AA2015-5

AIRCRAFT ACCIDENT
INVESTIGATION REPORT

J-AIR CO., LTD.
J A 2 1 1 J

May 28, 2015

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.

Norihiro Goto
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 THE SHAKING OF THE AIRCRAFT
J-AIR CO., LTD.
EMBRAER ERJ170-100STD, JA211J
AT AN ALTITUDE OF APPROX. 10,600 FT
OVER ISHIOKA CITY, IBARAKI PREFECTURE, JAPAN
AT AROUND 09:45 JST, APRIL 29, 2014

May 8, 2015

Adopted by the Japan Transport Safety Board

Chairman	Norihiro Goto
Member	Shinsuke Endoh
Member	Toshiyuki Ishikawa
Member	Sadao Tamura
Member	Yuki Shuto
Member	Keiji Tanaka

SYNOPSIS

<Summary of the Accident>

On Tuesday, April 29, 2014, at 09:16 Japan Standard Time (JST, UTC+9h), an Embraer ERJ170-100STD, registered JA211J, operated by J-AIR Co., LTD. took off from Yamagata Airport as the scheduled flight 1252 of codesharing with Japan Airlines Co., Ltd.. At around 09:45 JST when the aircraft was descending for Tokyo International Airport, it was shaken at an altitude of approximately 10,600 ft over Ishioka City, Ibaraki Prefecture. One cabin attendant was seriously injured and one other cabin attendant was slightly injured who were in the aft galley.

There were 39 people on board, consisting of the pilot in command (PIC), three other crew members and 35 passengers.

The aircraft was not damaged.

<Probable Causes>

It is probable that this accident occurred by the shaking of the Aircraft which encountered the strong wake turbulence from the Preceding Aircraft while the Aircraft was descending; accordingly, two cabin attendants in the aft galley fell down and one of them was seriously injured.

It is probable that the strong wake turbulence that the Aircraft encountered persisted longer than usual because of the stable weather condition with calm wind.

Abbreviations used in this report are as follows:

AD: Aerodrome
A/P: Auto Pilot
DVDR: Digital Voice and Data Recorder
FL: Flight Level
PF: Pilot Flying
PIREP: Pilot Report
PM: Pilot Monitoring
RNAV: Area Navigation

Unit Conversion Table

1 ft: 0.3048 m
1 G: 9.807 m/s^2
1 kt: 1.852 km/h (0.5144 m/s)
1 lb: 0.4536 kg
1 nm: 1.852 km

1. PROCESS AND PROGRESS OF THE AIRCRAFT ACCIDENT INVESTIGATION

1.1 Summary of the Accident

On Tuesday, April 29, 2014, at 09:16 Japan Standard Time (JST: unless otherwise stated all times are indicated in JST, UTC+9h), an Embraer ERJ170-100STD, registered JA211J, operated by J-AIR CO., LTD. took off from Yamagata Airport as the scheduled flight 1252 of codesharing with Japan Airlines Co., Ltd.. At around 09:45 when the aircraft was descending for Tokyo International Airport, it was shaken at an altitude of approximately 10,600 ft over Ishioka City, Ibaraki Prefecture. One cabin attendant was seriously injured and one other cabin attendant was slightly injured who were in the aft galley.

There were 39 people on board, consisting of the pilot in command (PIC), three crew members and 35 passengers.

The aircraft was not damaged.

1.2 Outline of the Accident Investigation

1.2.1 Investigation Organization

On April 30, 2014, the Japan Transport Safety Board designated an investigator-in-charge and two other investigators to investigate this accident.

1.2.2 Representatives from the Relevant States

Although this accident was notified to the Federative Republic of Brazil, as the State of Design and Manufacture of the aircraft involved in this accident, the State did not designate its accredited representative.

1.2.3 Implementation of the Investigation

April 30, 2014: Aircraft examination

May 1, 2014: Interviews

1.2.4 Comments from the Parties Relevant to the Cause of the Accident

Comments were invited from parties relevant to the cause of the accident.

1.2.5 Comments from the Relevant States

Comments were invited from the relevant State.

2. FACTUAL INFORMATION

2.1 History of the Flight

On Tuesday, April 29, 2014, at 09:16, an Embraer ERJ170-100STD, registered JA211J (hereinafter referred to as "the Aircraft"), operated by J-AIR CO., LTD. (hereinafter referred to as "the Company") took off from Yamagata Airport as a scheduled flight 1252 of codesharing with Japan Airlines Co., Ltd., and after climbing up to FL*1220 which was the cruising altitude, it was descending in stages for Tokyo International Airport.

The outline of the flight plan for the Aircraft was as follows:

Flight rules: Instrument flight rules

Departure aerodrome: Yamagata Airport

Estimated off-block time: 08:55

Cruising speed: 412kt

Cruising altitude: FL220

Route: (omitted) ~ Y10 (RNAV route) ~ STONE (waypoint)

Destination aerodrome: Tokyo International Airport

Total estimated elapsed time: 0 hours 41 minutes

Fuel load expressed in endurance: 2 hours 34 minutes

Alternate aerodrome: Narita International Airport

There were 39 people on board consisting of a PIC, three crew members and 35 passengers.

At the time when this accident occurred, in the cockpit of the Aircraft, the PIC sat in the left seat as a PM (pilot mainly in charge of duties other than flying) and the First Officer (FO) sat in the right seat as the PF (pilot mainly in charge of flying).

The history of the flight up to the time of the accident is summarized below, based on the records of the flight recorder, the Air Traffic Control (ATC) communications records, as well as the statements of the crew members.

2.1.1 History of the Flight based on the records of the flight recorder and the ATC communications records.

The Aircraft was flying at an altitude of 11,000 ft from STONE (waypoint) to DREAD (waypoint), following the standard terminal arrival route of Tokyo International Airport by autopilot (hereinafter referred to as "A/P").

09:44:23 Tokyo radar approach control facility instructed the Aircraft to

*1 "FL" stands for flight level. It is a pressure altitude expressed in hundreds of feet. This altitude is calculated from the international standard pressure datum of 1013.2 hPa (29.92 inHg), the average sea-level pressure. This expression applies to the altitudes higher than 14,000 ft in Japan.

descend to an altitude of 8,000 ft and to reduce the speed to 230 kt.

09:44:32 The vertical mode of the A/P of the Aircraft changed to the descent mode.

09:44:37 The Aircraft began to descend from the altitude of 11,000 ft.

09:44:47 The vertical acceleration of the Aircraft started to fluctuate little by little at an altitude of approximately 10,800 ft.

09:44:57 The Aircraft started to roll and veer to the left, and a large fluctuation of vertical acceleration and lateral acceleration began at an altitude of approximately 10,600 ft. The vertical acceleration fluctuated between 0.61 G and 1.64 G for 10 seconds until 09:45:07.

09:44:59 Lateral acceleration to the left of the Aircraft became approximately 0.32G (the maximum value during this flight).

09:45:03 The A/P of the Aircraft was disengaged manually.
Autothrottle*2 remained engaging.

09:45:04~05 The left bank angle of the Aircraft became approximately 58° (the maximum value during this flight).

09:45:04~10 The control column of the Aircraft was pulled a little, and the control lever of the Aircraft was operated to the right intermittently.

09:45:05 The bank angle of the Aircraft began to return to wing level.

09:45:07 The heading of the Aircraft which was veering to approximately 25° to the left began to return at an altitude of approximately 10,400 ft.

09:45:13 The A/P of the Aircraft was engaged.

09:45:15 Fluctuation of vertical acceleration of the Aircraft converged.

In addition, there were records of the flight recorder of the Aircraft which showed a temporary changes in the wind direction and wind speed for approximately 15 seconds around 09:45, but there was no record of a large change in the temperature.

2.1.2 Statements of Crew Members

(1) PIC

At the time of the pre-flight weather briefing, the PIC confirmed that there was an echo of the front in western Japan, but there was no forecast of bad weather for the flight from Yamagata Airport to Tokyo International Airport.

