AA2008-01

AIRCRAFT ACCIDENT INVESTIGATION REPORT

JAPAN AIRLINES INTERNATIONAL Co., Ltd.

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December 19, 2008

Japan Transport Safety Board

The investigation for this report was conducted by Japan Transport Safety Board, JTSB, about the aircraft accident of JAPAN AIRLINES INTERNATIONAL BOEING 767-300 registration JA611J in accordance with Japan Transport Safety Board Establishment Law and Annex 13 to the Convention on International Civil Aviation for the purpose of determining cause of the aircraft accident and contributing to the prevention of accidents and not for the purpose of blaming responsibility of the accident.

This English version report has been published and translated by JTSB to make its reading easier for English speaking people those who are not familiar with Japanese. Although efforts are made to translate as accurate as possible, only the Japanese version is authentic. If there is difference in meaning of the texts between the Japanese version and the English version, text in the Japanese version is correct.

Norihiro Goto,
Chairman,
Japan Transport Safety Board

AIRCRAFT ACCIDENT INVESTIGATION REPORT

JAPAN AIRLINES INTERNATIONAL CO., LTD.

BOEING 767-300

JA611J

AT AROUND 17:31 JST, OCTOBER 27, 2007

IN THE AIR, APPROXIMATELY 75 KILOMETERS

SOUTHEAST OF NARITA INTERNATIONAL AIRPORT

November 21, 2008

Adopted By The Japan Transport Safety Board (Air-Subcommittee)

Chairman	Nobuhiro Goto
Member	Yukio Kusuki
Member	Shinsuke Endo
Member	Noboru Toyooka
Member	Yuki Shuto
Member	Akiko Matsuo

1. PROCESS AND PROGRESS OF THE AIRCRAFT ACCIDENT INVESTIGATION

1.1 Summary of the Accident

On October 27 (Saturday), 2007, a Boeing 767-300, JA611J, operated by Japan Airlines International Co., Ltd. took off from Hangzhou Xiaoshan International Airport (The People's Republic of China) as a regularly scheduled JAL636 flight. At around 17:31 Japanese Standard Time (JST), as it was approaching Narita International Airport, at approximately 75 kilometers southeast of the Airport and an altitude of approximately 9,400 feet, the aircraft experienced unusual turbulence during which one passenger was seriously injured as her seatbelt came unfastened.

There were 246 people on board, consisting of the Pilot in Command (PIC), 11 other crew members and 234 passengers.

The inside of the aircraft was partially damaged due to the turbulence.

1.2 Outline of the Accident Investigation

1.2.1 Investigative Organization

On October 30, 2007, the Aircraft and Railway Accidents Investigation Commission assigned an investigator-in-charge and two investigators to the investigation of this accident.

1.2.2 Accredited Representative and Adviser of Foreign States

An accredited representative and an adviser from the United States of America, the state of design and manufacture of the aircraft involved in this accident, participated in the investigation.

1.2.3 Implementation of Investigation

October 31 and November 2, 2007	Interviews
November 15, 2007	Investigation of aircraft, interviews

1.2.4 Comments from Parties Relevant to the Cause of the Accident

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

1.2.5 Comments from the State Participating in the Investigation

Comments were taken from the state participating in the investigation of this accident.

2. FACTUAL INFORMATION

2.1 History of the Flight

On October 27, 2007, a Boeing 767-300, JA611J (hereafter called "the aircraft"), operated by Japan Airlines International Co., Ltd. (hereafter called "the company"), took off from Hangzhou Xiaoshan International Airport as a regularly scheduled JAL636 flight bound for Narita International Airport.

The flight plan submitted to the Fukuoka Area Control Center of the Ministry of Land, Infrastructure, Transport and Tourism is outlined below.

Flight rules: Instrument Flight Rules (IFR)

Departure aerodrome: Hangzhou Xiaoshan International Airport

Estimated off-block time: 14:15 (Japanese Standard Time; all times below are JST)

Cruising speed: 472 knots

Cruising altitude: FL350[1]

Route: Omitted – FU (Fukue NDB) – Y23 (airway) – PERRY (reporting point) – Y231 (airway) – VENUS (reporting point)

Destination aerodrome: Narita International Airport

Estimated flight time : 2 hours and 24 minutes

Fuel loaded in terms of endurance: 5 hours and 03 minutes

Alternate aerodrome: Chubu Centrair International Airport

There were 246 people on board the aircraft, consisting of the PIC, 11 other crew members and 234 passengers. In the cockpit, the PIC sat in the left seat as the PF (the pilot primarily responsible for controlling the aircraft), while the first officer sat in the right seat as the PM (the pilot primarily responsible for monitoring).

The flight history of the aircraft up to the accident, based on the digital flight data recorder (hereafter called "DFDR"), the cockpit voice recorder (CVR), the quick access recorder (QAR) and the air traffic control(ATC) communications records, as well as from the statements by the flight crew members, is outlined below.

2.1.1 Flight History Based on DFDR, CVR, QAR and ATC Communications Records

Taking off from Hangzhou Xiaoshan International Airport at 14:45, the aircraft kept flying according to the flight plan. After holding at an altitude[2] of 29,000 feet over MJE (Miyakejima VOR/DME) by instruction of the Tokyo Area Control Center (hereafter called "Tokyo Control"), it left MJE and headed for ORGAN (reporting point) at around 17h:13m:15s, then started its descent.

The aircraft entered turbulence at around 17h:24m:16s, at an altitude of approximately 22,500 feet. At about 17h:26m:30s, the aircraft turned its heading to 060° in order to avoid an area of significant weather. It continued its descent, avoiding the area of significant weather, and at

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[1] FL stands for flight level. It is the pressure altitude from the standard surface pressure. The FL is obtained by dividing the reading on the altimeter by 100, with the altimeter set to 29.92 inHg. It is usually used at FL 140 and higher.

[2] This is the pressure altitude recorded on the DFDR. Similarly to the flight level, it is the pressure altitude from the standard surface pressure obtained with the altimeter set to 29.92 inHg. As the aircraft had the altimeter setting for Narita International Airport set to 29.38 inHg at the time of the accident, the altimeter display in the cockpit was approximately 540 ft lower than that on the DFDR.

around 17h:30m:10s selected the heading to 270° and started to turn left, as instructed by the Narita Radar Approach Control Facility (hereafter called "the Narita Radar").

After 17h:30m:48s, at an altitude of approximately 10,500 feet, the aircraft started to experience intense turbulence, with the vertical acceleration intermittently exceeding +1.5G (minimum value –0.29G) and the roll angle marking a largest value of 66.8° leftward at 17h:30m:53s. After that, the roll angle of the aircraft later recovered. At 17h:30m:58s, the vertical acceleration exceeded +2G (minimum value +1.46G) from an altitude of approximately 10,000 feet, and recorded a maximum value of +3.34G at 17h:31m:01s (minimum value –0.27G two seconds later). The intense turbulence ceased at 17h:31m:07s, at an altitude of approximately 9,700 feet. However, the aircraft continued to fly in turbulence afterwards, and landed at Narita International Airport at 17:51.

For 19 seconds from 17h:30m:48s to 17h:31m:07s, during which the aircraft experienced intense turbulence, the instantaneous activation of the stick shaker[3] and stick nudger[4] were also recorded. The Auto Pilot System and Auto-Throttle System of the aircraft were engaged during the time period, and the Auto Pilot System was switched from FLCH[5] mode to ALT HOLD[6] mode.

The table below shows the major movements of the aircraft as recorded on the DFDR and QAR.

Time (hour minute second)	TAS (kt)	CAS (kt)	Pressure Altitude (ft)	Wind Direction (°)	Wind Velocity (kt)	SAT (°)	Vertical Acceleration (G)	Lateral Acceleration (G)	Heading (°)	Pitch Angle (°)	Roll Angle (°)	Stick shaker + Stick nudger
17:30:47	336	282	10,566	164	73	8	1.49	–0.05	358	–0.9	–9.8	
17:30:48	340	284	10,532	165	69	8	1.62	–0.07	358	–1.6	–15.1	
17:30:49	344	290	10,529	165	65	6	1.61	–0.09	358	–3.0	–24.3	
17:30:50	338	293	10.583	166	62	5	1.66	–0.19	358	–6.0	–27.4	
17:30:51	354	296	10,728	165	60	5	–0.29	0.23	358	–6.7	–38.0	
17:30:52	356	307	10,588	162	57	4	0.82	–0.54	357	–5.8	–59.8	
17:30:53	336	280	10,461	153	54	8	0.80	0.32	355	–4.4	–66.8	
17:30:54	338	288	10,275	148	59	8	1.90	0.13	351	–5.3	–58.0	
17:30:55	336	287	10,198	154	61	8	1.64	0.05	345	–6.7	–42.5	
17:30:56	346	280	10,125	162	62	9	1.80	–0.11	340	–6.9	–37.6	
17:30:57	344	300	10,044	169	64	7	1.71	–0.09	338	–6.3	–33.4	
17:30:58	374	297	9,969	173	65	8	2.39	–0.14	336	–4.8	–30.6	
17:30:59	360	321	9,959	178	64	5	2.84	0.16	333	–3.0	–32.7	Activated
17:31:00	376	305	9,939	178	60	7	1.15	–0.26	333	–3.2	–32.0	
17:31:01	354	298	9,962	178	56	8	3.34	0.29	331	–3.0	–34.5	
17:31:02	370	321	9,850	172	55	4	2.46	–0.27	330	–3.7	–33.4	Activated

[3] The stick shaker is a device for alerting the pilot when the velocity of the aircraft falls close to stalling, by vibrating the control column.

[4] The stick nudger is a device for lowering the nose by automatically putting the control column forward to keep the aircraft from stalling.

[5] FLCH stands for Flight Level Change. It is an Auto Pilot System mode in which a velocity calculated by the Flight Control Computer or set by the pilot is maintained to climb or descend to a specified altitude.

[6] ALT HOLD stands for Altitude Hold. It is an Auto Pilot System mode in which a specified altitude is maintained once the aircraft has reached it.

17:31:03	390	328	9,871	169	51	4	0.45	–0.20	331	–4.4	–36.2	
17:31:04	382	330	9,838	165	44	6	1.16	0.11	329	–3.2	–37.3	
17:31:05	364	316	9,725	161	38	8	2.59	0.13	326	–0.9	–34.5	
17:31:06	378	316	9,714	160	37	7	2.51	–0.14	322	–1.8	–22.2	Only Left shaker activated
17:31:07	374	323	9,671	161	38	6	1.21	–0.06	322	–1.8	–22.2	

Note 1 CAS stands for Computed Airspeed, meaning the airspeed displayed on the control panel after the position error and instrument error of the airspeed system are calibrated and processed by the computer.
Note 2 TAS stands for True Airspeed, meaning the speed of the aircraft relative to the air through which it flies. The TAS is calculated through correction of air density at the particular altitude and the air compressibility effect at high speed, by using CAS.
Note 3 SAT stands for Static Air Temperature, meaning the atmospheric temperature when the temperature measured by the airplane thermometer is corrected and processed by the computer.
Note 4 For vertical acceleration and lateral acceleration, the maximum values of each one second interval are extracted.
Note 5 Regarding pitch angle, + indicates nose-up and －indicates nose-down.
Note 6 In roll angle, + indicates rightward bank and －indicates leftward bank.
Note 7 The stick shaker activation was recorded only on the QAR.
(See Figure 2-2)

2.1.2 Crew members' Statements about History of Flight

(1) PIC

It was a round flight between Narita and Hangzhou that day. We received a briefing from the operation officer[7] at the company Operation Center at Narita at around 8 o'clock in the morning. We were told that a typhoon was approaching the Kanto Region, and although there would be no problem when departing from Narita, the typhoon was expected to affect our return flight from Hangzhou. After we arrived at Hangzhou, we were updated on the latest weather analysis and aerodrome forecast by the local operation officer there. Because the typhoon was predicted to travel rapidly, we decided with the cabin crew members that they would finish cabin service 30 minutes before arriving at Narita as it was highly possible that we would experience turbulence from an early stage after takeoff, and that they would report the completion of cabin service to us as soon as possible. We then took off from Hangzhou Xiaoshan.

After taking off from Hangzhou, we kept being updated with the latest METAR[8] and the conditions of the approach course, and conducted the landing briefing at an early stage, since we considered a diversion to Chubu Centrair International Airport or Kansai International Airport based on the wind shear[9] at the time of landing at Narita, the crosswind limitation of the aircraft,

[7] The operation officer gets a flight plan from a dispatcher, and conveys the information necessary for the flight, such as weather information, NOTAM, etc., to the PIC.
[8] The METAR is the format for reporting routine weather information, in which weather elements such as wind, visibility, clouds, pressure, etc. are expressed in alpha-numeric format.
[9] Wind shear on this report includes wind direction change on average wind velocity at runway, flight path and altitude, as well as wind velocity change at vertical direction.

and so on. Although the runway for landing at Narita was the shorter Runway 34R, we expected a direct headwind and less wind shear; taking all things into consideration, we decided to make the approach for Narita.

We then received an instruction from Tokyo Control to hold at Miyakejima, so we were holding at 29,000 feet.

Once the aircraft started the descent, it was highly possible that there would be turbulence from an altitude of approximately 20,000 feet, and I was sure that we would experience turbulence at 15,000 feet and below, so I directed the senior cabin attendant (CP) to make rounds of the cabin to confirm that passengers fastened their seatbelts when the seatbelt sign was turned on, and that the cabin attendants (CAs) themselves took their seats as early as possible.

After a while, Tokyo Control instructed us to head for ORGAN and then descend. I promptly made a cabin announcement to ask passengers to fasten their seatbelts, and the CAs to take their seats themselves, and turned on the seatbelt sign.

I then made a descent operating the weather radar, requesting the Narita Radar to change the heading in order to avoid radar echo[10] of turbulence, but the aircraft started to be turbulent as I had expected. We entered into clouds after the aircraft passed 18,000 feet, but there was no radar echo indicating turbulence. I could hear the CP making a cabin announcement again telling passengers to fasten seatbelts. I flew eastbound for a while so that I could fly in weaker radar echo as much as possible. As the Narita Radar instructed us to head for the final approach course, I was changing the heading westbound when we encountered strong turbulence that seemed to have been caused by wind shear, at an altitude of a little below 10,000 feet. I think it lasted for only a few seconds, but the airframe banked leftward markedly. Luckily, the Auto Pilot System remained engaged, so I monitored the conditions. The turbulence reduced slightly at approximately 8,000 feet, so I asked the CP how the cabin was, and she said there seemed to be no problems except that some things were scattered around. There was less wind shear than I had anticipated during descent after that, and we landed on Runway 34R at Narita International Airport.

