



MINISTRY FOR  
INNOVATION AND TECHNOLOGY  
TRANSPORTATION SAFETY BUREAU

# FINAL REPORT

2016-158-4

Incident

Chain Bridge (Danube River), Budapest, Hungary

01 May 2016

EDGE 540

N9ND

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

## General information

### **This investigation is being 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 7<sup>th</sup> December 1944,
- Act CLXXXIV of 2005 on the safety investigation of aviation, railway and marine accidents and incidents (hereinafter referred to as Kbvt.),
- Regulation 123/2005. (XII. 29.) of the Ministry of Economy and Transport on the rules of safety investigation of aviation accidents and incidents and other occurrences
- NFM Regulation 70/2015 (XII.1) on safety investigation of aviation accidents and incidents, as well as on detailed investigation for operators,
- In absence of other relevant regulation in the Kbvt., in accordance with Act CXL of 2004 on the general rules of administrative authority procedure and service.
- The competence of the Transportation Safety Bureau of Hungary is based on Government Regulation 278/2006 (XII. 23.), and, as from 01 September 2016, on Government Regulation № 230/2016. (VII.29.) on the assignment of a transportation safety body and on the dissolution of Transportation Safety Bureau with legal succession.

### **Pursuant to the aforementioned laws,**

- Transportation Safety Bureau Hungary shall investigate aviation accidents and serious incidents.
- Transportation Safety Bureau Hungary may investigate aviation and incidents which – in its judgement – could have led to more accidents with more serious consequences in other circumstances.
- Transportation Safety Bureau 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 of this report was written in the Hungarian language.

Incompatibility did not stand against the members of the IC. The persons participating in the safety 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 safety 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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## **Translation**

The present document is a translation from Hungarian. Although efforts have been made to provide a translation as accurate as possible, discrepancies may occur. In such eventuality, the Hungarian version is considered overriding.

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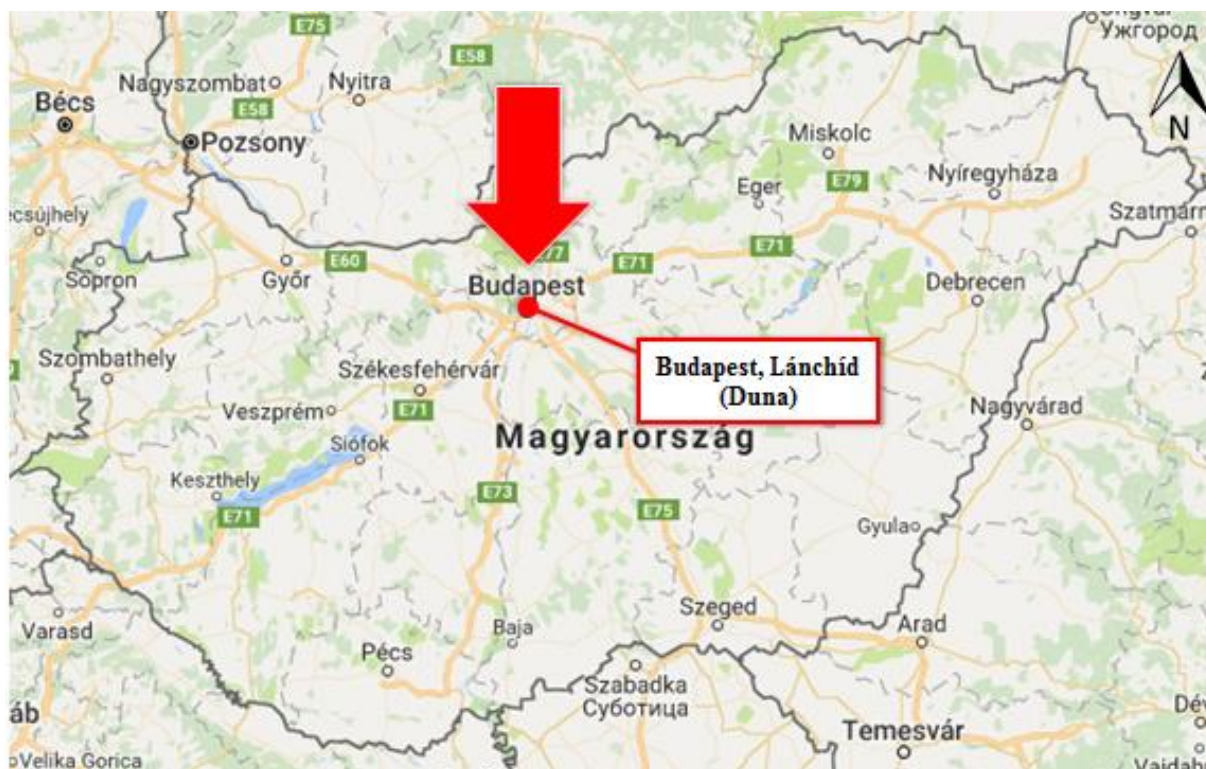
## List of definitions and abbreviations