The PIC turned off the seat belt sign at about five minutes after taking off from Yamagata Airport.

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*2 "Autothrottle" is a function that automatically controls the engine thrust.

PIREPs*3 of other aircraft which flew the northern area of Tokyo International Airport were received as below during flight from the Company's operation officer.

- Clouds observed between the altitudes of 6,000 ft and 4,000 ft, with light turbulence, reported at 08:49.
- Clouds observed between the altitudes of 8,000 ft and 4,000 ft, with light turbulence, reported at 08:57.

The Aircraft was instructed on the heading change and the speed reducing to keep the separation with a preceding aircraft before STONE which is the initial point for standard terminal arrival route, and passed STONE at a speed of 250 kt and an altitude of 11,000 ft as instructed. After that, the Aircraft began to descend at about 10 nm before DREAD upon receiving an instruction to descend to an altitude of 8,000 ft.

At the timing of cabin safety checks by the cabin attendants, the PIC confirmed with the FO that there are no clouds and the wind is calm, and informed the cabin attendants that he will shortly turn on the seat belt sign at an altitude of 10,000 ft, and that the cabin attendants can carry out cabin safety checks.

Just about when the PIC finished giving information, the Aircraft was shaken and started to bank considerably to the left; accordingly, the PIC turned on the seat belt sign as it was banking to the left faster than the normal circling. The roll of the Aircraft was an unintended movement, and it was banking fast although it was not drastically.

The A/P was disengaged at that time, and when the PIC monitored the operation of the FO, the Aircraft's attitude started to recover; therefore, the PIC judged that the FO could control the Aircraft, and then let the FO keep PF. When it became stable, there was an instruction from the FO to set the A/P, and the PIC engaged A/P by the consent. The PIC did not remember clearly how the Aircraft was shaken when it banked, but remembered that it was not in the clouds.

Even though there was enough separation with preceding aircraft, the PIC thought that this shaking was caused by the wake turbulence because he could not think of any cause other than a wake turbulence and judging from his experience with encountering wake turbulences before. Thus, in order to reassure the passengers, he made a public address announcement to them indicating that there will be no further

*3 "PIREP" denotes a report from a pilot to the ATC organization in case of an encounter of adverse weather conditions which affect the aircraft operations. In this report, PIREP includes C-PIREP (common PIREP) which contains weak turbulence information, which is shared among air carriers.

shaking. In addition, he confirmed with the cabin attendants about the situation in the cabin, and then there were no problems reported; accordingly, he instructed the cabin attendants once again to carry out cabin safety checks.

The Aircraft landed on runway 23 of Tokyo International Airport without further event.

(2) FO

The FO thought that although there was a nimbus from the low atmospheric pressure above the southern coast of Shikoku to Kii Peninsula on that day, there will be no effect on the flight from Yamagata Airport to Tokyo International Airport yet. In addition, as for the approach to Tokyo International Airport, by the PIREPs from other aircraft, he thought that the condition of airstream was good up to an altitude of 8,000 ft which was considered to be where the Aircraft was going into the clouds.

After the Aircraft passed through STONE at the designated speed of 250 kt, the FO thought that there was no preceding aircraft, since the aircraft which was thought to be preceding approximately 10 nm had deviated from the standard terminal arrival route and gone to other waypoint directly. As he did not recognize that the Aircraft was near the preceding aircraft, he did not expect any wake turbulence. In addition, there was no indication in the weather radar. Thereafter, he was instructed to descend to an altitude of 8,000 ft.

The FO judged that there was enough time for the cabin attendants to carry out cabin safety checks before reaching the cloud top height of 8,000 ft, and then requested the PIC to give an instruction to carry out cabin safety checks earlier and used the designate rate-of-descend mode of the A/P for descent. In order to keep the time to go into the clouds longer, the FO started to descend in a low rate-of-descend.

Just after the PIC conveyed on the instruction to the cabin attendants to carry out cabin safety checks, the Aircraft got into a large bank toward the left and the bank angle tended to get even deeper. The PIC turned on the seat belt sign while the Aircraft was rolling to the left. When the Aircraft rolled to the left, the FO monitored the bank angle to around 30° without feeling G force so much. As there was no sign that the A/P will recover the roll, he felt the danger; therefore, he disengaged the A/P, and recovered the bank angle slowly to wing level by carefully operating the ailerons. Although he did not remember the changing of altitude or speed, he operated as carefully as he can.

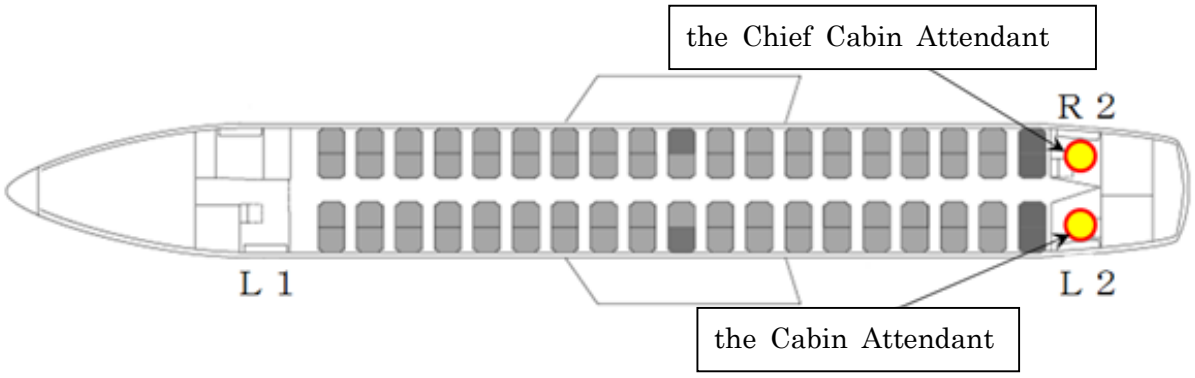
As the FO had an experience of encountering a short-time shaking of one to two seconds by wake turbulence before, up to the bank angle around 20° after the roll

started, he thought that the Aircraft might enter the wake turbulence from the preceding aircraft because it was similar to the past shaking, but it was his first experience of rolling to one side considerably more than that by wake turbulence.

When the Aircraft recovered to wing level, the FO instructed the PIC to engage the A/P, as the condition of airstream was mostly good even though there might be a rattling shake. In addition, the FO continued PF until landing with the notification from the PIC that no trouble was found in the cabin.

(3) Chief Cabin Attendant (L1*4)

When the Chief Cabin Attendant entered the aft galley from the front side after cabin safety check, the Cabin Attendant (L2) was responding the intercommunication call from the cockpit with the L2 handset; accordingly, she took the R2 handset and monitored the call. After receiving the information on the estimate time of passing an altitude of 10,000 ft and instruction to carry out cabin safety checks the cockpit, and when she tried to place back the handset, the Aircraft was strongly shaken and she collided with the R2 door; subsequently, collided with the Cabin Attendant (L2) who was strongly flung from the L2 side, and fell down.



Locations of the Injured when the Accident Occurred.

The Chief Cabin Attendant fell down with her head toward the L2 side on the aft galley floor with the Cabin Attendant (L2), laying on top of each other, and confirmed that the passengers were sitting from there. As the up and down shaking continued for about 10 seconds after falling down, she thought that she might hold down the Cabin Attendant (L2) with her arm.

Afterwards, as she crawled to the R2 cabin attendant's seat and sat down, there

*4 "L1", "L2" and "R2" represent the assigned locations of cabin attendants, and represent the positions of "front left", "rear left" and "rear right" respectively. Two cabin attendants were on board on this aircraft, and the Chief Cabin Attendant was assigned to L1 and the Cabin Attendant was assigned to L2.

was an announcement from the PIC that the Aircraft encountered the wake turbulence from the preceding aircraft, but there would be no problem in flight. In addition, as she was asked about the situation by the cockpit, she reported that there was no trouble, and then she returned to L1 while carrying out cabin safety check.

