AA2019-8

AIRCRAFT ACCIDENT
INVESTIGATION REPORT

JAPAN AIRLINES CO., LTD.
J A 8 9 4 4

September 26, 2019

JTSB 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 determine the causes of an accident and damage incidental to such an accident, thereby preventing future accidents and reducing damage. It is not the purpose of the investigation to apportion blame or liability.

Nobuo Takeda
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 ACCIDENT INVESTIGATION REPORT

CABIN ATTENDANT INJURY BY SHAKING OF AIRCRAFT JAPAN AIRLINES CO., LTD. BOEING 777-300, JA8944 AT FL300 OVER KURIHARA CITY, MIYAGI PREFECTURE, JAPAN AROUND 15:56 JST, JUNE 24, 2018

August 30, 2019

Adopted by the Japan Transport Safety Board

Chairman Nobuo Takeda
Member Toru Miyashita
Member Yoshiko Kakishima
Member Yuichi Marui
Member Yoshikazu Miyazawa
Member Miwa Nakanishi

1. PROCESS AND PROGRESS OF THE AIRCRAFT ACCIDENT INVESTIGATION

1.1 Summary of the Accident	On Sunday, June 24, 2018, a Boeing 777-300, registered JA8944, operated by Japan Airlines Co., Ltd., as a scheduled flight 514, experienced a fierce shaking in-flight from New Chitose Airport to Tokyo International Airport, and a cabin attendant fell down and was injured.
1.2 Outline of the Accident Investigation	The Japan Transport Safety Board designated an investigator-in-charge and one investigator on June 24, 2018 to investigate this accident. The accident was notified to the United States of America, as the State of Design and Manufacturer of the aircraft involved in this accident, however, the State did not designate its accredit representative. Comments on the draft report were invited from parties relevant to the cause of this accident and the Relevant State.

2. FACTUAL INFORMATION

2.1 History of the Flight	According to the statements of the captain, the first officer (FO) and cabin attendants, and flight data recorder (hereinafter referred to as "FDR"), the history of the flight is summarized as follows: A Boeing 777-300, registered JA8944, operated by Japan Airlines Co., Ltd. as a scheduled flight 514, with 515 persons in total on board, consisting of the captain, 11 crew members and 503 passengers, took off from New Chitose Airport for Tokyo International Airport on June 24, 2018 at 15:19 JST (JST: UTC+9 hours; unless otherwise noted, all times are indicated in

JST in this report on a 24-hour clock).

In the pre-flight briefing performed around 13:45, flight crew confirmed the flight plan, meteorological situation and forecast of the day and so on. The forecast indicated that there was vertical wind shearing (VWS) showing wind direction and wind velocity change of six to nine kt against altitude difference of 1,000 ft at the scheduled cruising altitude (FL*1 300), and furthermore, there was jet stream with the maximum wind velocity of 150 kt centered at FL370 in the upper air that was moving southward as time went by. Because turbulence by PIREP (weather report from pilot) on the scheduled cruising route of the aircraft from 12:43 till 13:43 was weak (-) or nil, the flight crew presumed that shaking might occur when the aircraft approached VWS region but an initial shaking would be light, and they mutually confirmed that the aircraft avoided VWS region by lowering the cruising altitude if it felt a light shaking (see Figure 1). Besides, considering a probable occurrence of a shaking in cruising, the flight crew instructed cabin crew in the pre-flight briefing to guard themselves against such a shaking in cruising and let them aware of a possible occurrence of an abrupt shaking from 50 minutes after take-off.

The captain sat in the left pilot's seat as PF*2 and the FO sat in the right pilot's seat as PM*2 in the cockpit.

