AA2019-6

AIRCRAFT ACCIDENT
INVESTIGATION REPORT

PRIVATELY OWNED
N 7 0 2 A V

July 25, 2019

Japan Transport Safety Board

The objective of the investigation conducted by the Japan Transport Safety Board in accordance with the Act for Establishment of the Japan Transport Safety Board and with Annex 13 to the Convention on International Civil Aviation is to determine the causes of an accident and damage incidental to such an accident, thereby preventing future accidents and reducing damage. It is not the purpose of the investigation to apportion blame or liability.

Nobuo Takeda
Chairman
Japan Transport Safety Board

Note:

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

AIRCRAFT ACCIDENT INVESTIGATION REPORT

CRASH DUE TO LOSS OF CONTROL DURING FLIGHT
PRIVATELY OWNED
SOCATA TBM700, N702AV
IN YAMAZOE VILLAGE, YAMABE-GUN,
NARA PREFECTURE
AT ARROUND 12:15 JST, AUGUST 14, 2017

June 14, 2019

Adopted by the Japan Transport Safety Board

Chairman Nobuo Takeda

Member Toru Miyashita

Member Yoshiko Kakishima

Member Yuichi Marui

Member Yoshikazu Miyazawa

Member Miwa Nakanishi

SYNOPSIS

<Summary of the Accident>

On Monday, August 14, 2017, a privately owned Socata TBM700, registered N702AV, took off from Yao Airport at 11:57 Japan Standard Time (JST: UTC + 9 hours; all times are indicated in JST on a 24-hour clock), for the purpose of leisure flight under Instrument Flight Rules (IFR), deviated from the route instructed by an air traffic controller on the way to Fukushima Airport and crashed into a mountain forest in Yamazoe village, Yamabe-gun, Nara Prefecture after the last communication at 12:13, saying that it would return to Yao Airport.

A captain and a passenger were on board the aircraft and both were fatally injured.

The aircraft was destroyed and a fire broke out.

<Probable Causes>

In the accident, it is highly probable that the Aircraft lost control during flight, nose-dived while turning, and disintegrated in mid-air, resulting in the crash.

It is somewhat likely that the Aircraft lost control during flight, because the captain did not have pilot skills and knowledge necessary for the operation of the Aircraft, and was not able to perform proper flight operations.

<Recommendations>

Recommendations to the Minister of Land, Infrastructure, Transport and Tourism

In the accident, it is somewhat likely that the Aircraft lost control during flight, because the captain did not have pilot skills and knowledge necessary for the operation of the Aircraft, and was not able to perform proper flight operations. The captain had a valid Japanese competence certificate in this regard, and in case of the competence certificate in Japan, with regard to the aircraft not requiring the type rating, if the aircraft meet each class rating, pilots can be entitled to operate the aircraft within the scope of services in accordance with each qualification, regardless of the characteristics of each aircraft.

Therefore, in view of the identified matters of the accident investigation, in order to ensure the safety of aviation, the Japan Transport Safety Board recommends to implement the following measure pursuant to the provision of Article 26 of the Act for Establishment of the Japan Transport Safety Board to the Ministry of Land, Infrastructure, Transport and Tourism.

In order to prevent pilots from flying without skills and knowledge necessary for operating the respective aircraft, it is necessary for the Civil Aviation Bureau of the Ministry of Land, Infrastructures, Transport and Tourism to instruct the pilots to master the skills and knowledge required for operating the aircraft which the pilots have never flown before, even in case of operating the aircraft not requiring the type rating.

The main abbreviations used in this report are as follows:

AIM-J	: Aeronautical Information Manual Japan
AOA	: Angle of Attack
ATO	: Approved Training Organization
ATPL	: Airline Transport Pilot License
BEA	: Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile
BPL	: Balloon Pilot License
CBT	: Computer Based Training
CFR	: Code of Federal Regulations
CPL	: Commercial Pilot License
CT	: Compressor Turbine
EU	: European Union
EASA	: European Aviation Safety Agency
ELT	: Emergency Locator Transmitter
FAA	: Federal Aviation Administration
FAR	: Federal Aviation Regulations
FCL	: Flight Crew licensing
FL	: Flight Level
FTO	: Flight Training Organization
HDG	: Heading
IAS	: Indicated Air Speed
IFR	: Instrument Flight Rules
IR	: Instrument Rating
KCAS	: Knots Calibrated Airspeed
KIAS	: Knots Indicated Airspeed
KTAS	: Knots True Airspeed
LAPL	: Light Aircraft Pilot License
MAC	: Mean Aerodynamic Chord
NAV	: Navigation
PCA	: Positive Control Area
POH	: Pilot's Operating Handbook
PPL	: Private Pilot License
PT	: Power Turbine

RGB	: Reduction Gear Box
SPL	: Sailplane Pilot License
SID	: Standard Instrument Departure
TCA	: Terminal Control Area
TGL	: Touch and Go Landing
TRTO	: Type Rating Training Organization
VFR	: Visual Flight Rules
VA	: Maneuvering Speed
VMO	: Maximum Operating Speed
VS	: Vertical Speed

Unit Conversion List:

1 ft	: 0.3048 m	
1 atm	: 29.92 inHg	: 1,013 hPa
1 nm	: 1,852 m	
1 lb	: 0.4536 kg	
1 kt	: 1.852 km/h (0.5144 m/s)	

Table of Contents

1 PROCESS AND PROGRESS OF THE AIRCRAFT ACCIDENT INVESTIGATION

1.1 Summary of the Accident

On Monday, August 14, 2017, a privately owned Socata TBM700, registered N702AV, took off from Yao Airport at 11:57 Japan Standard Time (JST: UTC + 9 hours; all times are indicated in JST on a 24-hour clock), for the purpose of leisure flight under Instrument Flight Rules (IFR), deviated from the route instructed by an air traffic controller on the way to Fukushima Airport and crashed into a mountain forest in Yamazoe village, Yamabe-gun, Nara Prefecture after the last communication at 12:13, saying that it would return to Yao Airport.

A captain and a passenger were on board the aircraft and both were fatally injured.

The aircraft was destroyed and a fire broke out.

1.2 Outline of the Accident Investigation

1.2.1 Investigation Organization

On August 14, 2017, the Japan Transport Safety Board designated an investigator-in-charge and an investigator to investigate this accident.

1.2.2 Representatives from the Relevant States

An accredited representative and an advisor of the French Republic, as the State of Design and Manufacture of the aircraft involved in the accident, an accredited representative and an advisor of Canada, as the State of Design and Manufacture of the engine of the aircraft, and an accredited representative of the United State of America, as the State of Registry of the aircraft, participated in the investigation.

1.2.3 Implementation of the Investigation

August 15 to 18, 2017	Interviews, aircraft examination and on-site investigation
September 19 and 20, 2017	Aircraft examination and on-site-investigation
October 31 to November 2, 2017	Aircraft examination
January 11, 2018	Yaw trim actuator examination (performed by the yaw trim actuator manufacture in the presence of BEA)

1.2.4 Comments from Parties Relevant to the Cause

Comments were not invited from parties relevant to the cause, because the captain as the party concerned were fatally injured.

1.2.5 Comments from the Relevant States

Comments on the draft report were invited from the Relevant States.

2. FACTUAL INFORMATION

2.1 History of the Flight

On August 14, 2017, a privately owned Socata TBM700, registered N702AV (hereinafter referred to as "the Aircraft"), took off from Yao Airport (hereinafter referred to as "the Airport") at 11:57, for the purpose of leisure flight, with a captain in the left pilot seat and a passenger, who did not have a pilot license, in the right pilot seat.

