Interim Report

Identification

Type of Occurrence: Serious incident
Date: 13 July 2018
Location: French Airspace; 33 NM west of Grostenquin (GTQ)-VOR
Aircraft: Airplane
Manufacturer / Model: Boeing / B737-800
Injuries to Persons: 33 persons suffered minor injuries
Damage: None
Other Damage: None
State File Number: BFU18-0975-EX
Abbreviations

ATC  Air Traffic Control
ATPL(A)  Airline Transport Pilot License (Aeroplane)
BEA  Bureau d'enquêtes et d’analyses pour la sécurité de l’aviation civile
BFU  German Federal Bureau of Aircraft Accident Investigation
BITE  Built In Test Equipment
CPC  Cabin Pressure Controller
CPL(A)  Commercial Pilot License (Aeroplane)
CVR  Cockpit Voice Recorder
EASA  European Aviation Safety Agency
FDR  Flight Data Recorder
FL  Flight Level
ft  Feet
hPa  hectoPascal
ICAO  International Civil Aviation Organization
kt  Knots
MCP  Mode Control Panel
ME (IR)  Multi Engine Instrument Rating
MEP(L)  Multi Engine Piston (Land)
METAR  Meteorological Terminal Aerodrome Routine Report
MSA  Minimum Safe Altitude
MSL  Mean Sea Level
NITS  Nature of incident
      Intention
      Time available
      Special instructions
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>NM</td>
<td>Nautical Miles</td>
</tr>
<tr>
<td>OFV</td>
<td>Outflow Valve</td>
</tr>
<tr>
<td>PSI</td>
<td>Pounds per Square Inch</td>
</tr>
<tr>
<td>QDM</td>
<td>Quick Donning Masks</td>
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<tr>
<td>SEP(L)</td>
<td>Single Engine Piston (Land)</td>
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Factual Information

During a passenger flight from Dublin, Ireland, to Zadar, Croatia, on 13 July 2018 a rapid decompression occurred at 2243:34 hrs\(^1\) at FL 370 in French airspace. The flight crew conducted an emergency descent and landed the airplane at Frankfurt-Hahn Airport.

Thirty-three passengers suffered minor injuries.

The French safety investigation authority BEA delegated the investigation of the occurrence to the BFU.

History of the Flight

At 2105 hrs the airplane had taken off at Dublin Airport (EIDW) to a scheduled flight to Zadar (LDZD). Six crew members and 190 passengers were on aboard the airplane.

At 2214:24 hrs while in French airspace at FL 370 prior to waypoint BEGAR, the first officer checked in with ATC Reims.

According to the FDR data at 2243:30 hrs the cabin outflow valve (OFV) started to move for 8 seconds from an opening angle of 18\(^\circ\) to the fully opened position of 104\(^\circ\). At that time the cabin had an initial pressure altitude of 7,925 ft.

According to the CVR the flight crew noticed the decompression at 2243:34 hrs. Two seconds later, the cabin altitude warning sounded while the cabin pressure altitude passed 9,470 ft. At 2243:41 hrs both pilots donned their oxygen masks (QDM) and began to complete the memory items for rapid depressurization. At the same time the master caution sounded. Both pilots stated that, due to the pressure drop, they had significant hearing problems and at that time seen the cabin pressure altitude indication climbing with a rate of more than 4,000 ft/min. At 2244:00 hrs the Fasten Seatbelt signs in the cabin were triggered. At 2244:02 hrs the OFV was switched to manual control mode and then put in position 9.3\(^\circ\) open. At that time, the cabin pressure altitude was at 14,830 ft. It had climbed for more than 32 seconds with a mean climb rate of 12,950 ft/min. At 2244:13 hrs the Pilot in Command (PIC) had used the cabin public address system to call three times “Emergency Descent” and, at 2244:27 hrs, initiated it. Over the next 12 minutes the cabin pressure altitude decreased with a maximum descent rate of 3,300 ft/min.

