

# **FINAL REPORT**

2009-207-4 SERIOUS INCIDENT

Romanian airspace 6 August 2009

> Boeing 757 G-LSAC

The sole objective of the technical investigation is to reveal the causes and circumstances of aviation accidents, incidents or irregularities 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 apportion blame or liability.

#### This present investigation was carried out 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 to ICAO Convention on Civil Aviation, put in force in Hungary by MTCW (Ministry of Transport, Communications and Water) Decree 20/1997. (X. 21.) on the declaration of the annexes of 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.),
- MET Decree 123/2005 (XII. 29.) on the regulations of the technical investigation of aviation accidents, incidents and irregularities.

In absence of other related regulation of the Kbvt., the Transportation Safety Bureau of Hungary carried out the investigation in accordance with Act CXL of 2004 on the general rules of administrative authority procedure and service.

The Kbvt. and the MET Decree 123/2005 (XII. 29.) jointly serve the compliance with Directive 2003/42/EC of the European Parliament and of the Council of 13 June 2003 on occurrence reporting in civil aviation, with the exception of its Annex I and Annex II.

The competence of the Transportation Safety Bureau of Hungary is based on Government Decree 278/2006 (XII. 23.).

#### Under the aforementioned regulations

- The Transportation Safety Bureau of Hungary shall investigate aviation accidents and serious aviation incidents.
- The Transportation Safety Bureau of Hungary may investigate aviation incidents and irregularities which - in its judgment - would have resulted in accidents in other circumstances.
- The technical investigation is independent of any administrative, infringement or criminal procedures.
- In addition to the aforementioned laws, the ICAO DOC 6920 Manual of Aircraft Accident Investigation is applicable.
- This present Final Report shall not be binding, nor shall an appeal be lodged against it.

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 safe keep 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 the disclosure of the data pursuant to the relevant act – available to other authorities.

# **DEFINITIONS AND ABBREVIATIONS**

AAIB	Air Accidents Investigation Branch, the air accident investigation organisation of the United Kingdom		
APU	Auxiliary Power Unit		
CAA	Civil Aviation Authority of the United Kingdom		
CVR	Cockpit Voice Recorder		
EICAS	Engine Indication and Crew Alerting System		
FAA	Federal Aviation Authority of the United States		
FDR	Flight Data Recorder		
FL	Flight Level, altitude in hundred feet		
IC	Investigating Committee		
ICAO	International Civil Aviation Organization		
Kbvt.	Act CLXXXIV of 2005 on the technical investigation of aviation, railway and marine accidents and incidents		
MET	Ministry of Economy and Transport (Gazdasági és Közlekedési Minisztérium, GKM)		
MTCW	Ministry of Transport, Communications and Water (Közlekedési, Hírközlési és Vízügyi Minisztérium, KHVM)		
n/a	Not available		
NTA AD	National Transport Authority, Aviation Directorate		
TSB	Transportation Safety Bureau (of Hungary)		

Occurrence cat	egory	serious incident	
	manufacturer	Boeing	
	type	757-200 (ICAO code B752)	
	registration	G-LSAC	
Aircraft	serial number	25488	
	owner	Dart Group Plc.	
	lessee	Jet2	
	operator	-	
Occurrence	date and time	06 AUG 2009	
	location	Romanian airspace	
Number of	fatal	0	
injured persons	serious	0	
Aircraft damage		none	
State of registry		United Kingdom	
Registering authority		United Kingdom	
Authority super	Authority supervising manufacturing FAA (USA)		
Competent investigating organization T		TSB	
Time zone used in the draft report		LT	

# **BRIEF DESCRIPTION OF THE OCCURRENCE**

#### **Reports and notifications**

The occurrence was reported to the dispatcher of the TSB at 21:10 on 06 August 2009 by the dispatcher of the HungaroControl Plc.

