AI2020-5

AIRCRAFT SERIOUS INCIDENT
INVESTIGATION REPORT

IBEX AIRLINES CO., LTD.
J A 1 1 R J

October 1, 2020

Japan Transport Safety Board

The objective of the investigation conducted by the Japan Transport Safety Board in accordance with the Act for Establishment of the Japan Transport Safety Board (and with Annex 13 to the Convention on International Civil Aviation) is to prevent future accidents and incidents. It is not the purpose of the investigation to apportion blame or liability.

TAKEDA Nobuo
Chairman
Japan Transport Safety Board

Note:

This report is a translation of the Japanese original investigation report. The text in Japanese shall prevail in the interpretation of the report.

AIRCRAFT SERIOUS INCIDENT INVESTIGATION REPORT

ABNORMAL DECOMPRESSION INSIDE AN AIRCRAFT

IBEX AIRLINES CO., LTD.
BOMBARDIER CL-600-2C10, JA11RJ
OVER OHNAN-CHO, OHCHI-GUN, SHIMANE PREFECTURE
FL260 AT ABOUT 18:02 JST, OCTOBER 30, 2019

August 28, 2020
Adopted by the Japan Transport Safety Board
Chairman TAKEDA Nobuo
Member MIYASHITA Toru
Member KAKISHIMA Yoshiko
Member MARUI Yuichi
Member MIYAZAWA Yoshikazu
Member NAKANISHI Miwa

1. PROCESS AND PROGRESS OF THE AIRCRAFT SERIOUS INCIDENT INVESTIGATION

1.1 Summary of the Serious Incident	At 16:31, on October 30, 2019, a Bombardier CL-600-2C10, registered JA11RJ, operated by IBEX Airlines Co., Ltd. took off from Sendai Airport as a scheduled flight 16 of the operator, and was flying at FL 340 to Fukuoka Airport, but the Pilot in Command found something like cracks in a cockpit windshield on his side. When the Pilot in Command was dealing with the situation according to the check list to be followed at the time of occurrence of damage to the windshield, the instrument indicated cabin decompression, therefore, he made an emergency descent to about 10,000 ft. In an emergency descent, the oxygen masks in the cabin were automatically deployed. The aircraft kept on flying and landed at Fukuoka Airport at 18:38.
1.2 Outline of the Serious Incident Investigation	The occurrence covered by this report falls under the category of "Abnormal decompression inside an aircraft" as stipulated in Item 11, Article 166-4 of the Ordinance for Enforcement of Civil Aeronautics Act of Japan (Ordinance of Ministry of Transport No. 56 of 1952), and is classified as a serious incident. On October 31, 2019, the Japan Transport Safety Board (JTSB) designated an investigator-in-charge and an investigator to investigate this serious incident. An accredited representative and an advisor of Canada, as the State of Design and Manufacture of the aircraft involved in the serious incident, participated in the investigation. Comments were invited from parties relevant to the cause of the serious incident and the Relevant State.

2. FACTUAL INFORMATION

2.1 History of the Flight

According to the statements of the Pilot in Command (PIC) and the First Officer (FO), records of the digital flight data recorder (DFDR) and the cockpit voice recorder (CVR), the history of the flight is as outlined below.

At 16:31 Japan Standard Time (JST, UTC+9 hours, unless otherwise stated all times are indicated in JST on a 24-hour clock) on October 30, 2019, the aircraft took off from Sendai Airport as a scheduled flight 16 of the Operator, with 73 people in total on board, consisting of the PIC and three other crewmembers and 69 passengers.