(4) Cabin Attendant (L2)

Immediately after the Cabin Attendant (L2) received the notification from the cockpit with the L2 handset about the estimate time of passing an altitude of 10,000 ft, and when she was about to make an announcement to the passengers, the Aircraft was strongly shaken and her body was strongly flung to the R2 side, and then collided with the Chief Cabin Attendant who was at R2.

The Cabin Attendant (L2) fell down on the aft galley floor, with her head in the L2 direction. Even after she fell down, the shaking continued and she felt like her body was floating. After the big shake, she crawled to the L2 cabin attendant's seat and sat down. When she tried to make an announcement to the cabin and picked up the handset, pain all over the body. Afterwards, as the PIC and the Chief Cabin Attendant were confirming the cabin situation, she informed them that she was all right and carried out cabin safety check. There was no big shake during the flight afterwards.

This accident occurred at an altitude of approximately 10,600 ft over Ishioka City, Ibaraki Prefecture (36°12' N, 140°09' E) at around 09:45 on April 29, 2014.
(See Figure 1: Records of the Flight Recorder)

2.2 Injuries to Persons

One cabin attendant was seriously injured and one other cabin attendant was slightly injured.

2.3 Damage to the Aircraft

After the day's flight, the Aircraft underwent a special inspection which is required after encountering severe turbulence, the auto flight operational test and the flight control system test; however, no damage or anomalies were found.

2.4 Personnel Information

(1) PIC Male, Age 48

Airline Transport Pilot Certificate (Airplane)	September 24, 1998
Type rating for Embraer ERJ170	August 20, 2012

Class 1 Aviation Medical Certificate	
Validity	May 6, 2015
Total flight time	13,067 hr 12 min
Flight time in the last 30 days	51 hr 25 min
Total flight time on the type of aircraft	1,195 hr 37 min
Flight time in the last 30 days	51 hr 25 min

(2) FO Male, Age 37

Commercial Pilot Certificate (Airplane)	March 30, 2007
Type rating for Embraer ERJ170	September 13, 2010
Instrument Flight Certificate	August 6, 2007
Class 1 Aviation Medical Certificate	
Validity	April 22, 2015
Total flight time	4,480 hr 54 min
Flight time in the last 30 days	55 hr 50 min
Total flight time on the type of aircraft	2,006 hr 22 min
Flight time in the last 30 days	55 hr 50 min

2.5 Aircraft Information

2.5.1 Aircraft

Type	Embraer ERJ170-100STD
Serial Number	17000251
Date of manufacture	October 13, 2008
Certificate of airworthiness	No. Dai-2013-124
Validity	June 16, 2014
Category of airworthiness	Airplane, Transport T
Total flight time	12,863 hr 55 min
Time in service since the last regular inspection (inspection A on April 24, 2014)	32 hr 13 min

(See Figure 2: Three Angle View of Embraer ERJ170-100STD)

2.5.2 Weight and Balance

When the accident occurred, the Aircraft's weight is estimated to have been 59,400 lb and the position of the center of gravity is estimated to have been 18.5% MAC[*5], both of which are estimated to have been within the allowable range (maximum takeoff weight of 76,000 lb, and 7.8 to 23.5% MAC corresponding to the weight at the time of the accident).

2.6 Flight Recorder Information

The Aircraft was equipped with two combination recorders that have the functions of a digital flight data recorder, a cockpit voice recorder and a data link recorder (DVDR made by Honeywell of the United States of America). These flight recorders are capable of recording for a duration of about two hours of cockpit voice and above 25 hours of flight data. Although the data of the cockpit voice was already overwritten as the Aircraft continued to be operated after the accident without unloading the flight recorders, the record of the flight data at the time of the accident had been retained.

The time correction of the flight recorder was executed by correlating the VHF radio transmitting keys and the ATC communications with the time signal recorded on the ATC communications records.

2.7 Meteorological Information

According to the Asia Surface Synoptic Chart at 09:00 and the Regional Significant Weather Prognostic Chart (Kanto) at 10:00 on the day of the accident, the airspace where the accident occurred was at the edge of a high atmospheric pressure area moving eastword at 20 kt, with no effects of a low atmospheric pressure approaching from the south coast of Shikoku island, and no bad weather was observed.

In addition, according to the Hourly Atmospheric Analysis Charts at 09:00 and 10:00, the wind was blowing at a low speed about 5 kt in the airspace where the accident occurred, and no vertical wind shear was observed. The temperature was stable at approximately minus two degrees.

(See Figure 3: Asia Surface Synoptic Chart, Figure 4: Regional Significant Weather Prognostic Chart (Kanto), Figure 5: Hourly Atmospheric Analysis Chart (09:00), Figure 6: Hourly Atmospheric Analysis Chart (10:00))

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*5 "MAC" stands for Mean Aerodynamic Chord, which denotes a wing chord that represents aerodynamic properties of the wing. In cases where wing chords are not constant, as exemplified by a swept-back wing, MAC represents the average value. For example, 23.1% MAC denotes the position 23.1% away from the leading edge of this average aerodynamic chord.

2.8 Information on the Preceding Aircraft

According to the radar track records of Tokyo radar approach control facility, an Airbus A340-600 (hereinafter referred to as "the Preceding Aircraft") was flying approximately 10 nm in front of the Aircraft (approximately two minutes ahead) for Tokyo International Airport at the time when this accident occurred. The Preceding Aircraft turned to left heading 190° to the route for the final approach course to runway 22 of Tokyo International Airport, following the radar vector by Tokyo radar approach control facility, at about 12 nm before DREAD on its way from STONE to DREAD. The altitude had been maintained at 11,000 ft since before it passed STONE.

(See Figure 7: Estimated Flight Route)

2.9 Change Time of Vertical Acceleration of the Aircraft

According to the records of the flight recorder and the radar track records of Tokyo radar approach control facility, the vertical acceleration of the Aircraft started to fluctuate little by little at around 09:44:47 when it began to fly approximately 200 ft below the Preceding Aircraft on the same flight route as the Preceding Aircraft, and after the large fluctuation began at around 09:44:57, when it was flying approximately 600 ft below the Preceding Aircraft. After that the fluctuation converged at around 09:45:15 when the Aircraft began to fly on a different route from the Preceding Aircraft due to its left turn.

(See Figure 8: Estimated Flight Altitude)

2.10 Wake Turbulence Control Procedure

According to the Air Traffic Control Regulations published by Civil Aviation Bureau of Ministry of Land, Infrastructure, Transport and Tourism, the wake turbulence control procedure is as follows.

(1) Categories of wake turbulence of aircraft

- *Heavy aircraft* — *Aircraft whose maximum takeoff weight is 300,000 pounds (136 tons) or above*
- *Medium aircraft* — *Aircraft whose maximum takeoff weight is 15,500 pounds (7 tons) to 300,000 pounds*
- *Light aircraft* — *Aircraft whose maximum takeoff weight is less than 15,500 pounds*

(2) Radar Separations (Underlines in the table are added.)

In the case that the following aircraft flies at the same altitude or under 1,000 ft below the preceding aircraft and is situated in the same track as the preceding aircraft

or passes in the 6 o'clock position of the preceding aircraft, the separations of more than the following figures should be set between the two aircraft.

