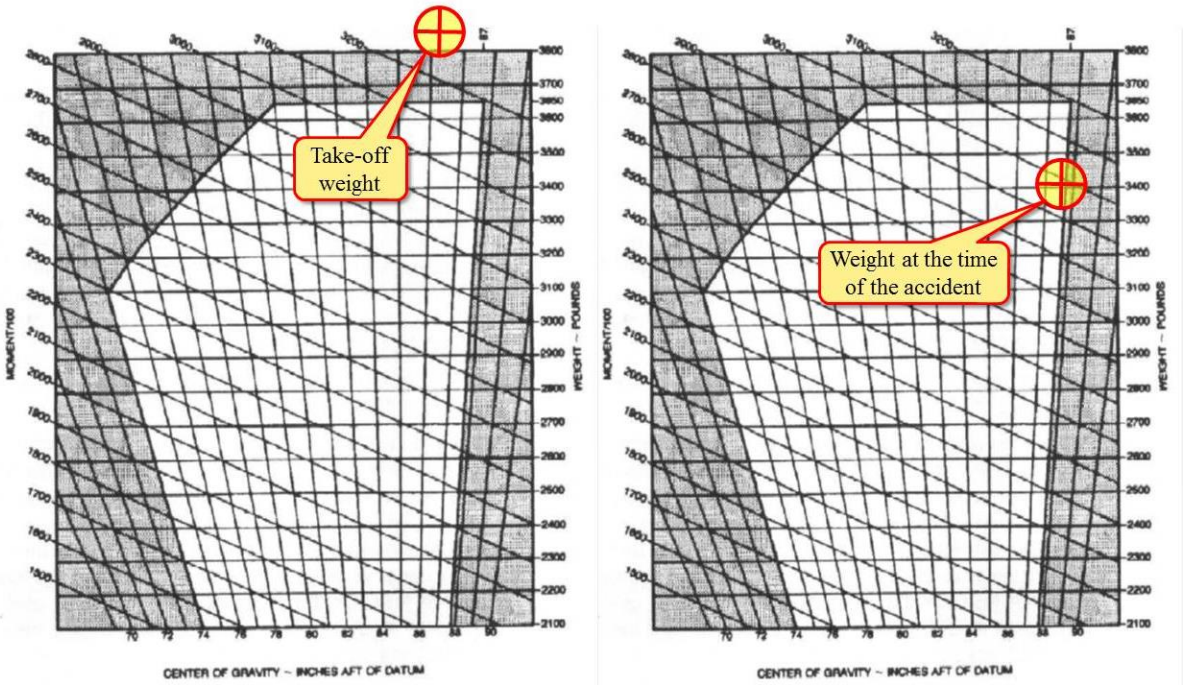

Figure 4: Respective load and centre of gravity of the aircraft at the time of take-off and at the time of the incident

The calculated centre of gravity was right in front of the rear limit position, but within the permitted range. During fuel consumption, the steering forces were in a state of constant change, which the autopilot managed by automatic trimming until the moment it was disabled. According to his report, the pilot tilted the nose of the aircraft by a resolute forward push of the elevator at the end of a cycle of rising, while, after pushing the button which disconnects the autopilot, he realised that the steering forces had changed. As a result, the aircraft trimmed almost fully forward started a vertical fall, which the pilot was able to stop (by lifting the nose of the aircraft) only at the cost of significant effort (Figure 5).