The passengers started to disembark the plane. When I thought that all passengers had got safely out of the plane, I was informed that a passenger who had injured her waist would deplane in a wheelchair, so I knew that there were injured persons.

(2) First Officer

Before we took off from Hangzhou, the weather forecast for Narita indicated a direct headwind on the runway. We figured there would be a chance for us to make a landing, so we loaded more fuel than usual in case we had to avoid significant weather, etc. After holding for about 25 minutes in the air over Miyakejima, we started to approach Narita. Before the aircraft started to make a descent, the PIC had directed the CAs to make rounds of the cabin and to finish checking whether all passengers had fastened their seatbelts.

In order to avoid strong radar echo and intense turbulence during the descent, we descended, requesting the air traffic control facility for heading changes. However, as we had

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[10] Radar echo refers to the electric waves or their images captured on the radar as they are reflected by precipitation particles, etc., in the air. The aircraft is equipped with a radar system that can convert the receiving strength of electric waves into precipitation intensity and display them as color-coded precipitation areas, or detect fluctuations in the air based on changes in the frequency of receiving electric waves and display this as turbulence.

anticipated, the aircraft started to be turbulent violently, and we encountered severe turbulence at approximately 9,500 feet. That turbulence lasted only temporarily, so the PIC instructed the CP to check the situation in the passenger cabin, and we were reported that there had been no problems. Because the aircraft continued to be turbulent, the CAs were ordered to remain seated.

The wind was strong, but we were able to make a stable landing. Once the aircraft had parked, I was wondering why there was no report telling us that all passengers had gotten out of the plane. We were then informed that they were arranging a wheelchair for a passenger who could not move from the seat because her waist had been hit when her seatbelt came unfastened.

This accident occurred at about 17:31, October 27, 2007, at a point approximately 75 kilometers southeast of Narita International Airport (latitude 35° 14' north, and longitude 140° 54' east) and an altitude of approximately 9,400 feet.
(See Figure 1, 2-1 and Photo 1.)

2.2 The Dead, Missing and Injured

One passenger was seriously injured, and a total of six people — three other passengers and three CAs – received minor injuries.

2.3 Information on the Damage to the Aircraft

After arrival, the aircraft was conducted severe turbulence inspection. The following was found to be damaged.

One of the clamps (toggles) buttressing the mid-cabin ceiling panels was destroyed.
(See Photo 2)

2.4 Pilot Information

(1) PIC Male, 58 years old

Airline transport pilot certificate (Airplane)	May 8, 1992
Type rating for Boeing 767	November 15, 1988
1st class aviation medical certificate	
Validity	January 4, 2008
Total flight time	13,465 hrs and 48 min
Flight time in the last 30 days	53 hrs and 18 min
Flight time on the aircraft type	5,835 hrs and 05 min
Flight time in the last 30 days	53 hrs and 18 min

(2) First Officer Male, 36 years old

Commercial pilot certificate (Airplane)	June 26, 1996
Type rating for Boeing 767	April 12, 2006
Instrument flight certification	March 31, 1997
1st class aviation medical certificate	
Validity	April 1, 2008
Total flight time	3,951 hrs and 59 min
Flight time in the last 30 days	42 hrs and 28 min
Flight time on the aircraft type	853 hrs and 09 min
Flight time in the last 30 days	42 hrs and 28 min

2.5 Aircraft Information

2.5.1 Aircraft

Type	Boeing 767-300
Aircraft serial number	33847
Date of manufacture	October 28, 2004
Certificate of airworthiness	2004-021
Validity	Period since November 16, 2004, the Maintenance Manual (Japan Airlines International Co., Ltd.) has been effective
Category of aircraft	Airplane, Transport category
Total flight time	11,600 hrs and 37 min
Time in service since last regular inspection (C inspection on October 26, 2007)	3 hrs and 15 min

(See Figure 3)

2.5.2 Weight and Balance

It is calculated that the weight and center of gravity of the aircraft at the time of the accident were 305,600 pounds and 22.5 percent mean aerodynamic chord (MAC), respectively. It is estimated that both were within the allowable limits (345,000 pounds is the maximum takeoff weight and 7.0 to 37.0 percent MAC corresponding to the weight at the time of the accident).

2.5.3 Fuel and Lubricating Oil

The fuel was Jet A-1, and the lubricating oil was mobile jet oil II for jet engines.

2.6 Meteorological Information

2.6.1 General Weather Conditions

According to the Asia Surface Weather Chart at 09:00 on October 27 (hereafter called "that day"), there was a typhoon (No. 0720, name: FAXAI) over the sea to the south of Japan, which was moving northeast at 27 knots. The typhoon was forecasted to a near the Izu Islands at 21:00 that day, and a front extending from an atmospheric low was reaching along the way from the Kanto coast side to the coast of the Kii Peninsula.

According to the 21:00 prognostic chart of domestic significant weather released at 15: 28 that day, the typhoon would move to the sea southeast of the Boso Peninsula, with fronts being analyzed to the north and south of the typhoon, and intense turbulence was predicted in the vicinity of the typhoon and the fronts.
(See Figures 4 and 5.)

2.6.2 500 hPa Weather Analysis Chart

According to the 500 hPa weather analysis chart at 09:00 that day, there was a clear trough at an altitude of approximately 5,700 meters over western Japan, and it was moving eastwards. The trough reached eastern Japan at around 21:00 that day, and the winds flowing at the back and front of the trough crossed the isothermal lines, causing a conspicuous cold air advection and a warm air advection.
(See Figure 6.)

2.6.3 850 hPa Weather Analysis Chart

According to the 850 hPa weather analysis chart at 09:00 that day, the isothermal lines were converged over Honshu, the main island of Japan, forming a frontal zone.[11] At 21:00 that day, the isothermal lines were converged further due to the typhoon moving northward and the upper-level trough (on 500 hPa) moving eastward as described in 2.6.2, causing a larger temperature gradient.
(See Figure 7.)

2.6.4 Wide-Area Cloud Analysis Chart

The wide-area cloud analysis chart at 17:00 that day showed cloud areas extending from the site of the accident to the northeast and south, which corresponded to the movement of the frontal zone described in 2.6.3, the 850 hPa weather chart. Cumulonimbus was indicated to the north of the occurrence point, with a cloud top altitude reaching 46,000 feet.
(See Figure 8.)

2.6.5 Weather Satellite Imagery

On the weather satellite infrared imagery at 17:37 that day, the eye of a typhoon, the typhoon's center could be observed, albeit obscurely, at approximately 133 kilometers south southwest from the occurrence point. The northern inland from the center of the typhoon was blanketed with convection cloud developed along the way to the upper layer. In addition, the water vapor imagery[12] at the same time that day showed a dry slot[13], accompanied by the influx of cold air in the south of the typhoon's center, and the typhoon transforming into an extratropical cyclone. (See Figure 9.)

2.6.6 Ground Weather Radar

The radar echo intensity[14] forecast at 17:30 that day indicated a rainfall area spreading from the northern part of the Izu Islands to eastern Japan. A magnitude of heavy precipitation exceeding 32mm/h was observed in the echo's southeast quadrant, while the radar echo top altitude[15] was reaching eight kilometers (26,246 feet) or higher. A marked linear color gradation change for precipitation intensity suggestive of a disturbance was stretching in the vicinity of the occurrence point. (See Attached Figures 10, and 11.)

2.6.7 Vertical Shear[16] Analysis Chart

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[11] The frontal zone is an area where the temperature differs drastically from that on the surface area, observed on the border between different air masses. The surface on the warm air side of the frontal zone is called the front surface, and the line at which the front surface crosses the land surface is called the front.

[12] The image indicates the amount of vapor in the air in the mid and upper layers. The brighter the display color becomes, the more the vapor increases; the darker the color becomes, the more it decreases.

[13] A dry slot is a zone of dry air formed by an influx of air flowing in from the cold air of a developing low pressure area.

[14] Radar echo intensity means the rainfall intensity, converted from the strength of electric waves reflected in the precipitation area detected by the surface weather radar. The data observed by the JMA's weather radar sites at an altitude of around 2 km is synthesized and displayed on a 1-km mesh.

[15] Radar top altitude refers to the top altitude of the echo displayed based on the data observed by the radar.

[16] Vertical shear is the difference in wind between the top and bottom layers converted into the difference per 1,000 ft, for the wind direction and velocity at locations obtained through wind analysis. It becomes larger as the change in wind direction or velocity, or both, become larger as the altitude increases.

According to the vertical cross sectional view of longitude 140° east at 17:00 that day, there was a vertical shear on the border of the cold and warm air, making the frontal zone conspicuous as the typhoon transformed into an extratropical cyclone. A vertical shear of 15 kt/1,000 feet was indicated from 5,000 feet to 10,000 feet in the vicinity of the Boso Peninsula (latitude 35° north), near the occurrence point.

The horizontal cross sectional view of the Flight Level at 9,000 ft at the same time showed the frontal zone extending from the Boso Peninsula to the northeast and south. The change in wind direction and velocity was especially notable on the north and south of the frontal zone stretching in a northeast direction.
(See Figure 12.)

2.6.8 The periodic aviation weather report(METAR) data of Narita International Airport at around the time of the aircraft landing was as follows:

17:00 Direction of wind… 010 degrees; Velocity of wind… 32 knots; Instantaneous wind velocity: maximum value… 46 kt, minimum value… 24 kt; Prevailing visibility… 2,200 meters; Present weather… Heavy shower, Mist; Clouds: amount… 1/8, type… stratus, ceiling… 500 feet; amount… 5/8, type… stratus, ceiling… 800 feet; amount… 7/8, type… cumulus, ceiling… 1,500 feet; Temperature… 16°C; Dew point… 14°C; Altimeter setting (QNH)… 29.36 inHg; Supplementary information: Wind shear Runway 34L; Remarks…at 16:50 severe turbulence was observed by B744 two miles east of VENUS at an altitude of 8,000; pressure falling rapidly

17:30 Direction of wind… 360 degrees; Velocity of wind… 34 knots; Instantaneous wind velocity: maximum value… 45 kt, minimum value… 24 kt; Prevailing visibility… 2,400 meters; RVR: Runway 34L Touchdown… 1,800 meters or more No change Midpoint… 1,800 meters or more No change Stop end… 1,500 meters upward; Runway 34R Touchdown… 1,800 meters or more No change Stop end… 1,500 meters Upward; Present weather: Heavy shower, Mist; Clouds: amount… 1/8, type… stratus, ceiling… 500 feet; amount… 5/8, type… stratus, ceiling… 800 feet; amount… 7/8, type… cumulus, ceiling… 1,500 feet; Temperature… 15°C; Dew point… 14°C; Altimeter setting (QNH)… 29.40 inHg; Supplementary information: Wind shear Runway 34L; Remarks…at 17:13 moderate turbulence was observed by B763 five miles south of VENUS at an altitude of 16,000 to 15,000 feet, at 17:23 moderate turbulence was observed by B763 five miles north of VENUS at an altitude of 6,000 feet; pressure rising rapidly.

18:00 Direction of wind… 350 degrees; Velocity of wind… 28 knots; Prevailing visibility… 2,600 meters; RVR: Runway 34L: Touchdown… 1,800 meters or more No change Midpoint… 1,800 meters or more No change Stop end… 1,600 meters Upward; Runway 34R: Touchdown… 1,800 meters or more No change Stop end… 1,800 meters Upward; Present weather: Heavy shower, Mist; Clouds: amount… 1/8, type… stratus, ceiling… 500 feet; amount… 5/8, type… stratus, ceiling… 800 feet; amount… 7/8, type… cumulus, ceiling… 1,500 feet; Temperature… 15°C; Dew point… 14°C; Altimeter setting (QNH)… 29.45 inHg; Supplementary information… Wind shear Runway 34L and 34R; Remarks… severe turbulence was observed by B763 at 40 miles southeast of Narita at an altitude of 10,000 feet at 17:30, wind shear with 10-knot velocity deviation was observed by B777 at an altitude below 2,000 feet on the departure route from Runway 34L at 17:33, moderate turbulence was observed by A333 over Narita from 14,000 feet to 16,000 feet at 17:36, pressure rising rapidly.

2.6.9 Information on Turbulence

Based on a statement by the person in charge of radio[17] for the company Operation Center at Narita International Airport, the weather conditions on that day were as outlined below.

My work started at 14:05 that day, so I was at my desk by 14:00. Before starting work, I looked at all the weather charts set up in the office and confirmed the surface weather chart and its forecast, especially the upper level cross sectional view and the location of jet streams. A large amount of moderate turbulence was predicted on the climbing and descent routes at Haneda and Narita at altitudes of 20,000 feet or below.

I reported to the aircraft via ACARS[18] about the conditions of the using runway, braking action, turbulence while descending and the surface wind at one hour and 12 minutes ahead of its landing.

2.7 Information on DFDR and CVR

The aircraft was equipped with a DFDR (part number: 980-4700-042) and a CVR (part number: 980-6022-001) manufactured by Honeywell Inc. of the U.S.A.

The DFDR retained all records, from the time the aircraft departed Hangzhou Airport to the time electric power was turned off after the aircraft landed and stopped at Narita International Airport, including the record of the occurrence of the accident. The DFDR time was determined by comparing the time of the VHF transmission keying recorded on the DFDR with the time signal of the ATC communication records.

The aircraft CVR is able to record audio data for at least a maximum of latest two hours before the equipment stops. The CVR retained the data before and after the accident.

2.8 Airborne Weather Radar Unit

The weather radar equipped in the aircraft was an RDR-4A manufactured by Bendix (current Honeywell Inc.). The detection range is 320 nm, and the rainfall area is differentiated by colors: red, yellow, and green, in the order of heavy, moderate and light precipitation. Furthermore, within 40 nm coverage, the radar detects turbulence based on the movement of raindrops in the rainfall area and indicates the turbulence in reddish purple. The precipitation and turbulence are color-coded and displayed on EHSI,[19] respectively.

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[17] The person in charge of radio is the company's operation officer who is in charge of in-house radio, monitors flights and collects and conveys the flight operation or weather information.

[18] ACARS stands for Aircraft Communications Addressing and Reporting System. It is equipment for providing the information necessary for an aircraft's flight from the ground to the aircraft and vice versa, via digital data communication.