Preceding aircraft	*Following aircraft*	*Minimum separation*
A380	*Heavy aircraft (Excluding A380)*	*6 nm*
	Medium aircraft	*7 nm*
	Light aircraft	*8 nm*
Heavy aircraft (Excluding A380)	*Heavy aircraft (Excluding A380)*	*4 nm*
	Medium aircraft	*5 nm*
	Light aircraft	*6 nm*
Medium aircraft	*Light aircraft*	*5 nm*

The maximum takeoff weight of the Aircraft is approximately 35 tons, and the maximum takeoff weight of the Preceding Aircraft is approximately 368 tons. Therefore, according to the categories of wake turbulence of aircraft, the Aircraft would be categorized as a medium aircraft and the Preceding Aircraft as a heavy aircraft. In the case that the air traffic controller is using radar, the minimum separation when a medium aircraft follows a preceding heavy aircraft is 5 nm as underlined in the table.
(See Figure 9: The Size Comparison of the Preceding Aircraft and the Aircraft)

2.11 Information on Wake Turbulence

2.11.1 Nature of Wake Turbulence

Advisory Circular No.90-23G "Aircraft Wake Turbulence" published by the Federal Aviation Administration, U.S. Department of Transportation contains the following description regarding the nature of wake turbulence.

(Excerpt)

4. VORTEX GENERATION

Lift is generated by the creation of a pressure differential over the wing surfaces. The lowest pressure occurs over the upper wing surface and the highest pressure under the wing. This pressure differential triggers the rollup of the airflow aft of the wing resulting in swirling air masses trailing downstream of the wing. After the rollup is complete, the wake consists of two counter-rotating cylindrical vortices
(See FIGURE 1. THE ROLLUP PROCESS).

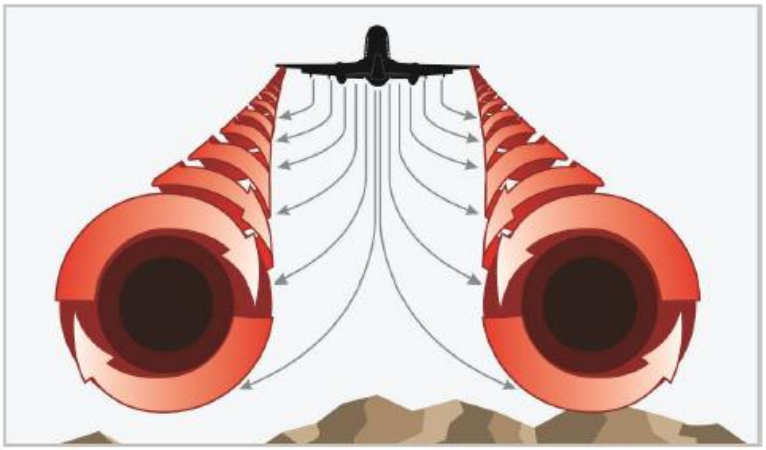


FIGURE 1. THE ROLLUP PROCESS

(Omitted)

7. VORTEX BEHAVIOR

Trailing vortices have certain behavioral characteristics which can help pilots visualize the wake location and movement and take appropriate avoidance actions.

(Omitted)

c. Vertical Movement

Flight tests have shown that at higher altitude the vortices from large aircraft sink at a rate of several hundred feet per minute (fpm), slowing their descent and diminishing in strength with time and distance behind the wake-generating aircraft (see FIGURE 5. DESCENT OF VORTICES FROM LARGE AIRCRAFT). Atmospheric turbulence hastens decay. Pilots should fly at or above the preceding aircraft's flightpath, altering course as necessary, to avoid the area behind and below the generating aircraft.

(Omitted)

The worst case atmospheric conditions are light winds, low atmospheric turbulence, and low stratification (stable atmosphere). In these atmospheric conditions, primarily in en route operations, vortices from Heavy and especially Super aircraft can descend more than 1,000 feet. In rare cases, wake turbulence can rise in an updraft or when it bounces off of a strong inversion layer where the strong inversion layer acts like the ground.

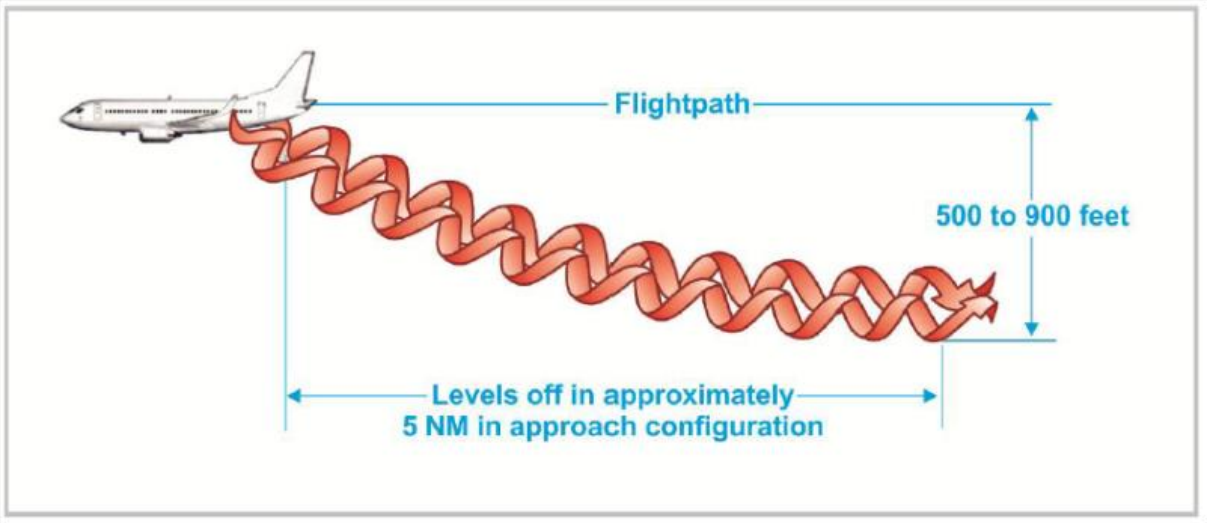


FIGURE 5. DESCENT OF VORTICES FROM LARGE AIRCRAFT

(Omitted.)

2.11.2 Wake Turbulence Encounter Guidance

Advisory Circular No.90-23G "Aircraft Wake Turbulence" published by the Federal Aviation Administration, U.S. Department of Transportation, which is described in 2.11.1, was revised on February 10, 2014 and the following content regarding the vortex encounter guidance has been added.

(Excerpt)

9. VORTEX ENCOUNTER GUIDANCE

(Omitted)

c. Control Inputs

There is a history of wake vortex encounter incidents in which pilot inputs exacerbated the unusual attitude situation caused by the wake vortex encounter. Upsets caused by wake vortex encounters may involve rapid roll reversals as the aircraft transitions across the wake. Pilots should exercise caution with pilot control inputs, especially avoiding abrupt reversal of aileron and rudder control inputs. If altitude and conditions permit, it may be better to allow the aircraft to transition through the wake and then recover from any resultant unusual attitude, rather than aggressively trying to control the aircraft during the wake encounter. If the autopilot is engaged and remains engaged, it may be better to allow the autopilot to recover from the wake vortex encounter rather than disconnecting the autopilot and using manual control inputs. However, be prepared to assume manual control of the aircraft if the autopilot disengages.

d. Rudder Inputs

Prior experience or training that emphasizes use of rudder input as a means to maneuver in roll may not apply to all aircraft operations. Using the rudder to counter roll rate during a roll upset may lead to an undesirable aircraft response. Large, aggressive control reversals can lead to loads that can exceed the structural design limits. Refer to your specific Aircraft Flight Manual (AFM) guidance.

(The rest is omitted.)

2.11.3 Measures Examples to Avoid Wake Turbulence

In AD 1.1.6.3.4 of Aeronautical Information Publications (AIP), examples how to avoid wake turbulence are described, such as to fly over flight path of preceding aircraft or at least 1,000 ft under, to stay to windward of preceding aircraft flight paths, and to keep alert specially on calm days when vortices persist longer.

3. Analysis

3.1 Qualifications of Personnel

Both The PIC and the FO held valid airman competence certificates and valid aviation medical certificates.