\(^1\) All times local, unless otherwise stated.
According to the air traffic control radar recording the airplane passed FL 367 at 2044:31 hrs with an indicated airspeed of 470 kt, a south-eastern heading, and FL 220 selected at the MCP. At 2244:36 hrs ATC Reims received the Mayday call and was informed about the emergency descent to FL 100. At 2245:22 hrs the first officer began to complete the Cabin Altitude Warning or Rapid Decompression Checklist. The radar controller instructed the flight crew at 2246:08 hrs, at a QNH of 1,019 hPa, to turn left to a heading of 050°. During the turn towards the new heading, at 2246:29 hrs, the airplane passed FL 274 with a speed of 500 kt and the pre-selected FL 100 (MCP). At 2246:36 hrs the radar controller asked the flight crew about their intentions. The crew answered at 2246:40 hrs that they wanted to continue with the prevailing heading and descend to FL 100. They requested the relevant Minimum Safety Altitude (MSA) for the region and the descent clearance to 9,000 ft, which the radar controller acknowledged.

At 2247:44 hrs the first officer read items 3 and 4 of the Cabin Altitude Warning or Rapid Decompression checklist (Appendix 1). “Pressurization mode selector: MAN; Outflow Valve Switch: Hold in CLOSE until the outflow valve indication shows fully closed”. The PIC acknowledged this, then the first officer completed item 5 “If cabin altitude is uncontrollable: Passenger Signs: ON; Passenger oxygen switch: ON.“

Reims Radar informed the flight crew about the MSA of 5,000 ft and, at 2248:02 hrs, transferred them to Langen Radar. When the radar controller asked the PIC about the reason for the emergency he answered: „Ja, we have emergency descent we are descending nine thousand feet and eh requesting heading towards eh Frankfurt […]“, The controller answered: “[…] that is copied, continue present heading there is no traffic in your way so nine thousand feet is fine”.

Then the first officer continued to complete the procedures of the Emergency Descent checklist (Appendix 2) as instructed by the PIC. The flight crew received the new heading of 040° from Langen Radar at that time. The first officer read: “Emergency Descent; Condition: one or more of these occur: cabin altitude cannot be controlled; a rapid descent is needed”. Then asked: “This is correct, do you agree?” The PIC answered: “Understood, yea […]“. According to the radar data at 2249:15 hrs the airplane passed FL 156 and the PIC informed the controller that he now would reduce speed to 250 kt. The controller answered: “Ja that’s fine and eh you eh intend to go to Frankfurt International, correct?”. The PIC replied: “Affirm eh could you just check please for us the nighttime […] so open and ah we get the weather from you […]”. The controller said: “Ja, they will be opened and eh just give me a call when you are ready to copy Frankfurt weather”. At 2252:05 hrs the PIC said: “Cabin alti-
tude is [...] 24,000 ft. "[…] it's kind of stabilizing, it's coming down slowly. [...] basically, I'm not too sure why we had this depressurization.". At 2252:15 hrs the airplane reached 9,500 ft and 18 seconds later the PIC said: "Now, it's still reducing [...] It's coming down [...] It's catching us up." The PIC transferred the controls to the first officer at 2254:28 hrs and then said: "Cabin altitude now is 25,000 ft" The first officer answered with "OK?". The PIC replied: "[...] Frankfurt is open, it's a good opportunity." And then: “Now it says the cabin altitude is climbing – it says 33,000 ft [...] it’s not working. What we have to do is opening the valve completely. We need to open the valve to depressurize.”

According to the radar data at this time the airplane was at FL 89 with a speed of 260 kt. The FDR analysis showed a cabin pressure altitude of approximately 7,000 ft below MSL and for 04:20 min maximum cabin differential pressure was 8.72 PSI. After the OFV had been opened completely the cabin pressure altitude reached 5,000 ft at 2256:04 hrs.

Shortly after that the purser called from the cabin. After the PIC had explained the circumstances, he asked about the situation in the cabin and learned that cabin crew and passengers were using oxygen masks and that everyone was “more or less okay”. At 2257 hrs the flight crew removed the oxygen masks at an altitude of 9,000 ft. Langen Radar advised a heading of 010°. Subsequently, the PIC conducted a so-called NITS briefing with the purser during which the purser told him that one of his colleagues from the aft cabin had reported a loud hissing sound. He asked whether there was a possibility of evacuation after landing which the PIC negated.