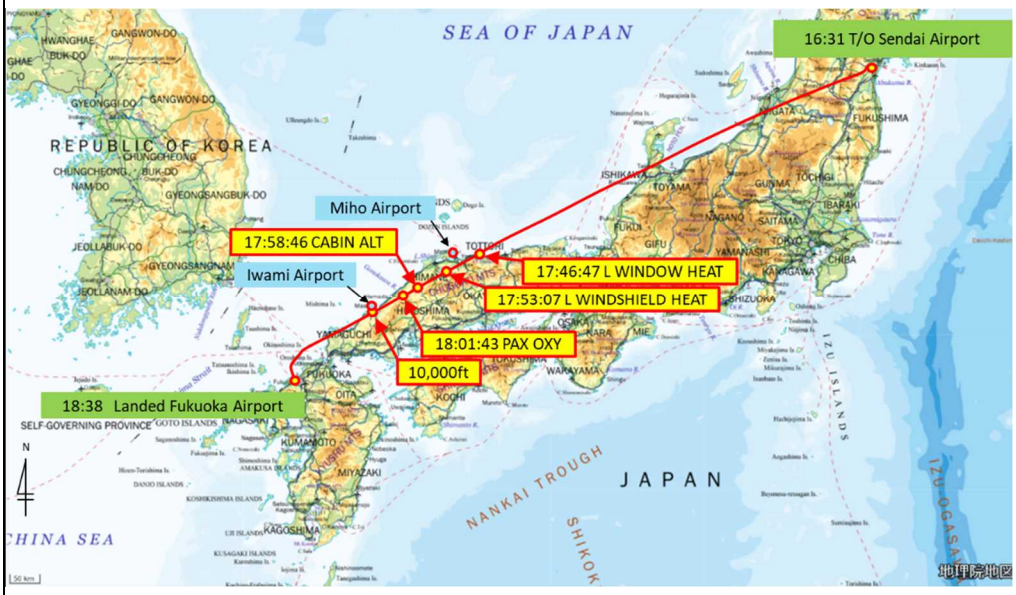


Figure 1: Estimated flight route

At around 17:47, when the aircraft was cruising at FL 340*1, about 50 km east of Miho Airport, the PIC saw a flash near the left window. After that, EICAS*2 displayed "L WINDOW HEAT" (Caution*3). According to the check list, the PIC switched the "L WSHLD HEAT SW" from "LOW" to "OFF/RESET", and when he set it to "LOW" again, the message disappeared.

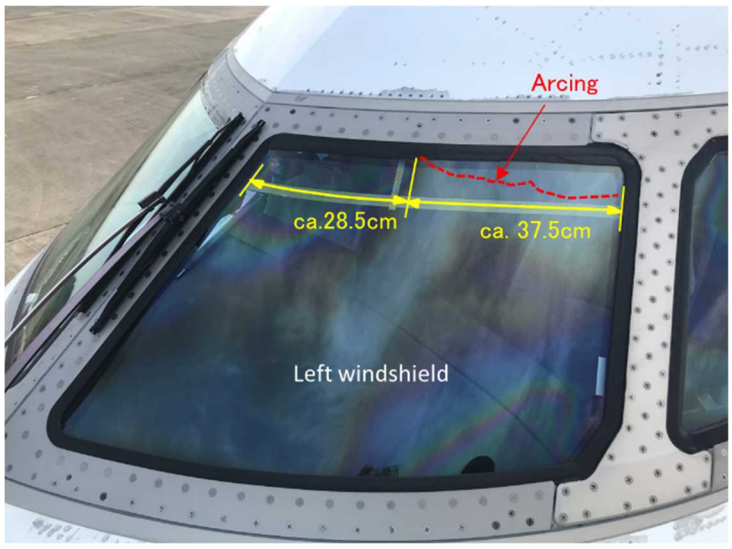
At around 17:53, the PIC saw a flash near the left window again. After a while, in turn, EICAS displayed "L WSHLD HEAT" (Caution). According to the check list, the PIC switched the "L WSHLD HEAT SW" from "LOW" to "OFF/RESET", and when he set it to "LOW" again, the message disappeared. According to the PIC, at the moment, the cabin altitude was about 5,700 ft.

At around 17:56, when flying at FL 340 about 50 km southwest of Miho Airport, the PIC found something like cracks in the left windshield. The PIC commenced dealing with the situation according to the check list (See the description in 2.7 (6)).

*1 "FL" denotes a pressure altitude in the standard atmosphere. FL is expressed in the value obtained by diving the reading on the altimeter (in feet) by 100 when the altimeter is set to 29.92 inHg. Flight altitude over 14,000 ft is generally expressed in FL in Japan. For instance, FL 340 stands for an altitude of 34,000 ft.

