

AA2016-4

**AIRCRAFT ACCIDENT
INVESTIGATION REPORT**

**ORIENTAL AIR BRIDGE CO., LTD.
J A 8 0 1 B**

May 19, 2016



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.

Kazuhiro Nakahashi
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

DAMAGE TO THE AIRFRAME DURING LANDING
ORIENTAL AIR BRIDGE CO., LTD.
BOMBARDIER DHC-8-201, JA801B
NAGASAKI AIRPORT
AT ABOUT 14:07 JST, FEBRUARY 12, 2014

April 22, 2016

Adopted by the Japan Transport Safety Board

Chairman	Kazuhiro Nakahashi
Member	Toru Miyashita
Member	Toshiyuki Ishikawa
Member	Sadao Tamura
Member	Keiji Tanaka
Member	Miwa Nakanishi

SYNOPSIS

<Summary of the Accident>

On Wednesday, February 12, 2014, at 14:07 Japan Standard Time (JST: UTC + 9 hrs, all times are indicated in JST on a 24-hour clock), a Bombardier DHC-8-201, registered JA801B, operated by ORIENTAL AIR BRIDGE CO., LTD., suffered a strong impact while landing on the runway, during touch-and-go trainings at the Nagasaki Airport.

The aircraft continued its flight training, and then damage on the nose landing gear and the forward outer skins of the fuselage section had been found in the postflight inspection.

The Captain and a trainee were on board the aircraft but there were no dead and injured.

The aircraft was substantially damaged, but there was no outbreak of fire.

<Probable Causes>

It is probable that this aircraft accident was occurred while JA801B was landing with strong cross-winds, under the condition that the main landing gear grounded without sufficient load being applied, the nose of the airplane downed excessively and the nose landing gear grounded heavily, which caused damage on the nose landing gear and the forward outer skin of the fuselage section.

As for the Aircraft grounding heavily, it is probable that the trainee continuously downed the nose of the airplane, and subsequently the Captain who was the instructor failed to provided an appropriate corrective operation.

The main abbreviations used in this report are as follows:

ATC : Air Traffic Control
CVR : Cockpit Voice Recorder
FDR : Flight Data Recorder
FAA : Federal Aviation Administration, the U.S. Department of Transportation
FOD : Foreign Object Damage
GND : Ground
JST : Japan Standard Time
MAC : Mean Aerodynamic Chord
QM : Qualifications Manual
QMS : Qualifications Manual Supplement
SCT : Scattered
VFR : Visual Flight Rules
VHF : Very High Frequency
WOW : Weight On Wheel

Unit Conversion Table

1 ft : 0.3048 m
1 kt : 1.852 km/h
1 lb : 0.4536 kg
1 G : 9.807 m/s²
1 inHg : 3,386 Pa

1. PROCESS AND PROGRESS OF THE ACCIDENT INVESTIGATION

1.1 Summary of the Accident

On Wednesday, February 12, 2014, at 14:07 Japan Standard Time (JST: UTC + 9 hrs, all times are indicated in JST on a 24-hour clock), a Bombardier DHC-8-201, registered JA801B, operated by ORIENTAL AIR BRIDGE CO., LTD., suffered a strong impact while landing on the runway, during touch-and-go trainings at the Nagasaki Airport.

The aircraft continued its flight training, and then damage on the nose landing gear and the forward outer skins of the fuselage section had been found in the postflight inspection.

The Captain and a trainee were on board the aircraft but there were no dead and injured.

The aircraft was substantially damaged, but there was no outbreak of fire.

1.2 Outline of the Accident Investigation

1.2.1. Investigation Organization

On February 13, 2014, the Japan Transport Safety Board designated an investigator-in-charge and two other investigators to investigate this accident.

1.2.2. Representatives of the Relevant State

An accredited representative of Canada, as the State of Design and Manufacture of the aircraft involved in this accident, participated in the investigation.

1.2.3. Implementation of the Investigation

February 13, 2014	Interviews and aircraft investigation Runway traces investigation
February 14, 2014	Interviews and aircraft investigation
February 15, 2014	Maintenance documents investigation

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

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

1.2.5. Comments from the Relevant State

Comments on the draft report were invited from the relevant State.

2. FACTUAL INFORMATION

2.1 History of the Flight

On February 12, 2014, a Bombardier DHC-8-201, registered JA801B operated by ORIENTAL AIR BRIDGE CO., LTD. (hereinafter referred to as “the Company”), took off from Nagasaki Airport (hereinafter referred to as “the Airport”), and as an company flight training in relation to the qualification for the First Officer of the Company, a touch-and-go*¹ trainings were repeatedly being conducted on the runway 32 at the Airport.

The outline of the flight plan was as follows.

Flight rules: Visual flight rules

Departure aerodrome: Nagasaki Airport

Estimated off-block time: 13:15

Cruising Speed: 200 kt

Cruising Altitude: VFR

Route: Omura

Destination aerodrome: Nagasaki Airport

Total estimated elapse time: 1 hour 0 minute

Fuel loading expressed in endurance: 2 hours 30 minutes

Persons on board: Two

Other information: Instrument approach one time and touch-and-goes six times

During this training flight, the trainee sat in the left seat, and the captain, who was the instructor, sat in the right seat.

The history of the flight up to the accident, based on the data of the flight data recorder (hereinafter referred to as “FDR”), the data of the cockpit voice recorder (hereinafter referred to as “CVR”), the air traffic control communication records and the statements of the crewmembers, is summarized below.

2.1.1 History of the Flight based on the FDR and the CVR Records, and the Air Traffic Control Communication Records

14:03:27	The airport traffic control tower (hereinafter referred to as “the Tower”) to the Aircraft to touch and go on the runway 32, and reported a wind direction of 040° and velocity of 17 kt. (The fourth touch-and go attempt on the day of the accident.)
03:35	The captain read back the clearance.
05:54	The captain gave advice to the trainee about the adjustment of the engine power.