#### Investigating committee

The Director-General of the TSB assigned the following Investigating Committee (hereinafter referred to as IC) for the investigation of the serious incident on 06 August 2009:

Investigator-in-Charge (IIC)	Zoltán NÉMETH	investigator
IC member	János ESZES	investigator

During the investigation Mr. Nemeth left the TSB therefore the Director-General assigned Mr. Eszes as IIC and accident investigator Mr. Laszlo Grez as IC member.

#### **Overview of the investigation process**

The IC conducted the site survey, in the course of which it took photos of the aircraft and its technical documentation, interviewed the flight crew and cabin attendants, and impounded the Cockpit Voice Recorder (CVR) and the Flight Data Recorder (FDR). TSB Communications Department officers – on request of the IC - conducted a survey among the passengers and were able to obtain several written accounts.

The IC requested assistance from the Air Accidents Investigation Branch of the UK regarding readout and preliminary analysis of the CVR and FDR units. AAIB kindly provided the requested assistance.

The IC reviewed the relevant data of the FDR and the events and actions mentioned in the Captain's report.

The IC requested the operator to provide copies of the maintenance and repair documentation of the aircraft. The operator was fully cooperative throughout the investigation.

The IC compared the safety demonstration text approved by the operator of the incident aircraft with the safety demonstration texts of two other operators. The IC also studied several safety presentation videos.

The IC reviewed several on-board safety information cards in order to compare the sections concerning the use of emergency oxygen and to find out whether the information is unambiguous.

The IC conducted a test to check whether the passengers sitting next to each other are able to reach the deployed oxygen masks.

AAIB UK in its remarks to the draft report has informed the IC that the operator added the Hebrew Safety Demonstration Public Address - which included the additional information on the oxygen bag - within a few weeks of the incident having taken place. In addition, the operator revised the text of the Safety Demonstration Announcement and implemented this change in their full procedures in January 2013. Therefore the IC - in agreement with the AAIB's recommendation - does not formulate a safety recommendation addressed to the operator in this present report.

The IC suggests to issue a safety recommendation for ICAO with regard to the content of the safety demonstration performed by the cabin attendants.

#### A short summary of the occurrence

The aircraft was en route from Tel Aviv to Manchester when at approximately 18:50 in Romanian airspace at cruising altitude when the pressure regulating shut-off valve of the RH engine bleed system failed. The cabin altitude suddenly started climbing at a high rate.

An emergency descent was initiated and the crew donned the oxygen masks. The passenger oxygen masks were also released. An emergency (MAYDAY) was declared to ATC. The crew requested and made a diversion to LHBP.

A passenger with previous angina problems complained of shortness of breath. A doctor on board attended the passenger. The emergency and medical services on the ground were advised of the situation.

The landing was uneventful. The aircraft stopped on the taxiway to remove the ill passenger, then was allowed to taxi to the stand under its own power.

# 1. FACTUAL INFORMATION

#### 1.1 History of the flight

The aircraft – Boeing 757-200, registration G-LSAC, operated by Jet2 - was dispatched to a planned roundtrip flight between EGCC (Manchester) – LLBG (Tel Aviv) on the day of the occurrence.

The aircraft's APU bleed system was inoperative prior to dispatch, which meant that the APU was suitable to provide electric power, however, it could not provide outside air for the cabin air conditioning system.

According to the Captain's Report, there was a large disparity between the LH and RH side AC pack duct pressure (LH: 20 psi; RH: 60 psi). This disparity gradually disappeared as the aircraft climbed to cruising altitude. The RH pack occasionally cycled to high flow.

The APU bleed was restored at LLBG airport by the ground crew. There were also numerous status messages on the EICAS display which were cleared and a full system reset was performed by disconnecting all electrical power on the aircraft.

The aircraft took off normally from LLBG. The pack duct pressure disparity re-occurred during initial climb. The aircraft levelled at FL360.

At approximately 18:30 the captain reduced the speed due to turbulence. Moments later the RH PACK OFF and RH ENG BLEED messages came in. The crew pressed

the recall button of the EICAS display to check the messages but both the RH pack and RH engine bleed were reset automatically. A few moments later the same warnings came in again. The captain manually reset the RH engine bleed and as a result both messages were cleared.