AAIB	<i>Air Accidents Investigation Branch (of United Kingdom)</i>
Aerodrome	<i>means a defined area (including any buildings, installations and equipment) on land or water or on a fixed, fixed off-shore or floating structure intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft</i>
AGL	<i>Above Ground Level</i>
ARP	<i>Airport Reference Point</i>
ATPL	<i>Airline Transport Pilot License</i>
EASA	<i>European Union Aviation Safety Agency</i>
IC	<i>Investigating Committee</i>
ICAO	<i>International Civil Aviation Organization</i>
ITM	<i>Ministry of Innovation and Technology (Innovációs és Technológiai Minisztérium)</i>
Kbvt.	<i>Act CLXXXIV of 2005 on the safety investigation of aviation, railway and marine accidents and incidents and other transportation occurrences</i>
LT	<i>Local Time</i>
MTOM	<i>Maximum Take-Off Mass</i>
NFM	<i>Ministry of National Development, (Nemzeti Fejlesztési Minisztérium)</i>
NKH LH	<i>National Transport Authority, Office of Air Transport (Nemzeti Közlekedési Hatóság Légügyi Hivatal - until 31 DEC 2016)</i>
PPL (A)	<i>Private Pilot Licence (Aeroplane)</i>
Public aviation event	<i>Airshow or competition to which visitors are invited by way of promotion or advertising</i>
TSB	<i>Transportation Safety Bureau</i>
UTC	<i>Coordinated Universal Time</i>

## Introduction

occurrence class		incident
aircraft	manufacturer	Zivko Aeronautics Inc.
	type	EDGE 540
	registration	N9ND
	operator	private person
occurrence	date and time	1 May 2016, 16:40 LT
	location	Chain Bridge over Danube river, Budapest (fig. 1)
Fatal and serious injuries related to the occurrence:		0 / 0
Extent of damage to the aircraft involved:		None

Each time indicated in this Report is local time (LT). At the time of the event: LT= UTC+2 hours. WGS-84 coordinates are used throughout this Report.



*Fig. 1: The location of the occurrence on the map of Hungary*

## Reports and notifications

The occurrence was reported to the duty service of TSB by the airshow organizer on 5 May 2016.

## Investigating Committee

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

Investigator-in-Charge (IIC)	<b>Zsuzsanna Nacsá JD</b>	investigator
IC member	<b>Gábor Erdósi</b>	investigator

## Overview of the investigation process

In the course of the professional examination the IC:

- collected information and documents on flight preparation and on the pilots;
- collected photos and video footage of the incident;
- was unable to interview the pilot involved in the occurrence after the event;
- obtained the supervisory authority's event documents and requested information on the number of authorised civil public aviation events from 2014 onwards;
- obtained and reviewed final reports describing similar incidents;
- acquired and reviewed several professional materials relating to public aviation events;
- reviewed the related legislation;
- analyzed the documents, data and photos at its disposal.

## Short summary of the occurrence

The pilot took off from Gyúró airfield with the Edge 540 aircraft, registration N9ND, on 1 May 2016 and flew to downtown Budapest in order to perform aerobatic display over the Danube river as part (left wing) of a three-plane formation. The final event of the display was a stunt flight under the Chain Bridge in formation. The formation was approaching the bridge when the N9ND suddenly lost altitude and touched water surface with both main landing gears. The pilot quickly corrected his position and successfully completed the manoeuvre. The formation then returned to Gyúró airfield without further problems.

There was neither injury to persons nor any damage to aircraft.

The IC, based on the analysis of available data and information, came to the conclusion that the pilot's momentarily loss of focus was the probable cause of the incident, in addition to unexpected turbulence being a contributing factor.

TSB Hungary was not obliged to investigate the above described occurrence due of its classification, outcome and circumstances. However, the initial occurrence report review revealed an issue that prompted a decision to launch an investigation. It was found that there was no law in effect determining the detailed rules of organizing civilian airshows for the public, in spite of an earlier TSB report (No. 2009-178-4) including a relevant safety recommendation, opinion No. JNO-443-1/2010 of the Parliamentary Commissioner for Future Generations as well as existing legal authorization to make such law.

The IC, taking into consideration of the above mentioned, is proposing to issue a safety recommendation in order to enhance the safety of airshow pilots and visitors as well as to minimise the considerable safety risks during similar events.

## 1. Factual information

### 1.1. History of flight

Following take-off from Gyúró airfield (LHGR) on May 01, 2016 with an Edge 540 aircraft, registration N9ND, the pilot flew to downtown Budapest as the left wing of a three-aircraft formation as part of a flight show called the “Great Race” over the Danube. In the closing part of the show, the task was to fly the formation under the Chain Bridge. Before doing so, the formation flew 6 minutes at 200 metres AGL and above. This was followed by the lead plane's solo aerobatics, while flying several times under the Chain Bridge, also checking the meteorological conditions at low altitudes. At the end of the solo flight, the lead pilot radioed the members about the weather and experience, and then they began flying the formation under the Chain Bridge. They approached the bridge from the North while descending towards the river surface. Seconds before reaching the bridge, the left wing lost altitude and touched the surface of the Danube with his landing gear. After the touch, the pilot's aircraft rose back into the formation and held his position there as they began to ascend. Detecting the incident, the local flight chief radioed the formation to interrupt the task, and all three aircraft landed at Gyúró airfield without problem.