*¹ “Touch and Go” refer to the flight method in which a landed aircraft immediately accelerates and takes off after landing without stopping on the runway . It is mainly used in taking-off and landing training.

06:11	The captain gave advice to the trainee about the correction of the approach course against the crosswind.
14:06:44	The captain made a remark that he recognized the grounding of the right main landing gear. The roll angle of the aircraft began to change, and a sudden increase in the lateral acceleration was recorded. Also the elevator angle began to move in the direction of the aircraft nose down, and the movement was recorded consecutively for about four seconds.
06:47	A vertical acceleration of +2.016 G was recorded on the FDR of the aircraft. The WOW* ² temporarily detected GND (on the ground); subsequently, it changed to AIR (in the air) again.
06:48	The pitch angle of the aircraft became -4.57° (nose down) and a severe impact sound was recorded. (The impact sound was recorded only at the time of the fourth landing.)
06:49	The captain made a remark that he was concerned about the condition of the aircraft.
07:02	The captain instructed to continue the touch-and-goes.
07:05	The captain made a remark that he recalled hearing a loud impact sound.
21:58	The aircraft landed. (the seventh landing being the last of the flight training)
around 26:00	The aircraft arrived at an apron and both engines were shutdown.
around 30:00	The captain asked the mechanic whether there was any damage, and then the mechanic replied to the captain that the nose landing gear was damaged. To this reply the captain reconfirmed that there was a strong impact at the time of the grounding.

(See Figure 1: FDR Records)

2.1.2 Statements of the Relevant Personnel

(1) Captain (Instructor)

The captain who was the instructor, was sat in the right seat on the aircraft.

The aircraft took off from the Runway 32 of the Airport and conducted a simulated instrument approach, and subsequently entered the traffic pattern of the Airport and was repeatedly conducted touch-and-goes.

For the fourth touch-and-go, the approach was initiated while simulating that left engine had shut down.

At the final leg*³, the aircraft had been flying more or less on an appropriate approach path along the center line of approach course, and there was no large divergence from the approach speed (100 kt). Therefore, although the captain gave some verbal advice and put his hand on the

*² "WOW" refer to the data recorded in the FDR from signals from sensors that operate due to the load being applied to all the landing gears. With the aircraft when load is applied to the nose landing gear and both main landing gears, the FDR records this as "GND". If on any of the landing gear no load is applied, even is the remaining landing gear touches and enough load is applied, it will be recorded as "AIR".

*³ "Final Leg" refer to the pathway of the extension of the approach side of the center line of the landing runway.

control column occasionally, he judged that there was no particular issue with the piloting control of the trainee; accordingly there was no need to take over.

The captain acknowledged that the trainee had change the crab method (refer to 2.8.1) to the wing low method (refer to 2.8.1) at right crosswind condition, and that the right main landing gear touched the ground first.

Subsequently the nose landing gear and the left main landing gear landed at the same time making a thud noise and the captain felt an impact stronger than usual.

The captain did not correct the trainee's maneuvering operation from the time the right main landing gear of the aircraft landed, to when he felt a strong impact.

The captain did not feel a sign of irregularity of the aircraft such as a strange noise, irregular tremble; therefore, he continued the flight training.

Thereafter, two touch-and-goes were conducted while both engines were operating, and in the final seventh time landed at the airport at flap 0° (flap up). Since the captain did not feel any irregularities of the airframe until the end of the training, he completed all of the planned training courses, and then completed the flight training.

When the aircraft reached the apron and shutdown the engines, he asked the mechanic whether there was any damage to the airframe. He was then told by the mechanic that there was damage to the nose landing gear of the aircraft.

(2) Trainee

At the time of the accident, the trainee had been in-company training to obtain a type rating for the type of aircraft upon joining the company. He had already finished the simulator training and check, and was conducting his fourth actual aircraft flight training on the day of the accident. Before he joined the company, he had operating experience with a small aircraft for the certificate acquisition training. However he had not had an experience operating an aircraft (a commercial aircraft other than an aircraft for training) that requires two pilots to operate until this training.

During the fourth touch-and-go, while the strong wind blew from the right (north-north east) the aircraft entered the final leg of the runway 32 in a crab angle to the right, and the trainee operated the aircraft to change it into a wing low method from around the runway threshold, in order to align the heading with the centerline of the runway.

The right main landing gear touched first, thereafter the trainee felt that the nose of the aircraft was not downing fast enough, and also that the right landing gear did not have enough airplane load applied, may be due to its speed being fast than normal.

When the trainee pushed the control column forwards to execute the nose down, the nose landing gear and the left main landing gear landed at the same time, and there was a strong impact. It was the grounding that was strong so that he had not experienced it until now, and due to the impact the oxygen mask installed in the rear right of the flight deck fell from the storage space.

In the prior landing during a crosswind condition, the trainee received an advice and assistance from the instructor, who pointed out that when change from a crab method to a wing low method, he had a tendency to pitch up the nose too high, and that he was insufficient in pushing forward the control column to maintain the heading during a landing roll.

The trainee did not feel any irregularities with the aircraft even during the landing roll. He was worried that he may have damaged the airframe; however the instructor, who had

considerable experience with the aircraft, had instructed him to continue the touch-and-go; accordingly he thought it was alright and continued the take-off operation and conducted a touch-and-go.

The trainee conducted two touch-and-goes after the event, and a flap 0° landing at the end of training after that, but he did not feel any irregularity during that time.

After landing, and after parking in the apron and shut down the engines, the trainee was notified about the damage to the nose landing gear.

(3) Mechanic

The mechanic was assigned to be in charge of the postflight maintenance and the preflight maintenance for the aircraft to be used for a passenger flight subsequent to the training flight.

There was a strong easterly wind when he arrived at the apron.

He had observed the seventh approach and landing (the last training flight via the traffic pattern) from the apron.

When the aircraft arrived at the apron the mechanic could not feel any abnormalities such as irregular sounds from the aircraft.