*2 EICAS stands for the Engine Indicating and Crew Alerting System, an electronic indication and warning device that displays engine data, and warns operating crewmembers, should an abnormality be found, of its location, and the like by indication of messages

*3 "Caution" is a message outlined in amber, meaning that there is an abnormality or a failure of the aircraft which does not require an emergency operation but need to let the pilot know it immediately.

	As the PIC decreased the cabin pressure manually according to the check list, the cabin altitude started to increase. At around 17:58, when the PIC was going to commence descending, EICAS displayed "CABIN ALT" (Caution), which soon turned into "CABIN ALT" (Warning *4). At around 17:59, the PIC commenced an emergency descent according to the check list. Considering the expansion of the crack in the windshield, the PIC had the aircraft descent to 10,000 ft at a descent rate of about 3,000 ft/min so as not to increase the aircraft's air speed. According to the PIC, at the moment, the cabin altitude was about 12,400 ft. At around 18:02, in an emergency descent, when the Aircraft was at around FL 260 and about 90 km southwest of Miho Airport, EICAS displayed "PASS OXY ON" (Caution) and the oxygen masks in the cabin were automatically deployed. According to the PIC and the FO, at the moment, the cabin altitude was about 14,000 ft, and the differential pressure was 5.2 psid. At around 18:10, the aircraft reached (the flight altitude of) about 10,000 ft over near Iwami Airport and the cabin altitude also reached about 10,000 ft. At 18:21, communicating with Fukuoka Approach, the PIC declared an emergency. At 18:38, the aircraft landed at Fukuoka Airport. This serious incident occurred at around 18:02 on October 30, 2019, over Ohnan-cho, Ohchi-gun, Shimane Prefecture at FL260 (Latitude 34°55'18"N, Longitude 132°32' 27"E).
2.2 Injuries to Persons	None
2.3 Damage to the Aircraft	Arcing on the upper part of the left windshield.  Figure 2: Condition of the left windshield

*4 "Warning" is a message outlined in red, meaning that there is an abnormality or a failure of the aircraft which requires the pilot to make an emergency operation immediately.

2.4 Personnel Information	PIC: Male, age 37 Airline transport pilot certificate (Airplane) October 17, 2018 Type rating for Bombardier CL-65 October 17, 2018 Class 1 aviation medical certificate Validity date: November 7, 2020 Total flight time 5,319 hours 16 minutes Total flight time on the type of aircraft 2,384 hours 46 minutes
2.5 Aircraft Information	Aircraft type: Bombardier CL-600-2C10 Serial number: 10344 Date of manufacture: June 14, 2015 Certificate of airworthiness No. Dai-2018-643 Validity: February 8, 2020 Category of airworthiness Airplane, Transport T Total flight time 10,237 hours 7 minutes Total cycles 9,918 cycles Flight time since last periodical check (6,000-hour inspection on September 27, 2017) 5,124 hours
2.6 Meteorological Information	The weather at the time of the serious incident was VMC and there was no turbulence.
2.7 Additional Information	(1) Outline of windshield / anti-ice systems The cockpit windows consist of two windshields placed at the front and two side windows on each side (Figure 3). A heater element is installed in each windshield and side window (Figure 4). The "LH WSHLD" switch on the anti-ice control panel controls the left windshield and the left side window, and the "RH WSHLD" switch controls the right windshield and the right side window. Each of four windows is independently equipped with a heater element, a controller, and sensors. The EICAS messages such as "L WSHLD HEAT" and "L WINDOW HEAT" are indicated under any of the conditions as follows. • Window Overheat • Temp Sensor Fault • Controller Failure • Power loss • Heater Element Short