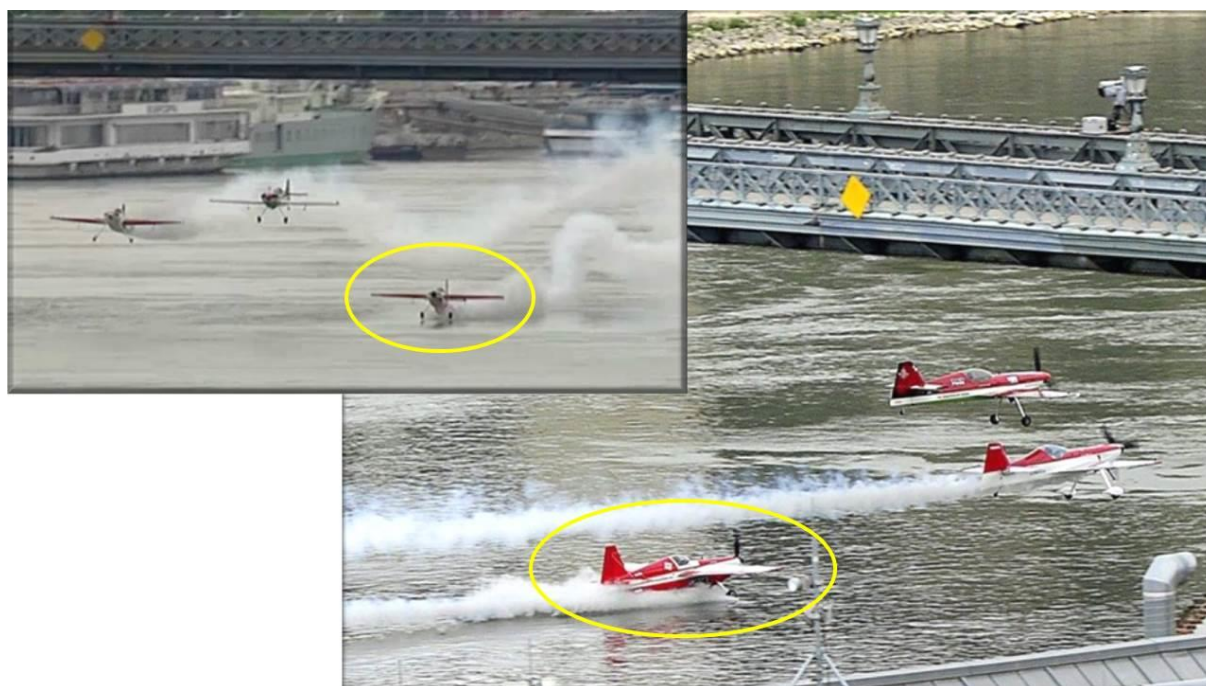


Fig. 2: Photos about the incident, front and side

(Source: internet – small photo: <https://24.hu/tag/veres-zoltan/>; big photo: Mark Mervai Photography)

### 1.2. Injuries to persons

Injuries	Crew		Passengers	Other
	Flight crew	Cabin crew		
Fatal				
Serious				
Light				
None	1			



### 1.3. Damage to aircraft

There was no aircraft damage.

### 1.4. Other damage

The IC was not informed of any third-party damage.

### 1.5. Personnel information

#### 1.5.1. Pilots

(Note: data for the pilot and aircraft involved are marked grey)

		In a three-plane formation		
		left wing	lead	right wing
Age, citizenship, gender:		27, South African, male	53, Hungarian, male	57, South African, male
Licence	type:	PPL(A)	ATPL	ATPL
	valid until:	31 MAY 2016	31 MAY 2016	18 NOV 2018
Type and expiry of medical certificate		class 1 31 MAR 2018	class 1 28 APR 2017	class 1 30 AUG 2018
Flight time (total):		more than 3.000 hrs	more than 19.000 hrs	more than 19.000 hrs

According to available information, the pilot flying as the left wing regularly carried out aerobatic and demonstration-flying activities.

He flew several times with the pilots of the other two aircraft during flight demonstrations and preparations for them, and previously practiced water contact during over-the-water flight. The IC was informed of the incident on 05 May 2016 and was unable to interview the pilot who had since left abroad.