The flight plan of the Aircraft is outlined below:

Flight rules:	Instrument Flight Rules (IFR)
Departure aerodrome:	Yao Airport
Estimated off-block time:	11:20
Cruising speed:	280 kt
Cruising altitude:	FL*1 220
Route:	ASUKA (Waypoint) – KCC (Nagoya VORTAC) – Y88 (RNAV route) – GOT (Daigo TACAN)
Destination aerodrome:	Fukushima Airport
Total estimated elapsed time:	2 hours 45 minutes
Fuel load expressed in endurance:	5 hours 30 minutes

Based on radar track records for air traffic control, the images of a dashboard camera, ATC communications records, and the statements of air traffic controllers (hereinafter referred to as "Controllers") and eyewitnesses, flight history up to the time of the accident is summarized as below,.

2.1.1 History of the Flight based on Radar Track Records for Air Traffic Control and ATC Communications Records

According to the radar track records for air traffic control at Kansai Aerodrome control tower, the estimated flight route of the Aircraft after the take-off until the crash is as shown in Figure 1.

The Aircraft received a clearance to Fukushima Airport via Standard Instrument Departure (SID), ASUKA SIX DEPARTURE from the air traffic controller at control position of Yao Aerodrome control tower (hereinafter referred to as "the Yao Tower"), and was instructed

*1 "FL" refers to the pressure altitude of the standard atmosphere. It is the altitude indicated by value divided by 100 of the index of the altitude indicator (unit: ft) when QNH is set to 29.92 inHg, FL is usually applied when flight altitude is 14,000 ft or above in Japan. E.g., FL 200 indicates an altitude of 20,000 ft.

to contact with the approach control of Kansai radar approach control (hereinafter referred to as "Kansai Approach") and maintain an altitude of 2,500 ft after the take-off; and then at 11:57, the Aircraft took off from the Airport.

11:58:10 The Aircraft received the second clearance from the Yao Tower and responded to the third call from Kansai Approach. Kansai Approach instructed the Aircraft to climb and maintain 4,000 ft.

11:59:17 Kansai Approach instructed the Aircraft to climb and maintain 5,000 ft, and it read back.

11:59:42 Kansai Approach instructed the Aircraft to turn right to heading 360°, but it did not respond.

11:59:49 Kansai Approach instructed the Aircraft to turn right to heading 010°, and it read back.

12:00:10 Kansai Approach instructed the Aircraft to contact with the departure control of Kansai radar approach control (hereinafter referred to as "Kansai Departure").

The Aircraft turned right at an altitude of 4,600 ft and at a ground speed of about 170 kt, and the climb rate decreased gradually.

12:00:30 The Aircraft said it was climbing to an altitude of 6,000 ft to Kansai Departure. Kansai Departure instructed it to maintain an altitude of 5,000 ft.

12:01:25 Kansai Departure instructed the Aircraft to turn right to heading 040°, and it read back.

12:01:52 The Aircraft turned right at an altitude of 5,200 ft and at a ground speed of about 240 kt.

12:02:00 Kansai Departure instructed the Aircraft to climb and maintain FL160, and it read back.

12:02:47 The Aircraft commenced to climb at an altitude of 5,300 ft and at a ground speed of about 220 kt.

12:03:03 Kansai Departure instructed the Aircraft to turn right to heading 090°, and it read back.

12:03:37 The Aircraft turned right while climbing at an altitude of 6,800 ft and at a ground speed of about 190 kt.

12:04:10 Kansai Departure instructed the Aircraft to turn right to heading 100°, and it read back.

12:05:14 Kansai Departure instructed the Aircraft to fly directly to ASUKA

(waypoint), and it read back.

12:05:54 The heading started to swing, while climbing at an altitude of 10,300 ft and at a ground speed of about 120 kt.

12:08:13 The Aircraft turned right and changed the heading to the southeast while climbing at an altitude of 12,500 ft and at a ground speed of about 180 kt.

12:09:22 Kansai Departure asked the Aircraft whether it was flying directly to ASUKA, and it responded saying that it was flying directly to ASUKA. .

12:10:39 Kansai Departure asked the Aircraft about its heading, but there was no response from the Aircraft.

12:11:02 Kansai Departure asked the Aircraft about its heading again, and it responded saying that its heading was 070°. Kansai Departure asked the Aircraft whether the heading was 070°, but there was no response from the Aircraft.

12:11:30 Kansai Departure confirmed whether the Aircraft was maintaining FL160, there was a response from the Aircraft. Kansai Departure instructed the Aircraft about heading 070°, but there was no response from the Aircraft.

12:11:54 The Aircraft started to descend and changed the heading to the east after climbing to an altitude of 17,200 ft at a ground speed of about 150 kt.

12:12:10 In Japanese, Kansai Departure instructed the Aircraft to promptly descend to FL160 and follow ATC instructions, but there was no response from the Aircraft.

12:12:42 The Aircraft requested radar vectors to the Airport. Kansai Departure confirmed in Japanese whether the Aircraft would return to the Airport.

12:12:58 The Aircraft cancelled IFR flight.

12:13:48 The Aircraft started a right turn while descending from an altitude of 16,000 ft at a ground speed of about 180 kt.

12:14:19 Kansai Departure instructed the Aircraft to contact with the air traffic controller at TCA*2 of Kansai radar approach control (hereinafter referred to as "Kansai TCA").

12:14:46 The Aircraft requested Kansai TCA to provide radar vectors to the Airport.

---

*2 "TCA (Terminal Control Area)" refers to public airspace within the approach control area in which TCA advisory operations are made for aircrafts flying under visual flight rules (VFR aircrafts) where VFR aircrafts are particularly congested. Within TCA, the following services shall be provided for VFR aircrafts that radar identified.
a) TCA Radar advisory service, b) Radar navigational guidance based on the requirement of said aircraft, c) The provision of positional information of said aircraft, d) Advice for approach order and holding.

12:14:56 Kansai TCA instructed the Aircraft to turn right heading to the west, but after that, the Aircraft did not respond to the calls from Kansai TCA.

12:15:22 The Aircraft nosedived while turning right near the crash site, passing an altitude of 13,000 ft.

12:15:53 The Aircraft disappeared from the radar after being confirmed last at 8,700 ft above around the crash site.

The flight route from 12:15:22 to 12:15:53 was about 2.21 nm in distance along the route and about 18° in descent angle. (See Figure 3.)