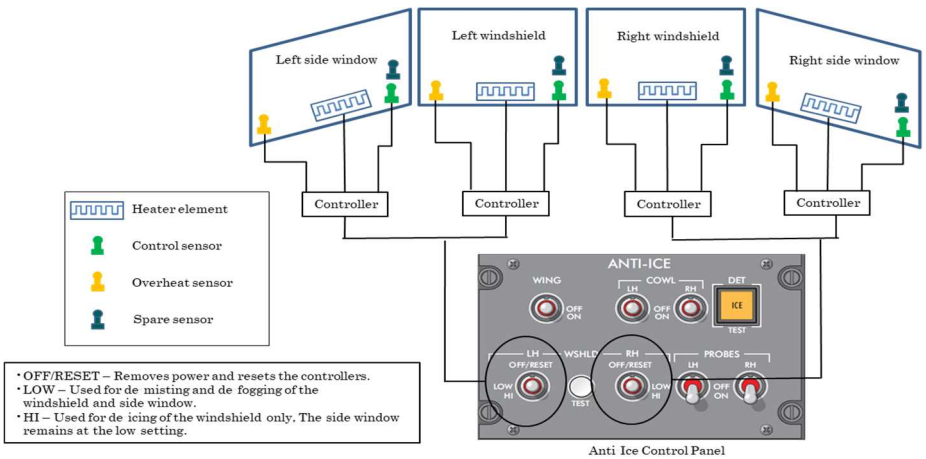


Figure 3: Windshield anti-ice systems

(2) Information on windshield

When the aircraft arrived at Fukuoka Airport, the circuit breakers were confirmed to be in the status of Push-in (normal state) for all four windows.

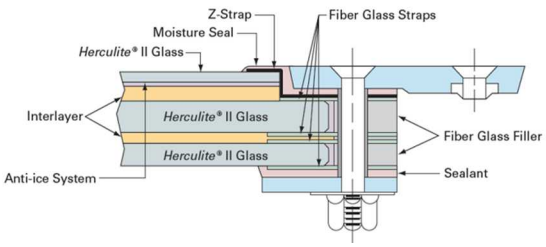


Figure 4: Cutaway view of the Windshield

In the upper part of the left windshield, arcing marks were recognized in the heater element layer, but cracks were not recognized in the glass layers.

On the outer upper part of the left windshield, it was confirmed that there was evidence of repairing the moisture seal that prevents moisture from infiltration. As for other three windows, no abnormalities were recognized. Upon confirmation of the maintenance record for the aircraft, it was found that visual inspection was conducted regarding the left windshield at a periodical inspection that was conducted according to the manual established by the Design and Manufacturer of the aircraft. On October 7, 2019, as the operator found degradation (erosion) of the moisture seal of the left windshield during the periodical inspection, they carried out repair work by coating sealant according to the Aircraft's Maintenance Manual (AMM). The left windshield and the left side window of the aircraft were installed at the time of its production, and had no records of replacement.

(3) Investigation on the parts removed from the aircraft

Based on the information obtained through the interview with the PIC, the operator replaced the following parts according to the maintenance actions specified in the AMM established by the Design and Manufacturer of the aircraft.

i. Left windshield
ii. Left side window
iii. Left windshield/heater controller
iv. Left side window/heater controller
v. Anti-ice/control panel

After the replacement of all the above-mentioned parts, the function test on the windshield/anti-ice systems was performed and all functioned normally.

In the investigation on the structural members on the airframe where the windows were mounted, heater-related wiring and others, all functioned normally.

As for the left windshield and the left side window removed from the aircraft, the investigation on sensors and heater elements was performed according to the AMM, and it was found that only the resistance of the heater element of the left windshield substantially exceeded the reference value, while all functioned normally for the left side window.

The two heater controllers and the anti-ice control panel were sent to a repair shop for investigation, which revealed all functioned normally.