The senior flight attendant contacted the flight deck because the passengers complained about the pressure fluctuation in the main cabin.

The RH pack and RH engine bleed failed again, and the captain switched them off. The LH pack should have switched to high flow, however, it did not happen. The crew contacted the ATC and requested a descent to FL340. Upon reaching FL340 it was noted that the LH pack still was not providing high flow and the cabin altitude was climbing at a 300 feet per minute rate. Therefore further descent was requested and made to FL280 where the cabin altitude stabilised at 9000 feet.

The crew increased speed above economical to maintain bleed pressure, however, it increased fuel burn and if continued, would have led to fuel level below diversion minimum at destination airport. Therefore the speed was again set to economical. The cabin rate and altitude fluctuation reappeared as the aircraft reduced speed.

As a final attempt to switch LH pack to high flow, the crew manually reset the LH recirculation fan. Unfortunately, the LH pack remained in low flow. A sudden whooshing sound followed and the cabin altitude suddenly started climbing at a 1500 feet per minute rate. The crew initiated an immediate descent and notified the ATC. Moments later the CABIN AUTO 2 FAIL warning came in.

An emergency descent was initiated and the crew donned the oxygen masks. This time the passenger oxygen masks were also released. An emergency (MAYDAY) was declared to ATC. The pressure controller was set to Auto. The aircraft levelled at FL110.

The outflow valve was in CLOSED position throughout all of the above.

The crew requested and made a diversion to LHBP.

A passenger with previous angina problems complained of shortness of breath. A doctor on board attended the passenger. The emergency and medical services on the ground were advised of the situation.

During the final descent the cabin pressure was regulated manually.

The landing was uneventful. The aircraft was stopped on the taxiway to remove the ill passenger, then was allowed to taxi to the stand under its own power.

The component failure took place approximately 18:50 in Romanian airspace.

# 1.2 Injuries to persons

There was no personal injury.

#### **1.3** Damage to aircraft

There was no damage to the aircraft.

#### 1.4 Other damage

There was no other damage.

# 1.5 Personnel information

# 1.5.1 Captain

Age, nationality, gender		39, Briton, Male
Liconco data	Professional valid until	01/03/2011
	Medical valid until	01/07/2010
	Licence type	ATPL
	Ratings	B757
	Total	
Flying	In the previous 30 days	72 Hrs 42 mins (11 take-offs)
experience, hours/takeoffs	In the previous 7 days	10 Hrs 52 mins (1 take-off)
	In the previous 24 hours	Nil
Total hours by airc	raft category	n/a
On the given type		1127 Hrs 31 mins

#### 1.5.2 First Officer

Age, nationality, gender 36, Briton, Male		36, Briton, Male
	Professional valid until	15/06/2013
l icence data	Medical valid until	01/05/2010
	Licence type	ATPL
	Ratings	B757
	Total	n/a
Flying	In the previous 30 days	39 Hrs 53 mins (5 take-offs)
experience, hours/takeoffs	In the previous 7 days	09 Hrs 05 mins (1 take-off)
	In the previous 24 hours	Nil
Total hours by aircraft category		n/a
On the given type		890 Hrs 57 mins

# **1.6** Aircraft information

#### 1.6.1 Certificate of airworthiness: valid until 13 May 2010

#### 1.6.2 General information

Boeing 757-200 type twin-engine passenger aircraft, manufactured in 1992. Registered in the UK: March 2006. Total hours flown prior to the incident: 55 279.

#### 1.6.3 Engine data

The aircraft engine parametres had no effect on the course of the events therefore their analysis was not required.

#### 1.6.4 Data of the faulty part/equipment

In the course of troubleshooting it was established that the pressure regulating shut-off valve of the RH engine bleed system failed.

#### Pressure Regulating Shut-Off Valve

Date of manufacture	n/a
Date of installation	27 Aug 2008
Date of last overhaul	09 Jan 2006
Date of last shop visit	20 May 2007

Type/grade of fuel used: JET A-1

The aircraft's parametres had no effect on the course of the events therefore their analysis was not required.