[19] EHSI stands for Electronic Horizontal Situation Indicator, and displays an integrated map for heading, navigation, etc. on the CRT display. The EHSI of the aircraft in question can display weather radar information as well.

The weather radar was inspected in the wake of the accident, and no faults were found.

2.9 Operating Conditions around the Time of the Accident

The radar tracking records of the Narita Airport Office recorded 26 arriving aircraft other than the aircraft between 16:30 and 17:40, during which time the accident occurred. However, there was no record aircraft that could have possibly been affected by wake turbulence.

In the same time period, one case of severe turbulence and three of moderate turbulence were reported in addition to the report from the aircraft.

2.10 Medical Information

2.10.1 The region and extent of the injury to the seriously injured passenger were as follows:

Passenger A	Female, 77 years old (seat number 63C)
Injury	12th thoracic vertebra, pressed and fractured

2.10.2 The region and extent of the minor injuries of the other three passengers and three CAs were as follows:

(1)	Passenger B	Female (seat number 62C, seated)
	Injury	Head, struck (Passenger A hit her on the head.)
(2)	Passenger C	Female (seat number 56E, seated)
	Injury	Cervical vertebra, distorted
(3)	Passenger D	Female (seat number 46K, seated)
	Injury	Cervical vertebra, distorted
(4)	CA responsible for L2 area	Female (CA seat in the left center, seated)
	Injury	Cervical vertebra, distorted Lumber vertebra, distorted Lower right thigh, struck and grazed
(5)	L3 area CA	Female (CA seat in the left aft, seated)
	Injury	Cervical vertebra, distorted
(6)	R3 area CA	Female (CA seat in the right aft, seated)
	Injury	Lumber vertebra, distorted Neck, contused

2.11 Provision of Information on Turbulence and Instruction to Fasten Seatbelts

From the time the aircraft was holding over Miyakejima until it landed at Narita International Airport, the information on turbulence and the instruction and guidance on fastening seatbelts given to the passengers and CAs by the operating crew were as outlined below, based on the recording of the CVR installed in the aircraft.

At around 17h:03m:20s, while the aircraft was holding over Miyakejima, the PIC made an announcement that a restriction had been imposed on landings at Narita International Airport due to the influence of a typhoon, and that the aircraft would fly through extremely strong turbulence once it started its descent, so seatbelts should be tightened securely upon the illumination of the seatbelt sign.

At around 17h:16m:22s, while en-route to ORGAN from Miyakejima, the PIC instructed the CP to direct all CAs to remain seated until landing once the seatbelt sign was turned on. The

CP, in turn, conveyed the PIC's instruction to the CAs, and told the passengers to wear seatbelts because strong turbulence was anticipated during descent.

At around 17h:21m:54s, before starting the descent, the PIC instructed the CP to make rounds of the cabin to confirm that all passengers fastened their seatbelts after the seatbelt sign was illuminated, and instructed all CAs to be seated as early as possible. He then made an announcement to the passengers to tighten their seatbelts, followed by one to the CAs to be seated themselves.

At around 17h:22m:23s, the seatbelt sign was illuminated.

At around 17h:24m:46s, the CP reported to the PIC that everyone had been seated, and once again made an announcement to the passengers to fasten their seatbelts tightly.

At around 17h:37m:07s, after the intense turbulence had ceased, the first officer asked the CP about the conditions in the cabin.

The CP seated in the forward cabin, collected information from the other CAs sitting in the center and aft seats, and reported to the first officer that there were no passengers who had suffered injuries, although some baggage had been thrown in the aisles. The first officer then instructed the CP again to make sure that all CAs remain seated until landing.

2.12 Information on the Injury

2.12.1 The situation in the cabin after the occurrence of this accident were as outlined below, based on the statements of the CP, L3 area CA and passengers.

(1) CP (in charge of L1)

Prior to departure from Hangzhou, the PIC briefed us that the strong turbulence around Narita would hinder us from offering in-flight service for an hour in the latter half of the flight, so we confirmed that in-flight service would be completed within one hour and 30 minutes after takeoff.

After takeoff, when I reported to the PIC that in-flight service had been completed, he told me that the aircraft would be holding over Miyakejima and would experience strong turbulence even if it was able to make the approach for Narita, and that we might be diverted for Chubu Centrair International Airport or Kansai International Airport. The aircraft during holding didn't experience much turbulence as we were tending to the in-flight service, so the seatbelt sign was not on.

After a while, there was an announcement by the PIC saying that the aircraft would start its descent, and the seatbelt sign was turned on. Having been instructed beforehand, we made the rounds of the cabin to confirm that all passengers had tightened their seatbelts, and then took our seats ourselves. Because the aircraft had started to be turbulent a while before we took our seats, I made an announcement again that there would be nothing to worry about during the turbulent flight, and that passengers should tighten their seatbelts securely.

At about 17:30, the aircraft suddenly shook so violently that passengers in business class in front of me seemed to be lifted up. I felt like I was floating up at one moment and being pushed down the very next, and then as if I was being shaken from side to side. I couldn't keep my posture straight, despite holding on tightly to the seat with my seatbelt fastened. Even male passengers were clinging to their seats, being pushed up and down and shaken from side to side, even obliquely.

After the strong shaking had receded, I made an announcement to the passengers to store their tables or personal TVs, and put their seats back to their original positions lest they be injured by them when the next intense turbulence occurred. A report then came from the cockpit that the aircraft had passed 10,000 feet, with an inquiry about the conditions in the cabin. I asked the CAs in the cabin mid and aft to make a visual check from their seats, and they responded that there were no problems, so I conveyed this to the cockpit. As I remember, at around that time, passengers seated in the mid and aft cabins had turned on their call lights. However, because there were no indications of an emergency, such as passengers calling us and raising their hands, I decided to make the confirmation after landing, complying with the PIC's instructions to remain seated. In addition, the CA in the aft then reported that there were some passengers whose baggage or passports had flown away. Because of this, after landing and immediately before parking, I made announcements requesting passengers to check their baggage themselves, and inform us if they were feeling sick due to the strong turbulence that we had been through.

After landing, and after the aircraft had stopped in the parking position, a passenger notified us of the injury, so when the door was opened, we asked the person in charge of passengers who had been waiting at the door for a wheelchair. We asked the injured passenger about her condition, and she said, "I flew up when my seatbelt came unfastened and then fell down. I can move my hands and legs, but I can't stand up."

(2) L3 area CA

Before taking off from Hangzhou, we had been briefed that quite strong turbulence was expected during the day's flight.

While the aircraft was holding over Miyakejima, there was an announcement from the PIC saying that the aircraft was holding to wait for the weather to become more favorable, and telling us to make sure to tighten seatbelts because turbulence was anticipated during the descent into Narita.

After a while, I received a report from another CA that the seatbelt sign would be turned on in five minutes, so we should make rounds of the cabin and then promptly take our seats. I made rounds of the area for which I was responsible and confirmed that the passengers had tightened their seatbelts before the final check. At around 17:20, the PIC made an announcement in which he asked individual passengers to confirm that they had fastened their seatbelts, and told the CAs to take their seats. After that, the seatbelt sign was illuminated, so we made rounds for the final check, and took our seats after confirming that all passengers had tightened their seatbelts. For about 20 minutes after that, we were shaken up and down and from left to right several times; I felt particularly intense turbulence twice. The turbulence at about 17:31 was notably intense. I was unable to keep looking forward at the cabin because I couldn't keep my face up due to pressure from below, and all I could do was somehow manage to secure my posture by holding firmly on to the bottom of the seat. When the strong shaking had receded, I looked around and found that some baggage and in-house journals from the seat pockets had been scattered in the aisles, and the passengers seemed to be in a state of confusion. So I said in a loud voice, "Are you all alright? Calm down, look forward and please remain seated with your seatbelts tightened." Nobody seemed to be feeling sick or to have been injured and there were no such reports either.

The CP then inquired via the interphone if there were any injured passengers. I called to the passengers from my seat in the aft cabin asking if they were alright. As there were no reports of injury, I reported that there were no injured passengers but that there was baggage scattered in the aisles. There were passenger call lights turned on, but there were no signs of an emergency, such as raised hands, nor were there any reports of such. As the aircraft had passed 10,000 feet, I made another announcement telling passengers to put reclined seats back to their original position, and so on.

After landing, I asked the other CAs to check about the call lights because I was in charge of the door operation. I received a report that one passenger had been injured, so I went to the passenger. She was quite conscious, and said "I flew up when my seatbelt came unfastened, and I hit my waist against the seat in front. I have a pain in my waist."

(3) Passenger A (the seriously injured passenger)

During the flight, I checked my seatbelt repeatedly. I left my seat for the lavatory before the aircraft started its descent into Narita, and I remember fastening my seatbelt after I returned to my seat. When the turbulence started, I held my bag on my lap with my right hand, and held on to my husband's right arm with my left hand. Then a huge jolt came, just like a big earthquake, at which point my body lifted up in the air and flew about one meter forward. I fell on the back rest of the front seat, and I think my waist bone was broken at that time.

(4) Passenger E (the husband of Passenger A: seated to her left)

While flying in the vicinity of Omaezaki in Shizuoka Prefecture, we were informed via the cabin announcement that the aircraft might head for Kansai International Airport, and I realized that the aircraft was turning to fly over Miyakejima. After that, the aircraft headed for Narita, at which point it started to be turbulent. I should have held my wife, as she was clinging to my right arm, saying "I'm scared, I'm scared." After that, there came an enormous turbulence. I couldn't make out what was going on, but when I came to my senses, my wife was floating in the air, and flew over the back rest of the seat in front, so I caught her by her ankle and pulled her back to her seat. As the aircraft was still turbulent, I couldn't help her tighten her seatbelt, but I kept holding her until the aircraft landed. I didn't press the call button to call a CA.

After landing, I tried to get out of the plane holding my wife, but she couldn't stand up. They prepared a wheelchair for her, and we took her to the airport clinic. The doctor said it would be better to take an X-ray check and made a referral to a hospital near the airport. Accompanied by the company employee, she was examined at the hospital, and diagnosed as having no abnormalities with her bones. The doctor prescribed her pain-killers. Because my wife said that she was still in pain, we stayed at a hotel near the airport that day, and went back home the following day. Three days after we returned to Japan, the pain in her waist grew severe, so we went to a hospital near our house. She was diagnosed as having a bone fracture.

Before approaching for Narita, we were told many times to fasten our seatbelts securely because the aircraft was expected to experience severe turbulence. I'm sure that my wife fastened her seatbelt.

(See Figure 13.)

2.12.2 The Company Treatment of Passenger A after the Aircraft's Landing

At about 18:07, the aircraft parked at Spot 62 at Narita International Airport.

At about 18:12, the company staff from the passenger service department at the Narita Airport Branch Office, who had been waiting at the boarding bridge[20] for Spot 62, were told by

[20] A boarding bridge is a movable bridge connecting the airport building and the aircraft, via which passengers and crew members can get on board or deplane.

the CP about the passenger who had injured her waist while the aircraft was turbulent, as the boarding door of the aircraft was opened, and asked the company passenger arrival desk[21] to arrange a wheelchair.

Having received an instruction from the passenger arrival desk, the personnel in charge of accompanying passengers prepared a wheelchair, and at around 18:40, Passenger A was brought into the clinic in Narita International Airport. A doctor at the clinic diagnosed that though there were no problems with her leg joints, the bones in her back could have been broken. The doctor made a referral to a nearby hospital, saying that she should be examined by X-ray. She was taken to the hospital by ambulance.

At around 21:15, on the basis of the result of the X-ray check, she was diagnosed as having no abnormality with her back bones, and told that she could go home. However, as passenger A said that she was in pain, they decided it would be difficult for her to go home and arranged a hotel, then guided her to the hotel in a wheelchair.

They asked passenger A to tell them of any change in her condition that might occur later on. Passenger A returned home the following day. On October 29, 2007, the husband of Passenger A (Passenger E) reported to the company that she had gone to a hospital near her house, where she was diagnosed as having a bone fracture in her waist.

2.13 Seatbelts Installed in the Aircraft

The seatbelts installed in the aircraft were manufactured by AmSafe (part number: 2011-1-731-2847) in the U.S. A.. They are configured such that the connector fixes with the latch when inserted into the buckle, and is released when the flap of the buckle is lifted up.

When the seatbelt of the seat in which passenger A was sitting was inspected, there was no external damage, and it was confirmed that the belt was functioning normally.
(See Photos 3 and 4.)

2.14 The Bag Passenger A was Carrying

At the time of the accident occurrence, passenger A was carrying a leather bag with her, which was 27 cm in height and width. There was a pocket on the front, and metal fittings were attached on the back for carrying it on the back.

In addition, there were some necessary personal belongings (a pair of glasses) as well as valuables such as a wallet, passport, etc. in the bag.

The bag falls under the category of "personal belongings travelers can carry and keep with them," as stipulated in Clause D (carry-on baggage), Article 10 (baggage) of the company's International Passengers Transport Provisions, and is thus allowed to be brought onto the aircraft.
(See Photo 5.)

2.15 Fact-Finding Test and Study

A test was conducted by simulating the conditions of passenger A sitting in the seat in order to determine the possibility of the bag's having released the seatbelt due to the turbulence of the aircraft. When the seatbelt was fastened, the passenger was stabilized on the seat, leaving no

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[21] A passenger arrival desk is in charge of coordinating how to deal with the passengers from arrived flights in tandem with the pertinent departments, and manages treatment of passengers.

allowance for movement around the waist; therefore, the vertical and horizontal commotion of the aircraft was reproduced by moving the bag on the lap up and down and from left to right.

As a result of the investigation, it was confirmed that when the bag on the lap was moved rightwards (in the direction in which the flap of the buckle is pulled upward), the bag touched the metal flap, and the flap was easily lifted upward, releasing the seatbelt.
(See Photos 6 and 7.)

3 ANALYSIS

3.1 The PIC and the First Officer of the aircraft both possessed proper airman competency certificates and valid aviation medical certificates.

3.2 The aircraft had a valid airworthiness certificate and had been maintained and inspected in an orderly manner.

3.3 Weather Conditions on the Aircraft's Descent Route

As described in 2.6, at around the time that this accident occurred, the typhoon, which had reached the vicinity of the accident site, was in the process of transforming into an extratropical cyclone with the change of clouds. As the frontal zone gained strength to the north of the typhoon, a very strong vertical shear was analyzed in the vicinity of the accident site. Furthermore, while the radar echo intensity indicated a rainfall area with a large gradation change in the color of precipitation strength alongside the movement of the frontal zone, it is estimated that there was intense air disturbance in the vicinity of the accident site.