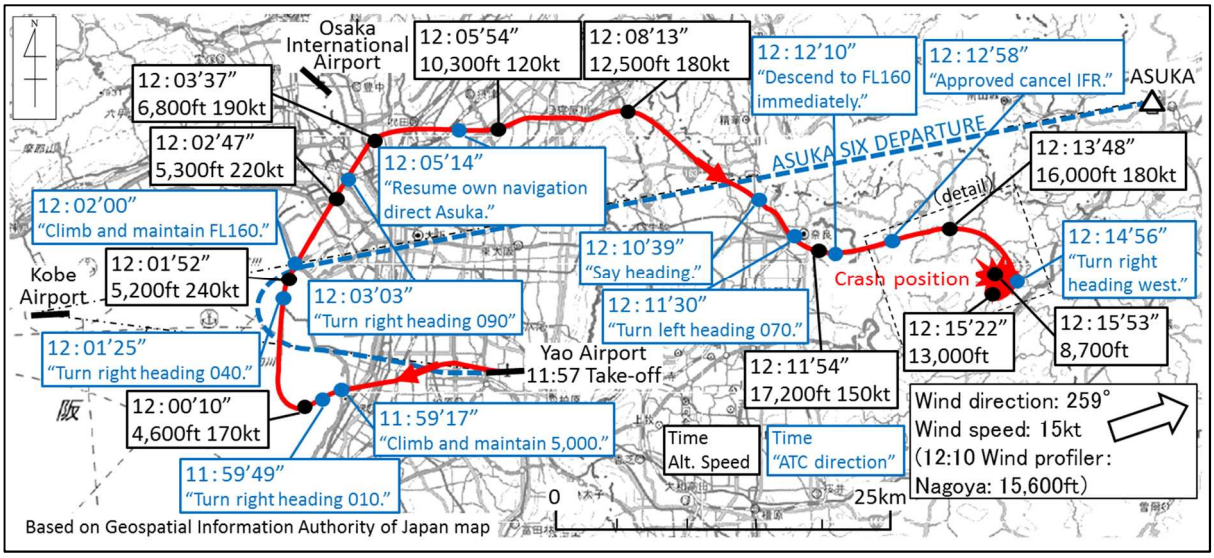


Figure 1: estimated flight route

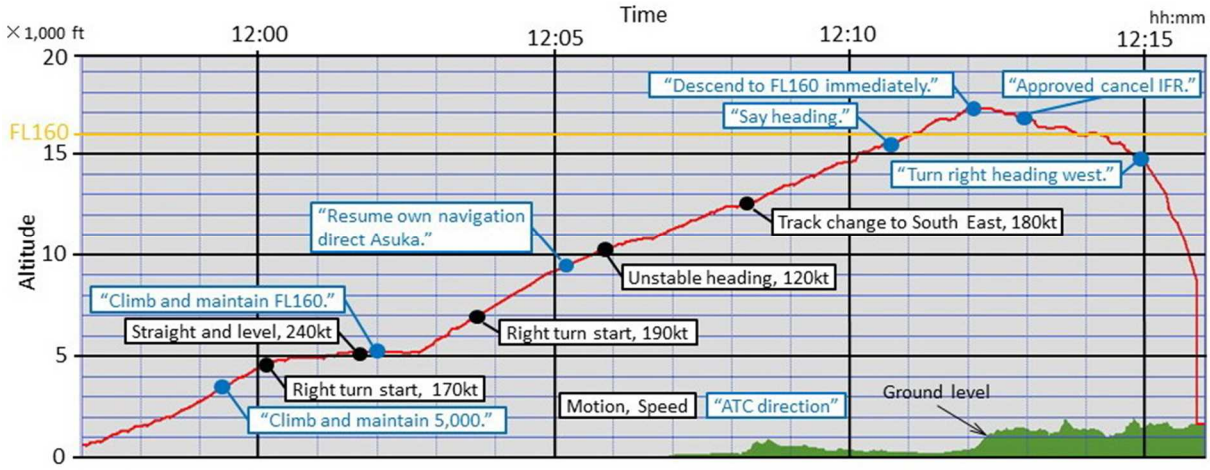


Figure 2: vertical cross section chart of the estimated flight route

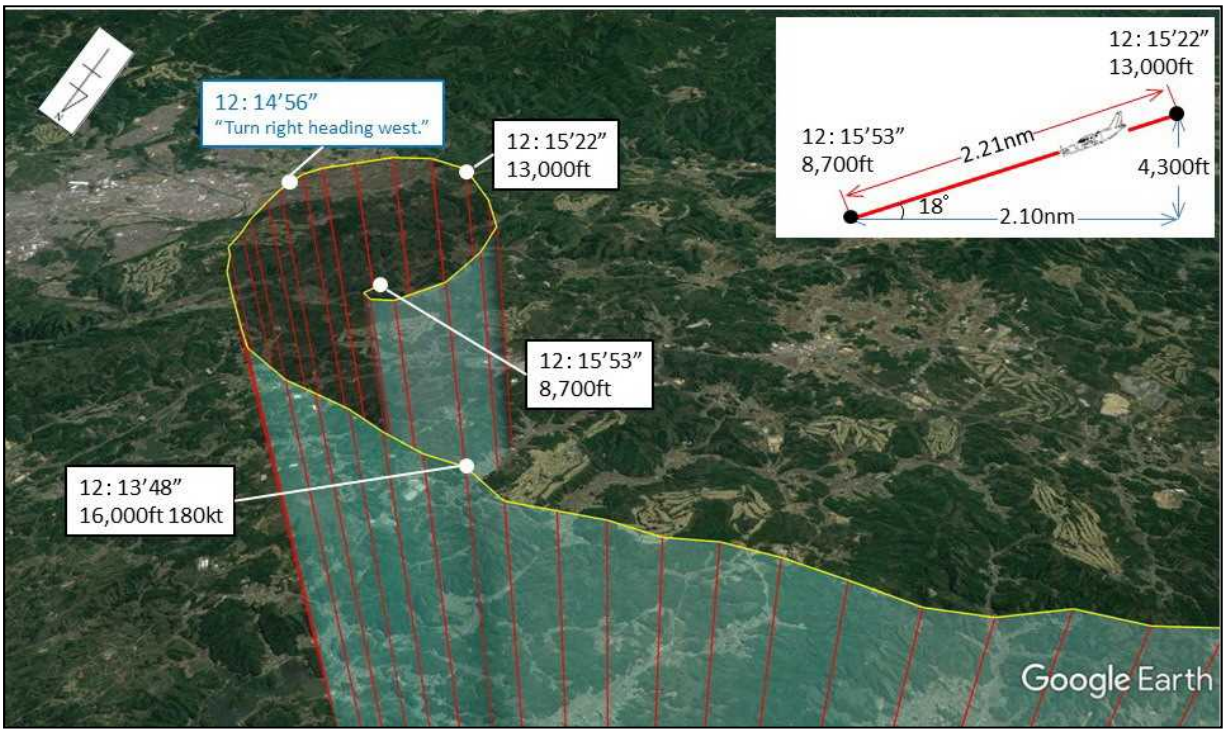


Figure 3: estimated flight route (detailed)

2.1.2 Statements of Controllers

(1) Controller at Kansai Approach

The Aircraft took off from the Airport, but it did not call to Kansai Approach soon, therefore, Kansai Approach called to the Aircraft, and finally it responded to the third call from Kansai Approach. The Aircraft deviated southward rather than the SID flight path. As it could have a great influence on the aircraft take-offs / landings at the surrounding airports, if the Aircraft would deviate further westward, the Controller instructed earlier the Aircraft to turn heading 360°, but there was no response from it. When the Controller instructed the Aircraft to turn right to heading 010° and climb to an altitude of 5,000 ft, it read back and changed to heading 010° at an acute angle.

(2) Controller at Kansai Departure

The Aircraft was transferred from Kansai Approach to Kansai Departure. As the Aircraft mentioned an altitude of 6,000 ft that was different from the instruction by Kansai Approach, the Controller instructed it to maintain an altitude of 5,000 ft. After avoiding another aircraft by instructing the Aircraft to turn to heading 040°, the Controller instructed it to climb to FL160. The Aircraft's timing of read-back was deviated every time. The Aircraft was heading southward even though it was supposed to fly directly to ASUKA, and when

asked about the ongoing heading, the Aircraft replied "070°", the direction toward ASUKA. As the altitude of the Aircraft passed FL 170, the Controller instructed it to return to FL160. Nevertheless, the Aircraft was still heading southward. The Controller instructed it not to raise the altitude in Japanese, because it might have an influence on another aircraft. The Aircraft said abruptly that it would return to the Airport without explaining any reasons, and as the Aircraft requested to cancel the flight under IFR, the Controller instructed it to contact with Kansai TCA.

(3) Controller at Kansai TCA

As the captain of the Aircraft said that it would return to the Airport, the Controller instructed the Aircraft to head westward, however it did not respond. The Aircraft suddenly went descending while turning right without communicating about its abnormality to the Controller. Before long, it became difficult to identify the Aircraft on radar, and it disappeared from the radar screen. Immediately, the Controller called the Aircraft, but there was no response from the Aircraft. Since around this area, it happens often that the aircraft cannot be captured by radar when an aircraft flies at a lower altitude, the Controller asked Yao Aerodrome control tower to let him know when the Aircraft arrived. As the arrival of the Aircraft was not able to be confirmed even after 30 minutes passed, the Controller immediately started the search and rescue operation.