At 2300 hrs the radar controller enquired once again about the kind of emergency, the number of persons on board and the remaining fuel. The PIC subsequently reduced the emergency from Mayday to Pan in reference to the stable situation and requested the prevailing weather conditions at Frankfurt-Hahn Airport. The radar controller made sure the flight crew indeed wanted to fly to Frankfurt-Hahn Airport and not to Frankfurt International Airport. At 2301 hrs he advised the flight crew of the new heading of 270°, the prevailing weather conditions and the expectable landing direction. On enquiry, the PIC declined further assistance after landing. At 2303 hrs the PIC informed the passengers via public address system about the pressure loss and the subsequent diversion to Frankfurt-Hahn Airport and then began with the approach preparations and briefing. He told the first officer again that he considered Hahn a good alternate aerodrome because of its status as maintenance base of the operator; he also believed that the OFV had caused the problem, and that he did not think they needed further assistance on the ground. He asked the purser once again
whether passengers had said they needed medical assistance. The purser answered, that there was one passenger with ear bleeding. At 2310 hrs via ATC the PIC requested an ambulance to the parking position of the airplane.

During the continued approach the PIC said: “[…] Valve now is completely open. Very strange, because cabin altitude reached over 30,000 ft.” The first officer replied: “I know, how did that happen?” At 2314 hrs after the airplane had been established on approach to runway 03 of Frankfurt-Hahn Airport, it was transferred to the Tower Controller. At 2319 hrs the landing occurred without further incident on runway 03. At 2322 hrs the engines were shut off after the parking position had been reached. The PIC asked the passengers who needed medical assistance to remain seated. The purser reported, that another two passengers did not feel well.
Personnel Information

Pilot in Command

The 29-year-old pilot in command was a British citizen holding an Airline Transport Pilot's License (ATPL(A)) initially issued on 19 April 2016 by the Irish civil aviation authority in accordance with ICAO and EASA standards. The type rating for the B737-300-900 was valid until 30 April 2019.

His Class 1 Medical Certificate was valid until 15 October 2018.

He had a total flying experience of 4,867 hours, of which 4,647 hours were on type. In the last 72 hours he had flown 14:37 hours. In the last 24 hours prior to the occurrence flight his rest period had been adequate.

First Officer

The 36-year-old first officer was a Croatian citizen holding a Commercial Pilot's License (CPL(A)) including ATPL theory knowledge initially issued on 28 April 2015 by the Irish civil aviation authority in accordance with ICAO and EASA standards. The type rating for the B737-300-900 was valid until 28 February 2019. In addition, the class ratings for Single Engine Piston (land) (SEP(L)), for Multi Engine Piston (land) (MEP(L)), and the Multi Engine Instrument Rating (ME IR) were listed in the licence.

His Class 1 Medical Certificate was valid until 3 October 2018.

He had a total flying experience of 2,447 hours, of which 2,244 hours were on type. In the last 72 hours he had flown 14:37 hours. In the last 24 hours prior to the occurrence flight his rest period had been adequate.

The flight crew had conducted all flights on the day of the occurrence and the two previous days together.
Aircraft Information

Manufacturer: Boeing
Type: B737-8AS
Manufacturer’s serial number: 35038
Year of Manufacture: 2011
MTOM: 66,900 kg
 Engines CFM International, CFM56-7B26

The aircraft had an Irish certificate of registration and was operated by an Irish operator.

At the time of the occurrence the aircraft had a total operating time of 24,038 hours at 12,575 cycles.

The cabin pressure system essentially consisted of the pressurised airframe, two air cycle machines, one OFV, two overpressure relief valves and one negative pressure relief valve. The position of the OFV controlled the cabin pressure. The airplane was equipped with two Cabin Pressure Controllers (CPC); one of which actively controlled the OFV and the other remained on standby.

