ÚZPLN

AIR ACCIDENTS
INVESTIGATION INSTITUTE
Beranových 130
199 01 PRAGUE 99

CZ-17-0366

# FINAL REPORT

## Investigation of causes of a serious incident of Boeing B737 - 800 aircraft, ID mark OK-TSF, in the area of Kyiv UIR and Bratislava FIR, on 29 May 2017

Prague
November 2018

**Glossary of Abbreviations Used in this Report:**

| | | |
|---|---|---|
| ACMS | - | Aircraft Condition Monitoring System |
| AMM | - | Aircraft Maintenance Manual |
| ACU | - | Approach Control Unit |
| ATCo | - | Air Traffic Controller |
| ATPL (A) | - | Air Transport Pilot Licence |
| ATS | - | Air Traffic Services |
| CAB ALT | - | Cabin Altitude |
| CAVOK | - | Visibility, cloud and present weather better than prescribed values or conditions |
| CPL | - | Commercial Pilot Licence |
| CPT | - | Captain |
| CVR | - | Cockpit Voice Recorder |
| DFDR | - | Digital Flight Data Recorder |
| E/WD | - | Engine/Warning Display |
| ECAM | - | Electronic Centralised Aircraft Monitor |
| ECS | - | Environmental Control System |
| EPBC | - | Warsaw/Babice Aerodrome, Poland |
| FIR | - | Flight Information Region |
| FL | - | Flight Level |
| FSQ | - | Flight Safety and Quality |
| ft | - | Foot (unit of length – 0.3048 m) |
| h | - | Hour (unit of time) |
| hPa | - | Hectopascal (unit of atmospheric pressure) |
| ILS | - | Instrument Landing System |
| kg | - | Kilogram (unit of weight) |
| kt | - | Knot (unit of speed – 1.852 $km.h^{-1}$) |
| LLBG | - | Tel Aviv Aerodrome, Israel |
| LZKZ | - | Košice Aerodrome, Slovakia |
| MC | - | MASTER CAUTION (central indication warning of non-standard operation of aircraft systems) |
| MEL | - | Minimum Equipment List |

| | | |
|---|---|---|
| METAR | - | Aviation routine weather report |
| min | - | Minute (unit of time) |
| MP | - | Maintenance Process |
| MPS | - | Metre per second |
| NIL | - | None |
| NOSIG | - | No Significant Change |
| OFV | - | Drain valve |
| PAX | - | Passenger |
| PR | - | Pressure |
| psi | - | Unit of pressure |
| RWY | - | Runway |
| SB | - | Service Bulletin |
| SD | - | System Display |
| SDAC | - | Sensor Data Acquisition System |
| sec | - | Second (unit of time) |
| SEL | - | Selector |
| SIM | - | Pilot simulator training |
| SSFDR | - | Solid State Flight Data Recorder |
| SV | - | Safety Valve |
| t | - | Time |
| THSA | - | Trimmable Horizontal Stabiliser Actuator |
| TSM | - | Trouble Shooting Manual |
| TVS | - | Travel service, a.s. |
| TWR | - | Aerodrome traffic control |
| UIR | - | Upper Information Region |
| UTC | - | Coordinated Universal Time |
| AAII | - | The Air Accidents Investigation Institute |
| V/S | - | Vertical Speed |
| WQAR | - | Operating data recorder |
| Z | - | UTC indicator |

## A) Introduction

| | |
|---|---|
| Owner: | NBB MURRELET CO., LTD |
| Aircraft operator: | Travel service, a.s. |
| Aircraft Manufacturer and Type: | Boeing B737- 800 |
| Registration mark: | OK–TSF |
| Location of Incident: | Kyiv UIR and Bratislava FIR |
| Date: | 29 May 2017 |
| Time: | 17:02 UTC (all times given in UTC) |

## B) Synopsis

On 30 May 2017, TVS, a.s. informed the Air Accidents Investigation Institute of a serious incident of the B737- 800 aircraft, reg. mark OK-TSF, which occurred in Kyiv UIR and Bratislava FIR.

During a commercial flight from EPBC to LLBG at FL390 when flying in KYIV UIR, cockpit air over-pressure suddenly changed several times. The crew completed an emergency descent to FL100 and informed ATC. They interrupted flight on the planned route and landed at LZKZ without further complications. There were no crew or passenger injuries.

A check at LZKZ detected organic and inorganic pollutants in sensors and static/dynamic pressure piping. The following defects were then identified:

- Temperature sensor of engine No. 1 – damage caused by high temperature.
- Precooler control valve of engine No. 1 – failed to meet test check requirements.
- High stage valve of engine No. 2 – failed to meet test check requirements.
- Cabin altitude and differential pressure indicator oscillated between 8 and 1 psi at least five times.

The cause of the incident was investigated by the AAII commission. The investigation team comprised of:

| | |
|---|---|
| Investigator-in-charge: | Ing. Josef Procházka |
| Commission member: | Pavel Mráček |
| | Ing. Martin Fořt, TVS, a.s. |
| | Dušan Kajan, TVS, a.s. |

The Final Report was issued by:

AIR ACCIDENTS INVESTIGATION INSTITUTE
Beranových 130
199 01 PRAGUE 99

on 05 November 2018

## C) This Final Report Consists of the Following Main Parts:

1. Factual Information
2. Analyses
3. Conclusions
4. Safety Recommendations
5. Annexes

# 1 Factual Information

## 1.1 The Event History

### 1.1.1 History of the Flight

Flight description was based on the crew's statements, flight data recorder data evaluation, radar records, and radio communication recording.