3.2 Aircraft Airworthiness Certificate

The Aircraft had a valid airworthiness certificate, and had been maintained and inspected as prescribed.

3.3 Relation to Meteorological Conditions

As described in 2.7, it is highly probable that the meteorological conditions around the accident airspace were that there was no cloud associated with bad weather, calm winds and no atmospheric turbulence.

Under these conditions, the possibility of occurrence of a clear-air turbulence that could affect the operation of the Aircraft was low; thus it is probable that not shaking of the Aircraft by clear-air turbulence.

3.4 Relation to Wake Turbulence

According to the statements of the flight crew members and the records of the flight

recorder, it is highly probable that the Aircraft suddenly rolled to the left with a large abrupt shaking for approximately ten seconds from around 09:44:57.

Based on the Change Time of Vertical Acceleration of the Aircraft described in 2.9, the Nature of Wake Turbulence described in 2.11.1, and the Relation to Meteorological Conditions described in 3.3, it is probable that the shaking of the Aircraft was caused by the strong wake turbulence encounter of the Preceding Aircraft.

As described in 2.11.1, wake turbulence is believed to decay earlier if there is an atmospheric turbulence; however, it is probable that the strong wake turbulence that the Aircraft encountered persisted longer than usual, because of the stable meteorological condition with calm winds in the airspace.

3.5 History of the Shaking of the Aircraft

As described in 2.1.1, the Aircraft started to descend upon receiving an instruction from the Tokyo radar approach control facility, and as the vertical acceleration of the Aircraft started to fluctuate little by little at an altitude of approximately 10,800 ft around 09:44:47, it is probable that the Aircraft started to be affected by the wake turbulence from the Preceding Aircraft around that time.

After that, the Aircraft began to roll and veer to the left at an altitude of approximately 10,600 ft around 09:44:57, and with the vertical acceleration fluctuating between approximately 0.9 G and 1.5 G until 09:44:59, the lateral acceleration to the left changed to approximately 0.32 G. According to the statements in 2.1.2 (3) and 2.1.2 (4), it is probable that the Chief Cabin Attendant collided with the R2 door, the Cabin Attendant (L2) was strongly flung to the R2 side at this time, and then both collided with each other, fell down on the aft galley floor and got injured.

This big shake continued until it recorded the vertical acceleration of approximately 1.64 G at 09:45:07, and then turned toward convergence. Therefore it is probable that the Aircraft encountered the strong wake turbulence from around 09:44:57 until around 09:45:07 while it was descending from an altitude of approximately 10,600 ft to approximately 10,400 ft.

After the Aircraft started to roll and veer to the left at around 09:44:57, the bank of the Aircraft changed toward recovering to wing level once as a result of the A/P trying to bring it back to the original attitude with the ailerons; however, it is probable that the Aircraft soon rolled further to the left again due to the strong wake turbulence. Although it was at around 09:45:15 that the Aircraft recovered to wing level, it is probable that the Aircraft began to recover to wing level after the FO disengaged the A/P at 09:45:03 and significantly operated the ailerons.

It is probable that the Aircraft was no longer effected by the wake turbulence at around 09:45:15 at an altitude of approximately 10,400 ft when it began to fly on a different route from the Preceding Aircraft due to its left turn.

3.6 Separation behind the Preceding Aircraft

As described in 2.1.1 and 2.8, while Tokyo radar approach control facility instructed the Aircraft, which was flying behind an aircraft, to descend earlier than the Preceding Aircraft, the separation between both aircraft was approximately 10 nm according to the radar track records. Therefore certain that there was enough separation exceeding 5 nm, which is the Minimum Separation by the wake turbulence control procedure described in 2.10.

3.7 Involvement of the Flight Crew Members

According to the statements of the flight crew members and the records of the flight recorder, it is highly probable that the FO disengaged the A/P manually around the time when the left bank angle of the Aircraft exceeded 30°, and stabilized the Aircraft by operating the ailerons carefully.

As described in 2.11.3, even though the flight crew members needed to be careful of the calm wind condition where the wake turbulence persists longer than usual, it is probable that it was difficult to predict such shaking of the Aircraft that would cause passengers or cabin attendants to fall, as there had been very few examples of report of encounter with a strong wake turbulence from an aircraft flying approximately 10 nm ahead, and it is probable that it was not a situation where they were required to change the flight route or altitude to avoid it, nor instruct the passengers and cabin attendants to fasten their seatbelts in preparation for the shaking of the Aircraft.

As described in 3.5, while it is probable that a big shake of the Aircraft caused the injuries of the cabin attendants, it is probable that the flight crew members conducted the recovery operation of the unexpected unusual attitude of the Aircraft properly.

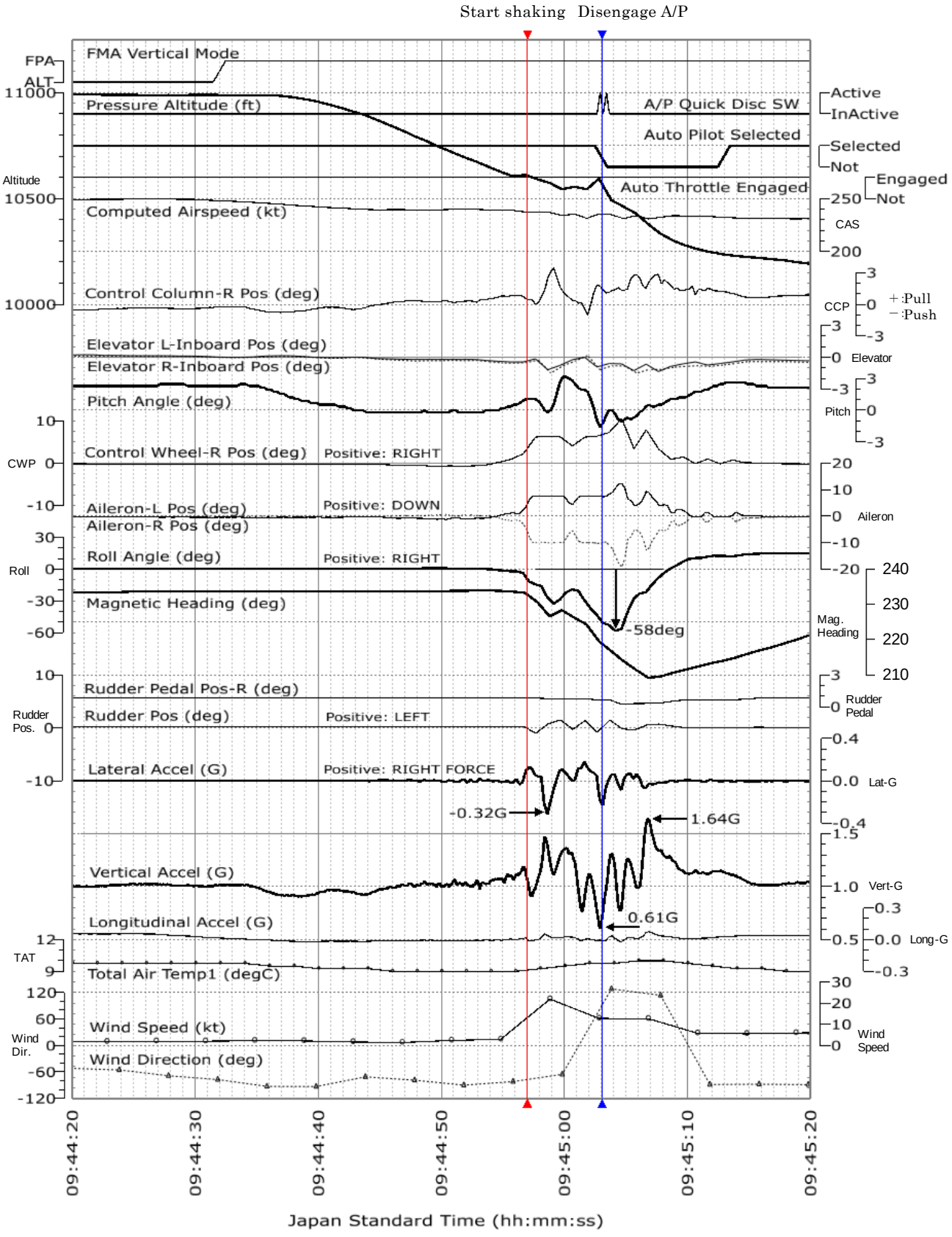
It is probable that it would be beneficial for pilots to keep in mind the content described in 2.11.2, and review the operation continuously to appropriately recover the fuselage attitude in case of unexpected encountering with a wake turbulence.