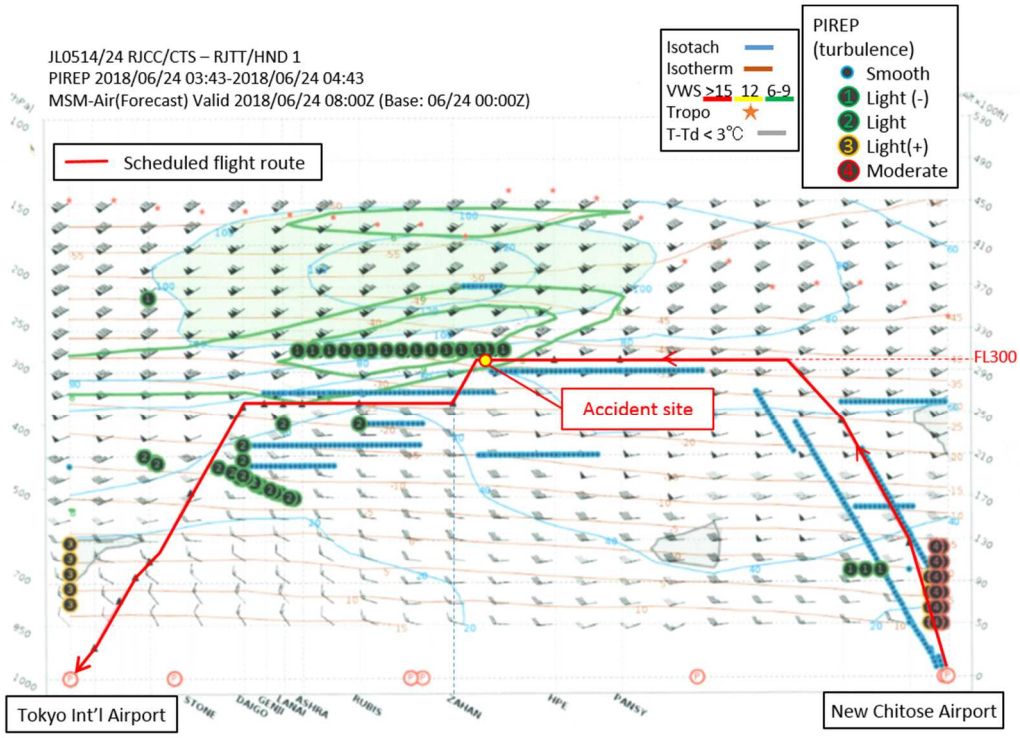


Figure 1: Predicted VWS in the pre-flight briefing

Initial time: 09:00, Time predicted for: 17:00

*1 FL stands for the pressure altitude in the standard atmosphere and is expressed in the value dividing the reading (in ft) on the altimeter by 100, when the altimeter is set to 29.92 inHg. It is usually used in Japan when flight altitude is 14,000 ft or higher. For instance, FL300 means altitude of 30,000 ft.

*2 "PF" and "PM" are terms used to identify pilots with the roles assigned to each pilot in aircraft operated by two persons. PF is an abbreviation of Pilot Flying and is mainly responsible for maneuvering the aircraft. PM is an abbreviation of Pilot Monitoring and mainly monitors flight status of the aircraft and cross-checks operations of PF, and undertakes other non-operational roles.

After take-off and climbing, the seat belt sign was turned off and the cabin attendants started in-flight service. The aircraft reached the cruising altitude of FL300. While the aircraft was cruising in the upper air over Miyagi Prefecture, PF temporarily switched the flight control with PM in order to prepare for the landing briefing. Immediately thereafter, because the aircraft shook relatively fiercely, the crew member commenced to contact with the air traffic control for descending. At this time, a cabin attendant who was holding a tray to collect used cups on the aft aisle of the aircraft tried to grasp an armrest of a passenger seat in accordance with the manual so stipulated by the operator. However, due to the second fiercer shaking occurred about 15 seconds thereafter, the cabin attendant was unable to grasp the armrest, fell down and had her ankle injured after feeling that she was floating (see Figure 3).