On 29 May 2017, the crew of the Boeing B737-800 aircraft, reg. mark OK-TSF, was to perform a commercial flight from EPBC to LLBG. The pilot flying was aircraft captain during this leg. The aircraft took off from EPBC at 16:15.

During flight at FL390 at 17:02, in Kyiv UIR, MC indicator came on. Immediately after MC indication, the crew noticed cabin pressure indicator oscillating from 8 to 1 psi at least five times. At the same time, both PIC and FO started feeling dizzy. Shortly afterwards, they realised that normal breathing was impossible in such conditions. Both of them put on oxygen masks. PIC announced RAPID DESCENT in the passenger cabin. The purser informed PIC that masks in the passenger cabin had not been deployed. Subsequently, PIC deployed the masks manually. At the same time, the crew commenced descent. They considered reaching of safe flight level and informing ATS as their priority. Because of very bad breathing conditions they were unable to perform the NON-NORMAL CHECKLIST.

While they were descending, the situation has stabilised. The crew carried out tasks from the EMERGENCY CHECKLIST, reported emergency to ATS, set code 7700 on the secondary radar transponder, and decided to continue flying to the nearest suitable aerodrome, i.e. LZKZ.

Having reached FL100, the pilots advised the crew and passengers of the situation. Once they transferred to Košice Radar frequency, the crew cancelled the state of emergency and set a new code on the transponder. Approach and landing at LZKZ were performed without further complications at 17:46.

### 1.1.2 Event described by the cabin crew members

During cabin service, the cabin crew received the RAPID DESCENT instruction from the pilots. Crew members had problems breathing. Masks were not deployed automatically. They informed the pilots of the situation. Consequently, the masks were deployed. Approximately 10 minutes later, they received the CABIN CREW RESUME YOUR DUTIES instruction from the pilots. Cabin crew members checked the condition of passengers. The flight ended without any additional problems. Following landing, ambulance was called to aid one female passenger with blood pressure problems.

## 1.2 Injuries to persons

| Injury | Crew | Passengers | Other persons (inhabitants, etc.) |
|---|---|---|---|
| Fatal | 0 | 0 | 0 |
| Serious | 0 | 0 | 0 |
| Light/No injury | 0/6 | 0/99 | 0/0 |

## 1.3 Damage to aircraft

The aircraft was not damaged.

## 1.4 Other damage

NIL

## 1.5 Personnel Information

1.5.1 Captain

Age/Gender: 36-year-old male
Licence: ATPL (A) – valid, qualification valid
Medical certificate: 1.Class, valid

Pilot – flying experience:

| Hours flown | Total |
|---|---|
| All types in total: | 3761 |
| PIC – all types in total: | 478 |
| Type | 3486 |
| PIC – type | 232 |

The captain's pre-flight rest lasted 19 h 55 min. and the event took place after 3 h 05 min. of his service.
Last check completed on 2 May 2017 and SIM on 14 April 2017.
He PASSED both examinations.

1.5.2. First officer

Age/Gender: 27-year-old male
Licence: CPL (A) – valid, qualification valid
Medical certificate: 1. Class, valid

Pilot – flying experience:

| Hours flown | Total |
|---|---|
| All types in total: | 1117 |
| PIC – all types in total: | 105 |
| Type | 951 |
| PIC – type | 0 |

FO's pre-flight rest lasted 19 h 55 min. and the event took place after 3 h 05 min. of his service.
Last check completed on 22 December 2016 and SIM on 16 March 2017.
He PASSED both examinations.

## 1.6 Aircraft Information

1.6.1 Basic Information
The Boeing B737-800 aircraft is a twin-engine cantilever low-wing monoplane.

| | |
|---|---|
| Type/model: | Boeing B737- 800 |
| Registration mark: | OK-TSF |
| Manufacturer: | The Boeing Company |
| Owner: | NBB MURRELET CO., LTD |
| Serial number: | 37360 |
| Year of manufacture: | 2009 |
| Total hours flown: | 21,342:26 |
| Number of cycles: | 10,154 |
| MTOW: | 79015 kg |
| Weight during the event flight: | 73,355 kg |
| Last revision / total cycles: | 16 February 2017 / 10,154 |
| Total hours flown / since the last revision: | 21,342:26 h/ 705:07 h |
| Certificate of airworthiness inspection: | Valid |
| Statutory insurance: | Valid |

1.6.2 Power Unit

| | |
|---|---|
| Two engines: | CFM56-7B26/3 |
| Engine No. 1: | |
| Serial number: | 896895 |
| Total hours: | 21,342:26 |
| Engine No. 2: | |
| Serial number: | 896878 |
| Total hours: | 21,342:26 |

1.6.3 Aircraft Operation
The aircraft was used for short and mid-distance passenger transportation. The maximum authorised weight was set to 79,015 kg.
While transporting passengers, the aircraft repeatedly performed missions in areas with an increased amount of organic and inorganic air pollutants.

1.6.4 Presence of pollutants in the static/dynamic pressure system
Soiling of static/dynamic pressure sensors and piping was caused by:
- Sand/dust – its burning-on inside the system;
- Organic materials (pollen, plume, insects, etc.) – their burning-on inside the system.