4. Probable Causes

It is probable that this accident was caused by the shaking of the Aircraft which encountered the strong wake turbulence from the Preceding Aircraft while the Aircraft was descending; accordingly, two cabin attendants in the aft galley fell down and one of them was seriously injured.

It is probable that the strong wake turbulence that the Aircraft encountered persisted longer than usual because of the stable weather condition with calm wind.

Figure 1: Records of the Flight Recorder



Pressure altitude is the value after correction

Figure 2: Three Angle View of Embraer ERJ170-100STD

Unit: m

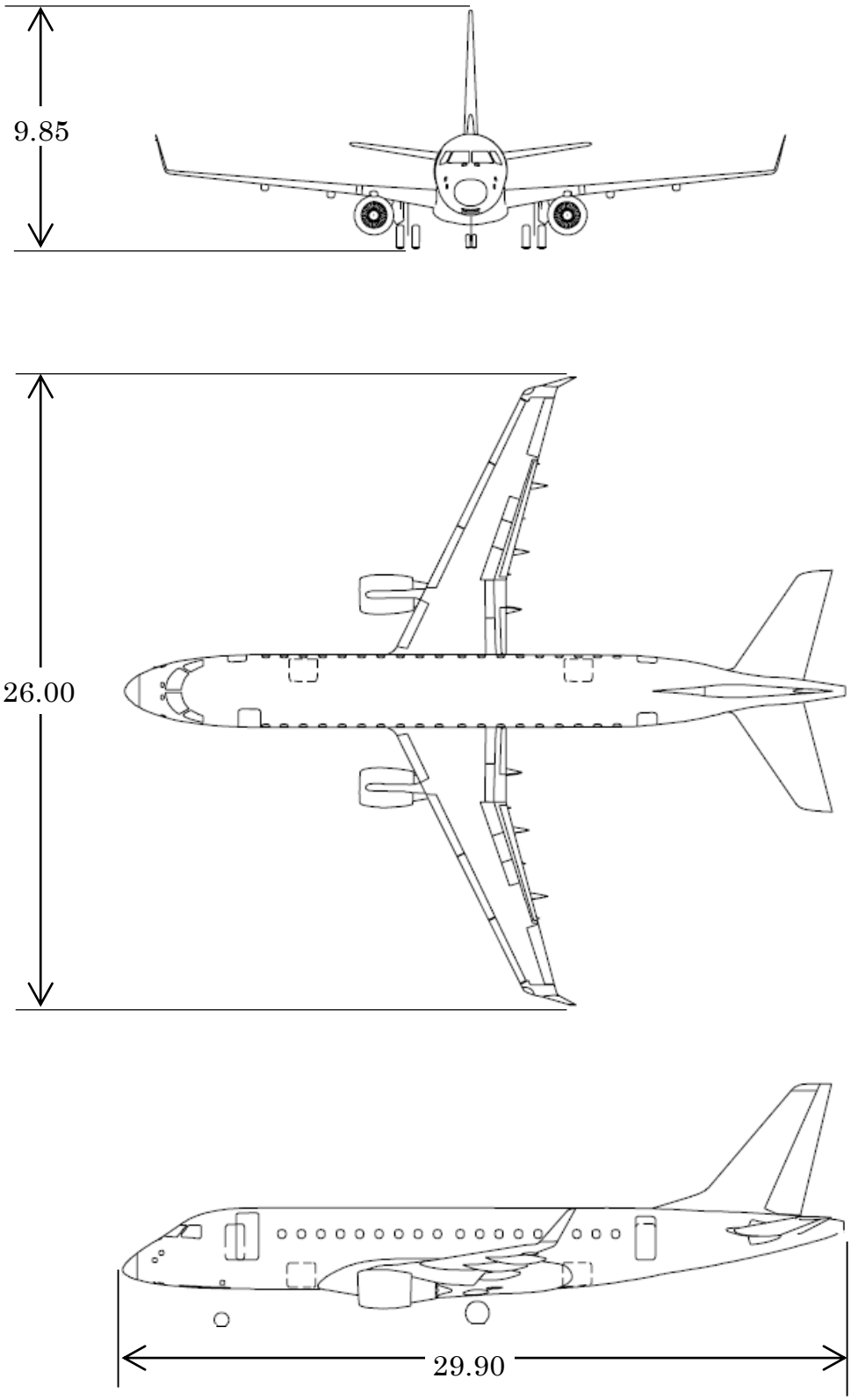


Figure 3: Asia Surface Synoptic Chart (09:00 on April 29)

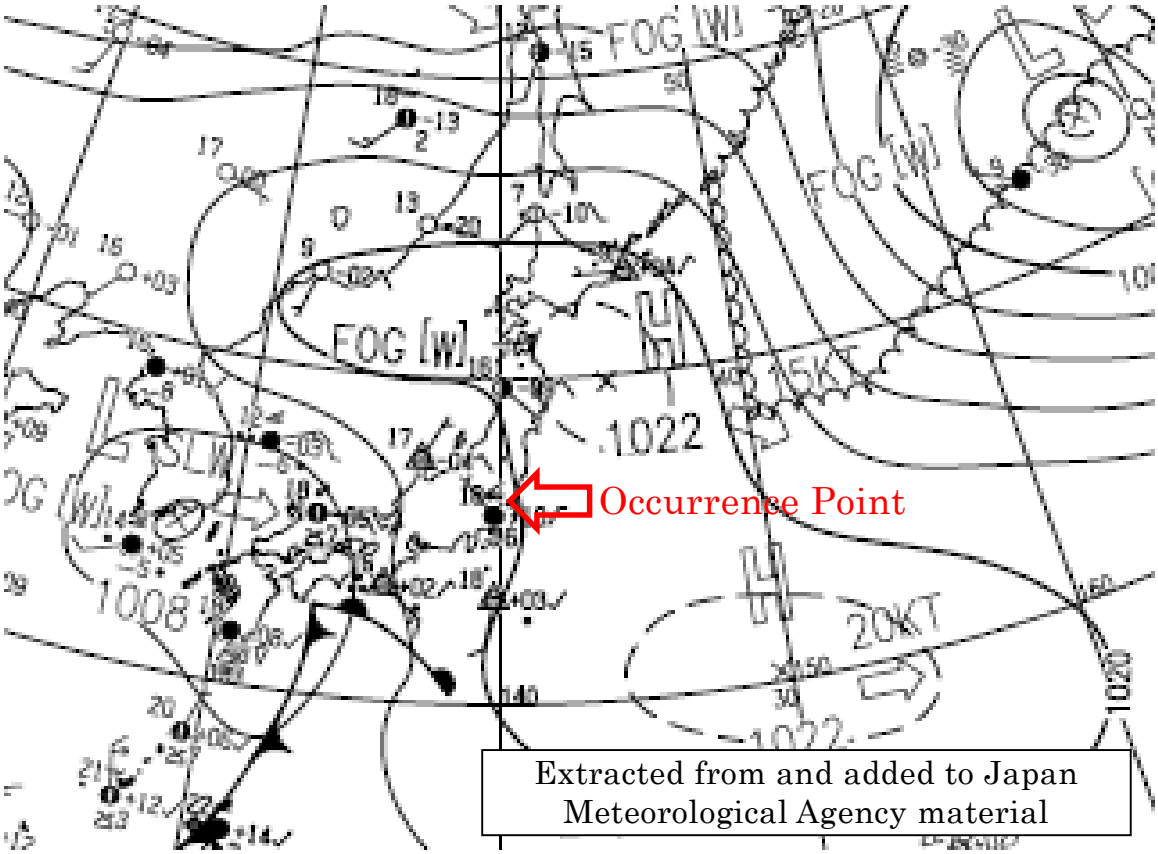


Figure 4: Regional Significant Weather Prognostic Chart (Kanto) (10:00 on April 29)