Figure 2: Estimated flight route

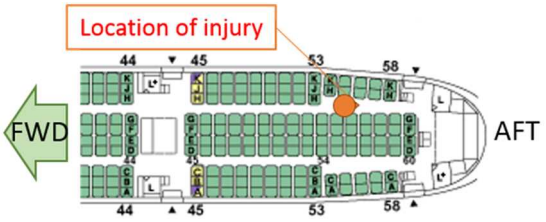
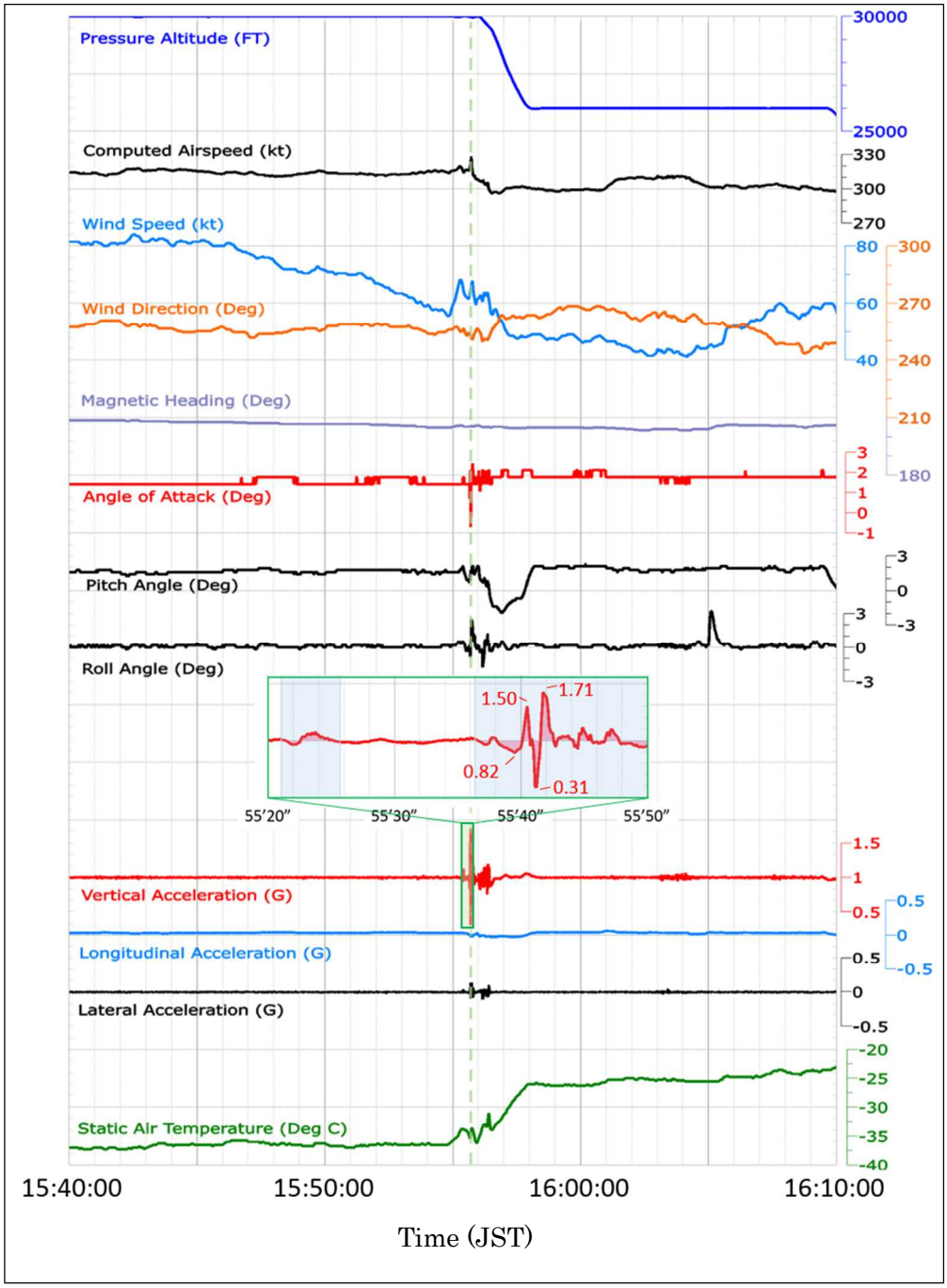
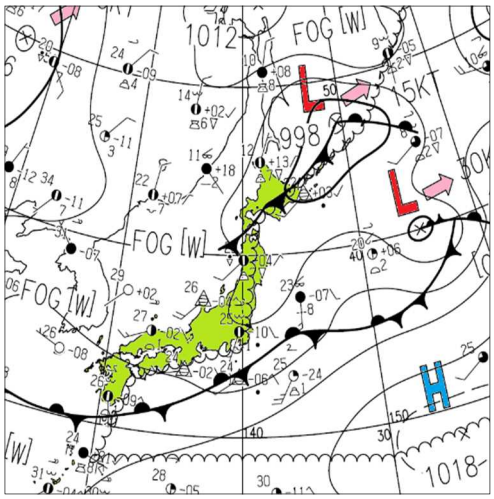