1.6.5 Defects/faults identified
- Temperature sensor of engine No. 1 – damaged by high temperature – was replaced.
- Precooler control valve of engine No. 1 – failed to meet test check requirements – was replaced.
- High stage valve of engine No. 2 – failed to meet test check requirements – was replaced.
- Cabin altitude and differential pressure indicator oscillating between 8 and 1 psi – was replaced.

## 1.9 Communications
The communication with the aircraft was carried out on the ATS L´viv Radar, KOŠICE RADAR, APP and TWR frequencies.

The following chart presents the transcripts of radio-correspondence from the moment of incident notification by the crew on L´viv Radar frequency until the transition to communications with LZKZ APP.

| Час(UTC) | Абоненти | ЗМІСТ ПЕРЕГОВОРІВ |
|---|---|---|
| | | **LVC+LVU f-135,6** |
| 16:58:49 | ISR734 | L'viv Radar, Israir seven three four, maintain flight level three niner zero, proceeding BUKOV. |
| 16:58:58 | Д | Israir seven three four, L'viv Radar, hallo, you identified. |
| 16:59:56 | ISR734 | ("May day – Mayday – Mayday", this is Israir seven three four, request descend … **Bad to hear**) |
| 17:00:04 | ISR734 | Emergency descend. |
| 17:00:14 | ISR734 | …(unreadable)… |
| 17:00:19 | ISR734 | …(unreadable)… |
| 17:00:42 | ISR734 | …(unreadable)… |
| 17:00:49 | Д | India Sierra Romeo seven three four, L'viv Radar, radio check, how do you read me. |
| 17:00:59 | Д | India Sierra Romeo seven three four, L'viv Radar. |
| 17:01:15 | Д | India Sierra Romeo seven three four, L'viv Radar, if you read me squawk "IDENT". |
| 17:01:23 | ISR734 | … (unreadable) … this is … (unreadable) … Israir seven three four request emergency descending one zero zero. |
| 17:01:31 | Д | India Sierra Romeo seven three four, roger, continue descend altitude one zero thousand feet, QNH one zero zero seven, transition level one two zero. |
| 17:01:42 | ISR734 | Descending one zero zero, … (unreadable) …, "Mayday – Mayday". |
| 17:01:55 | Д | India Sierra Romeo seven three four, roger decompression, continue descend. |
| 17:02:00 | ISR734 | Descending. |
| 17:02:07 | ISR734 | … (unreadable) … |
| 17:02:15 | ISR734 | … (unreadable) … |
| 17:02:17 | Д | India Sierra Romeo seven three four, L'viv Radar, go ahead. |
| 17:03:09 | ISR734 | Israir seven three four, … (unreadable) … passing. |
| 17:03:15 | ISR734 | Israir seven three four, descending, passing two six zero, descending one hundred. |
| 17:03:21 | Д | Israir seven three four, L'viv Radar, roger, continue descend one zero thousand feet. |
| 17:03:27 | ISR734 | Okay, descending one zero thousand feet. |
| 17:03:31 | Д | Israir seven three four, when able, advise people on board. |
| 17:03:36 | ISR734 | We have niner one passengers on board and we have fuel …( |

| | | |
|---|---|---|
| | | unreadable)… |
| 17:03:44 | ISR734 | … (unreadable) … nine thousand one hundred kilograms on board. |
| 17:04:09 | Д | India Sierra Romeo seven three four, are you able to change frequency? |
| 17:04:13 | ISR734 | Yes, we are … (unreadable)… frequency, say again frequency. |
| 17:04:18 | Д | India Sierra Romeo seven three four, if able change frequency one one eight decimal six seven, I say again, one one eight decimal six seven. |
| 17:04:26 | ISR734 | One one eight six seven, Israir seven three four, thank you. |
| | | **LVE+LVW f-118,675** |
| 17:04:32 | ISR734 | … (unreadable) … Radar, this is Israir seven three four, "Mayday – Mayday", descending one hundred. |
| 17:04:41 | Д | India Sierra Romeo seven three four, L'viv Radar, good day, you identified, descend to altitude one zero thousand feet, QNH one zero zero seven, transition level one two zero. |
| 17:04:53 | ISR734 | Descending one zero one seven, descending for ten thousand feet, one zero one seven, seven zero, Israir seven three four. |
| 17:05:33 | Д | Israir seven three four, report your intensions. |
| 17:05:50 | Д | Israir seven three four, L'viv Radar, when able, advise your intensions. |
| 17:05:56 | ISR734 | This Israir seven three four, request proceed one miles … ( unreadable) … flight level one zero zero, I let you know. |
| 17:06:05 | Д | Israir seven three four, roger. |
| 17:07:52 | ISR734 | … (noise) … |
| 17:08:06 | ISR734 | … (noise) … |
| 17:08:13 | Д | Israir seven three four, L'viv Radar, you unreadable. |
| 17:08:19 | ISR734 | … (noise) … |
| 17:08:36 | ISR734 | … ( unreadable, noise) … |
| 17:08:50 | Д | Israir seven three four, L'viv Radar, you are still unreadable. |
| 17:09:04 | ISR734 | Radar, this is Israir seven three four, do you read me? |
| 17:09:08 | Д | Israir seven three four, read you five. |
| 17:09:10 | ISR734 | Okay. |
| 17:09:13 | ISR734 | So … (unreadable) … condition is now save, maintaining ten thousand feet, QNH one zero one seven and request vectoring or initial information to Kosice, Lima ... stand by. |
| 17:09:39 | ISR734 | Israir seven three four, request vectors to Lima Kilo Zulu Kilo, Kosice, please. |
| 17:09:46 | Д | Israir seven three four, turn right heading two six zero. |
| 17:09:49 | ISR734 | Heading two six zero, so, now condition is okay, we are maintaining two zero … one zero thousand feet. So, say again the heading. |
| 17:10:02 | Д | Israir seven three four, turn right heading two six zero. |
| 17:10:05 | ISR734 | Heading two six zero, Israir seven three four. |
| 17:10:37 | Д | Israir seven three four, L'viv Radar. |
| 17:10:52 | Д | Israir seven three four, L'viv Radar. |
| 17:11:20 | ISR734 | Israir seven three four, now heading two six zero turning right and maintaining ten thousand feet. |
| 17:11:34 | Д | Israir seven three four, also can recommend you, can advise you aerodrome Uniform Kilo Lima Lima, that is situated five six nautical miles north-west from your present position. |
| 17:11:48 | ISR734 | Okay, stand by. |
| 17:12:19 | ISR734 | Israir seven three four, our destination still Lima Zulu Kilo Zulu, thank you. |
| 17:12:25 | Д | Israir seven three four, would you confirm, you would like to proceed to |