# 1.7 Meteorological data

The weather conditions had no effect on the course of the events therefore their analysis was not required..

#### **1.8** Aids to navigation

The aircraft was equipped with standard navigational instruments and they functioned normally. They had no effect on the course of events therefore their analysis was not required.

#### 1.9 Communications

The aircraft was equipped with standard communications instruments and they functioned normally. They had no effect on the course of events therefore their analysis was not required.

# **1.10** Aerodrome information

The parametres of the aerodromes had no effect on the course of events therefore their analysis was not required.

# 1.11 Flight recorders

Data recorder	Туре	Manufacturer	Serial number
FDR	Model UFDR	Sundstrand Data Control, Redmond, WA, USA	3480
CVR	Model A100A	Fairchild, Sarasota, FL, USA	59566

The IC impounded the CVR and FDR units in the course of site survey and forwarded them to the AAIB for readout and preliminary analysis.

The CVR did not contain relevant information. It can be explained by the fact that the component failure occurred while the aircraft was still flying over Romania. By the time the aircraft landed in Budapest, the voice conversation recorded at the time of the event had been overwritten several times.

The IC looked into the FDR readout and established that the FDR data support the information contained in the Captain's report (failure of the RH air conditioning pack, intensive descent, among others).

# 1.12 Wreckage and impact information

There was no wreckage.

# 1.13 Medical and pathological information

The IC does not have information on the crew's psychophysical condition prior or during the flight.

#### Medical forensics examination

Not applicable.

#### 1.14 Fire

There was no fire.

#### 1.15 Survival aspects

A passenger with previous angina problems complained of shortness of breath. A doctor on board attended the passenger. The emergency and medical services on the ground were advised of the situation. The aircraft stopped on the taxiway to remove the ill passenger. He was transported to the hospital, treated and released later the same day.

# 1.16 Tests and research

A number of passengers mentioned the unsatisfactory operation of their oxygen masks to TSB personnel during the passenger survey. The IC therefore took a look into the situation during a field test.

The test took place in the passenger cabin of a B737-400 that was parked on the apron of LHBP awaiting maintenance and repair works. The location and construction of the oxygen masks are very similar in this aircraft type and in the affected B757.

During the test a number of volunteers sat in the seats with their seatbelts fastened. They were asked to reach for the released oxygen masks.

The IC determined that they were all able to reach a mask regardless of height, weight, or bodily type. It was also determined that one cannot put on a mask without initiating the chemical oxygen generator.

#### 1.17 Organisational and management information

Not applicable.

# 1.18 Additional information

The oxygen masks in the main cabin had to be replaced. Due to the timeconsuming nature of the replacement, the operator sent another airplane for the stranded passengers the following day. Officers of the Communications Department of TSB – on request of the IC - conducted a survey among the passengers who were waiting to board the plane and were able to obtain several written accounts. The purpose of the survey was to find out what happened in the main cabin during the emergency descent.

The IC looked into the collected questionnaires and determined that although the Captain announced the emergency descent via the public address system, many passengers did not hear it due to the loud ambient noise therefore the sudden descent took them by surprise. A number of passengers also complained that their mask did not work.

After the passengers disembarked, the IC examined the released oxygen masks in the main cabin. It was established that the masks' chemical oxygen generators functioned normally, with the exception of one mask the plastic tube of which was found torn off from the overhead panel.

The IC requested and received the text of the in-flight safety demonstration from the operator. The text reads as follows below:

"If the cabin air supply fails, masks like these will automatically be presented from the panel above your head. When the mask appears pull downwards, place over your mouth and nose and breathe normally, adjusting the band to secure it. Do make sure that your own mask is fitted before assisting others."

AAIB UK has informed the IC that the operator added the Hebrew Safety Demonstration Public Address - which included the additional information on the oxygen bag - within a few weeks of the incident having taken place. In addition, the operator revised the text of the Safety Demonstration Announcement and implemented this change in their full procedures in January 2013.