2.1.3 Statements of Eyewitnesses

(1) Eyewitness A

Eyewitness A saw the Aircraft crashing when he was sitting in a chair outside about 1.3 km northeast of the crash site.

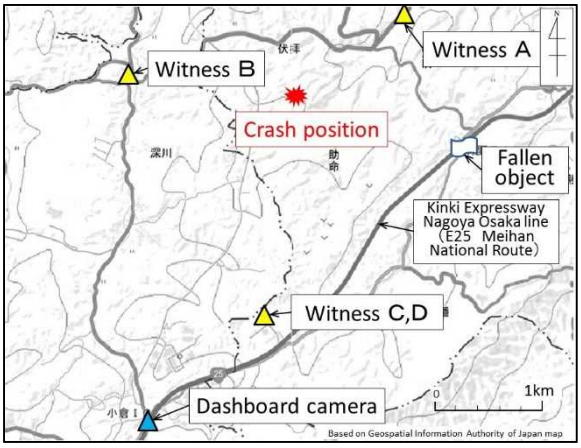


Figure 4: positions of eye witnesses

From the west sky, hearing a high sound of malfunctioning engine noise as if a small motorbike was racing its engine to the utmost, Eyewitness A looked up at the sky. Eyewitness A saw the Aircraft falling almost vertically into the mountain, with one wing catching on fire and nearly half of the airframe enveloped in flames. The Aircraft was hidden behind the mountain, and after a moment, Eyewitness A heard a big bang like a rumbling of the earth.

Eyewitness A got in a car and headed for rescue of the passengers of the Aircraft, but could not reach the Aircraft because the accident site was in a mountain area

without any roads.

(2) Eyewitness B

Eyewitness B saw the Aircraft crashing about 1.7 km west of the crash site.

At about 12:15, sitting in the parking car with its window opened, Eyewitness B heard the big sound like a motorbike running. As the sound was so loud that Eyewitness B got out of the car and looked at the sky over the direction the sound was coming from, when the Aircraft was coming out from the clouds and flying from west to east while making a huge noise that he had never heard of before. While spiraling and being enveloped in white smoke and orange flame, the Aircraft was falling straight from its nose. The Aircraft fell at a tremendously high speed, and when he thought it had gone off the other side of the mountain, the smoke rose with a big bang.

(3) Eyewitness C

Eyewitness C saw the Aircraft crashing about 2.1 km south-southwest of the crash site.

Hearing a buzzing sound and looking up at the sky, in the direction of the northeast, Eyewitness C saw the Aircraft flying. When something large parts came off from the Aircraft, immediately after white smoke rose and fire started from around its wing, soon the Aircraft crashed into the mountain with its nose down while spiraling, and then black smoke rose.

(4) Eyewitness D

Eyewitness D saw the Aircraft crashing about 2.1 km south-southwest of the crash site.

When Eyewitness D spotted the Aircraft for the first time, it was already on fire. While Eyewitness D was watching it thinking that it might be an acrobatic flight, the Aircraft was falling down while spiraling. Eyewitness D heard a buzzing noise of the engine, and in a while, a loud thumping noise. After its crashing, black smoke rose.

2.1.4 Images of Dashboard Camera

The image of the Aircraft's crash was recorded on the dashboard camera of the vehicle travelling northeast on the Kinki Expressway Nagoya Osaka Line (E25, Meihan National Route) about 3.4 km southwest of the crash site.

One second before the crash, an object that seemed to be the Aircraft emerged from the low cumulus layer trailing black smoke, and went falling down. Subsequently, an object separated from the object falling first came out trailing black smoke. The first emerged object burned explosively emitting orange light before impacting the ground. After the two objects had reached the ground, the trailing black smoke disappeared gradually. Five seconds after the crash, two columns of black smoke trailed from the vicinity of the crash site.

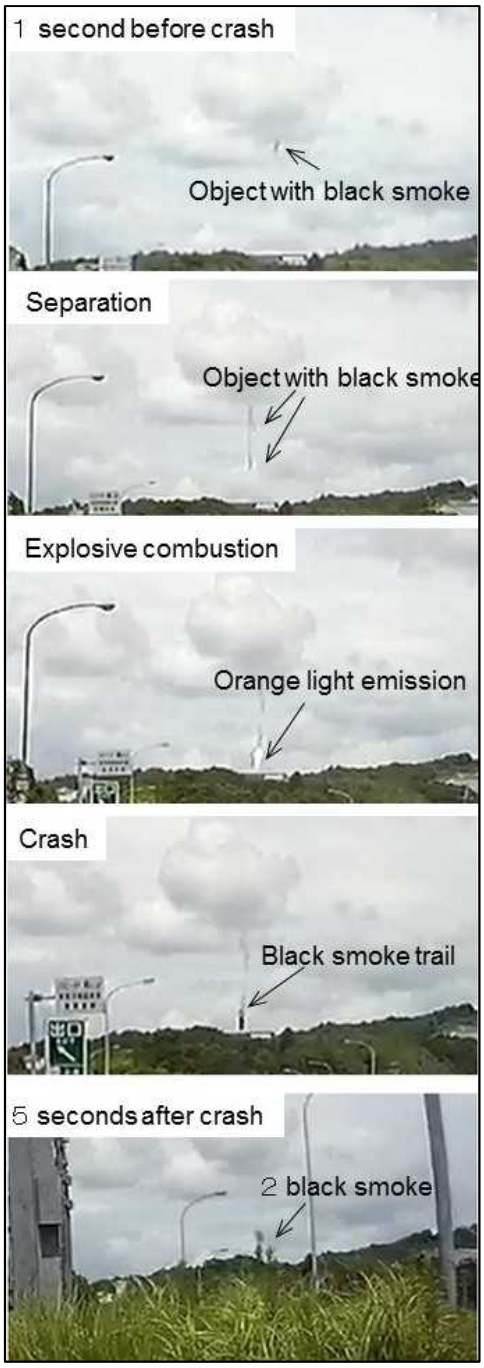


Figure 5: continuous photos of the dashboard camera

2.1.5 Information on falling objects

The permission, which the Aircraft was carrying, concerning the proviso to paragraph 1 of Article 11 (Airworthiness Certificate) of the Civil Aeronautics Act (Act No. 231 of July 31, 1952) was found on the road of the Konoguchi Interchange descending acceleration lane of the Meihan National Route about 1.6 km east-southeast of the crash site, and recovered.

This accident occurred in the mountains of Yamazoe village, Yamabe-gun, Nara Prefecture (34°39'16"N, 136°00'01"E) at around 12:15 on August 14, 2017.

(See Figure 1: estimated flight route, Figure 2: vertical cross section chart of the estimated flight route, Photo 3: estimated flight route (detailed), Figure 4: positions of eyewitnesses and Figure 5: continuous photos of the dashboard camera.).

2.2 Injuries to Persons

There were two persons on board the Aircraft, consisting of a captain and a passenger and both were fatally injured.

2.3 Damage to the Aircraft

2.3.1 Extent of Damage

Destroyed

2.3.2 Damage to the Aircraft Components

Fuselage	Broken, burned
Left wing	Broken, damaged
Right wing	Broken, burned
Horizontal stabilizer	Detached, damaged
Vertical stabilizer	Detached, damaged
Engine	Burned, damaged

2.4 Personnel Information

Captain Male, Age 68

Commercial pilot certificate	June 26, 1984
Pilot competency assessment	
Expiry of practicable period for flight	April 14, 2018
Rating for single engine (land)	February 28, 1979
Instrument flight certificate	September 3, 1983
Class 1 aviation medical certificate	
Validity	June 22, 2018
Total flight time	3,750 hours or more
Flight time in the last 30 days	5 hours 30 minutes
Total flight time on the type of aircraft	7 hours 00 minute
Flight time in the last 30 days	5 hours 30 minutes
Total flight time on instrument flight in the last 180 days	Unknown

The captain did not have any appropriate certificates or licenses issued or validated by the United States of America, the State of Registry of the Aircraft.