After the engines had shut down, the mechanic immediately found the damage on a part of the nose landing gear lower brace, and, in reply to the captain's query, answered that the nose landing gear was damaged.

The accident occurred 665 m from the end of the runway 32 of Nagasaki Airport (32° 54' 40" N and 129° 55' 10" E), and time that it occurred was around 14:07, February 12, 2014.

2.2 Damage to the Aircraft

2.2.1 Extent of the Damage

Substantially damaged

2.2.2 Damage to the Aircraft Components

(1) Nose landing gear: Partial attrition of the lowest end of the shock strut brace, damage to the shock strut parts, deformed marks to both tires.

(2) Fuselage section: Deformation of the right and the left fuselage skins on the rear of the nose landing gear mounting areas.

(See Photos : Damage to the aircraft involved in the accident)

2.3 Personnel Information

(1) Captain	Male, Age 40	
Airline transport pilot certificate		December 8, 2006
Type rating for Bombardier DHC- 8		October 15, 2002
Class 1 aviation medical certificate		
Validity		June 12, 2014
Total flight time		5,595 hr 49 min
Total flight time within the last 30 days		10 hr 18 min
Total flight time on the type of aircraft		5,355 hr 40 min
Total flight time on the type of aircraft in the last 30 days		10 hr 18 min
Training Instructor Qualification		
The Captain had obtained an in-house flight instructor pilot qualification.		

(2) Trainee	Male, Age 25	
Commercial pilot certificate (airplane)		February 25, 2010
Type rating for multi- engine (land)		February 25, 2010
Instrument flight certificate		April 30, 2010
Class 1 aviation medical certificate		
Validity		August 16, 2014
Total flight time		273 hr 53min
Total flight time within in the last 30 days		3hr 11 min
Total flight time on the type of aircraft		3hr 11min
Total flight time on the type of aircraft in the last 30 days		3hr 11 min

2.4 Aircraft Information

2.4.1 Aircraft

Type of aircraft	Bombardier DHC -8-201
Serial number	566
Date of manufacture	December 6, 2001
Certificate of airworthiness	No.DAI-2012-672
Validity	March 21, 2014
Category of airworthiness	Airplane Transport T
Total flight time	21,811 hr 31 min
Flight time since the last periodical maintenance check	
(A check conducted on January 30, 2014)	71 hr 45 min

(See Figure 2 Three Angle View of Bombardier DHC-8-201)

2.4.2 Weight and Balance

When the accident occurred, the weight of the aircraft is estimated to have been 25,888 lb and the position of the center of gravity is estimated to have been 24.3 % mean aerodynamic chord (MAC^{*4}). Both of them were estimated to have been within the allowable ranges (maximum take-off

^{*4} "MAC" refer to the abbreviation of Mean Aerodynamic Chord. It is a wing chord that represents the aerodynamic characteristic of the wing, and indicates the average of when the wing chord such as the rear wing chord is variable. 24.3% MAC indicates a 24.3% position from the front of the mean aerodynamic chord.

weight of 34,500 lb, and range of position of center of gravity corresponding to the weight at the time of the accident, 16.8 to 36.3 % MAC).

2.5 Meteorological Information

2.5.1 Aviation Weather Observations

Aeronautical weather observations for the Airport around the time of the accident were as follows:

14:00 (Aerodrome routine meteorological report)

Wind direction 30 ° ; Wind velocity 22 kt; Prevailing visibility 10 km,

Cloud: Amount: FEW*⁵, Type: Cumulus, Cloud base 3,500 ft

Amount: SCT*⁶, Type: Stratocumulus, Cloud base 4,500 ft

Temperature 10°C; Dew point minus 3°C

Altimeter setting (QNH) 30.16 inHg

Aviation special weather report around the time of the accident was as follows:

13:34 Wind direction 40°, Wind velocity 15 kt, maximum instantaneous wind velocity 22 kt

14:27 Wind direction 40°, Wind velocity 19 kt, maximum instantaneous wind velocity 29 kt

2.5.2 Status of the Surface Wind

Surface wind observations measured by the 2-minute anemometer*⁷ installed at Nagasaki Airport around the time of the accident were as follows:

Time of observation	14:06 -14:07
Wind direction	030° (magnetic bearing)
Average wind velocity	21 - 22 kt
Maximum wind velocity	27 kt

2.6 Information on FDR and CVR

The aircraft was equipped with a FDR manufactured by L3 Communications of the United States of America and a CVR manufactured by Honeywell of the United States of America, and both recorders had retained records at the time of the accident.

The time of the FDR and CVR was determined by correlating the FDR recorded VHF transmission keying signals and the ATC communications recorded on the CVR with the time signal recorded on the ATC communication records.

(See Figure 1 FDR Records)

*⁵ "FEW" refer to the apparent cloud cover percentage of the cloudy section against the unobstructed sky is 1/8 ~2/8.

*⁶ "SCT" refer to the apparent cloud cover percentage of the cloudy section against the unobstructed sky is 3/8 ~4/8.

*⁷ "2-minute anemometer" updates the wind direction and wind speed of the past two minutes on average every six seconds.

2.7 Information of Accident Site and Detailed Damage

2.7.1 Accident Site

The runway of the Airport is 3,000 m (9,840 ft) in length at 60 m (200 ft) in width, and had been grooved (a groove on the surface of the runway); besides, the runway 32 threshold had a height of about 4.6 m (15 ft).

At about 665 m from the runway 32 threshold, and about 2 m (west side) towards the approach direction from the runway centerline marking, there was an abrasion mark of about 8 cm in width and about 230 cm long.

This abrasion mark was discovered when after the discovery of the damage to the nose landing gear of the aircraft was reported by the Company and the Japan Civil Aviation Bureau carried out runway inspection.

There were no damage uncountable to runway lights, markings and other facilities.