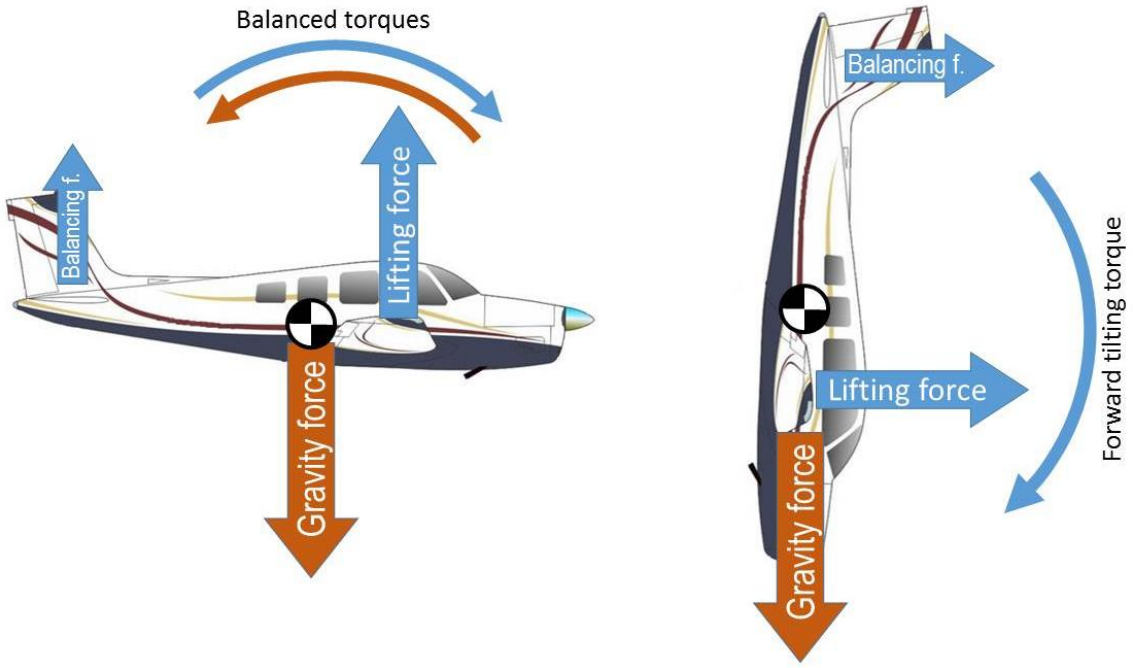

Figure 5: Forces and torques affecting the aircraft during its flight and fall

The cause of the dangerous phenomenon was an imbalance of the torques affecting the tilt movement of the aircraft. During cruise, the backward tilting torque generated by the force of gravity acting behind the fulcrum of the lifting force of the wing is balanced by the forward tilting torque of the aerodynamic force awakening upward on the forward-trimmed elevator. This situation changes significantly during a fall of the aircraft. The backward torque generated by the different fulcrums of the lifting force and the force of gravity disappears. At the same time, the balancing force of aerodynamic origin (coming from the remaining forward trim) does not decrease, but generates even greater forward torque (due to increase of velocity) which further pushes the nose of the aircraft toward the ground, or, in absence of intervention, the aircraft may even turn on its back, which almost certainly leads to disaster (Figure 5). The pilot was able to recover the aircraft from this changed attitude only by giving the elevator a drastic pull, which required a significantly greater steering force than usual. The position of the IC is that the change to the steering force was due to the situation which occurred in the manner described above, and not to malfunction of the autopilot.

3. Conclusions

3.1. Factual statements

The pilot had only little experience for the given flight task at the time of the occurrence.

The aircraft was airworthy. It had a valid airworthiness certificate. According to its documents, the aircraft was equipped and maintained in compliance with the requirements in effect and with the approved procedures.

At the time of the occurrence, the weight and weight distribution of the aircraft were within the relevant ranges, although the weight exceeded the maximum value at the time of take-off. The aircraft was adequately fuelled for the flight.

The flight took place according to the flight plan, at daytime, in good visibility conditions.

As regards the activities of the air traffic management services and the ground personnel and the characteristic features of the airport, no such information was obtained which could be related to the occurrence.

3.2. Causes of the accident

The investigation performed by the IC has concluded that the causes of the occurrence were as follows:

- The static inlets iced partly or fully, and
- the pilot had little experience with using the autopilot.

4. Safety recommendations

The Investigating Committee of TSB identified no circumstance which would warrant issuance of a safety recommendation.

Budapest, 27 03 2019

György Háy
Investigator-in-Charge

Gábor Torvaji
IC Member