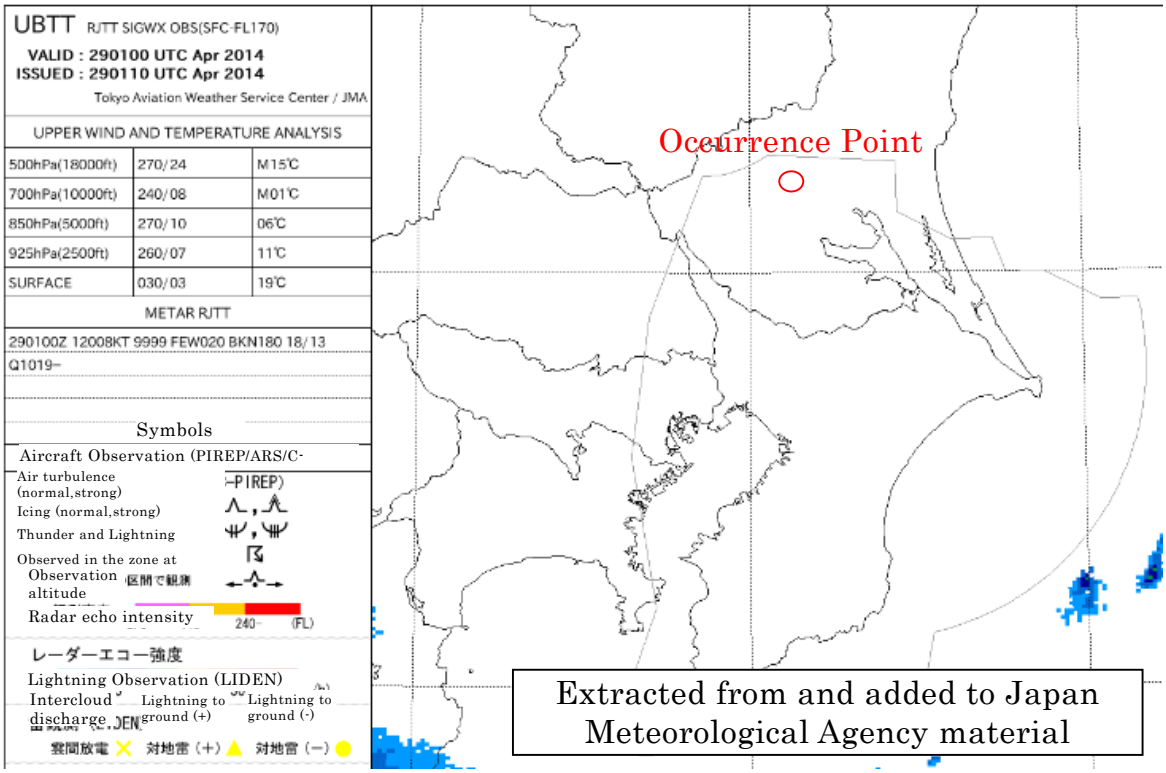


Figure 5: Hourly Atmospheric Analysis Chart
(09:00 on April 29)

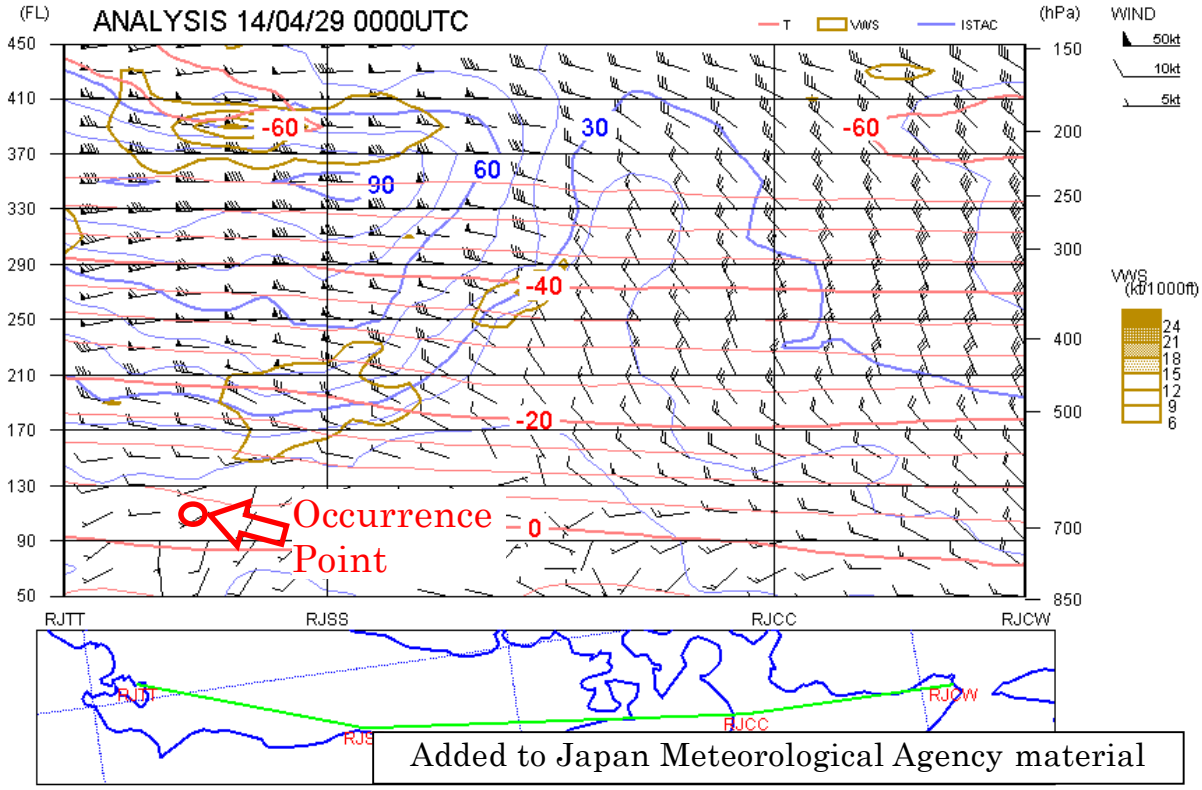


Figure 6: Hourly Atmospheric Analysis Chart
(10:00 on April 29)