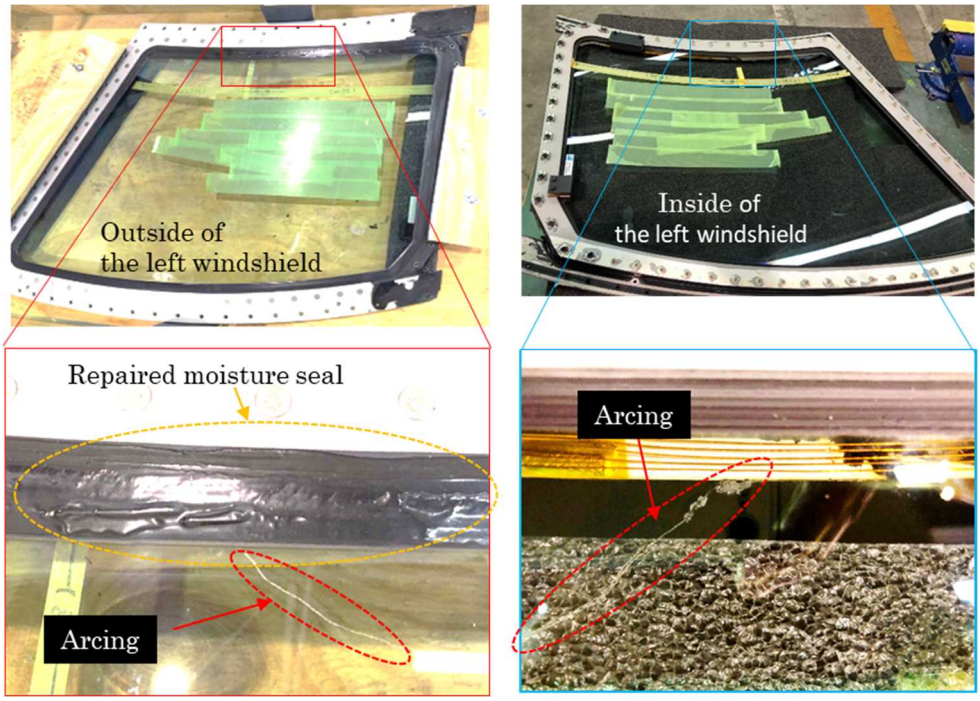


Figure 5: Condition of the Left windshield

(4) Cabin pressurization system

A cabin pressurization system is usually controlled in automatic mode, but it can be controlled by the pilot in manual mode with the cabin pressurization control panel (Figure 6).

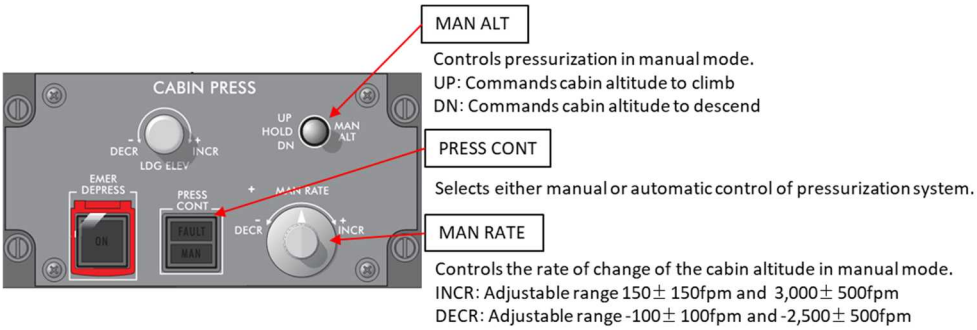


Figure 6: Cabin Pressurization Panel

There were the following descriptions in the second volume of the Aircraft Operations Manual (AOM) for the aircraft as regards the targeted cabin altitude (ft) for the flight altitude (FL) when the cabin pressurization system is controlled in manual mode.

Flight Altitude (FL)	180	200	220	240	260	280	290	310	330	350	370	390	410
Cabin Altitude (ft)	1,100	1,500	2,000	2,400	2,900	3,500	3,800	4,500	5,300	6,000	6,700	7,400	8,000

Table 1: Targeted cabin altitude (ft) for FL

When the cabin altitude greater than or equal to 8,500 ft, EICAS displays "CABIN ALT" (Caution), and when it greater than or equal to 10,000 ft, the

	Message changes to “CABIN ALT” (Warning). According to records of the Quick Access Recorder (QAR), at 17:58:15, “CABIN ALT” (Caution) was displayed, at 17:58:46, the Message changed to “CABIN ALT” (Warning), and at 18:09:00, the Message changed to “CABIN ALT” (Caution) again. (5) Oxygen masks in the cabin The oxygen masks for passengers are installed above the seats in the cabin and these are automatically deployed when the cabin altitude exceeds 14,000±300 ft. The oxygen masks in the cabin can be manually deployed by pushing the “PASS OXY switch” (Figure 7) in the cockpit. When they are deployed, EICAS displays “PASS OXY ON” (Caution) and the “PASS OXY switch” illuminate.  Figure 7: PASS oxygen According to QAR records, at 18:01:43, EICAS displayed “PASS OXY ON”. (6) Procedure in the check list There were the following descriptions in the second volume “ABNORMAL PROCEDURE” of the AOM for the aircraft as regards the check list to be followed when arcing, delaminated, shattered, or cracked are found on the windshield, and the following are the excerpts. ① ANTI-ICE, LH or RH WSHLD----------Affected side OFF ② PRESS CONT----------MAN ③ MAN RATE----------INCR MAX ④ MAN ALT----------UP (position) ⑤ Crew and passenger oxygen----------On, if required ⑥ Descent----------Initiate, if required (7) The procedure that the crew members operated According to CVR records, at both 17:46:47 and 17:53:07, the PIC called, "The EICAS message, LEFT WSHLD HEAT.” And the FO read back the same message. The PIC was dealing with the situation in accordance with the check list.