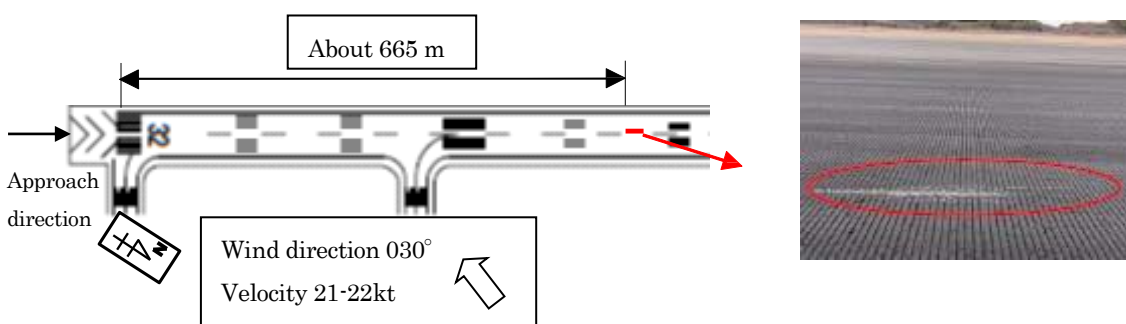


Diagram 1: The approach direction of the aircraft and the abrasion mark location on the runway

Photo: The abrasion mark on the runway

2.7.2 Detailed Damage Description

(1) Nose landing gear

Attrition could be seen on a section of the lowest end of the shock strut brace and the piston cap was destroyed and had fallen downwards from the original attachment point.

(2) Fuselage

The right and left fuselage skins on the nose landing gear mounting areas were deformed (wrinkle) in three places on the left and one place on the right. These deformations were maximum 0.8mm in depth. The internal structural member of the deformed section had no damage uncountable.

(3) Others

Based on the airplane maintenance manual, a special inspection was carried out. No abnormalities were found in the other parts of the aircraft, engine nor the propellers.

(See Photos: Damage to the aircraft involved in the accident)

2.8 Additional Information

2.8.1 Typical Landing Method During Crosswind

When a head wind is blowing, an airplane axis can be aligned with the runway approach centerline while approach.

However, when there is a crosswind and an airplane axis is aligned to the runway approach centerline, the airframe will be blown leeward. In such instances, by the nose heading windward on the final approach course the crosswind factor is cancelled out, thus it can fly along the runway approach centerline. This method of approach by heading the nose windward is called the crab method. This is because it resembles the crab walking sideways. Besides, the approach method that

involves moving the main wing of the windward side downwards to align with the runway approach centerline, and slide the airplane though is called the wing-low method.

Conventionally, if the crosswind is not severely strong, the approach is made through the crab method, and near the runway threshold, the axis is aligned with the runway approach centreline, and then shifted to wing-low method; consequently, it led to ground from the main landing gear of the windward side.

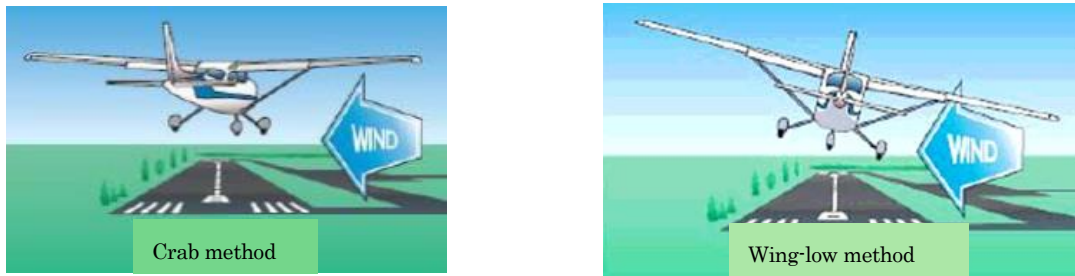


Diagram 2 : Approach by Crab Method and Wing- Low Method
 「Airplane Flying Handbook」 published by FAA (Fig. 8-15, 16)



Diagram 3 : Crosswind landing (first touch down is with the main landing gear of the windward side)
 「Airplane Flying Handbook」 (Fig. 8-17)

2.8.2 The Maximum Crosswind Value of the Aircraft during Take-off and Landing

There were the following descriptions in the operation manual and aircraft operation manual of the Company as regards the maximum crosswind value.

The maximum crosswind value against the condition of the runway during take-off and landing was as follows:

(Excerpt)

<i>The condition of the runway</i>	<i>Maximum Crosswind Value (KT)</i>
<i>DRY</i>	<i>36</i>

The aforementioned maximum value is applied regardless of the passenger flight or the training flight, and the surface wind data that was informed by the air traffic controller to the aircraft before the take-off and landing, and the wind observation data described in 2.5 were both within the maximum limit.

2.8.3 The Maximum Vertical Acceleration Recorded in the FDR

The maximum G (maximum vertical acceleration) at landing during the flight training recorded in the FDR of the aircraft was +2.016.

The value was recorded at the fourth landing; however, it had not exceeded the limitation value (+2.1 G) that is specific in the Aircraft maintenance manual as the value that requires special inspection when there has been a hard landing.

Moreover, the maximum G recorded on the landing for the flight training conducted seven times in total were as follows.

No. of Landing	1	2	3	4	5	6	7
Maximum Vertical Acceleration (G)	1.529	1.598	1.341	2.016	1.528	1.614	1.707

2.8.4. FDR Records about the grounded situation of the Landing Gears

In the FDR records after the maximum G described in 2.8.3. was recorded, the WOW was continuously changing to GND and AIR.

2.8.5. Training by the Company

The training manual of the Company described the following as regards the training that was being taken by the trainee.

(Excerpt)

3. Training course and training time

(Omitted)

COPUPG - The person applying for a change in the type and requires two pilots to fly the airplane for the first time

Table The training course and training time for the trainee

Training Course	Training Time	Lesson Number of Times
<i>COPUPG</i>	<i>6 + 00</i>	<i>7</i>

Besides, there was the following description about the training subjects that are to be conducted.
(Excerpt)

1. Training Purposes

The purpose of this training is to enhance the technical skills under various flight conditions and will practice on the overall manual control skills.