## 1.6. Aircraft data

### 1.6.1. General information

	In a three-plane formation		
	left wing	lead	right wing
Aircraft Class	Fixed aircraft wing (MTOM<5700kg)	Fixed aircraft wing (MTOM<5700kg)	Fixed aircraft wing (MTOM<5700kg)
Manufacturer	Zivko Aeronautics Inc.	MXR Technologies INC	Stegner Alexander
Type	EDGE 540	MXS	Xtreme 3000
Date of manufacturing	1998	2008	2008
Serial number	0020	6	002
Registration	N9ND	N540XX	N900YS
Sate of Registry	USA	USA	USA
Owner	private person	Executive Sales and Leasing LLC	International Air Services INC Trustee



Fig. 3: The aircraft involved in the incident (source: <https://www.airport-data.com/aircraft/photo/000390760.html> - Steve Nation)

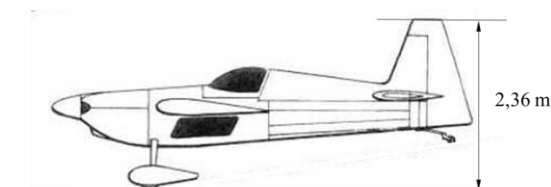


Fig. 4: The height of EDGE 540<sup>1</sup> is 2.36 m (7ft 9")

<sup>1</sup> Aircraft height: Distance between ground level and the highest point of airframe measured on levelled aircraft

## 1.6.2. Airworthiness information

Airworthiness certificate	Issued on	20 OCT 2014	22 AUG 2012	13 FEB 2014
	Valid until	31 OCT 2023	31 AUG 2021	28 FEB 2023
	limitations	None	None	None

Aircraft data had no effect on the occurrence, therefore there is no need for their further elaboration.

## 1.7. Meteorological information

On Sunday, May 01, 2016, the weather in central Europe was unsteady because of cyclones. The clouds and precipitation system of the cyclone, which deepened southwest of the Carpathian Basin, determined the weather. The clouds increased from the southwest, gradually thickening, and for short periods the sun was visible through thin clouds, mostly in the Tiszántúl. In the afternoon, rain and showers fell in several places approximately southwest of the Sopron-Kiskunfélegyháza-Mezőhegyes line. The peak temperatures were mostly between 12 and 18 degrees in the Dunántúl and between 19 and 24 degrees east of the Danube.

METAR issued for LHBP valid for the time of the incident were as follows:

*METAR LHBP 011500Z 07010KT 9999 FEW048 SCT069 OVC100 19/08 Q1015 NOSIG=*

*METAR LHBP 011430Z 07010KT 030V090 9999 SCT048 OVC100 19/09 Q1015 NOSIG=*

In plain words, at 16:30LT the weather conditions in LHBP were as follows: wind speed 10 kts, wind direction from 70 degrees but varied between 30-90 degrees; visibility 10 kms or more; scattered clouds at 4800 ft becoming overcast at 10.000 ft; air temperature 19°C; dew point 9°C, air pressure 1015 hPa.

According to local measurements by the ground staff, the wind was at 8-12 kts from 110 degrees.

The incident occurred in daytime in good visibility conditions.

### Hydrological information

Chain Bridge, position: N47°29'900", E19°02'645"; marker: 1647 km. The minimum navigation water level (MNWL) under the bridge's central span is 0.8 m. Based on MNWL, there is a 130-m-wide zone with a height of 7.36 m and a narrower, 80-m-wide zone with a height of 8.22 m (see Fig. 5).

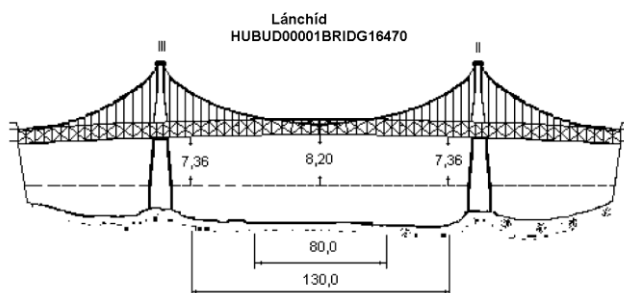


Fig. 5

The actual clearance between water surface and the bridge is calculated from MNWL and the actual daily water level. The actual water level of Danube was 206 cm on the date of

the occurrence (which corresponds to a low water level). Therefore the real clearances were as follows: 696 m in the central 80m wide zone and 610 m in the broader 130m wide zone. (MNWL-206= -126 cm; 822-126= 696 cm / 736-126= 610 cm)

## 1.8. Aids to navigation

The navigation equipment had no effect on the occurrence, therefore there is no need for their further elaboration.

## 1.9. Communication

The responsible head of the airshow (Event Director) had radio transceiver equipment to communicate with the pilots of the aircraft participating in the programme, on one main frequency and one backup frequency.

The Event Director had continuous UHF-based communication with the event's field commanders and liaisons. The heads of units and commanders were located at the control point in the so-called Emergency Control Centre.

No comments on ground-based installations were found or reported to the IC and they were found to be suitable for the performance of the task.

The communication equipment had no effect on the occurrence, therefore there is no need for their further elaboration.