| | | |
|---|---|---|
| | | Kosice? |
| 17:12:30 | ISR734 | Kosice, thank you. |
| 17:12:45 | Д | Israir seven three four, for information, in two zero kilometers ahead of you start zone weather minimum safe alti … of route altitude is one … flight level one two zero, temperature corrected. |
| 17:13:02 | ISR734 | Okay, request … request avoid, request avoid if possible, some heading. |
| 17:13:11 | ISR734 | … two eight zero will be okay, we have to maintain ten thousand feet. |
| 17:13:16 | Д | Israir seven three four, turn right two zero degrees. |
| 17:13:20 | ISR734 | Two zero, two zero degrees to the right, Israir seven three four. |
| 17:13:58 | ISR734 | ... (unreadable) … if possible. |
| 17:14:03 | Д | Israir seven three four, would you confirm, you would like weather for Kosice and aerodrome details? |
| 17:14:10 | ISR734 | Yes, please, weather from Kosice if possible. |
| 17:14:16 | Д | Israir seven three four, stand by shortly. |
| 17:14:38 | Д | Israir seven three four, are you ready to copy actual weather for Lima Zulu Kilo Zulu? |
| 17:14:45 | ISR734 | … (unreadable, noise) … |
| 17:14:52 | Д | Israir seven three four, actual weather for Lima Zulu Kilo Zulu at time one seven zero zero UTC: wind two three zero degrees, nine knots, CAVOK, temperature plus two four, due point plus one zero, QNH one zero one five. |
| 17:15:10 | ISR734 | … (unreadable, noise) … |
| 17:15:15 | Д | Israir seven three four, you are unreadable. |
| 17:15:18 | Д | Israir seven three four, turn right one zero degrees. |
| 17:15:22 | ISR734 | … zero degrees to the right, Israir seven three four. |
| 17:15:27 | ISR734 | Please, confirm runway in use. |
| 17:15:29 | Д | Israir seven three four, stand by. |
| 17:16:48 | Д | Israir seven three four, turn left heading two seven zero. |
| 17:16:52 | ISR734 | Heading two seven zero, Israir seven three four. |
| 17:17:02 | ISR734 | And please confirm, maintaining ten thousand feet … MSA. |
| 17:17:09 | Д | Israir seven three four, maintain altitude one zero thousand feet. |
| 17:17:12 | ISR734 | Maintaining one zero thousand feet and heading three one seven. |
| 17:17:17 | Д | Israir seven three four, heading two seven zero. |
| 17:17:22 | ISR734 | Two seven zero heading, Israir seven three four. |
| 17:17:33 | Д | Israir seven three four, and confirm QNH one zero zero seven. |
| 17:17:39 | ISR734 | One zero zero seven I do confirm, Israir seven three four. |
| 17:17:59 | Д | Israir seven three four, do you have any dangerous goods on board? |
| 17:18:05 | ISR734 | No danger goods, no danger goods, nine one passengers and we have enough of fuel, we have eight point six now. |
| 17:18:19 | ISR734 | Seven three four, please, do you have any Alal or Israel or … (unreadable) … airplanes on the radio now. |
| 17:18:30 | Д | Israir seven three four, stand by. |
| 17:18:32 | ISR734 | Thank you very much. |
| 17:18:47 | Д | Israir seven three four, we don't have any Israel airplanes in our airspace. |
| 17:18:53 | ISR734 | Okay, roger, if you have, please, contact them, because it is … is Israel flight and decision to go to Kosice is very important for us, thank you. |
| 17:19:05 | Д | Israir seven three four, roger. |
| 17:19:09 | Д | Israir seven three four, runway in use in Kosice is zero one. |
| 17:19:14 | ISR734 | Okay, zero one, thank you. |

| | | |
|---|---|---|
| 17:19:18 | Д | Israir seven three four, do you need aerodrome details? |
| 17:19:23 | ISR734 | No, thank you, we have everything, thank you. |
| 17:21:49 | Д | Israir seven three four, turn left heading two five five. |
| 17:22:00 | ISR734 | Left heading two five five, Israir seven three four. |
| 17:26:09 | Д | Israir seven three four, you approaching FIR boundary, QNH one zero one three, contact Kosice Radar one one nine decimal eight five. |
| 17:26:23 | ISR734 | One zero one three QNH, one one niner eight five, thank you, Israir seven three four. |
| 17:26:34 | ISR734 | Kosice, добрый вечер, this is Israir seven three four, Mayday now, to request … to declare to Pan-Pan only, Pan-Pan only maintaining ten thousand and … |
| 17:26:52 | Д | Israir seven three four this is still L'viv Radar, you have not changed the frequency, contact one one nine decimal eight five, Kosice Radar. |
| 17:26:59 | ISR734 | One one niner eight five, sorry. |