Figure 3: Location where cabin attendant was injured

Vertical acceleration speed at the second shaking of the aircraft varied by increase from +0.82G to +1.50G followed by decrease to 0.31G and increase again to 1.71G (see Figure 4) in approximately three seconds. Besides, echo was not displayed on airborne weather radar of the aircraft. The seat belt sign was turned off because the aircraft kept stable cruising from take-off and climbing until the occurrence of the shaking. Immediately after the occurrence of the shaking, the FO illuminated the seat belt sign, and the aircraft descended to the altitude FL260 and continued the flight. The aircraft landed at Tokyo International Airport at 16:34.

The place of the occurrence of the accident was at FL300 over Kurihara

	City, Miyagi Prefecture (38° 50'34" N, 140° 55'03" E) and time of the occurrence was June 24, 2018 around 15:56.  Figure 4: FDR Record
2.2 Injuries to Persons	One cabin attendant was seriously injured (bone fracture).
2.3 Damage to Aircraft	None
2.4 Personnel Information	(1) Captain Male, Age 47 Airline transport pilot certificate (Airplane) October 3, 2008 Type rating for Boeing 777 December 10, 1998 Class 1 aviation medical certificate

	Validity July 13, 2019 Total flight time 10,475 hours 14 minutes Total flight time on the type of aircraft 10,037 hours 2 minutes (2) First Officer Male, 48 Commercial pilot certificate (Airplane) August 18, 1995 Type rating for Boeing 777 January 8, 2014 Instrument flight certificate June 20, 1996 Class 1 aviation medical certificate Validity November 9, 2018 Total flight time 9,373 hours 58 minutes Total flight time on the type of aircraft 2,769 hours 36 minutes
2.5 Aircraft Information	Aircraft Type Boeing 777-300 Serial number 28396 Date of manufacture March 30, 1999 Certificate of airworthiness 2009-176 Validity From October 1, 2009 until the time when the maintenance manual (JAL Engineering Co., Ltd.) approved based on the permission of Article 113-2 of Civil Aeronautics Act is applied. When the accident occurred, the weight and the balance of the aircraft were within the allowable ranges.
2.6 Meteorological Information	(1) General Weather Conditions According to Asia Pacific Surface Analysis Chart (excerpt) (see Figure 5) as of 15:00, June 24, 2018, a cold front line extending from a low pressure centered in the Sea of Okhotsk was passing over northern part of Japan and a seasonal rain front was stationary on the sea of southern part of Japan. (2) Hourly Atmosphere Analysis Hourly atmosphere analysis chart (see Figure 6) as of 16:00, June 24, 2018 in the vertical cross-sectional chart of air route indicated that there were jet stream with the maximum wind velocity of about 150 kt centering at FL370 and VWS region of 9 – 12 kt/1,000 ft near the accident site.  Figure 5: Asia Pacific Surface Analysis Chart (excerpt)