3. ANALYSIS

3.1 Involvement of Weather	None
3.2 Involvement of Pilots	None
3.3 Involvement of Aircraft	None
3.4 Analysis of Findings	(1) It is probable that based on CVR records and the result of the detailed investigation on the replaced parts, the “Flash”, which the PIC saw two times, was caused by the arcing in the heater element of the left windshield. (2) It is highly probable that as a result of an investigation on the windshield, something like cracks, which the PIC found in the upper part

	of the left windshield, were arcing marks, and since cracks were not observed on the windshield. There was no decrease in strength regarding the left windshield. There was evidence of repairing the moisture seal, but it is highly probable that according to the maintenance record of the operator, repair work was carried out in accordance with the AMM. It is probable that the arcing marks were caused by the deterioration of the moisture seal and moisture penetration into inside of the left windshield, resulting in an arcing in the heater element; however, it could not be determined when this moisture penetration occurred. (3) It is highly probable that based on CVR records, the PIC found something like cracks on the windshield and dealt with the situation in accordance with the check list as described in 2.7 (6). (4) It is highly probable that as the PIC switched the cabin pressurization to manual mode and set the cabin altitude at the maximum climb rate according to the check list, the cabin altitude started to increase, resulting in abnormal decompression inside the aircraft. (5) When flying at FL 340, the PIC commenced the check list, and the aircraft descended at a descent rate of about 3,000 ft/min, however, it is highly probable that it took more than 10 minutes for the aircraft to reach a flight altitude of 10,000 ft. On the other hand, the cabin altitude was approximately 5,700 ft when the PIC commenced the check list. It is highly probable that as the PIC switched to manual mode to set the cabin altitude at the maximum climb rate of 3,000±500 ft/min in accordance with the check list, the cabin altitude exceeded 10,000 ft within about two minutes. (6) It is highly probable that based on DFDR records, the cabin altitude was exceeding 10,000 ft for 10 minutes 14 seconds between 17:58:46 and 18:09:00 while "CABIN ALT" (Warning) was being displayed. (7) It is highly probable that in view of the fact that the oxygen masks in the cabin were automatically deployed and EICAS message "PASS OXY ON" (Caution) was displayed, the cabin altitude had exceeded 14,000±300 ft. (8) Based on these factors, it is highly probable that as an arcing occurred in the left windshield during cruise, the PIC dealt with the situation in accordance with the check list to be followed at the time of occurrence of such problems, which caused the cabin altitude to rapidly climb, resulting in abnormal decompression inside the aircraft. The procedure of the checklist was required to uniformly set the cabin altitude at the maximum climb rate regardless of the degree of windows damage and the flight altitude. When flying at a high altitude like the aircraft, it is highly probable that it was inevitable that the cabin altitude reached the threshold for automatic deployment of the passenger oxygen masks. (9) It is desirable that the Design and Manufacturer of the aircraft should review the check list in order to improve procedures which will prevent from occurring an abnormal decompression even when there occurs a similar incident.

4. PROBABLE CAUSES

It is highly probable that this serious incident occurred because an arcing occurred in the left windshield while the aircraft was flying at FL 340, and the PIC performed the operation to raise the cabin altitude in accordance with the check list, resulting in abnormal decompression inside the aircraft.

It is also highly probable that the abnormal decompression inside the aircraft occurred because irrespective of the flight altitude, the procedure in the check list would require the pilot to perform the set to climb the cabin altitude at the maximum climb rate without any exception.