## 1.10. Aerodrome information

Take-off and landing on the day of the occurrence (1 May 2016) was performed from/to Gyúró airfield that is a class IV aerodrome.

The aerodrome had a valid operating certificate at the time of the occurrence.

Aerodrome name	Gyúró
ICAO code for the aerodrome	LHGR
Operator	MX-treme Kft.
Location coordinates (ARP)	47°23'40"N 18°45'18"E
Aerodrome altitude (ASL)	199 m
Runway heading	15/33
Runway size	750x20 m
Runway surface	grass

Aerodrome parameters had no effect on the occurrence, therefore there is no need for their further elaboration.

## 1.11. Data recorders

Several video footage and photos of the incident, taken from quays and surrounding areas, were posted online.

The aircraft had no flight recorder installed; it is not required for the given aircraft type.

**1.12. Wreckage and impact information**

There was no wreckage.

**1.13. Medical and pathological information**

There was no need for pathological examination.

**1.14. Fire**

There was no fire.

**1.15. Survival aspects**

There was no injury.

**1.16. Tests and research**

The IC decided not to conduct test or research.

**1.17. Organizational and management information****1.17.1. Civil aviation event**

The IC did not find a detailed legal provision for civil aviation events in Hungary in connection with the event, but there is a regulation in force for state aviation events („military airshows”).

The IC also established that:

- Section 74(1)(s) of the XCVII Act 1995 empowers the Minister responsible for transport to lay down these rules by decree.
- The resolution of the Parliamentary Commissioner for Future Generations on the Red Bull Air Race (case JNO-443-1/2010) contains the following Parliamentary Commissioner's measure:

*“On the basis of Article 25 of the Obtv, in view of the lack of legislation on the issue under consideration, I shall initiate with the Minister for National Development detailed rules on non-governmental public aviation events, in particular as to the establishment of rules for the preparation, conduct and implementation of the event, the technical and safety requirements applicable and the definition of responsibilities, detailed procedural rules and the authorities to be involved in the procedure.”*

- the final report of the TSB No. 2009-178-4P, issued on 03 June 2010, contains the following recommendation:

*„BA2009-178-4\_1: An independent technical investigation of an air accident involving serious and fatal injuries has established that there is no legal provision relating to a flight event in the case under consideration, although Section 74(1)(s) of the Aviation Act 1995 authorises the Minister responsible for transport to lay down these rules by decree.*

*The IC recommends that the Minister responsible for transport take measures to issue a regulation setting out the rules, conditions and safety requirements for the implementation of civil flight demonstrations and events.*

*The aim of the recommendation is to ensure that Hungarian flight demonstrations, open and restricted aviation events and competitions are organised and conducted in a well-organized and safe environment."*

In its reply on 08.09.2010, the Ministry of National Development informed the TSB that the recommendation BA2009-178-4\_1 had been adopted and is in the process of implementation.

### **1.17.2. Activities of the organisation managing the event**

On the basis of the documents provided to it, the IC found that during the preparation of the "Great Race" flight demonstration on 01 May 2016, the organisation managing the event

- has requested the authorisation provided for in Article 33(1) of the Aviation Act XCVII of 1995, drawn up and attached the annexes to the application (documents relating to the validity of crew licences and medical certificates, aircraft documents and their validity, description of the programme and weather minimums, insurance),
- carried out a risk analysis, including a risk management plan (the risk analysis took into account, inter alia, possible aircraft collisions with terrain, birds, etc.),
- has drawn up an event management (emergency, rescue) plan and presented it to the participants of the airshow as well as to emergency and rescue staff (it also consulted and prepared contracts with external organisations to ensure the event),
- prepared a separate information brochure to inform the participating staff.

### **1.17.3. Authorisation issued by the National Transport Authority's Office for Air Transport (NKH LH)**

The "Grand Race" air show, which took place on 01 May 2016, was authorised by decision of the National Transport Authority's Aviation Authority, as set out in the Annexes listed in 1.17.2 - and contained additional restrictive conditions.

The Annex to the approval decision issued set the altitude and meteorological limits for the implementation of the part of the flight demonstration discussed (including stunt flight under the Chain Bridge) as follows:

- altitude limit: AGL 0 m - QNH 3500 feet;
- meteorological conditions: minimum visibility of 5 km, maximum wind speed 10 m/s, minimum cloud base at 450 m

The approval decision issued laid down the additional conditions for the airshow as follows:

- ”
1. *The organiser of the event shall be responsible for verifying the validity of the documents of the participating aircraft and crew and for providing professional information to the staff attending the demonstration.*
  2. *Safety measures are binding on all participants in accordance with the Annex submitted.*
  3. *Air demonstrations are only permitted with a working and activated mode C or S transponder.*
  4. *Demonstration flights and aerobatics may only be carried out above the area indicated in the Annex. Demonstration flight is prohibited over inhabited areas and above the audience attending the event. Execution of high-energy manoeuvres towards groups of people and buildings is prohibited.*
  5. *The demonstration flight should be carried out with the least possible disturbance to the surrounding population.*