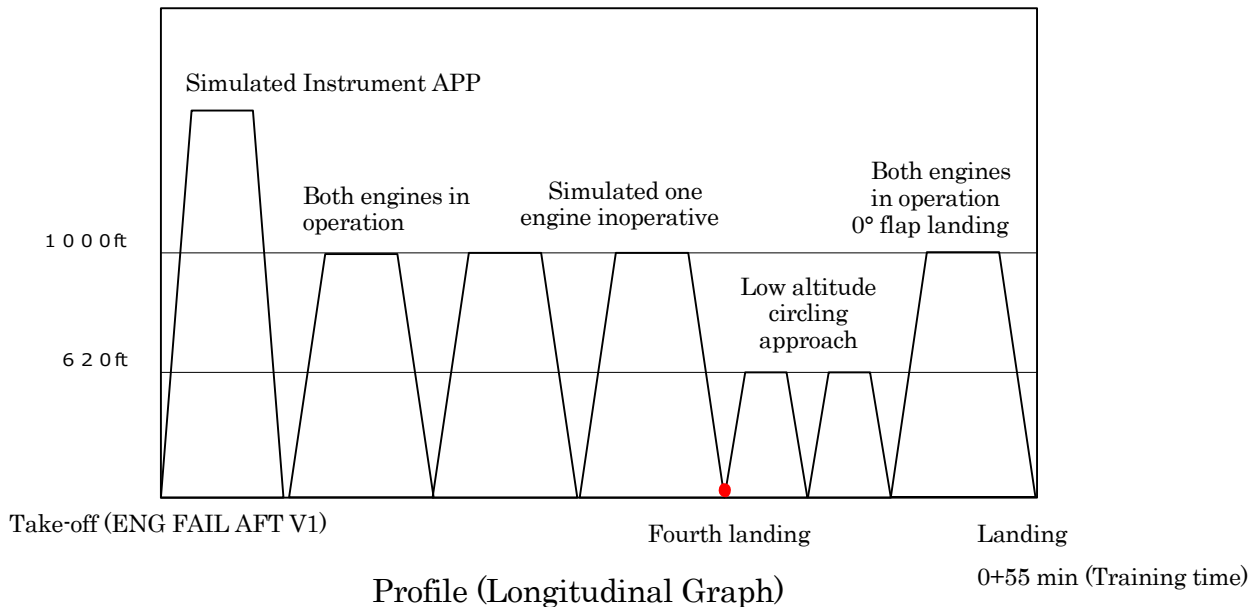
The training will focus on the operation of the take-off and landing with two ENGS, steadying at PATH CONTROL on FINAL, and the practice regarding one ENG MANEUVER.

3. Training Subjects

3-1 Training Time 0+55 (55 minutes)

The training subjects and profiles (longitudinal graph) of the day of the accident were as follows:

Training Subjects
ENG START (engine start) or SHUT DOWN (engine shut down)
ENG FAIL AFT V1 (engine failure after the decision speed)
ILS APP : instrument landing approach (DA LDG : visual landing from Decision Altitude)
Two ENG NML TRAFFIC AND TGL (Traffic Pattern flight and touch-and-go with both engines in operation)
One ENG NML TRAFFIC AND TGL (Traffic Pattern flight and touch-and-go with simulated one engine not in operation)
MIN CIRCLING GO-AROUND TGL (Low altitude circuit, go-around, touch-and-go)
FLAP UP LDG (Flap 0° Landing)



2.8.6. The Captain's Experience as an Instructor

The captain began his instructor pilot training on July 14, 2013, attended classroom lectures, right seat flight training and other subjects. He passed the instructor pilot examination on November 9, 2013, and was officially appointed as an instructor pilot on November 10, 2013.

The captain was in charge of a group of four trainees for his first assignment of instruction after his appointment.

The trainings given to the group of trainees consisted of the following:

Date, Period	Contents of the Training	Trainees (number)
October 8- October 19, 2013	Part of classroom lectures of aircraft system	4
November 4 , 2013 - January 25, 2014	Part of airplane maneuvering manual, classroom lecture of maneuvering related aircraft system , and flight training using flight simulator	4
February 4, 2014	Actual flight training 55 min	In charge of other trainees
February 5, 2014	Actual flight training 50 min	In charge of the trainee
February 10, 2014	Actual flight training 55minutes	In charge of the trainee
February 11, 2014	Actual flight training 55 min	In charge of other trainees

2.8.7. The Provisions of Assist and Take-over Stipulated in the Instructor Pilot Training Material of the Company

The instructor pilot training material had the following description as regards an assist and a take over. (Excerpt)

ASSIST: A phase with a relative safety margin, where one can add slight power, or lightly offer hand support to the CONTROL COLUMN.

It is important that the trainee is not deprived of independence and judgment in this phase.

TAKE OVER: Literally, take over the CONTROL immediately. This is a matter of emergency and although it is hoped that it will not progress to this phase, it is important to act without hesitation once decision is made.

Appropriate TIMING is key and also important not to miss the opportunity.

3. ANALYSIS

3.1 Airman Competence Certificate and Aviation Medical Certificate

The captain and the trainee held both valid airman competence certificates and valid aviation medical certificates.

3.2 Airworthiness certificate

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

3.3 Meteorological Conditions

As described in 2.5.1, it is highly probable that the weather of Nagasaki Airport around the time of the accident was cloudy, visibility was good ; accordingly there were no clouds that would be an obstacle for landing approach.

As described in 2.5.2, it is highly probable that the status of the wind over the runway 32 around the time of the accident was that the wind direction was from the right 70° direction, and the crosswind component was on average 20 kt and maximum about 25 kt.