### 1.10 Aerodrome Information

The Košice aerodrome is a public international aerodrome at 230 m AMSL, with a 01/19 runway, 10,171 x 148 ft (3,100 x 45 m), with H24 operation hours.
The aerodrome had no effect on the origin or course of the serious incident.

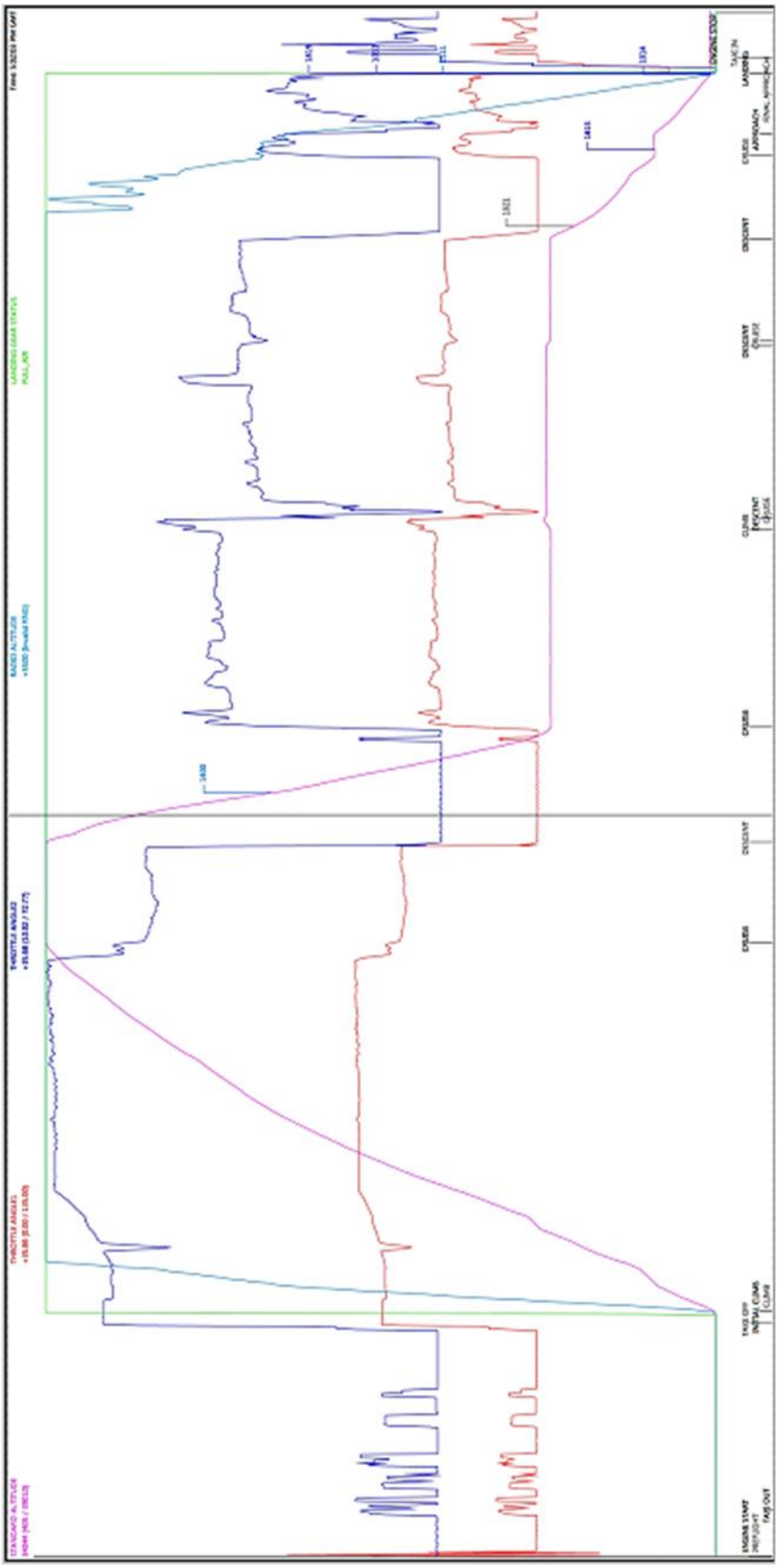
### 1.11 Flight Recorders and Other Means of Recording

During the evaluation of the course of the flight and the description of change of relevant parameters concerning the event origin and course, the committee used the CVR data, WQAR on-board recording equipment, and the DFDR emergency recorder. Data records were perfectly usable.