2.5 Aircraft Information

2.5.1 Aircraft

Type	Socata TBM700
Serial number	182
Date of manufacture	December 14, 2000
Date of obtaining airworthiness certificate (the United States of America)	December 14, 2000
Category of airworthiness	Airplane Normal N
Total flight time	2,094 hours 18 minutes
Flight time since last periodical check (Annual inspection carried out on July 3, 2017)	5 hours 30 minutes

(See Appendix 1: Three Angle View of Socata TBM700)

2.5.2 Weight and Balance

When the accident occurred, the weight of the Aircraft is estimated to have been 6,424 lb and the position of the center of gravity is estimated to have been 24.9% MAC*3, both of which are estimated to have been within the allowable range (maximum take-off weight of 6,579 lb, and 18.6 to 36.6% MAC corresponding to the weight at the time of the accident).

2.5.3 Characteristics

Turboprop engine, engine output 700 horse power, pressurized aircraft (maximum operating altitude 30,000 ft), maximum operating limit speed 266 KIAS.

2.6 Meteorological Information

2.6.1 Weather Radar Echo Status

The echo status of the weather radar (reflection intensity) near the accident site was as shown in Figure 6, and no noticeable echo was confirmed near the Aircraft's crash position.

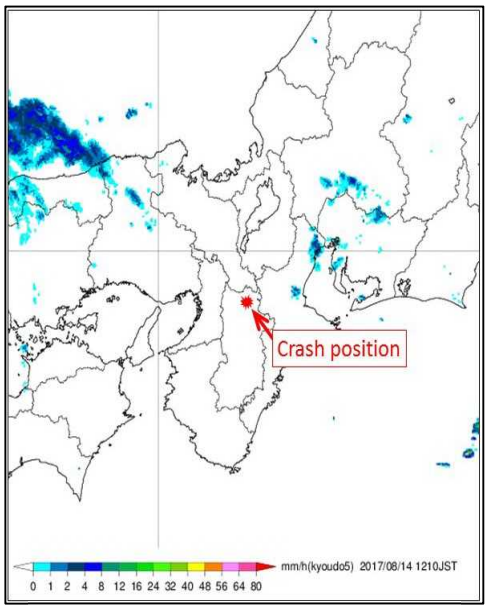


Figure 6: radar image (12:10)

*3 "MAC" refers to the abbreviation Mean Aerodynamic Chord. It is a wing chord that represents the aerodynamic characteristic of the wing, and indicate the average of when the wing chord such as the rear wing chord is variable. 24.9 % MAC indicates a 24.9 % position from the front of the mean aerodynamic chord.

(See Figure 6: radar image [12:10].)

2.6.2 Wind Conditions in the Upper Air

According to the wind profiler records at the Nagoya Observation Station (about 105 km northeast of the accident site) and the Takamatsu Observation Station (about 185 km southwest of the accident site), the wind direction and speed in the upper air around the time when the accident occurred were as shown in Table 1.

Table 1: wind profiler record

Point	Nagoya	Takamatsu
Time	12:10	12:10
Altitude	4,657 – 4,708 m (Around 15,600 ft)	5,531 – 5,540 m (Around 18,500 ft)
Wind direction and speed	259° 8 m/s	290° 12 m/s

2.6.3 Weather Observations at the Airport

Aviation weather observations at the Airport, around the time when the accident occurred, were as follows;

12:00 Wind direction variation; wind speed 1 kt; Prevailing visibility 35 km

Cloud: Amount 1/8; Type cumulus; Cloud base 3,000 ft

Amount 4/8; Type cumulus; Cloud base 4,000 ft

Amount 5/8; Type unknown; Cloud base unknown

Temperature 31°C; Dew point 20°C

Altimeter setting (QNH*4) 29.74 inHg

2.6.4 Weather Observations in the vicinity of the Accident Site

Weather observations at the Observation Stations "Nara" (about 15 km west of the accident site, an elevation of 102 m) and "Hari" (about 7 km southwest of the accident site, an elevation of 468 m), around the time when the accident occurred, were as shown in Table 2.

Table 2: regional weather station observations

Station	Time	Wind direction (°) / Wind speed (m/s)		Temperature (℃)	Precipitation (mm)	Sunshine duration (minutes)
		Average	Maximum instantaneous			
Nara	12:10	292.5 / 2	292.5 /3.9	29.4	0	10
	12:20	270 / 1.6	315 / 3.3	29.3	0	5
Hari	12:10	270 / 2.1	225 / 4.9	26.9	0	10
	12:20	247.5 / 2	247.5 / 5.2	27.3	0	10

*4 "QNH" is one of the pressure altimeter settings, and is usually provided in inHg units. In Japan, when an airplane is at less than 14,000 ft above mean sea level shall be set to QNH of a point on the nearest flight path.

2.7 Scene of the Accident

The crash site was a forested site covered with tall trees near the top of the mountain (an elevation of 514.3 m) in the suburbs of Nara City.

The wreckage of the Aircraft was scattered within the range of about 200 m north-south and about 100 m in the east-west. The main components of the Aircraft (front part of cabin, engine part and propeller) were found being crashed into the bottom of the valley with its nose facing north-northeast in upside down, and were severely burned. The trees on the south-southwest side of the main components were cut down halfway, and the elevation angle of the cut part measured from the position of the propeller was at about 60°.

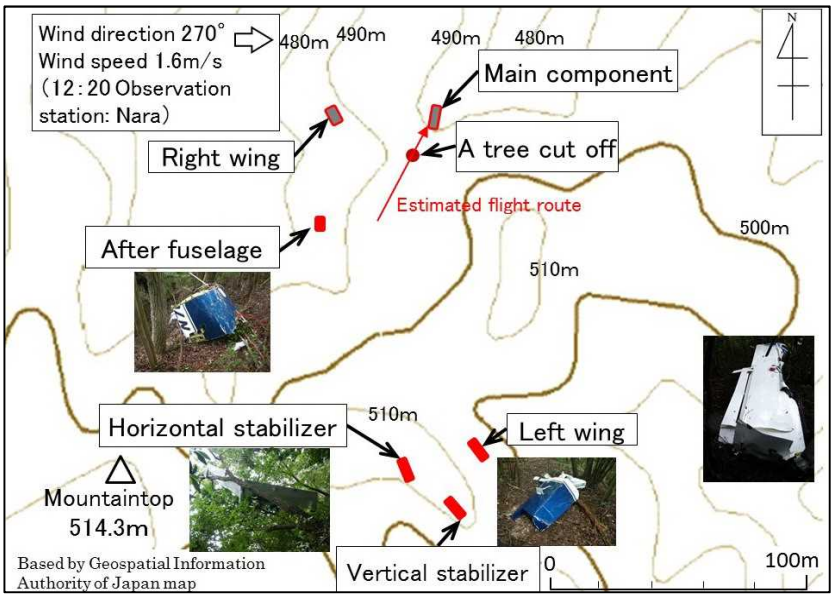


Figure 7: condition of the Aircraft scattering

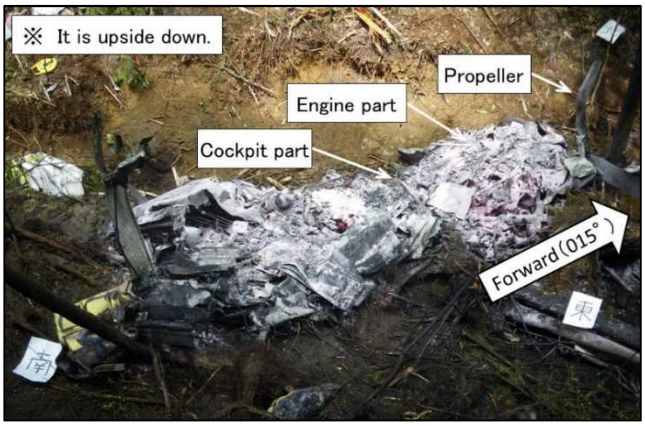


Figure 8: main components

The right wing was broken halfway and found lying with its top surface facing up, on the ground of a slope over the ridge about 40 m away in a straight distance on the west side of the main components. The right wing was entirely burned, particularly the fracture surface was burned at high temperature, and therefore, the metal was melted and its color changed to white.