As described in 2.8.2, although it did not exceed the maximum crosswind value that is applicable to the aircraft upon take-off and landing, it is probable that the flight training that includes touch-and-goes that simulates one engine , was of a considerably high level for a trainee who had a lack of experience with the same type of aircraft.

3.4 Development of the Damage to the Airframe

3.4.1 Situation of Touch Down

(1) Situation of the touch down of the aircraft

According to the statements of the captain and the trainee described in 2.1.2, the timing of the vertical and lateral acceleration changes and the significant decrease in the roll angle recorded in the FDR as indicated in Figure 1, it is highly probable that the under the crosswind situation blowing from the right, the aircraft changed from the crab method to wing low method and landed with the right landing gear first.

After the right main landing gear touched down, it is somewhat likely that, with pitch slightly moved upward and rolled to the left, the Aircraft became slightly float. Therefore, it is probable that the stronger vertical acceleration (+2.016 G) mentioned in 2.8.3 was recorded as the main landing gear and nose landing gear touched down around the same time as the pitch was dropped to adjust this situation.

Subsequently, as described in 2.8.4, it is probable that in the FDR records of the aircraft, the WOW had changed from GND to AIR, and it bounced slightly, causing the nose to move upwards slightly, resulting in no load to the landing gears.

It is probable that before there were complete loads on the main landing gears, the pitch angle abruptly reached a maximum minus 4.57°, and the nose landing gear touched down with strong impact, causing the lowest end of the shock strut brace of the nose landing gear to make contact with the runway surface.

(2) Maneuvering operation at the time of landing

As described in 2.1.2 (2), after first the right main landing gear touched the ground, the trainee thought that it was taking longer than one thought for the nose of the Aircraft became to be low and there was no load on the right main landing gear. Also judging from the fact that, before the landing, the trainee had also received advice and assistance by the instructor who is also the captain that the trainee had a tendency to pitch-up the nose too high during the change from crab method to wing low method in situations when there was crosswind situation, and had also received advice that as regards maintaining the direction during the take-off roll pushing forward the control column was insufficient, it is somewhat likely that the trainee was conscious of having to push the control column forward and had conducted the operation to down the nose continuously.

Moreover, due to this operation to down the nose , it is probable that a significant pitch down moment (the turning force that works in the direction of the nose down) caused , and then the nose landing gear to touch the grounding with strong impact.

3.4.2 Correction Operation by the Captain

As described in 2.8.6, it is somewhat likely that the captain had not carried out a corrective operation as in the statement described in 2.1.2(1) was caused by the fact that captain did not have prior experience as an instructor , and as described in 2.8.7, there was a lack of awareness as regards taking over and corrective operation .

It is probable that the captain should give adequate consideration to the training environment and have a strong awareness of take over, and that before the trainee enters a realm that exceeds his/her capability, and before the instructor himself/herself becomes unable to comply, the take over should be conducted at a suitable timing.

Moreover, as regards the above, it is probable that the Company should provide appropriate education such as through maneuvering education methods, by referring to the examples of past accidents on the aircraft damage due to a strong impact on the grounding of the nose landing gear at opportunities such as the instructor pilot training and check.

3.4.3 The Damage Mechanism of the Airframe

It is probable that due to the heavy load on the nose landing gear of the aircraft, the nose landing gear trailing arm contacted the runway surface, and also that the shock strut of the nose landing gear had shrunk to the maximum, which then broken the piston cap of the bottom of the strut, and caused the deformation of the tires on the right and left. It is possible that the load could not be absorbed the damage to the nose landing gear alone, and due to the effect of this the right and left fuselage skins on the rear of the nose landing gear mounting areas were deformed.

(See Photos: The Damage to the aircraft involved in the accident)

3.5 The Recognition of the Aircraft Damage by the Crew

The captain did not feel the abnormality of the engine instrument and other parts of the aircraft during the fourth landing roll and had made a decision to continue with the training. However, as described in 2.1.1, taking into consideration the comments of the captain recorded together with the impact sound at the time of landing, and that fact that straight after landing the captain had asked the mechanic whether there was a damage to the aircraft, it is somewhat likely that the captain had thought the possibility that there was damage to it.

Actually the aircraft had suffered damage and there was also a sufficient possibility of an expanded damage due to the continuity of the touch-and-goes, leading to a deterioration of the airworthiness of the aircraft. If there are parts which were damaged and were scattered, it is probable that it generate a secondary damage by Foreign Object Damage (FOD). Therefore, it is probable that when the captain had felt there was a danger of a damage to the aircraft, the training should have been suspended immediately and that an aircraft inspection should have been conducted by the mechanic accordingly.

4. PROBABLE CAUSE

It is probable that the accident occurred while the aircraft was landing under strong crosswind, under the condition that the main landing gear grounded without sufficient load being applied, the nose of the airplane downed excessively and the nose landing gear grounded heavily, which caused damage on the nose landing gear and the deformation of the right and left fuselage skins.

As for the nose landing gear of the aircraft grounding heavily, it is probable that the trainee continuously downed the nose, and subsequently the captain who was the instructor failed to provide an appropriate corrective operation.

5. SAFETY ACTIONS

5.1 Safety Actions Taken by the Company

5.1.1 Measures Concerning the Overall Training

Taking into account the occurrence of the accident, the Company implemented the following prevention measures.

- (1) The establishment of limits to the crosswind take-off and landing during actual flight training with actual airplanes.

The following maximum crosswind value was defined in the training manual for the actual flight training for the First Officer up-grade training (including training for type rating change)

First to Third : 10 kt

Fourth and Fifth : 20 kt

Sixth and Seventh : In accordance with the existing flight operation guideline

However, even if it was within the above mentioned crosswind limit, this will not hinder the judgement of the instructor to stop a training in accordance with a skill of a trainee.

- (2) The enhancement of the crosswind landing training during simulator training

It was added in the training manual that the crosswind training for the pre-local training of the simulator training will be conducted by adding the rough air (a situation where the atmospheric air is unstable) to 20 kt -36 kt of crosswind.