1.11.1 : Graphic profiling of selected parameters of the recorded flight data:

Barvy parametrů:

| | | | |
|---|---|---|---|
| Dark blue: | Throtle Angel 1 | Red: | Throtle Angel 2 |
| Purple: | Standard Altitude | Blue : | Radio Altitude |
| Green: | Landing Gear Status | | |



1.11.2 Chart 1: Abridged time progress of events from the selected flight data parameters:
(CAS – Calibrated Airspeed, STD – Standard)

| Time | Status | STANDAR | COMPUTE | VERTICAL | CABIN ALT | MASTER C | MASTER C | ALTITUDE | ADEPT AL | ECS PACK | ECS PACK | ECS PACK | ENGINE 1 | ENGINE 2 | BLEED AIR | BLEED VAI | ISOLATIOI | ECS ISOL | BLD VALV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ALT_STD | CAS | SPEED | CALT | WARN | WARN | ALT_MOD | ALT_STD | LEFT | aLECSO | RIGHT | aRECSO | BVS1 | BVS1 | SWITCH | OPEN | Valve R | VALVE | OPEN |
| | | FEET | KNOTS | FT/MIN | | | | QNH | FEET | | | | | | | | | | | |
| 16:20:42 | VZLET | 417 | 45 | 0 | NO WARN | NO WARN | NO WARN | STD | 41,7 | OFF/HIGH | OFF | OFF/HIGH | OFF | ON | ON | ON | OPEN | 0 | OPEN | OPEN |
| 16:55:00 | FL390 | 39001 | 244 | 210 | NO WARN | NO WARN | NO WARN | STD | 3900,1 | LOW | ON | LOW | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 16:55:18 | | 38999 | 245 | -22,5 | NO WARN | NO WARN | NO WARN | STD | 3899,9 | LOW | ON | LOW | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 16:55:19 | | 38999 | 245 | -15 | NO WARN | WARN | WARN | STD | 3899,9 | LOW | ON | LOW | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 16:55:20 | | 38998 | 245 | 0 | NO WARN | WARN | WARN | STD | 3899,8 | LOW | ON | LOW | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 16:55:21 | | 39000 | 244,8 | 15 | NO WARN | NO WARN | NO WARN | STD | 3900 | LOW | ON | LOW | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 16:56:00 | | 39004 | 245 | -7,5 | NO WARN | NO WARN | NO WARN | STD | 3900,4 | LOW | ON | LOW | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 16:57:00 | | 38992 | 241,5 | -30 | NO WARN | NO WARN | NO WARN | STD | 3899,2 | LOW | ON | LOW | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 16:58:00 | | 38999 | 241,8 | 22,5 | NO WARN | NO WARN | NO WARN | STD | 3899,9 | LOW | ON | LOW | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 16:59:00 | | 38995 | 238,8 | -37,5 | NO WARN | NO WARN | NO WARN | STD | 3899,5 | LOW | ON | LOW | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 16:59:37 | | 38999 | 240,5 | -37,5 | NO WARN | NO WARN | NO WARN | STD | 3899,9 | LOW | ON | LOW | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 16:59:38 | 1. Změna | 38998 | 240,8 | -52,5 | NO WARN | WARN | WARN | STD | 3899,8 | LOW | ON | LOW | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:00:34 | | 38965 | 239,8 | -457,5 | NO WARN | WARN | WARN | STD | 3896,5 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:00:35 | | 38957 | 239,5 | -607,5 | NO WARN | WARN | WARN | STD | 3895,7 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:00:36 | | 38948 | 239,3 | -787,5 | NO WARN | NO WARN | NO WARN | STD | 3894,8 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:00:37 | | 38935 | 238,8 | -1005 | NO WARN | NO WARN | NO WARN | STD | 3893,5 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:00:38 | | 38915 | 238,5 | -1267,5 | NO WARN | NO WARN | NO WARN | STD | 3891,5 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:00:39 | | 38895 | 238 | -1530 | NO WARN | NO WARN | NO WARN | STD | 3889,5 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:00:40 | | 38867 | 238 | -1800 | NO WARN | NO WARN | NO WARN | STD | 3886,7 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:00:41 | | 38834 | 237,8 | -2115 | NO WARN | NO WARN | NO WARN | STD | 3883,4 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:00:42 | | 38796 | 237,5 | -2400 | NO WARN | NO WARN | NO WARN | STD | 3879,6 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:00:43 | | 38753 | 237,5 | -2685 | NO WARN | NO WARN | NO WARN | STD | 3875,3 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:00:44 | | 38708 | 237,5 | -2970 | NO WARN | NO WARN | NO WARN | STD | 3870,8 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:00:45 | | 38653 | 237,8 | -3217,5 | NO WARN | NO WARN | NO WARN | STD | 3865,3 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:00:46 | | 38595 | 239,3 | -3442,5 | NO WARN | NO WARN | NO WARN | STD | 3859,5 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:00:47 | | 38537 | 240,3 | -3697,5 | NO WARN | NO WARN | NO WARN | STD | 3853,7 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:00:48 | | 38471 | 241,3 | -3892,5 | NO WARN | NO WARN | NO WARN | STD | 3847,1 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:00:49 | | 38405 | 242,5 | -4020 | NO WARN | NO WARN | NO WARN | STD | 3840,5 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:00:50 | OXY | 38337 | 243,8 | -4155 | NO WARN | WARN | WARN | STD | 3833,7 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:00:51 | | 38260 | 245,3 | -4312,5 | NO WARN | WARN | WARN | STD | 3826 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:00:52 | | 38189 | 246,5 | -4395 | NO WARN | WARN | WARN | STD | 3818,9 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:00:53 | | 38117 | 248 | -4477,5 | NO WARN | NO WARN | NO WARN | STD | 3811,7 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:00:59 | | 37654 | 253,5 | -4230 | NO WARN | NO WARN | NO WARN | STD | 3765,4 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:01:30 | | 36271 | 258 | -2887,5 | NO WARN | NO WARN | NO WARN | STD | 3627,1 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:02:00 | | 34282 | 268 | -4687,5 | NO WARN | NO WARN | NO WARN | STD | 3428,2 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:02:30 | | 31609 | 285,3 | -6022,5 | NO WARN | NO WARN | NO WARN | STD | 3160,9 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:03:00 | | 28372 | 308,8 | -6877,5 | NO WARN | NO WARN | NO WARN | STD | 2837,2 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:03:20 | | 26038 | 323,8 | -7192,5 | NO WARN | NO WARN | NO WARN | STD | 2603,8 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:04:00 | | 22440 | 333 | -4635 | NO WARN | NO WARN | NO WARN | STD | 2244 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:04:30 | | 19956 | 332,8 | -5497,5 | NO WARN | NO WARN | NO WARN | STD | 1995,6 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:05:00 | | 17304 | 337,3 | -5250 | NO WARN | NO WARN | NO WARN | STD | 1730,4 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:05:30 | | 14920 | 336,5 | -4815 | NO WARN | NO WARN | NO WARN | STD | 1492 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:06:00 | | 12595 | 335 | -4815 | NO WARN | NO WARN | NO WARN | STD | 1259,5 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:06:30 | | 10674 | 338,8 | -2407,5 | NO WARN | NO WARN | NO WARN | STD | 1067,4 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:06:50 | | 10043 | 330,8 | -1297,5 | NO WARN | NO WARN | NO WARN | STD | 1004,3 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |
| 17:06:51 | FL100 | 10021 | 329,8 | -1237,5 | NO WARN | NO WARN | NO WARN | STD | 1002,1 | OFF/HIGH | OFF | OFF/HIGH | ON | ON | ON | OFF | NOT OPEN | 0 | CLOSED | NOT OPEN |