3.4 Aircraft's Turbulence

As described in 2.1.1, according to the DFDR record, the turbulence of the aircraft started at around 17h:24m:16s, at an altitude of approximately 22,500 ft, and continued until landing. At an altitude from approximately 10,500 to approximately 9,700 ft, particularly intense turbulence was recorded, with vertical acceleration marking a maximum of +3.34 G.

At an altitude of approximately 22,500 ft, at which the aircraft started to enter turbulence, the direction of the wind began to shift, blowing counter-clockwise from southwest to north northeast, while the velocity of the wind also changed remarkably. A maximum wind velocity of 94 kt (direction of wind: 182°) was recorded at an altitude of approximately 12,000 ft during the descent, thereafter diminishing to 32 kt (direction of wind: 142°) at an altitude of approximately 9,700 ft. The differences in the direction and velocity of the wind during that time period were 40°/62kt, respectively, with about a 2,300 ft difference in altitude, indicating a remarkable change in the wind.

The turbulence of the aircraft was triggered by this remarkable change in the wind, as has been explained so far. Therefore, it is estimated that the aircraft experienced the severe turbulence due to the intense air disturbance caused by a strong vertical shear from the frontal zone, as described in 3.3. This turbulence was powerful enough to cause the attitude and speed of the aircraft to change, at which point the stick shaker and stick nudger were activated. However, it is estimated that the aircraft gradually recovered a stable attitude, as the Auto Pilot System was working to control the flight.

3.5 The Process of Injury

With regard to the use of the seatbelt by Passenger A, because there were announcements instructing the passengers to fasten their seatbelts prior to starting the descent, the CAs had made rounds to check that passengers had fastened their seatbelts, and moreover, because the passenger remembered checking that her seatbelt was fastened herself, it is estimated that the seatbelt had been fastened before the aircraft started its descent.

Concerning the unfastening of Passenger A's seatbelt, in line with the investigation result described in 2.15, it is estimated that, when the aircraft experienced the huge turbulence, the bag that the passenger was holding on her lap touched the buckle of the seatbelt, which in turn pulled the flap upward, upon which it is estimated that Passenger A flew out of her seat, and was injured when she hit her waist against the back rest of the seat in front.

The six people (three of whom were CAs) who suffered minor injuries wore seatbelts; however, it is estimated that they were injured in their neck (cervical vertebra) or waist (lumber vertebra) because these regions are prone to be affected by the turbulence of the aircraft, as described in 3.4. In particular, as the CAs in charge of L3 and R3 were blocked from having a good view of the cabin from their seats, it is considered that they had difficulty trying to maintain a stable posture against the turbulence while also trying to ascertain the condition of the passengers.

3.6 Avoidance of Significant Weather and Operation of Weather Radar

Although it is estimated the aircraft experienced violent turbulence even though the flight crew members had: confirmed the weather information for the approach course that they had obtained beforehand; made efforts to avoid turbulence, by actively searching for the turbulence and heavy precipitation area using the weather radar equipped in the aircraft; and done their best to fly through the heavy precipitation area in as little time as possible. Therefore, it is estimated that there was an extended frontal zone extending covering a vast area, crossing perpendicular to the approach course of the aircraft, and that the aircraft had no choice but to pass the frontal zone.

3.7 Cabin Announcement and Fastening of Seatbelts

The flight crew members were well aware of the fact that the approach course into Narita International Airport had been under significant weather conditions and air disturbance, based on the pre-departure briefings they had been given at both Hangzhou and Narita airports, and on the weather information they obtained during the flight. Therefore, as described in 2.11, in order to prevent injuries by turbulence, the flight crew members made announcements to the passengers giving information about turbulence on the approach course and instructing them to fasten their seatbelts, and also turned on the seatbelt sign.

The cabin announcements were made while the aircraft was holding over Miyakejima, when it departed from Miyakejima, and at the start of the descent, and it is estimated that the announcements were made at proper intervals in accordance with the respective phases of the flight. Furthermore, the CAs repeated the PIC's cabin announcements, and made rounds to confirm that passengers had tightened their seatbelts before the aircraft started its descent, as they had discussed at the briefings. Therefore, it is estimated that each and every passenger had fastened their seatbelt securely.

When the powerful shaking receded, the flight crew members instructed the CAs to confirm the cabin conditions, to which the CAs responded that there were no injured people as far as they could observe visually. With the aircraft being continuously turbulent, it is estimated that the CAs were unable to check details in the cabin, as they remained seated in accordance with the PIC's instructions. Moreover, there were no signs of urgency in the cabin, despite the fact that call lights from passengers were turned on.

Concerning the fact that the CAs remained seated, it was an appropriate decision from the perspective of preventing them from being injured while making rounds of the cabin during the continued shaking of the aircraft. They found that there was an injured passenger after the aircraft had parked, when the seriously injured Passenger A told them, as other passengers were starting to deplane.

Based on the aforementioned factors, it is estimated that it was difficult for the CAs to recognize right after the turbulence of the aircraft that there were some passengers who had been injured.

3.8 Ground Personnel's Support of the Injured

After the aircraft parked, having received a report from the CP of a passenger who had injured her waist, the ground personnel arranged a wheelchair and checked the condition of the passenger. The personnel then guided her to the airport clinic and a hospital, in an attempt to support her as well as to check the condition of the injury.

On the day the accident occurred, it was not possible for the doctor to diagnose the case as a bone fracture, so the passenger was told that she could go home. However, it is estimated that it was appropriate for the personnel to inquire how the passenger was feeling and arrange a hotel room, and guide her to the hotel to rest.

3.9 Measures for Alleviating Damage

This accident indicated that there is a possibility that a seatbelt could be unfastened by the personal belongings of a passenger when an aircraft experiences turbulence.

Passengers are allowed to keep hold of personal belongings such as valuables. However, in order to ensure passenger safety during flight, the flight crew members and CAs should pay attention to the possibility of a seatbelt being disengagement by the personal belongings of the passenger if the aircraft encounters turbulence. When powerful turbulence is anticipated, it is necessary that they should give explanations on this matter to the passengers and recommend them to keep their personal belongings in the compartments in the cabin ceilings, beneath their seats or in the seat pockets, so as to prevent such an incident from occurring.

4 PROBABLE CAUSE

It is estimated that this accident occurred as follows: while passing through the frontal zone generated north of a typhoon, the aircraft experienced powerful turbulence as it encountered intense air disturbance, upon which the seatbelt of one passenger came unfastened, causing the passenger to fly up from her seat and then hit her body against the back rest of the seat in front, resulting in a serious injury.

With respect to the unfastening of the seatbelt, when the aircraft experienced the severe turbulence, it is estimated that the bag the passenger was holding on her lap touched the buckle of the seatbelt, causing the flap to be pulled upward.

Figure 1　Estimated Flight Route

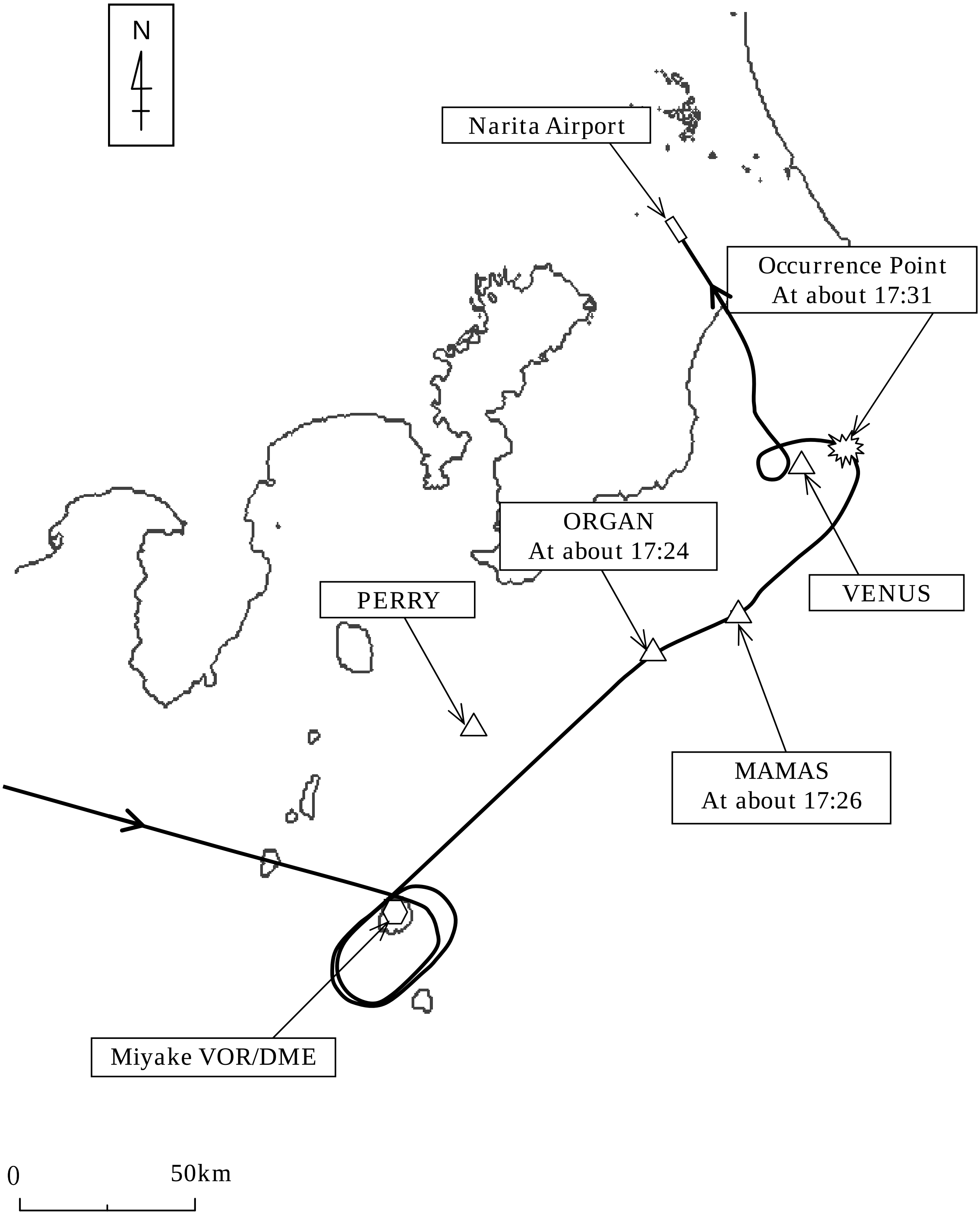
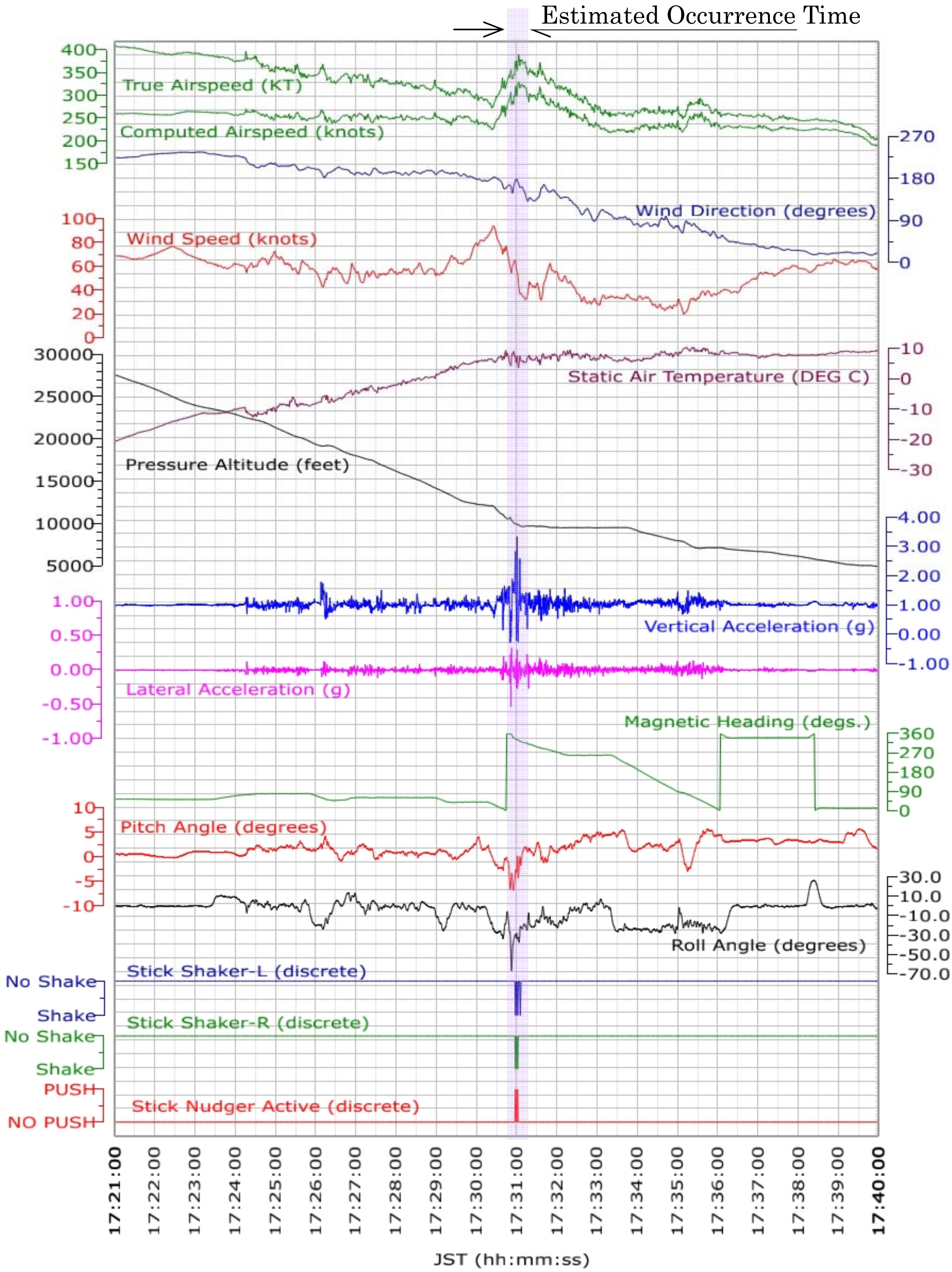
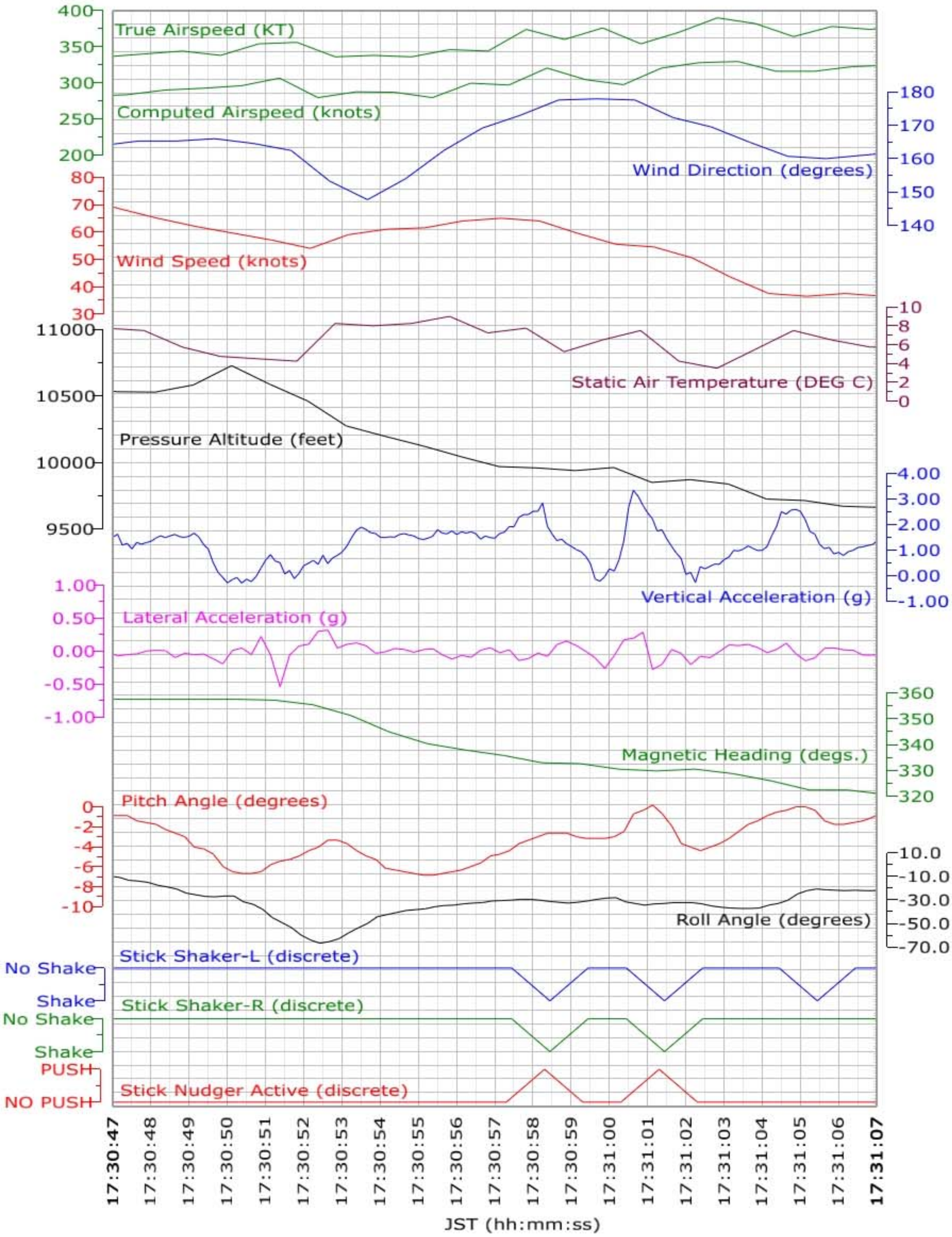