- (3) Setting of detailed regulations on Take Over

Detailed regulations that require attention about take over, in particular during flight training, were added to the STUDY GUIDE, and widely distributed to all the flight crew members and trainees.

- (4) Review of accident cases

It was defined in the syllabus of the instructor pilot training that the program "The past accident cases relating to the training and examination, including the Accident" is to be performed within the QM (the manual defining the standard relating to the training and examination of crew members and crew personnel), and QMS (additional manual that stipulates points relating to training and examination) for one hour. Moreover, at the

instructor inspection meetings, the introduction of example cases were performed to the current instructor pilots and current inspection pilots.

5.1.2 Measures Concerning the Flight Instructor Pilot Training

The Company organized points of consideration (items that the instructor pilot should pay attention to relating to the damage of the nose landing gear at the time of landing) during training and examination and added there to the education materials.

Points to consider during training and examination (Excerpt)

1. The damage to the nose landing gear can be anticipated even base on the weather conditions.
2. Do not miss the timing to take over.
3. When a bounce occurs, do not pitch down the nose of an aircraft to restrain the bounce, but go around without hesitation.
4. Even if there is no bounce due to hard landing and other situations, avoid a sudden nose wheel touching down.
5. The nose down operation increases the risk of nose landing gear damage.
6. When there is even a small possibility of the nose landing gear being damaged, suspend the training or examination and always conduct an inspection.

Figure 1 FDR Records

Pressure
Altitude (ft)