5. PREVENTIVE ACTIONS

The Design and Manufacturer of the aircraft added the procedures to adjust the cabin altitude according to the cruise level, and revised the checklist so as to prevent from occurring an abnormal decompression inside an aircraft.

6. APPENDIXES

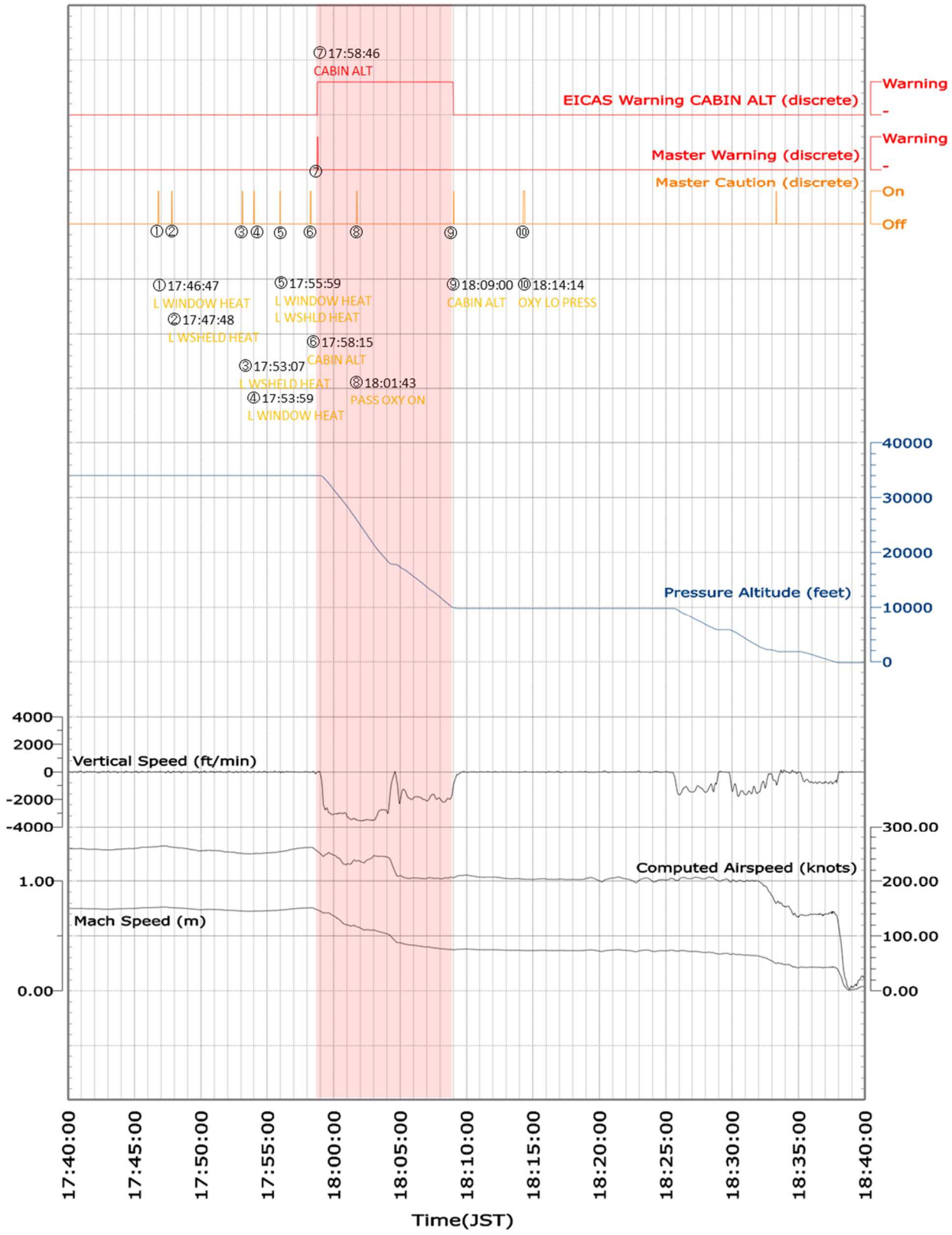


Figure 8: DFDR records and displayed messages (according to the statement of the PIC)