Figure 2-1 DFDR and QAR Records



Note: Stick Shaker alert is derived from QAR

Figure 2-2 DFDR and QAR Records



Note: Stick Shaker alert is derived from QAR

Figure 3　Boeing 767-300 3 Dimensions

unit : m

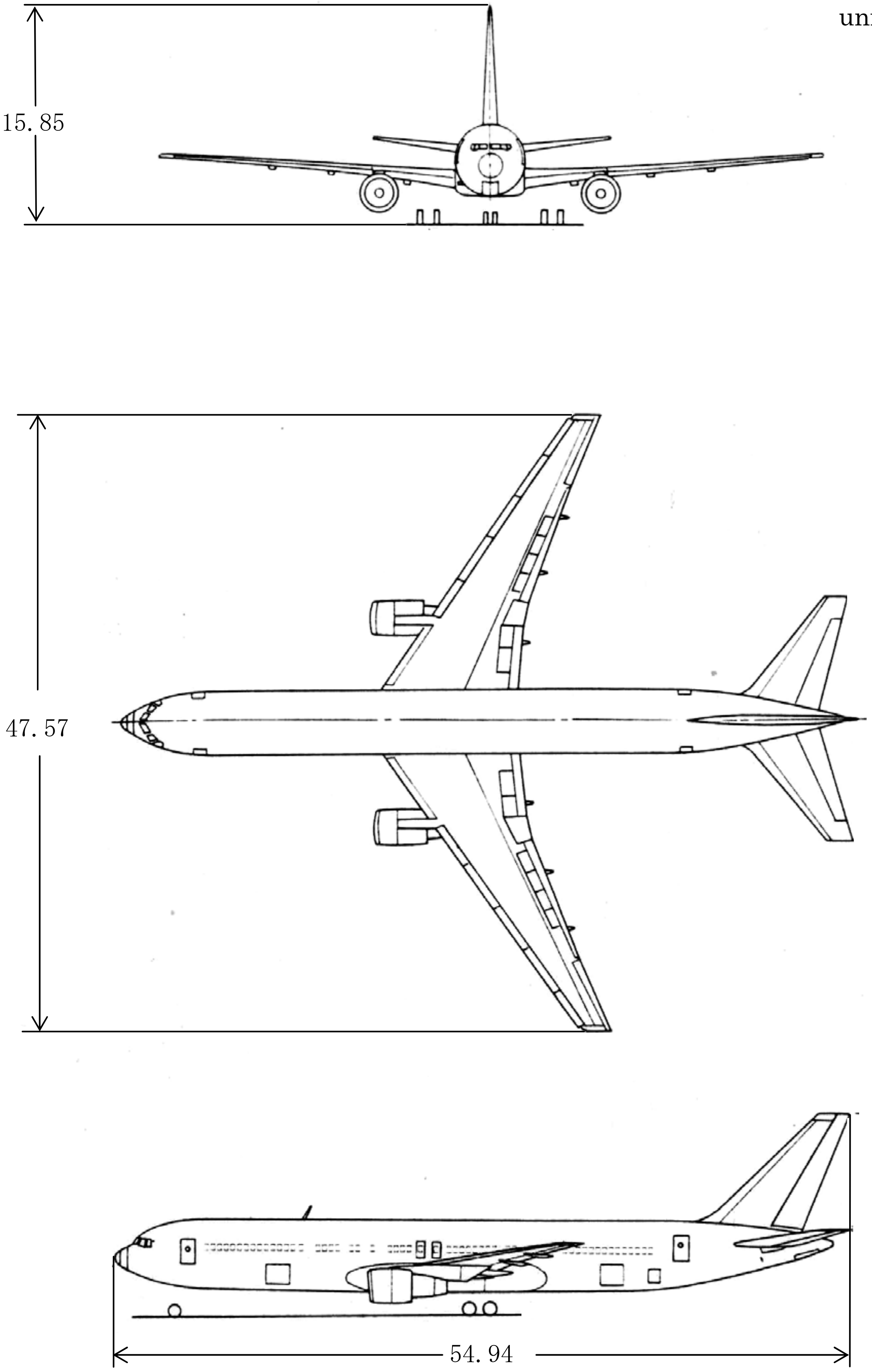


Figure 4　Asia Surface Weather Chart

at 09 on Oct 27, 2007

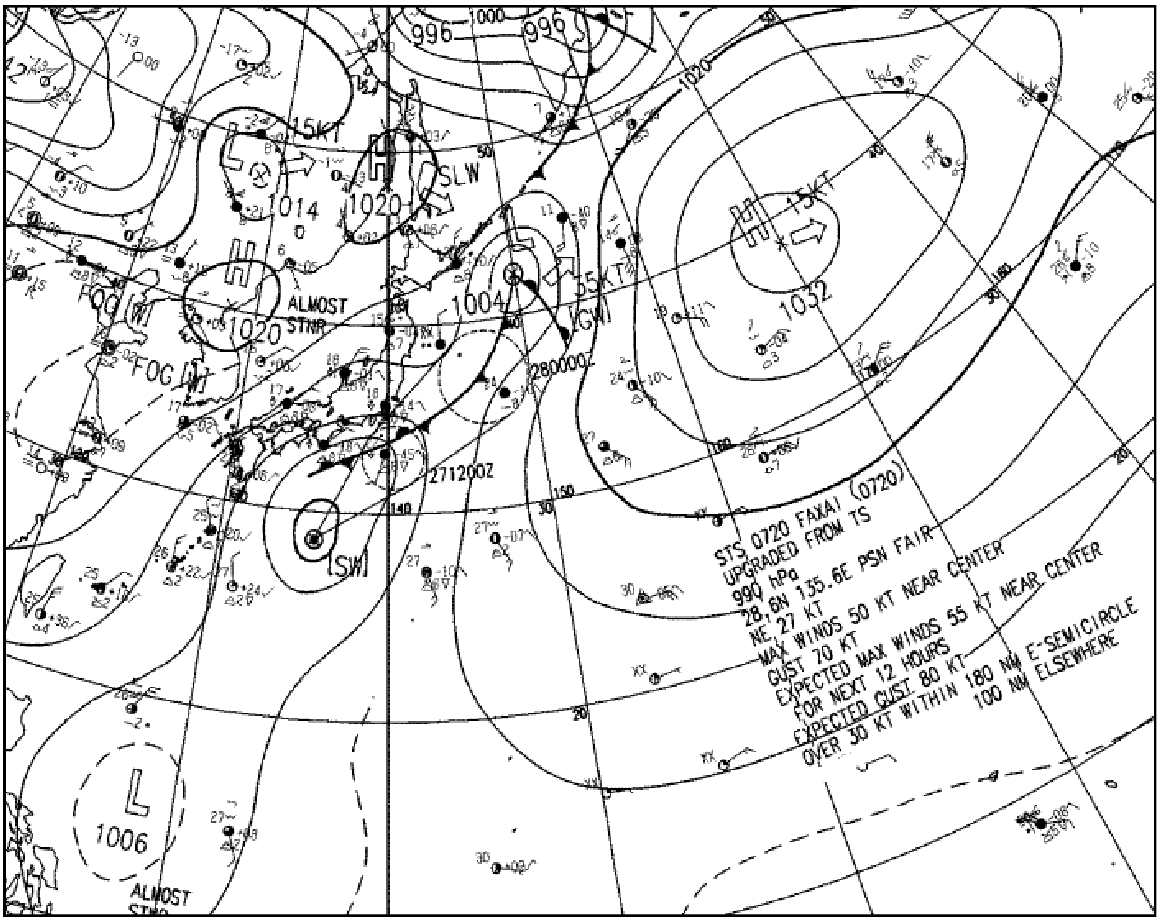


Figure 5　Significant Weather Chart

at 15:28 on Oct. 27, 2007

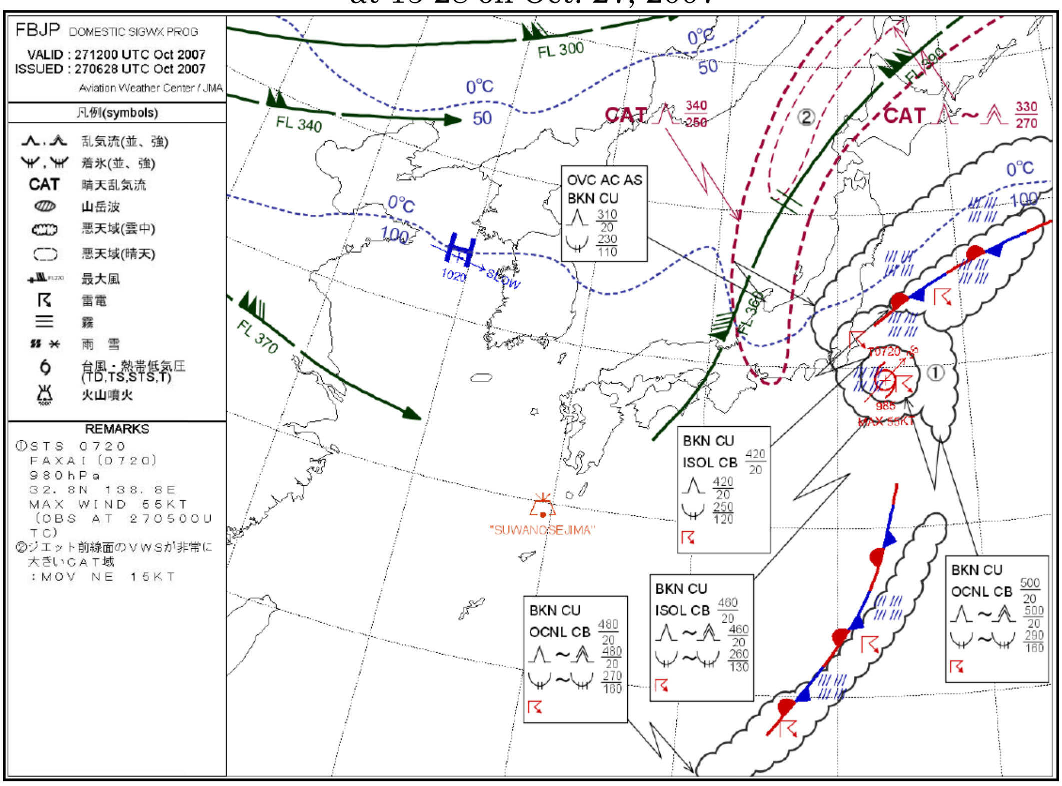
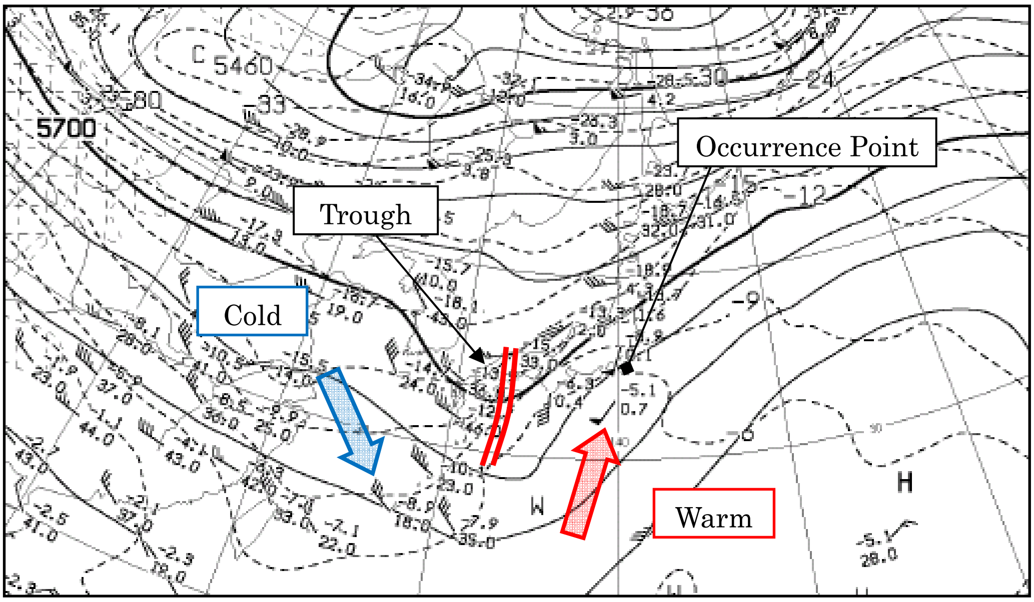
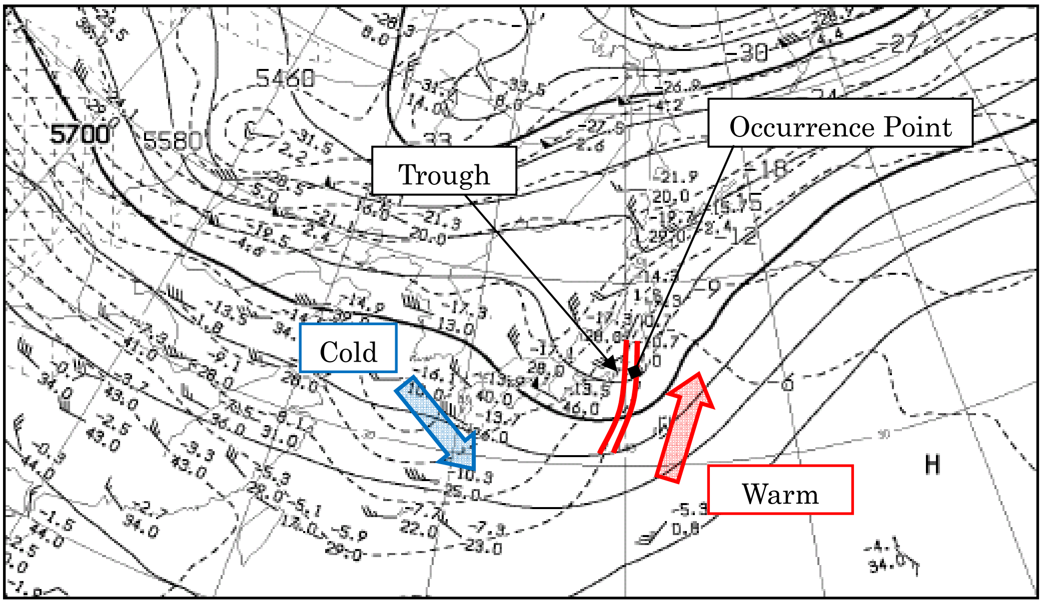


Figure 6　500hPa Weather Analysis Chart

09 of Oct. 27