Note re Chart 1:

| Time | Status |
|---|---|
| 16:20:42 | Take-off |
| 16:55:00 | Reaching FL390 |
| 16:55:19 | MC indication Pressure system check performed by the crew. |
| 16:59:38 | MC indication ECS Pack Left and Right (Environmental Conditioning System LEFT and RIGHT) from LOW to OFF/HIGH. |
| 17:00:35 | MC indication stopped. ECS L and R status remained at the same level. From that point on, with slight alterations in CAS and decreasing ALT STD 38,998 ft to 38,337 ft in 1 min 12 sec (until UTC 17:00:50), sharp fluctuation in vertical speed took place. |
| 17:00:50 | MC indication Status ECS L and R not changed. |
| 17:00:53 | MC indication stopped. Status ECS L and R not changed. From that point on, CAS as well as V/S increased significantly, and marked speedy decrease in ALT STD could be detected. |
| 17:06:51 | Aircraft reached FL100. Status ECS L and R not changed. |

## 1.12 Serious Incident Location Description

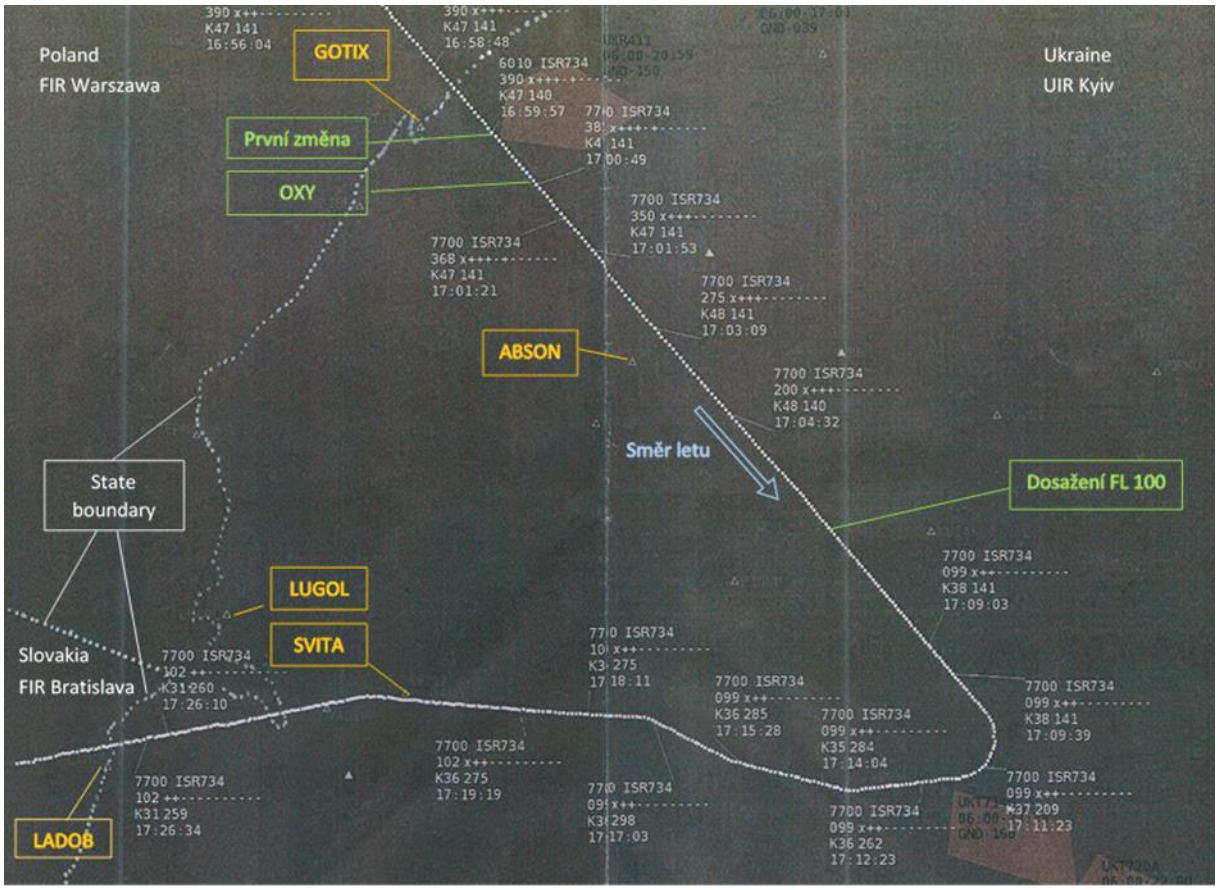



Fig. 1: Radar flight record

Significant points with their codes are inserted in yellow. MC indications and reaching of FL100 are marked in green.

## 1.13 Medical and pathological information

NIL

### 1.14 Fire

NIL

### 1.15 Survival aspects

NIL

### 1.16 Test and research

NIL

### 1.17 Organisational and Management Information

The subject aircraft operator held a valid aircraft operator license. The organisation completing the subject aircraft maintenance and repairs was fully licensed for their performance.

Upon determining the cause of this incident, the operator took the following measures:

1/ Issued Technical Information Bulletin for maintenance regarding the observance of the procedure of covering the pressure sensors.

2/ Issued the Job Card regarding the blowing through of the static and dynamic pressure sensors.

### 1.18 Additional information

NIL

### 1.19 Useful or Effective Investigation Techniques

The professional investigation of the serious incident causes followed the ICAO Annex 13 regulation.

## 2. Analyses

### 2.1 Basic Factual Information Analysis

The crew were valid flight crew licence holders with corresponding qualifications and valid Class 1 medical certificate holders. The aircraft had a valid airworthiness inspection certificate and valid legal insurance coverage,

### 2.2 Flight Crew Acting

The take-off and ascent to the cruising level were performed in a standard manner. Up to the event origin moment, the course of flight did not show any signs that would have indicated any aircraft pressurisation system failure.

Once the event occurred, the crew completed an emergency descent in line with the Aircraft Operating Manual. The total time of emergency descent from FL390 to FL100 was about 6 min. The radio-communication records made it obvious that the situation negotiation, from the onset and namely throughout the time period of emergency descent, was hindered by the illegibility of aircraft transmission reading for both, the crew as well as the ATC. At FL100, the crew continued in flight towards LZKZ for approximately 27 min, where they performed ILS approach and landing on RWY01 at 17:43 with no further complications.