6. *No other aircraft shall be allowed in the airspace during the demonstration flight.*
7. *Design and implementation of the flight demonstration as well as compliance with flight rules is the responsibility of the pilot.*
8. *The local municipality and the competent authorities shall be informed on the airshow.*
9. *It is the organizer's duty to obtain the official weather forecast from the national weather service (OMSZ in Hungary).*
10. *The flight manager shall also carry a functioning backup radio with adequate transmitter power throughout the demonstration."*

## 1.18. Additional information

### 1.18.1. Number of authorized public airshows in Hungary between 2014-2019

Figure 6. shows the number of authorized public airshows between 2014 and 2019, which increased from 37 to 49.

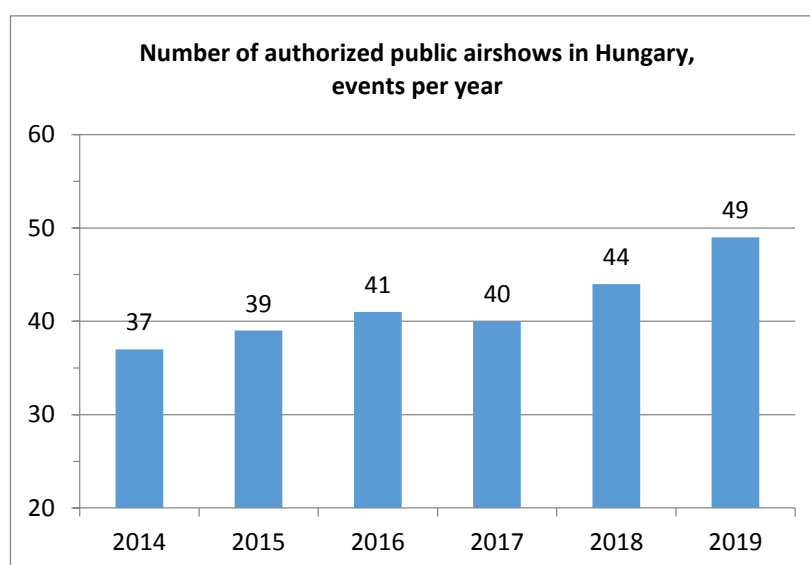


Fig. 6

### 1.18.2. A tragic accident at an air show and its implications for regulation in the UK

On August 22, 2015, a Hawker Hunter aircraft with registration number G-BXFI was involved in an accident at Shoreham Airport in England. During the accident, the aircraft crashed into an audience outside the airport. During the event, the pilot suffered serious injuries, 11 people in the audience were killed, 1 was seriously injured and 11 people suffered minor injuries.

Following the tragedy, the British Accident Investigation Organisation (AAIB) launched an investigation into the cause of the crash and released its No. 1/2017 report on the investigation<sup>2</sup>. In view of the lessons learned from the incident, the investigation report contained a significant number of recommendations, including a number to amend

<sup>2</sup> [https://assets.publishing.service.gov.uk/media/58b9247740f0b67ec80000fc/AAR\\_1-2017\\_G-BXFI.pdf](https://assets.publishing.service.gov.uk/media/58b9247740f0b67ec80000fc/AAR_1-2017_G-BXFI.pdf)

existing British regulations on civil aviation demonstrations in order to make these air shows safer. As a consequence, the relevant legislation has been significantly improved<sup>3</sup>.

### 1.18.3. EGAST circular<sup>4</sup>

In 2006, EASA launched a 10-year aviation safety partnership programme called the European Strategic Safety Initiative (ESSI), one of the three pillars of which was the EGAST (European General Aviation Safety Team). EGAST had extensive international cooperation with the aviation industry and had more than 50 member organisations.

During its operation until 2016, EGAST provided an opportunity and organisational framework for EASA and aviation industry to act jointly, optimising resources, to improve general aviation safety and reduce the number of accidents. During its operation, the organization created valuable, useful methods, guides and knowledge, and issued several circulars promoting aviation safety to the general aviation (GA)<sup>5</sup> community.

EGAST stated in its December 2015 Circular on Aviation Safety of Air Shows<sup>6</sup> that, with a few exceptions, all areas of aviation are regulated by EU aviation and aviation safety rules. They will also be applied by EU countries from 2017. However, there are no European rules on the organisation of civil aviation events. The organisation of such events is subject to national rules, which vary depending on the country of the events.

The circular also contains a guide for pilots flying at air shows. The introduction to the guide underlines that all flights performed at demonstrations or events, in particular aerobatics, are a specific form of flight that often involve flying close to the aircraft's flight envelope limits. Unfortunately, it goes on, there are fatalities in almost every year, despite the fact that many of the pilots had great airmanship skills and extraordinary experience in both the aircraft and the demonstration flight. The guide asks what can be done to minimise the risk and continues to provide advice to pilots participating in airshows.