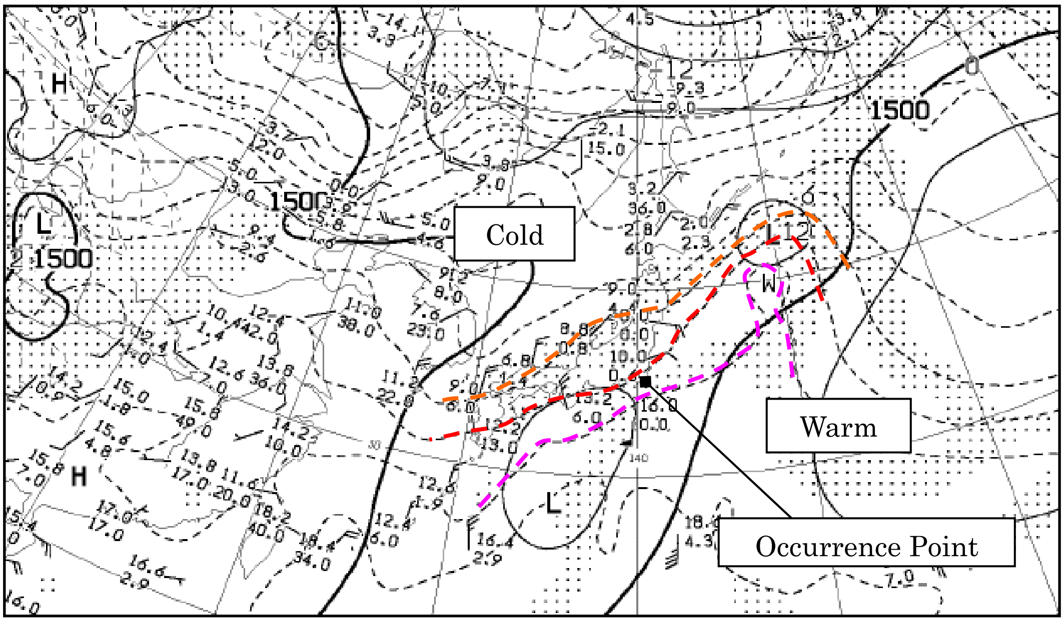
21 of Oct. 27



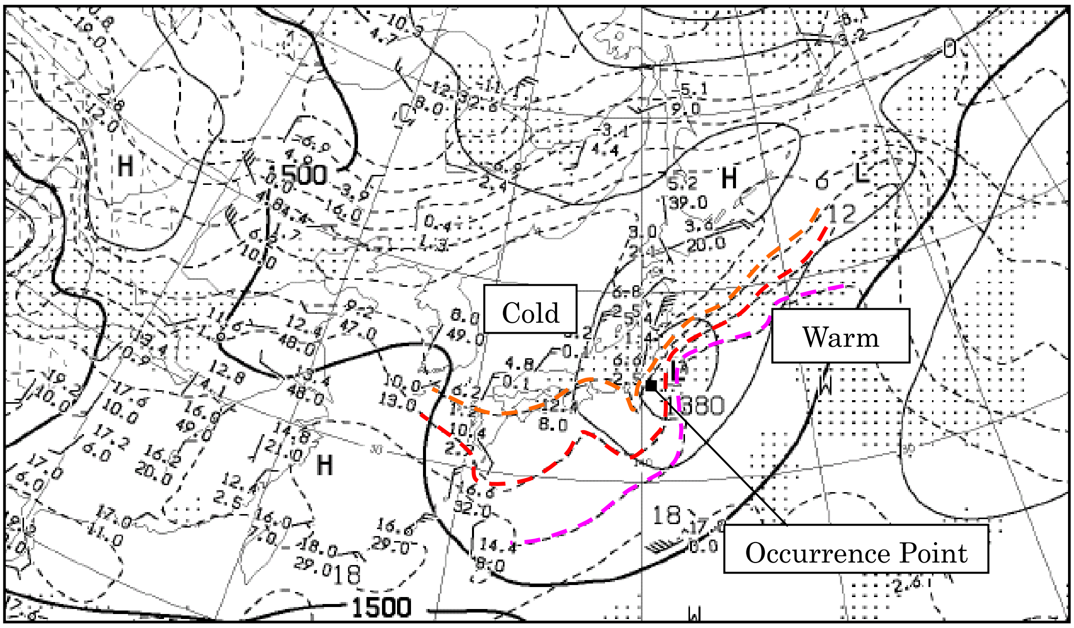
Solid Line: altitude(m), Dotted Line; temperature (℃)
Arrow; wind direction and speed (short; 5kt, long; 10kt, flag; 50kt)

Figure 7　850hPa Weather Analysis Chart

09 of Oct. 27



21 of Oct. 27



Solid Line; altitude (m)

Dotted Line; temperature(℃)

9℃、 １２℃、 １５℃

Arrow; wind direction and speed (short;5kt, long;10kt, flag;50kt)

Hatched Area; dew point below 3℃

Figure 8　Wide-Area Cloud Analysis Chart

17 of Oct. 27, 2007

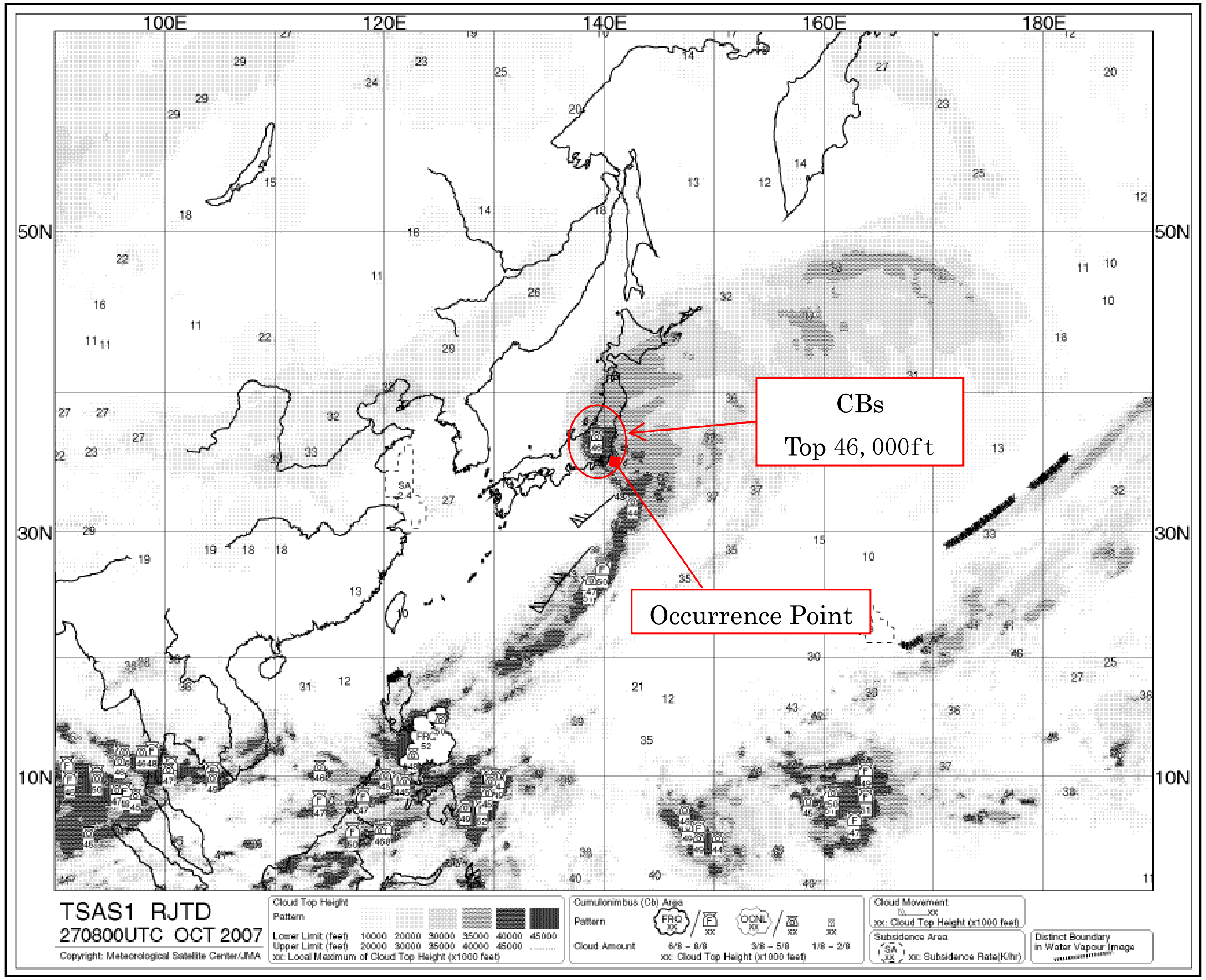
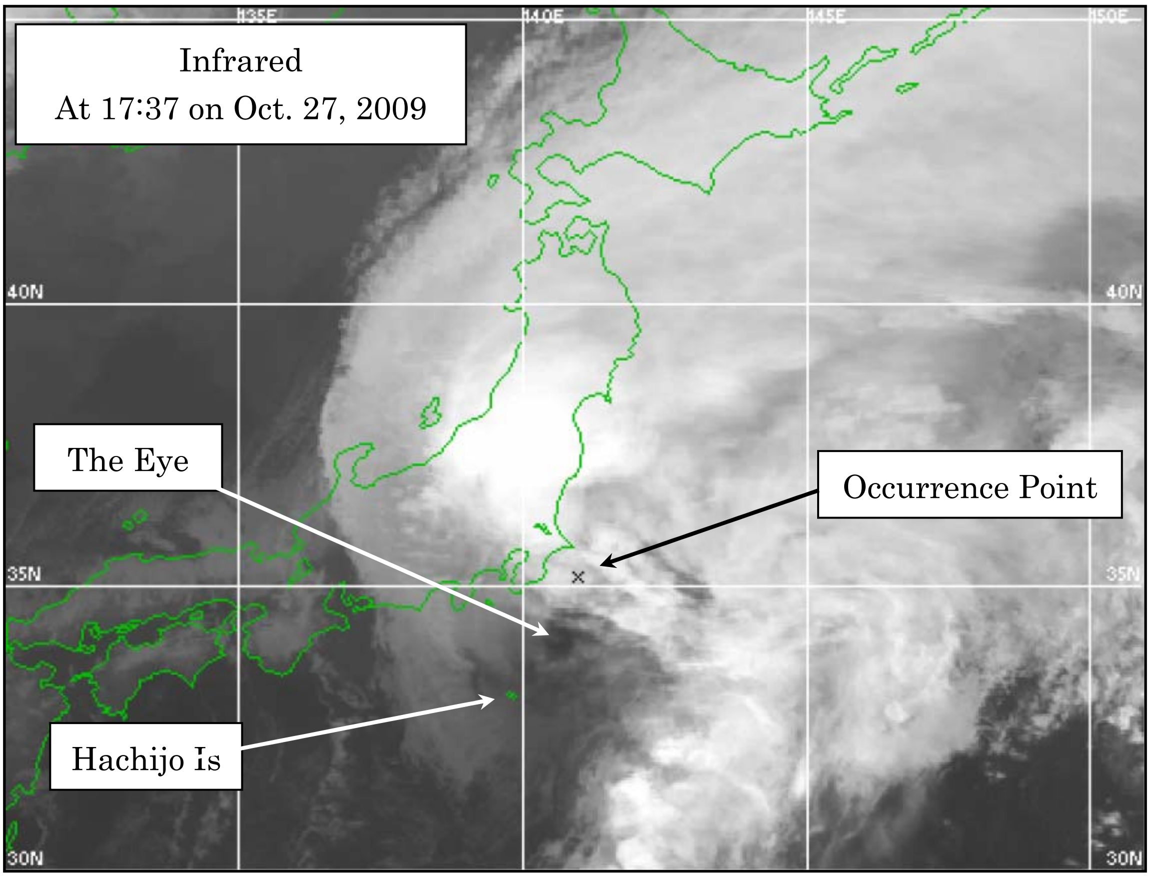