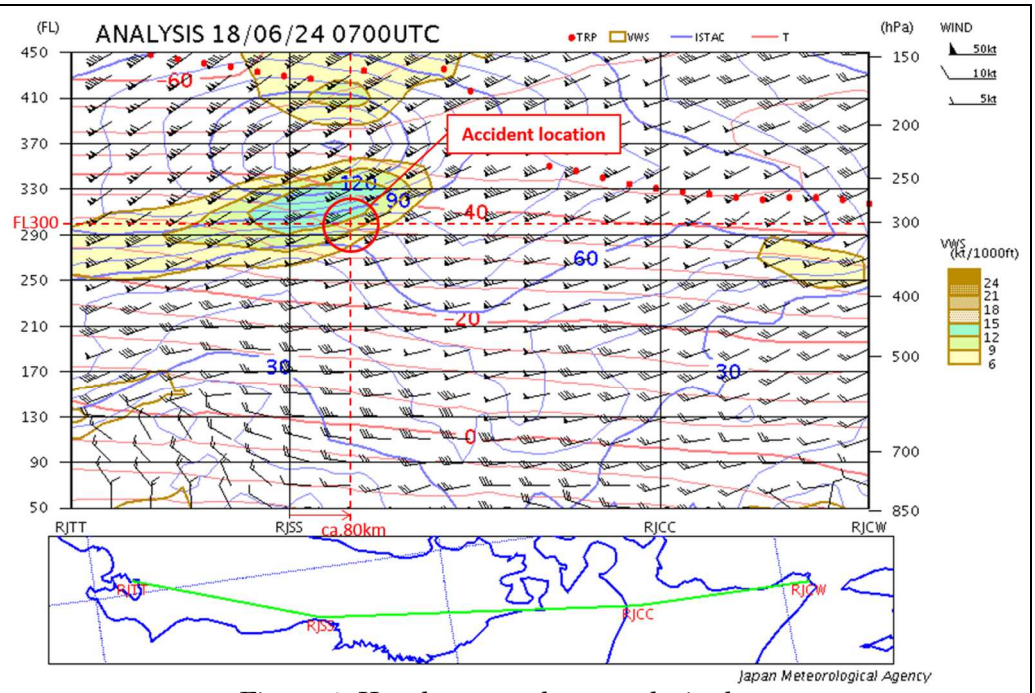


Figure 6: Hourly atmosphere analysis chart
(vertical cross-sectional chart of air route)

(3) PIREP

From 13:00 till the occurrence of the accident, there was no PIREP that indicated the chance of encountering turbulence that was equal to or greater than normal, in the airspace where the accident occurred.

2.7 Additional Information

(1) Manual for the Case of Occurrence of Shaking Stipulated by the Operator

The cabin attendant manual safety of the operator incorporates following treatments in case of occurrence of shaking. (excerpt)

- *Immediately take the nearest vacant seat available and fasten a seat belt. Unless there is a vacant seat available nearby, hold structures of aircraft such as a seat, an assist grip and so on. Take a low attitude, retain the body by holding an armrest or in whatever manner available and secure own safety.*

(2) Clear Air Turbulence

According to "AIM-J" (854 in the first half edition of 2019, published by Japan Aircraft Pilot Association) and "Analysis and Utilization of Meteorological Satellite Images – Aeronautical Weather Series –" (page 27 in 2002 edition, published by Meteorological Satellite Center of Japan Meteorological Agency), clear air turbulence stands for the turbulence that generates in clear region or cirrus region and, in many cases, it generates near deep trough or accompanies jet stream or front surface (stable layer). Occasionally, it can visually be detected from the characteristics of the cirrus region, however, because in most cases it cannot visually be detected and is not reflected on airborne weather radar, it abruptly encounters in-flight in the clear airspace.