### 2.3 Cabin Crew Acting

The cabin crew completed all the emergency situation procedures in line with the Aircraft Operating Manual.

### 2.4 Presence of pollutants in the static/dynamic pressure system

Covering of static and dynamic pressure sensors is possible only in times when the aircraft is not used for flight operations.

Soiling of the said sensors and of the connecting lines from them was caused by:

- Inorganic material – Sand/dust – its burning-on inside the system
- Organic materials (pollen, plume, insects, etc.) – their burning-on inside the system

### 2.5 Defects/faults identified

During the follow-up inspection, defects were discovered on the aircraft that influenced the cabin over-pressure system functioning.

- Temperature sensor of engine No. 1 – damaged by high temperature – was replaced.
- Precooler control valve of engine No. 1 – failed to meet test check requirements – was replaced.
- High stage valve of engine No. 2 – failed to meet test check requirements – was replaced.
- Cabin altitude and differential pressure indicator oscillating between 8 and 1 psi – was replaced.

### 2.6 Aircraft Operating Limitations

None of the aircraft's operating limitations was exceeded.

### 2.7 Weather Impacts

The weather conditions were suitable for the completion of the scheduled commercial flight.

## 3. Conclusions

### 3.1 The AAII Commission concludes as follows:

3.1.1 Aircraft flight and cabin crews

- held valid operating licenses and had valid adequate qualifications,
- held valid medical certificates,
- were capable of completing the scheduled commercial flight,
- acted in line with the procedures identified in the Aircraft Operating Manual during the defect solution and used the emergency procedures specified in it.

3.1.2 Aircraft

- had a valid airworthiness inspection certificate,
- its insurance coverage was current,
- its landing weight was below the maximum landing weight. No operating limitations were exceeded,
- had in flight at FL390 sudden and significant alterations in the cabin over-pressurising,
- had reduced passability of the static/dynamic pressure system,
- had defects on the temperature sensor of engine No. 1, precooler control valve of engine No. 1, high stage valve of engine No. 2, and cabin altitude and differential pressure indicator.

3.1.3 Meteorological Conditions

- had no impact on the event origin and course.

### 3.2 Causes

- The serious incident was caused by the reduced passability of the static/dynamic pressure system which together with the defects on aircraft pressure system components initiated the indication and fluctuating in indication of “Cabin Differential Pressure”.

## 4 Safety Recommendations

AAII has not issued any recommendations.