Figure 9 Weather Satellite Imagery



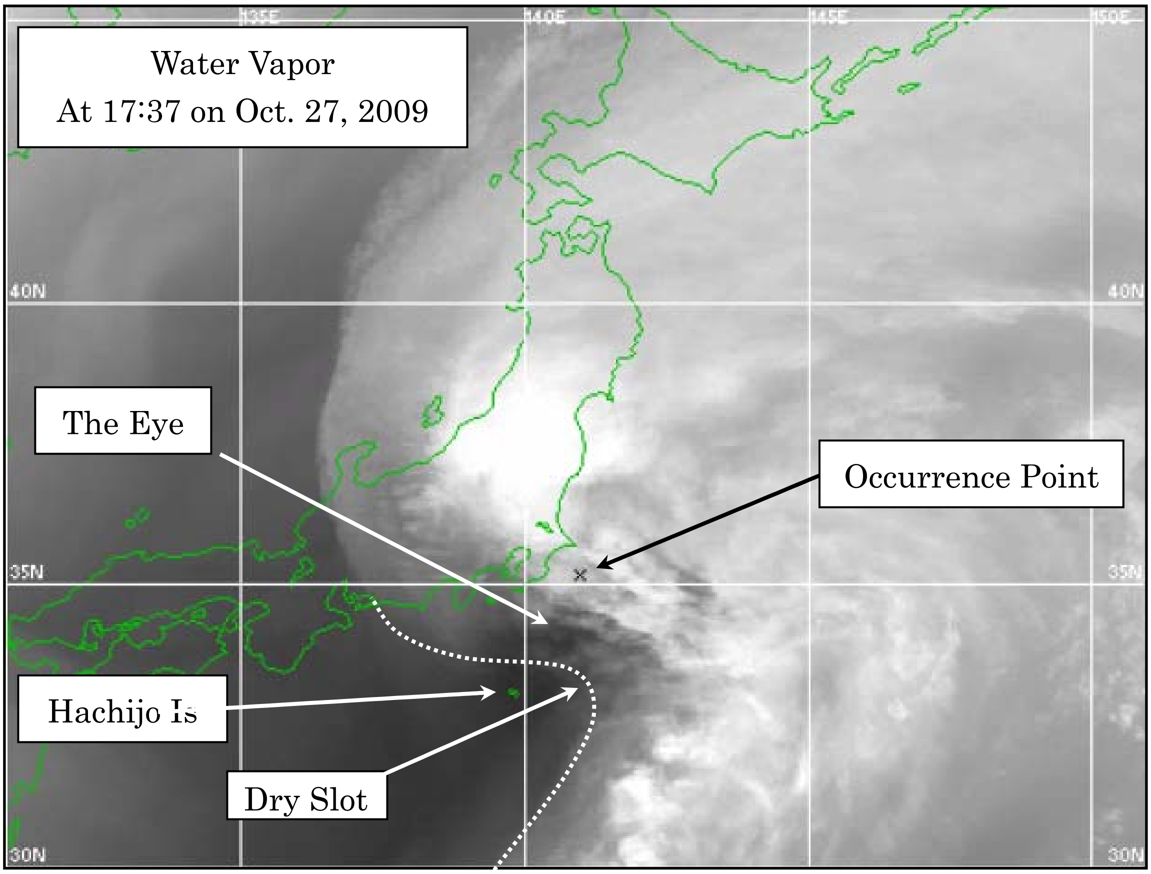


Figure 10　Radar Echo Intensity

At 17:30 on Oct. 27

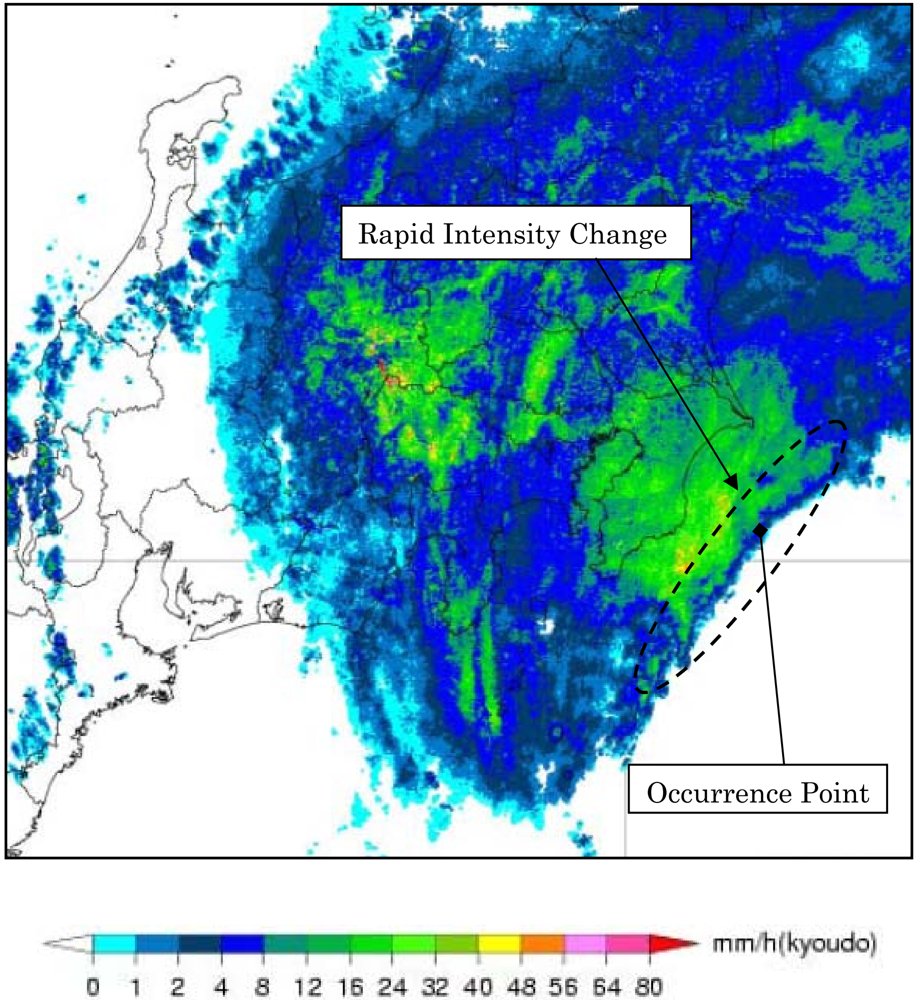


Figure 11　Echo Top Altitude

At 17:30 on Oct. 27

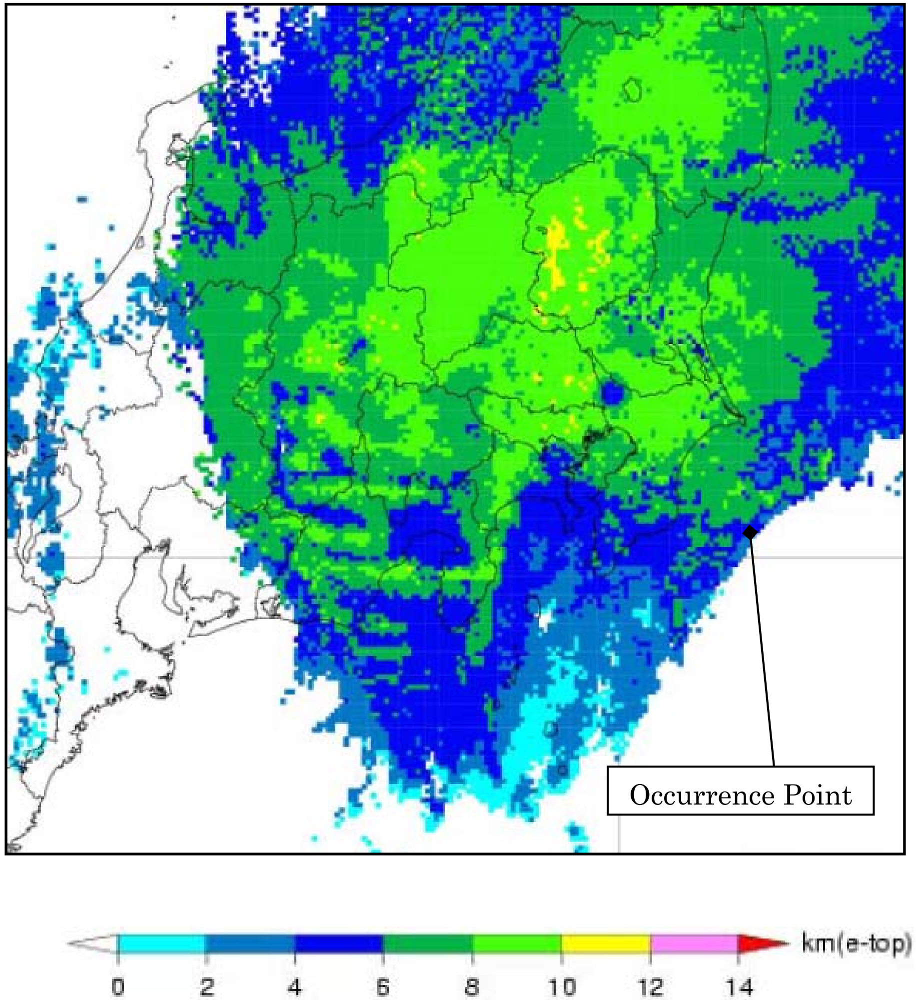
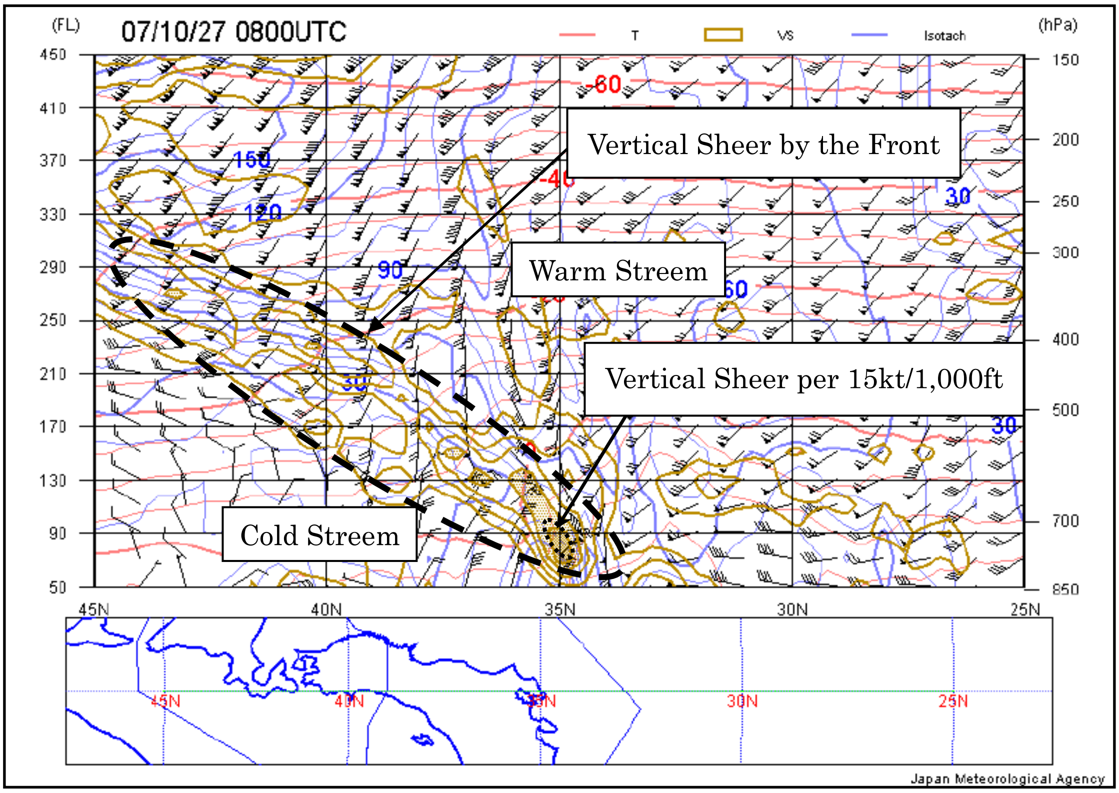