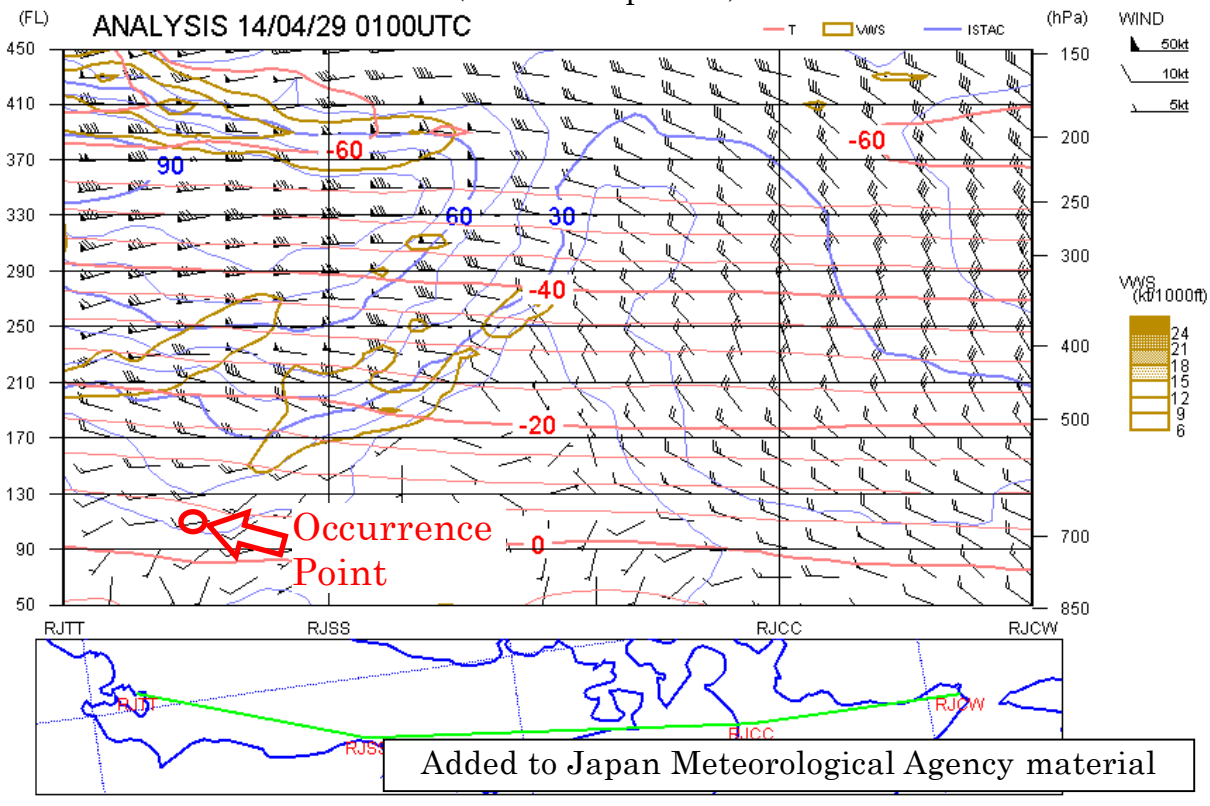


Figure 7: Estimated Flight Route

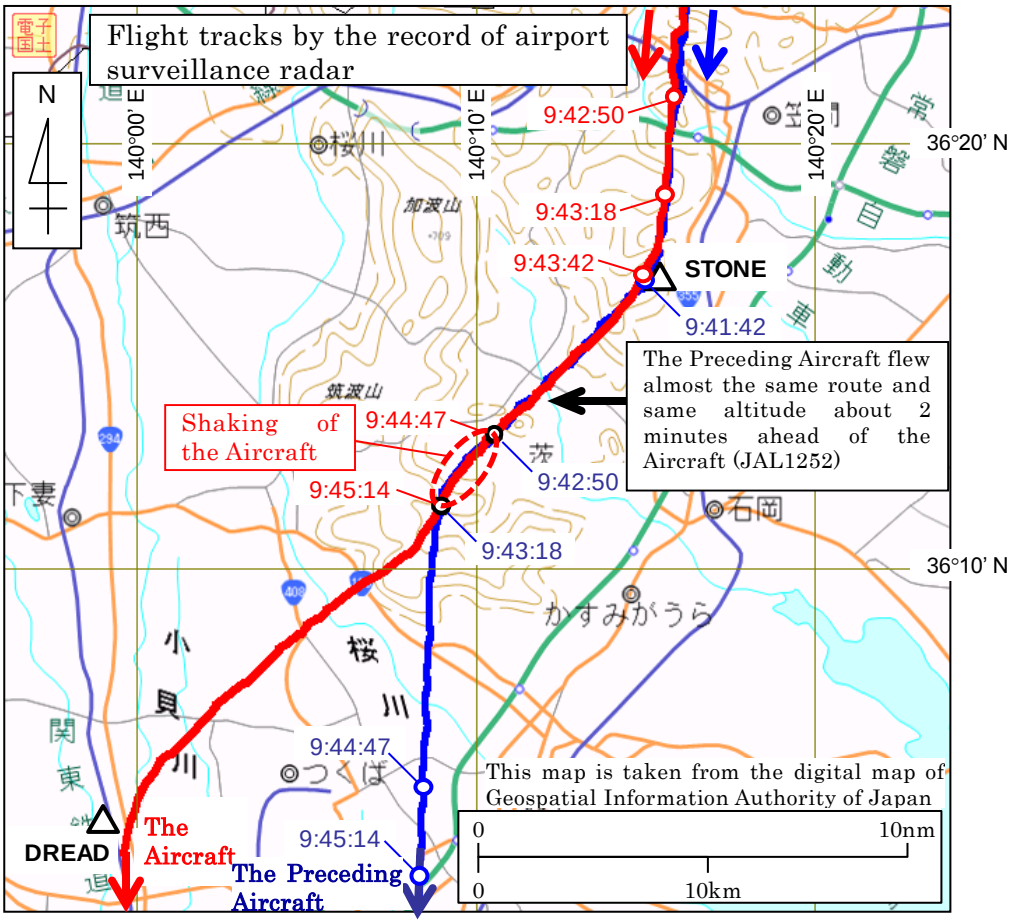
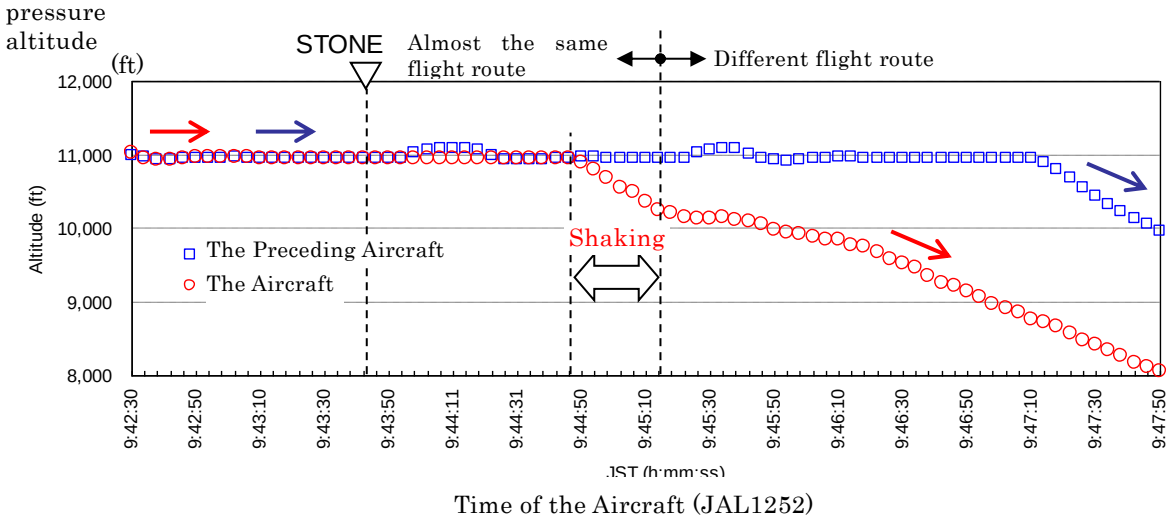


Figure 8: Estimated Flight Altitude



Time of the Aircraft (JAL1252)

Smoothed altitude after correction of the atmospheric pressure by the record of airport surveillance radar

Figure 9: The Size Comparison of
the Preceding Aircraft and the Aircraft

The Preceding Aircraft	The Aircraft
Airbus A340-600	Embraer ERJ170-100STD
Maximum takeoff weight:	Maximum takeoff weight:
Approximately 368 tons	Approximately 35 tons
Wake turbulence classification:	Wake turbulence classification:
Heavy aircraft	Medium aircraft