The broken fuselage aft was found on a slope over the ridge about 60 m away in a straight distance on the southwest side of the main components. With its front part was grounded, there was no trace of fire and the electrical wirings were extended toward the main components. The antenna of the emergency locator transmitter (ELT) installed in the fuselage aft had fallen off.

Figure 9: cut trees

The left wing was also broken halfway, whose main part was found on the ridge about 130 m south of the main components, and there was no trace of fire. The horizontal stabilizer was found on trees about 130 m south of the main components, and there was no trace of fire. The vertical stabilizer was found on a slope about 140 m south of the main components, and there was no trace of fire.

The yaw trim tab on the trailing edge of the rudder was open 3 cm to the left side (the direction in which the right rudder is applied) from the neutral position.

(See Figure 7: condition of the Aircraft scattering, Figure 8: main components, Figure 9: cut trees, Figure 10: right wing, and Figure 11: opening in yaw trim tab.)

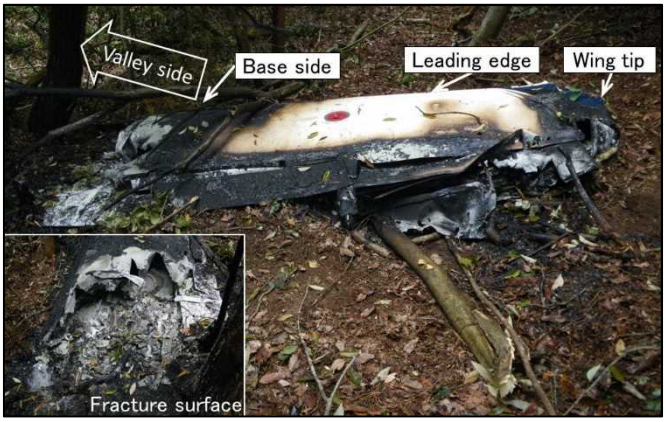


Figure 10: right wing

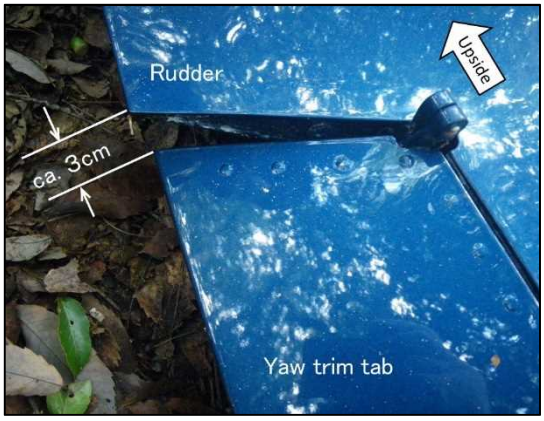


Figure 11: opening in yaw trim tab

2.8 Details of the Damage

(1) Fuselage

The fuselage was broken at the positions of frame (F) 10, from F12 to F16, and F17.

The fuselage was severely burned from F1 to F10. The fuselage part from F1 to F10 was not found (stabilizer was recovered).

There were black scratch marks on the upper part of the fuselage and the upper front of the cabin door. The right part of the ceiling from F10 to F15 was broken due to an impact from above.

(Figure 12: damage to the fuselage)

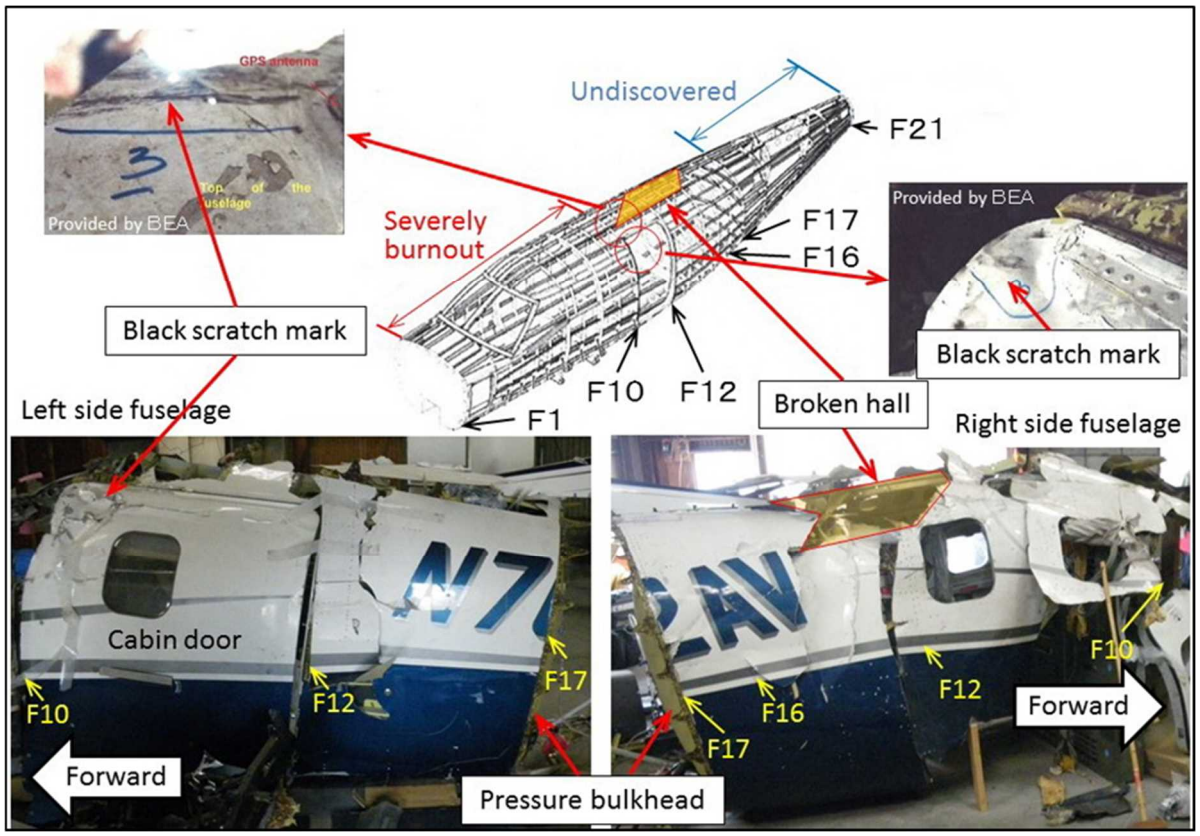


Figure 12: damage to the fuselage

(2) Left wing

The left wing was broken near the rib (R) 8, and the spar was bent upward at an angle of 45° or more and broken. The wing root side from R8 was severely burned along with the fuselage, but there was no trace of fire on the wing tip side from R8. About 180 cm from R10 to R20 of the leading edge equipped with black rubber deicing boots was damaged and dented by the impact from the front. As the aileron had not been found, it was impossible to identify the position of the aileron trim tubs mounted only on the left wing. The spoilers in unison with aileron did not sustain any damage and were retracted. The flaps were detached from the main wing and cut into three parts, but there was no trace of fire. The jackscrew used for moving the flaps was in the "up" position.

(See Figure 13: damage to the left wing.)