The amended text reads as follows:

"If the cabin air supply fails, masks like these will automatically be presented from the panel above your head. When the mask appears pull downwards, place over your mouth and nose and breathe normally, adjusting the band to secure it. Do make sure that your own mask is fitted before assisting others. The bag on the mask may not inflate but oxygen will still be flowing."

The conclusions taken by the IC can be found in paragraph 2. Analysis.

# **1.19** Useful or effective investigation techniques

The investigation did not require techniques differing from the traditional approach.

# 2. ANALYSIS

The IC looked into the FDR readout and established that the FDR data support the information contained in the Captain's report (failure of the RH air conditioning pack, intensive descent, among others).

Based on the information contained in the passenger surveys as well as the safety demonstration text provided by the operator, and also based on the factual information listed in points **1.16** and **1.18** of this present Final Report, the IC determined the following:

- a) The captain announced the emergency descent, however, many passengers did not hear it due to ambient noise, therefore they were taken by surprise when the plane started a steep descent and simultaneously the emergency oxygen masks appeared. A number of passengers complained about a non-operational mask
- b) The text does not contain any information on whether or not the mask's transparent plastic bag should inflate when oxygen is flowing through the mask. The IC found that the majority of passengers on the flight in question assumed the bag should inflate while in operation. When they had to use the mask and their expectations did not match their experience, they panicked.

The IC requested and received the text of the in-flight safety demonstration from two other operators for comparison. The IC found that no explanation of function and status of the mask's plastic bag was included in those texts either.

The IC reviewed several on-board safety information cards in order to compare the sections concerning the use of emergency oxygen and to find out whether the information was unambiguous.

The above mentioned sections of the safety information cards can be found in **Appendix 1.** The IC believes that most of the illustrations show the plastic bag of the mask in an inflated rather than flat state. The only exception is the very last example where the use of the mask is illustrated with photographs instead of drawings.

Since the activation of the mask is not necessarily accompanied by the inflation of the attached clear plastic bag this kind of illustration can be misleading especially because the oxygen does not have a specific smell or colour. Therefore the passengers have absolutely no feedback whether their bag is operating.

The IC did find safety demonstration videos approved by other operators that tell the passengers not to worry if the plastic bag on their masks would not inflate.

The IC believes that a slight amendment in the in-flight safety demonstration which is targeted on the operation of oxygen masks could help the passengers feel more secure while on board.

# 3. CONCLUSIONS

# 3.1 Factual statements which can directly be linked to the occurrence

Based on the available information the IC determined that the faulty pressure regulating shut-off valve of the RH engine bleed system caused the occurrence.

# 3.2 Factual statements which can indirectly be linked to the occurrence

None.

#### 3.3 Risk factors not related to the occurrence

The pilots had to take the aircraft in a steep descent because of a faulty pressure regulating shut-off valve of the RH engine bleed system. The emergency oxygen masks were deployed. A number of passengers panicked because they believed that their masks were not operational. The IC believes that the information contained in the on-board safety demonstration was not adequate.

#### 4. SAFETY RECOMMENDATIONS

The Investigating Committee of Transportation Safety Bureau suggests to issue the following safety recommendations upon concluding the investigation:

**BA2009-207-4P-1**: The aircraft made an emergency descent due to a malfunction in the engine bleed system. The passengers' oxygen masks were released. Many passengers panicked because they believed their masks did not function.

In order to prevent similar cases the Transportation Safety Bureau recommends to the ICAO to direct the attention of signatory countries to the unambiguity of the in-flight safety demonstration concerning the use of oxygen masks with special attention to the function and status of the clear plastic bag while in operation.

Should this recommendation be accepted and implemented the IC believes that such a measure could help the passengers feel more secure while on board.

#### 5. APPENDICES

Appendix 1 – Examples of on-board safety information cards concerning the use of emergency oxygen masks

Budapest, "17, July 2014.

János Eszes IIC

László GRÉZ IC member

#### Appendix 1

Examples of on-board safety information cards concerning the use of emergency oxygen masks















#### NOTE:

The present document is the translation of the Hungarian version of the final 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.