Occurrence of clear air turbulence accompanies a very dynamic change in time and space, and the signs detectable in the cockpit include following:

- Rapid change in wind velocity

	● Temperature change of 1℃ or more per minute ● Fluctuations of the first decimal place of digital outside air temperature indicator ● Fluctuations of Mach number at a constant power set ● Oscillations of control column

3. ANALYSIS

3.1 Involvement of Weather	Yes
3.2 Involvement of Pilot	None
3.3 Involvement of Aircraft	None
3.4 Analysis of Findings	(1) From the history of the flight, it is probable that the shaking of the aircraft corresponded to the abrupt change of vertical acceleration speed recorded in FDR. Due to the shaking, it is probable that there occurred the fierce change of the vertical acceleration speed near the aft cabin of the aircraft as well, and it is highly probable that the cabin attendant, who was on the aisle of the aft cabin, was unable to hold a passenger seat or structures of the aircraft, fell down and had her ankle fractured after feeling that she was floating. (2) It is highly probable that the shaking of the aircraft occurred while it was passing through the side edge of the jet stream. Besides, from angle of attack, wind direction, wind velocity and abrupt change of outside temperature, all of which were recorded in FDR, and VWS region shown in the hourly atmosphere analysis chart as well as echo that was not displayed on airborne weather radar, it is highly probable that the aircraft encountered clear air turbulence that generated on the side edge of the jet stream. (3) It is probable that the jet stream that generated clear air turbulence the aircraft encountered accompanied VWS region in the accident airspace, which had an increased strength at the time of the accident compared to the strength of weather forecast in the pre-flight briefing. (4) From weather information flight crew confirmed prior to the flight and PIREP as well as display of airborne weather radar in-flight, information regarding such a strong turbulence on the flight route as the one that adversely affected the flight operation was not confirmed, and it is probable that they did not predict to suddenly encounter the strong turbulence. However, due to the existence of VWS region on the flight route that became stronger than forecasted at the time when the aircraft was flying, it is probable that it encountered clear air turbulence. (5) In the pre-flight briefing, flight crew instructed cabin attendants to use caution against a possible abrupt shaking from 50 minutes after take-off. On the other hand, flight crew presumed that the shaking that would occur when the aircraft approached VWS region would be light at the beginning and

	decided to avoid VWS region by lowering the cruising altitude, if the aircraft felt the light shaking, and it is highly probable that they did not remind cabin attendants of the caution when the aircraft approached the airspace where VWS region was predicted. It is probable that providing information pertaining to the safety of flight with cabin attendants as appropriate when turbulence during cruising can be predicted is effectual from a stand point of preventing similar accidents.

4. PROBABLE CAUSES

In this accident, it is highly probable that the aircraft encountered clear air turbulence while it was passing through the side edge of the jet stream, and because of that the aircraft was so fiercely shaken that the cabin attendant who was on the aft aisle of the aircraft fell down and was injured.

With regard to the encountering of the aircraft with clear air turbulence, it is probable that the existence of VWS region on the flight route of the aircraft, which was stronger than the forecast confirmed prior to the flight, was attributable to the encountering.

5. SAFETY ACTIONS

The operator has already implemented following measures in order to prevent recurrence.

(1) The history of the accident and the descriptions below were informed to all crew members and let them recognize again that flight plan does not take bad weather conditions into consideration unless noted on the briefing memo.

(i) An altitude that consumes fuel most effectively is automatically selected as the current selected altitude in automatically established flight plan.

(ii) In case that the operator manually altered the altitude of flight plan, such an alteration is described on the briefing memo.

(2) The outline of the accident and the descriptions below were informed to all cabin attendants.

(i) To have mindset of preparedness that shaking is possible to occur anytime in-flight and to imagine what actions to take in the event of shaking.

(ii) Establishment and alteration of service plan depending on the situation.

(iii) Treatment in the event that cabin attendant has been injured.

(3) Cabin attendant's request to illuminate seat belt sign to flight crew has additionally been incorporated in "Guideline for operation of seat belt sign".

(4) Practical points of confirmation in case of encountering shaking have been added in the regular safety education for cabin attendants.