The control and regulation interface for the Digital Cabin Pressure Control System was located at the front overhead panel in the cockpit. It showed the cabin altitude, the differential pressure, the climb and descent rate of the cabin pressure, and the position of the OFV. Here, the modi of the OFV, flight and landing altitude could be selected.
The flight crew completed two checklists in regard to the pressure drop in the cabin: The Cabin Altitude Warning or Rapid Depressurization checklist (Appendix 1) and the Emergency Descent checklist (Appendix 2).

Meteorological Information

At the time of the occurrence it was night and visual meteorological conditions prevailed. The relevant METARs for Frankfurt-Hahn read:

METAR EDFH 132050Z 00000KT CAVOK 17/12 Q1021=
METAR EDFH 132120Z VRB01KT CAVOK 17/12 Q1021=

Radio Communications

The recordings of the radio communications between flight crew and the corresponding air traffic control unit were made available for the investigation.
Aerodrome Information

Frankfurt-Hahn Airport is located 5.5 NM west of the town Kirchberg (Hunsrück). Aerodrome elevation is 1,649 ft above MSL. It is equipped with one runway with the orientation 032°/212°. The runway is 3,800 m long and 45 m wide. Both landing directions are approved for visual and instrument approach procedures. The airport is in service 24 hours a day.

On the day of the occurrence runway 03 was in service.

Flight Recorders

The aircraft was equipped with a Honeywell SSFDR and a Honeywell SSCVR. The BFU read out and analysed both recorders.

Both cabin pressure controllers (Nord Micro 21933-01AC) were seized. In the presence of a BFU investigator they were read out and analysed at the manufacturer's facilities.

Findings at the Aircraft

At the day of the occurrence BFU investigators visually examined the airplane at daylight. No damages were evident. In the cockpit both oxygen masks had been removed from their storage; in the cabin and lavatories the containers were open and the masks had fallen out.

The OFV was subject to a functional test in manual mode; there was no indication of mechanical malfunction.

The read-out of the Built-In Test Equipment (BITE) of the two still installed CPCs showed concordant events:

- MANUAL SWITCH
- CAB RATE HI
- CAB ALT 10000 FT
- CAB ALT 13500 FT
- CAB PRES SW ACTIV

In addition CPC # 1 showed the report “NO AUTO FAIL”.

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Fire

There was no fire.

Additional Information

After the landing more than the three initially reported passengers needed medical assistance. According to the documentation of the rescue personal 15 patients were treated at the site and another 28 were transported with rescue vehicles to hospitals for ambulant treatment.

Investigator in charge: Dr. Thomas Harendza
Assistance: Axel Rokohl, Philipp Lampert, Hans-Werner Hempelmann
Field Investigation: Thomas Kostrzewa, Lutz Jäkel

Appendices

- Appendix 1: Non Normal Checklist “Cabin Altitude Warning or Rapid Depressurization”
- Appendix 2: Non Normal Checklist “Emergency Descent”
- Appendix 3: Excerpt operating parameters pressurized cabin
Appendix 1: Non Normal Checklist Cabin Altitude Warning or Rapid Depressurization  
Source: Manufacturer

Appendix 2: Non Normal Checklist Emergency Descent  
Source: Manufacturer
Appendix 3: Operating parameters pressurized cabin 1/2

Source: Manufacturer

Appendix 3: Operating parameters pressurized cabin 2/2

Overpressure relief valve active 8.72 (8.74) PSI from 6150s to 6410s

Source: Manufacturer
This investigation is conducted in accordance with the 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 the Federal German Law relating to the investigation of accidents and incidents associated with the operation of civil aircraft (Flugunfall-Untersuchungs-Gesetz - FlUUG) of 26 August 1998.

The sole objective of the investigation is to prevent future accidents and incidents. The investigation does not seek to ascertain blame or apportion legal liability for any claims that may arise.

This document is a translation of the German Investigation Report. Although every effort was made for the translation to be accurate, in the event of any discrepancies the original German document is the authentic version.

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