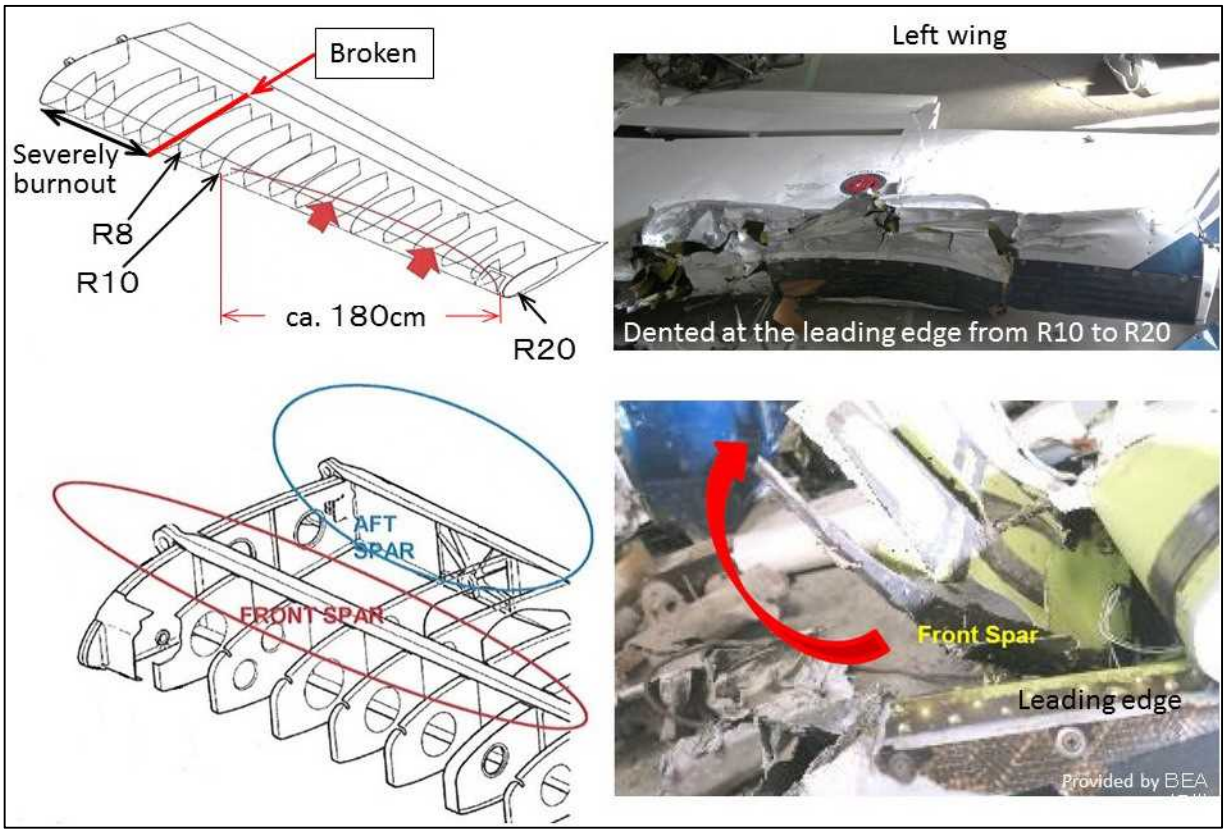


Figure 13: damage to the left wing

(3) Right wing

The right wing was broken around R8 and the wing tip side was entirely burned, especially around the fractured surface was severely burned. The wing root side from R8 was not found. As for the fitting part between the front spar and the fuselage, the part for the front spar was broken, the aft spar was bent backward and broken around the root part. The ailerons and spoilers were burned down. The flaps were detached from the main wing and cut into three parts, and there was no trace of fire except the wing root side found around the fuselage. The jackscrew used for moving the flaps was in the "up" position.

(See Figure 14: damage to the right wing.)

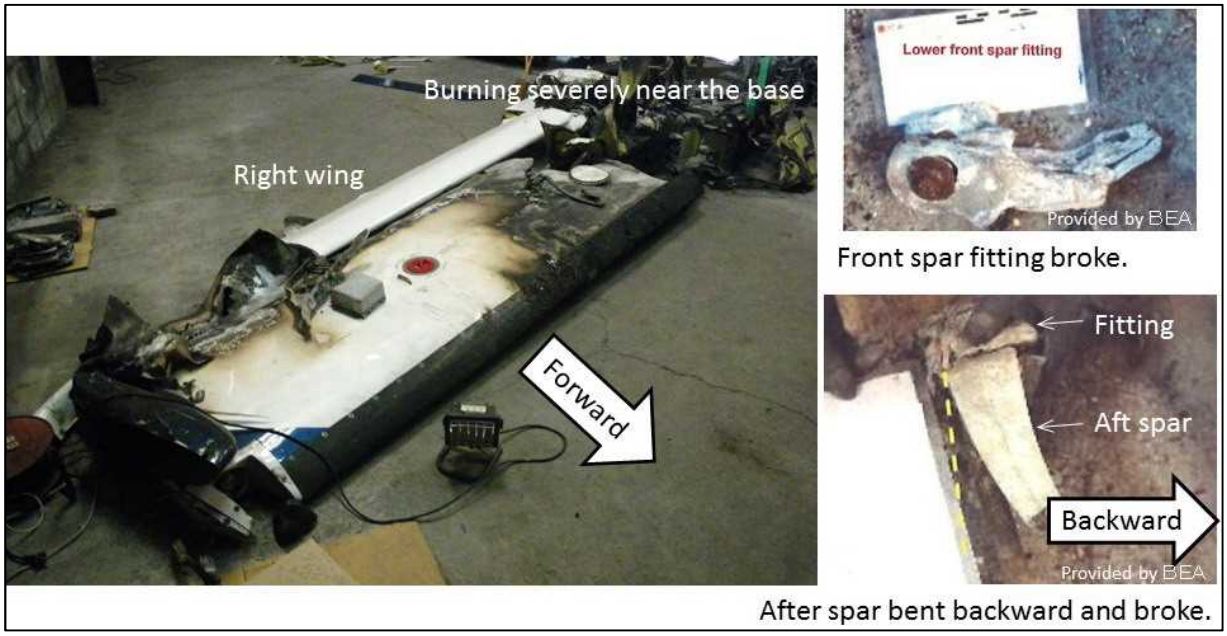


Figure 14: damage to the right wing.

(4) Horizontal stabilizer

The fitting part between the fuselage of frame 21 and the horizontal stabilizer was broken and bent forward. The front spar of the right horizontal stabilizer was bent upward and the dihedral angle increased upward. The left elevator trim tab was broken around at the center, and its fuselage side was bent upward, but the positions of both elevator trim tabs were close to the neutral. The control systems for the elevators were remained in the horizontal stabilizer.

(See Figure 15: damage to the horizontal stabilizer.)

Figure 15: damage to the horizontal stabilizer

(5) Vertical stabilizer

As the dorsal fin and all screw holes for connecting the fuselage in the lower part of the vertical stabilizer were broken, and indicating that the vertical stabilizer was

falling-off upwards. The vertical stabilizer was fractured from the fuselage attachment part of the fuselage structure.

For the yaw trim actuator, the manufacturer performed the operation test, but found no abnormality. The yaw trim actuator was set at the left position (the difference between the trailing edges of the yaw trim tub and the one of the rudder was 30 mm). According to the design of the manufacturer, the value was close to the maximum movable width (37.5 mm). The control systems for the rudder were remained in the vertical stabilizer.

Figure 16: damage to the vertical stabilizer

(See Figure 16: damage to the vertical stabilizer.)

(6) Engine

The engine of the Aircraft, Pratt & Whitney Canada Type PT6A-64, is two shaft reverse-flow free turbine engine consisting of a four-stage axial flow compressor, a one-stage centrifugal compressor, a one-stage compressor turbine (CT) and a two-stage power turbine (PT). Both rotors of two shafts were stuck and could not be rotated. All the magnesium or aluminum case and accessories in the engine aft were burned down by fire.