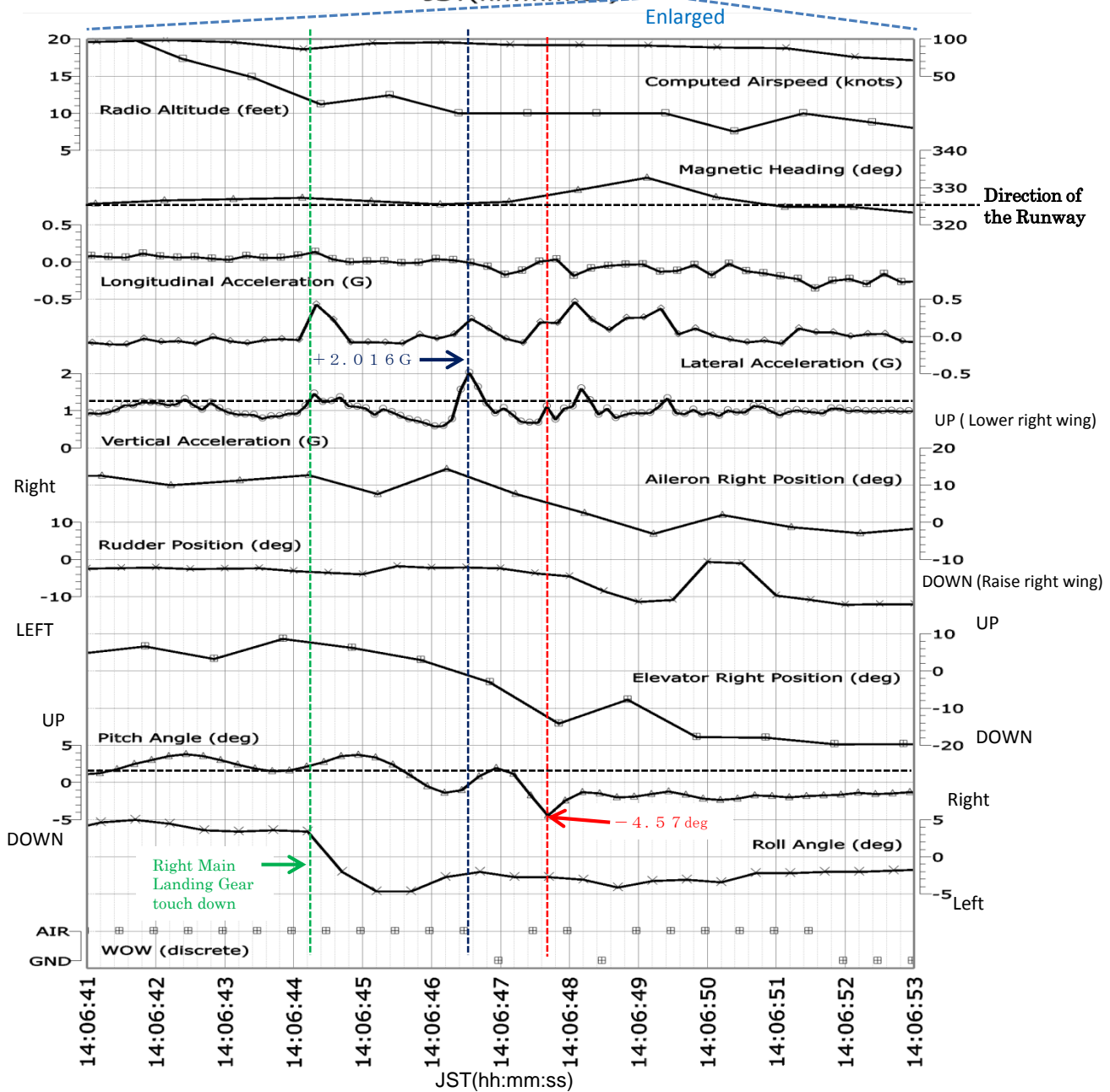
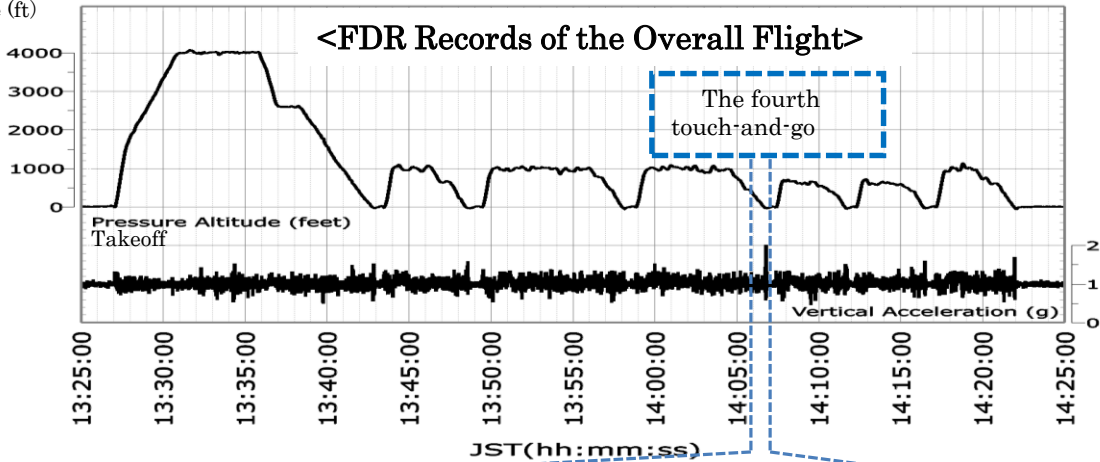
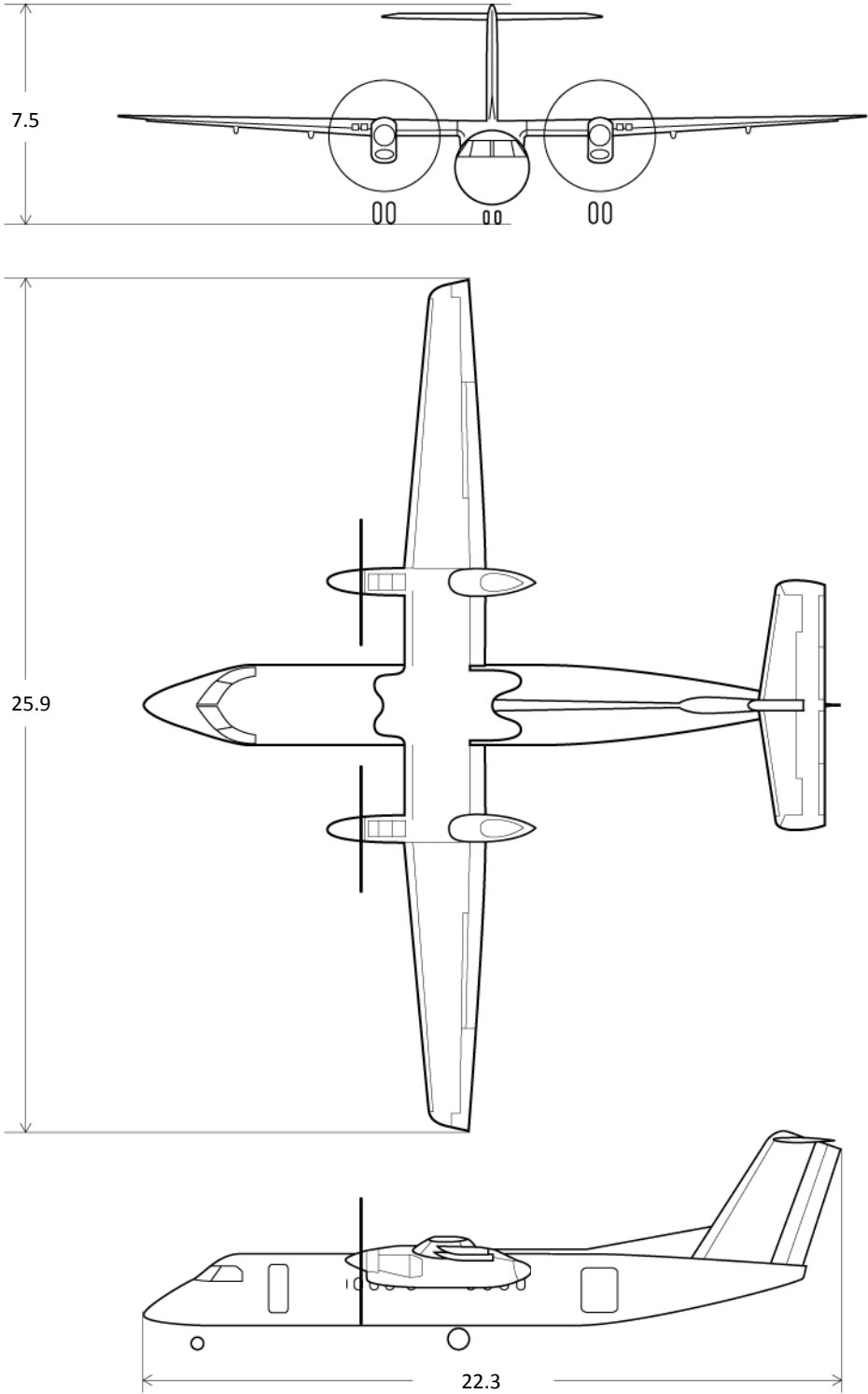


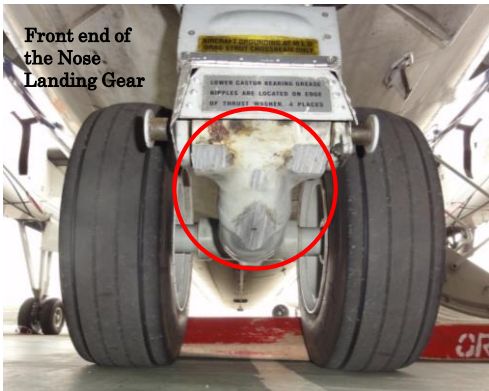
Figure 2 Three Angle View of Bombardier DHC-8-201

Unit:m



Photos: Damage to the aircraft involved in the accident

Damage to the Nose Landing Gear



Undamaged part of the same type aircraft (Piston cap)

Damage to Fuselage Skin