Figure 12　Vertical Sheer Analysis Chart

140E Vertical Cross Section at 17:00 on Oct. 27



9,000ft Horizontal Cross Section at 17:00 on Oct. 27

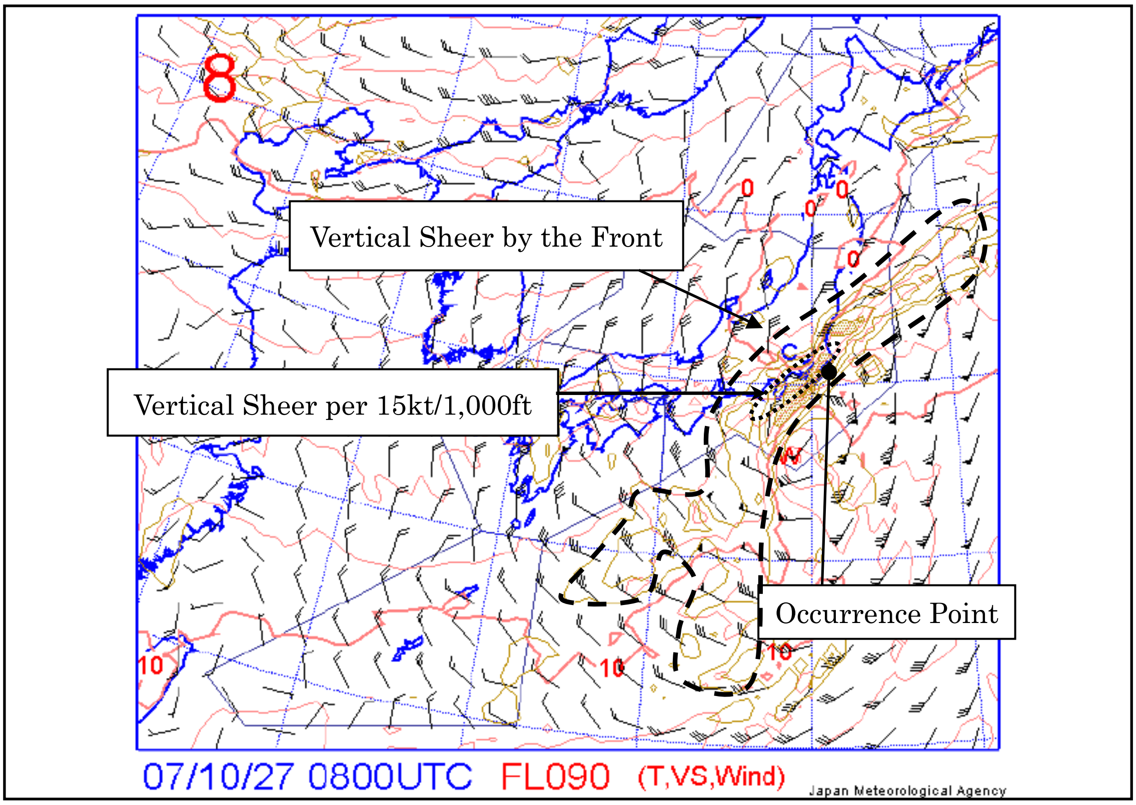


Figure 13 Injured Passengers and CAs' Position on Occurrence

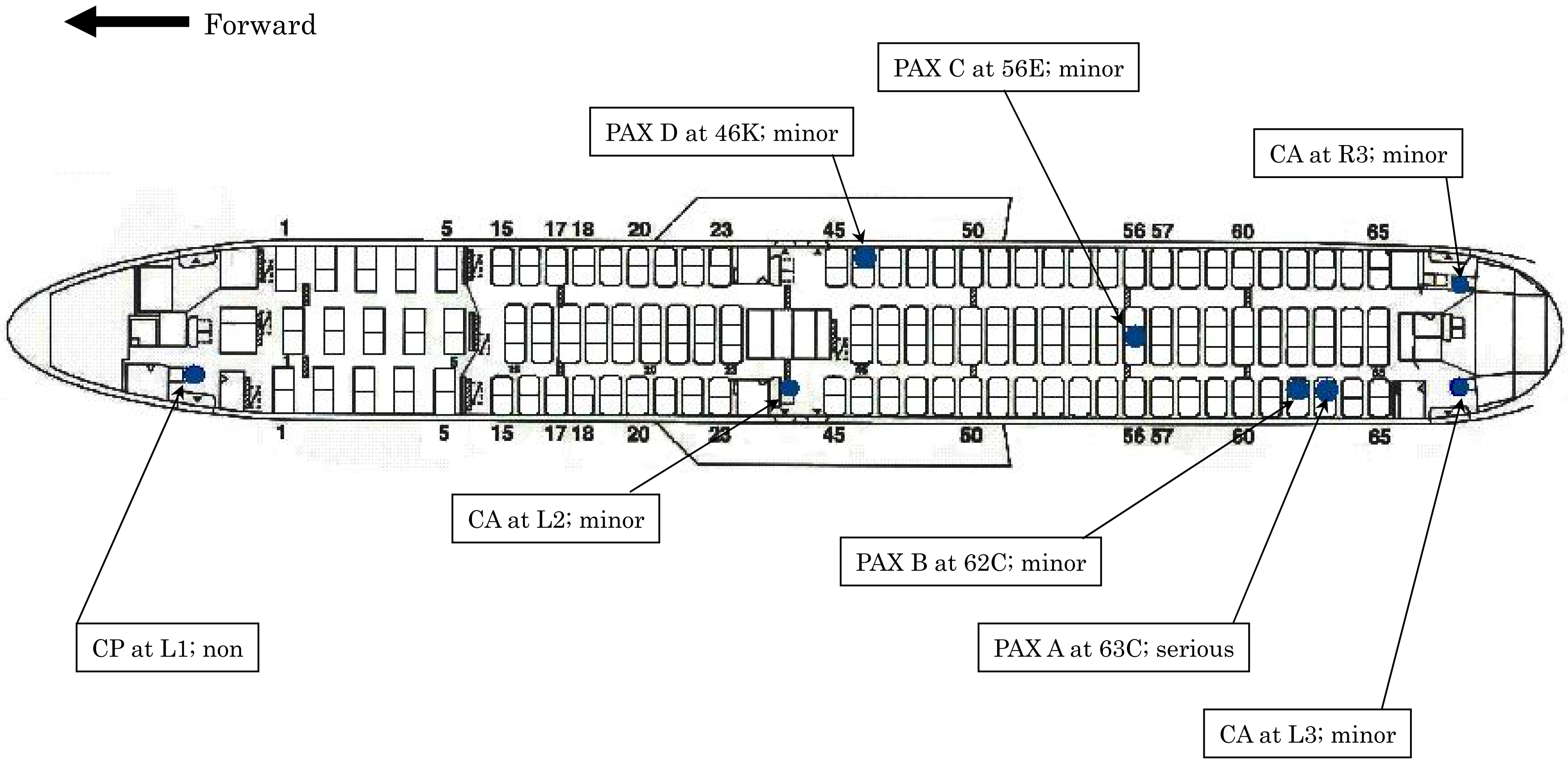


Photo 1　The Same Type of the Aircraft

Photo 2　Destroyed Clamp

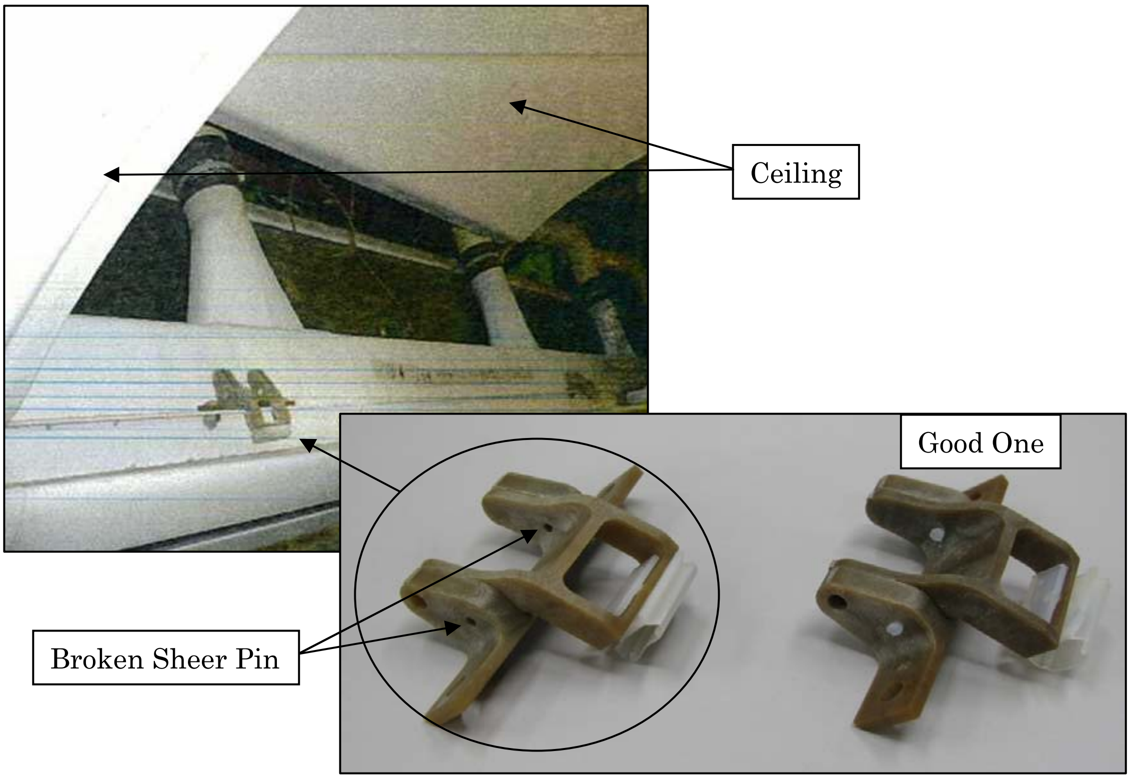


Photo 3　Sheet Belt of the aircraft

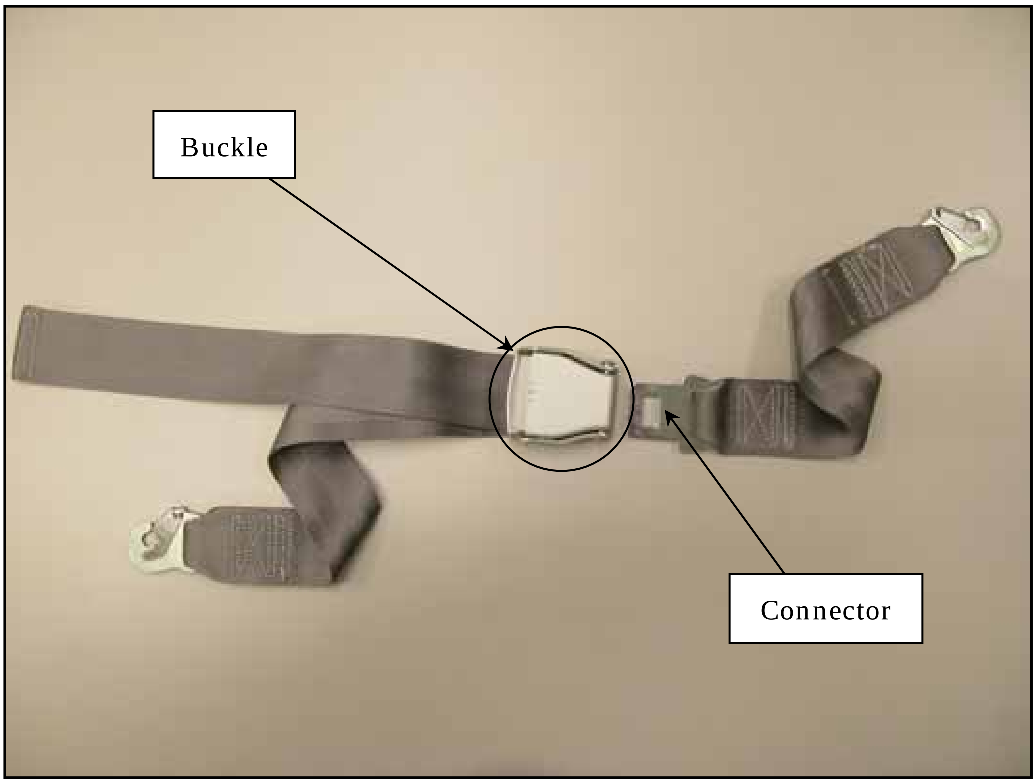


Photo 4　Structure

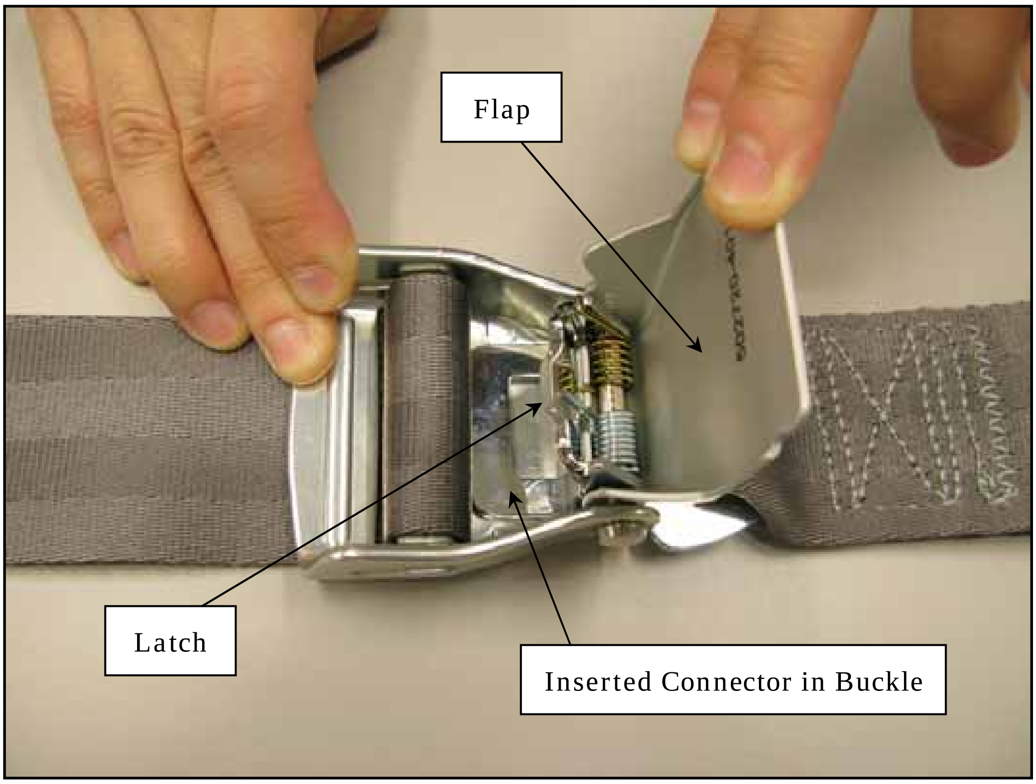


Photo 5 The Bag Carried by Passenger

The Front

The Back

Photo 6　Situation of Holding the Bag (simulated)

Photo 7　Verification of unfastening

(Moving the bag to the direction of the below Arrow)