## 1.19. Useful or effective investigation techniques

There was no need for special methods or techniques.

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<sup>3</sup> <https://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=7318;https://publicapps.caa.co.uk/docs/33/CAP%201400%20MAY16.pdf>

<sup>4</sup> EGAST – European General Aviation Safety Team

<sup>5</sup> GA – General Aviation

<sup>6</sup> Safety at flying displays and events: A guide for pilots / Safety promotion leaflet / GA11



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## **2. Analysis**

### **2.1. Meteorological conditions**

The IC has drawn conclusions about local conditions and from the data measured at the nearest airport, Budapest Liszt Ferenc International Airport, as well as from the video recordings. Based on this, at the time of the event, visibility was more than 10 km. The wind blew from an average of 70° at 10 knots (5.1 m/s). Wind gusts were not measured according to the data, but the wind direction showed changes between 30° and 110°. The weather conditions were within the limits set by the aviation authority for the task. When comparing the wind direction (70° on average) and the flight direction (160-170°), it can be concluded that pilots had to deal with weak left crosswinds during the incident. In the IC's opinion, turbulence may have arisen above the Danube, especially near the left bank, due to the buildings situated there.

Based on the hydrological information received (1.7) and the aircraft's height of 2.36 meters, the IC considered that the clearance of nearly 7 meters – almost three times the aircraft's height (2.36 meters) – available in a minimum 80-m-wide zone for overflight, was sufficient to safely carry out the task.

In view of the above, the IC considers that the impact of an unexpected meteorological factor (unexpected turbulence over the surface of the water, gust of wind) cannot be ruled out.

### **2.2. Pilot's skills and preparedness**

According to information available to the IC, the pilot had flown in airshows and had obtained experience in formation flying prior to the occurrence at hand.

### **2.3. Implementation of the flight**

During the day, those involved monitored meteorological information on the location of the flight event that affected the flight. The members of the formation also gained direct experience of current meteorological conditions during the flight carried out prior to the event. Immediately before the event, the lead plane flew under the Chain Bridge several times during its solo aerobatics program, checking the meteorological conditions at low altitude. At the end of the solo flight, the lead pilot discussed the weather and experience with the members of the team. The meteorological conditions were found to be suitable for the task and the formation began flying under the Chain Bridge.

From the recordings available to the IC, it was found that during a three-plane flight under the Chain Bridge, the left wing suddenly lost altitude just before reaching the bridge. The airplane touched the surface of the Danube with both main landing gear wheels. Thanks to the immediate reaction of the pilot, further descent was stopped. The left wing quickly re-established and held his position in the formation.

Aircraft designed for aerobatic flight (as in this case) are very sensitive to the smallest movement of controls. As a result, even the pilot's smallest involuntary, uncertain control input or a momentary loss of attention can result in significant reactions of the aircraft.

If the aircraft's wheel dives into the water, it leads to a sharp increase in drag. This may result in serious damage to the landing gear and/or loss of aircraft control.

An aerobatic flight, or in particular the performance of an air show, challenges pilots in an increased physical, physiological way, with mental-psychological strain. Formation flight requires a high level of situational awareness for the escorts, with the attention focused on the lead plane. During the event, a special task to be performed (overflight between the water surface and the bridge) may have been a significant psychological

stress for the pilot. On this basis, the IC believes that a momentary uncertainty and decrease in concentration of the pilot may have caused the incident to occur.

## 2.4. Preparation, risk management and legal control of the public aviation event

On the basis of the documents made available to the IC, both the organisation conducting the event and the aviation authority moved towards safety when they exceeded requirements laid out in legal obligations during preparation, approval and management (1.17.3). Both organisations, drawing on individual experiences and their own position, sought to increase the security of the event through these measures.

During the investigation, the IC concluded that there was no legislation containing detailed rules on public aviation events for civil purposes in Hungary. The IC would like to note here that there is also a regulation in force in Hungary on the rules of public aviation events for state aviation („military airshows”).

The EGAST circular<sup>7</sup> mentioned in 1.18.5. found that, with a few exceptions, all areas of aviation were regulated by EU aviation and aviation safety rules. They will also be applied by EU countries from 2017. However, there are no European rules on the organisation of civil aviation events. The organisation of such events shall be subject to national rules, which vary according to the country in which the events take place.

According to the IC’s knowledge, such rules intended to reduce the significant risks associated with the organisation and conduct of civil air shows and public aviation events exist worldwide (for example: Australia<sup>8</sup>, USA) and also in the majority of European countries United Kingdom<sup>9</sup>, Germany<sup>10</sup>, Switzerland<sup>11</sup>, etc.). Their development and review are also ongoing many times in relation to regrettable events such as the accident at Shoreham Airport on 22 August 2015<sup>12</sup>. That accident, the findings of the follow-up investigation and the British legislation that has been amended as a result are exemplary and they support the need for regulation of public civil aviation events.

As the number of air shows, public aviation events and their popularity increases (see relevant data for Hungary in 1.18.1), the IC takes the view that the risk of accidents at such events and, at the same time, possible deaths or serious injuries would be significantly reduced by a regulation for such events. In addition to increasing aviation safety, the regulation would also protect participating pilots and, in particular, the public at events.

According to the IC, it is not enough to depend on ad-hoc safety-enhancing measures based on individual experience and situational awareness when it comes to protecting the lives and physical well-being of the spectators attending public aviation events.

Having taken into consideration the above and the fact that, in spite of existing recommendations of similar nature (see 1.17.1), until the completion of this report, no detailed regulation has been issued on civil aviation events in Hungary, and the fact that not only civil aircraft may take part in public civil aviation events, the IC considers it necessary to issue another safety recommendation with a broader scope relating to the adoption of detailed rules for public civil aviation events.

<sup>7</sup> Safety at flying displays and events: A guide for pilots / Safety promotion leaflet / GA11

<sup>8</sup> <https://www.casa.gov.au/sites/default/files/air-display-administration-procedure-manual.pdf>

<sup>9</sup> [https://publicapps.caa.co.uk/docs/33/CAP403\\_E17\\_FEB\\_2020.pdf](https://publicapps.caa.co.uk/docs/33/CAP403_E17_FEB_2020.pdf)

<sup>10</sup> [https://www.dfs.de/dfs\\_homepage/de/Unternehmen/Richtlinien/1-1679-19.pdf](https://www.dfs.de/dfs_homepage/de/Unternehmen/Richtlinien/1-1679-19.pdf)

<sup>11</sup> <https://www.bazl.admin.ch/bazl/de/home/fachleute/flugplaetze/flugveranstaltungen.html>

<sup>12</sup> [UK civil air display review: final report CAA CAP 1400](#) (2016); [The UK AAIB Investigation into the 2015 accident during the Shoreham Air Display](#)

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## **3. Conclusions**

### **3.1. Findings**

#### **3.1.1. Aircraft**

The aircraft was suitable for flight. (1.6.2)

It had a valid airworthiness certificate. (1.6.2)

There was no aircraft damage. (1.3)

#### **3.1.2. Pilot**

The pilot was adequately trained and qualified at the time of the incident and had sufficient experience for the specific flight. (1.5.1.; 2.2)

#### **3.1.3. Air operation**

The flight was conducted in daytime at good visibility. (1.7.; 2.1)

#### **3.1.4. Organizer of the civil aviation event**

It prepared a risk analysis and risk management plan for the event in advance. (1.17.2)

It prepared a management (emergency rescue) plan for the event and presented it to the participants and signed contracts with the external organisations included in the plan (involved in the rescue and elimination of emergency situations). (1.17.2)

#### **3.1.5. Air navigation services / aerodrome**

No information has been provided on the characteristics of air navigation services and the airports that could be related to the occurrence of the incident. (1.9)

No comments on ground-installed radio communication equipment were found or reported to the IC and such items were found to be suitable for the task. (1.9)

The airports concerned in the case had a valid operating licence. (1.10.)

#### **3.1.6. Data recorders**

The aircraft did not have a data recorder, it is not required for the type of aircraft concerned. (1.11)

#### **3.1.7. Medical and pathological information**

No medical examinations have been carried out. (1.13.)

#### **3.1.8. Survival aspects**

There was no injury. (1.2.)

#### **3.1.9. Oversight of aviation safety**

The aviation authority has issued the statutory authorisation to hold a public flying event and has laid down additional conditions for the holding of the event. (1.17.3)

By setting specific conditions, the aviation authority shifted towards safety in addition to the obligations under the law. (2.4)

No legislation contains detailed rules on civil aviation events in Hungary. (1.17.1., 1.18.3)

### **3.2. Causes**

The IC concluded during its investigation that the direct cause of the incident was presumably the pilot's momentary attention deficit.

An unexpected turbulence may have contributed to the occurrence.

## 4. Safety recommendations

### 4.1. Safety recommendation(s) issued upon completion of the investigation

With regard to the contents of Section 2.4., the Investigating Committee of TSB proposes the following safety recommendation at the conclusion of the technical investigation:

**BA2016-158-4-1:** *The Investigation Committee of Transportation Safety Bureau has found during the technical investigation that there is no legal provision concerning the organization of civil aviation events in Hungary. Therefore*

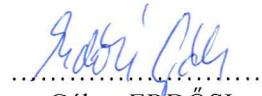
**The Transportation Safety Bureau proposes to the Minister for Innovation and Technology – on the grounds of empowerment provided in Section 74(1)(s) of the XCVII Act 1995 – to consider creating detailed regulations for civil aviation events.**

*Should the recommendation be adopted and implemented, the IC considers that the organisation and conduct of civil aviation events in Hungary could be carried out with significantly less risk, and the level of safety of the events would increase significantly.*

Budapest, 16 July 2021



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