The reduction gear box (RGB) and propellers were broken at A flange and detached from the engine body. One of the four propeller blades was broken near the hub and two of them were bent forward, and other two blades (including the broken one) were bent backward. Each propeller blade did not show any traces that would clash while rotating. And each propeller blade was shown to have an adequate pitch.

The front of the first stage compressor was covered with combustion residue of surrounding parts, and there was damage to the front edge of blades. The inside of the compressor was observed using a borescope and then the case of the third stage

compressor was cut and inspected, but there was no trace showing it had any abnormality before crashing and impacting.

The impellers (of the centrifugal compressor) had slight scratch marks at the gas outlet. There was slight scratch marks on the tip of the CT blade. The downstream side of the CT disc showed slight circular scratch marks in the blade fixed region as those on the central hub. All of the blades of the first stage PT were found in a certain position, and there were scratch marks caused by contact with the first stage PT vane in the leading edge of the blades. These scratch marks indicate that rotors at both of the CT (the blue part in Figure 17) side and PT side (the red part in Figure 17) were rotating at low speed when the impact was applied to the engine.

The Aircraft was equipped with the engine trend monitor system (SHADIN), but its recorder was not found.

(See Figure 17: damage to the propellers and engine)

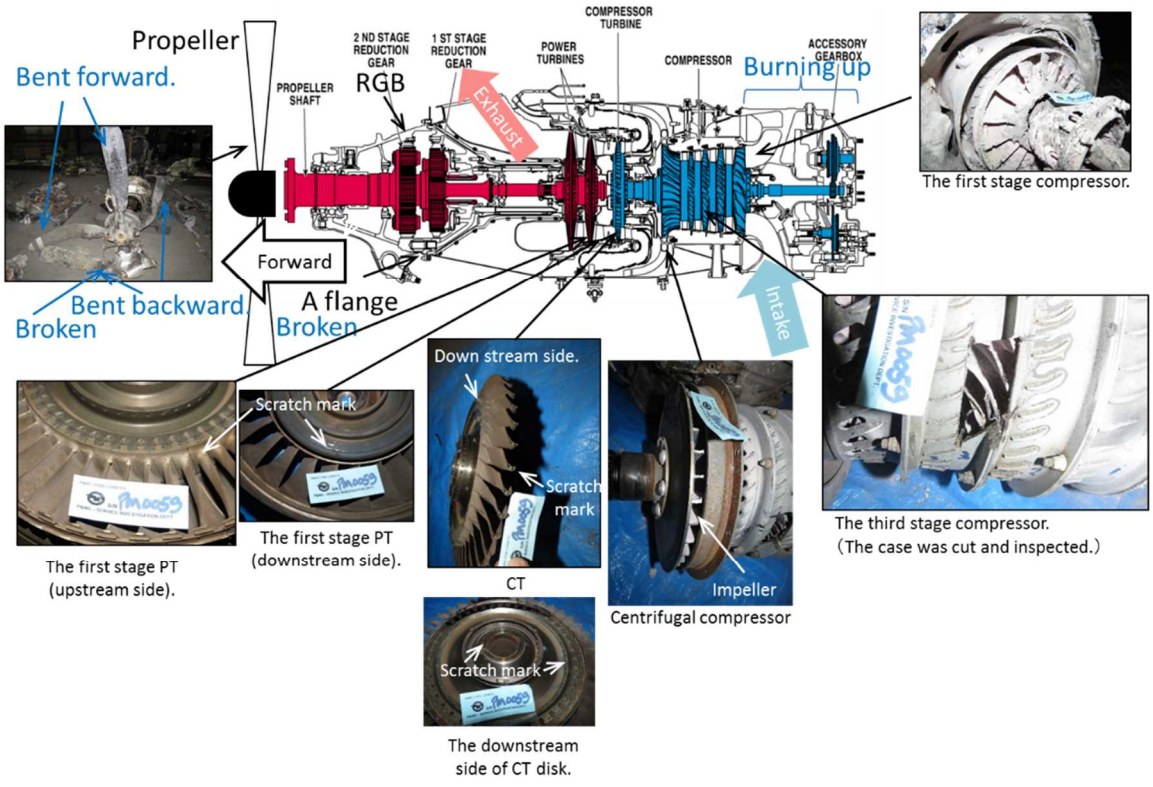


Figure 17: damage to propellers and engine

(7) Others

All three landing gears were placed in the “up” position.

The cabin door was locked.

The flight control system, fuel system and electrical system could not be confirmed due to damage or loss of the components caused by fire or crash impact. There was no

useful information remained in the instrument panel due to a serious damage caused by fire.

2.9 Medical Information

2.9.1 Information on Deaths and Injuries

According to the Nara Prefectural Police, the cause of death of two persons on board were whole body crush which were caused by whole body contusion.

The captain's intake of alcohol and drug was unknown as it was impossible to collect his blood and urine.

2.9.2 Information on Past Medical History

2.9.2.1 Information on Past Medical History for the Captain

The past medical history (including operative information) for the captain was as follows:

Table 3: medical history of the captain

	Disease name	Initial	Last	Next	Hospitali-zation
(A general hospital)					
1	Paroxysmal atrial fibrillation	2006.9.25	2017.8.4	2017.8.22	2006.11.1 2009.2.18 2016.5.7
2	Gastric varix Alcoholic hepatitis Intractable reflux esophagitis	2016.11.18	2017.7.14	2017.10.17	
3	Leukocytosis (Scheduled re-examination due to suspicion of hematopoietic disorder)	2017.8.2	2017.8.2	Unknown	
4	Type 2 diabetes mellitus Polyarthralgia	2017.6.28	2017.8.2	Unknown	
5	Shingles	Unknown	2017.8.4	2017.8.25	
(B general hospital)					
6	Gastric varix Alcoholic hepatocirrhosis	2017.2.24	2017.4.14	Unknown	2017.4.6 - 2017.4.10
	* A treatment for gastric varices, balloon obstruction retrograde radial vein embolization (BRTO), was performed.				
(C clinic)					
7	Type 1 diabetes mellitus Hyperlipidemia High blood pressure Alcoholic hepatitis Agrypnia	2002.6.3	2017.8.3	Unknown	

2.9.2.2 Standards for Past Medical History

The Civil Aeronautics Act states as follows:

Article 71 (Physical Disabilities) No member of the aircrew of an aircraft shall, when

he/she becomes physically unfit to the medical examination standards under Article 31 paragraph (3), engage in air navigation services, even if his/her aviation medical certificate issued under Article 32 is still valid.

In addition, the Ordinance for Enforcement of Civil Aeronautics Act (established on July 31, 1952: Ministry of Transport Ordinance No.56) states as follows (excerpts):

Article 61-2 (Medical Standards and Aviation Medical Certificate) The medical standards pursuant to the previsions of Ordinances of the Ministry of Land, Infrastructure, Transport and Tourism pursuant to Article 31 paragraph (3) of the Act and the aviation medial certificate pursuant to paragraph (2) of the Article shall be the following table.

Qualification	*Medical standard*	*Aviation medical certificate*
Commercial pilot	*Class 1*	*Class 1 Aviation medical certificate*

(2) The contents of the medical examination standards listed in the table of the preceding paragraph shall be listed in Appended Table 4, and the format of aviation medical certificate shall be in accordance with Format 24.

Appended table 4 (Re: Art. 61-2)

Physical examination criteria Class 1

1 General

(5) A person shall not have endocrine disorder or metabolic disorder, or organ damage or dysfunction due to these disorders that may disrupt flight operation.

(8) A person shall not have sleep disorder causing sleepiness that may disrupt flight operation.

3 Circulatory system and vascular system

(1) A person shall have less than 160 mm mercury of systolic blood pressure and less than 95 mm mercury of diastolic blood pressure, and shall not have orthostatic hypotension accompanying subjective symptom.

(8) A person shall not have disorder of impulse formation or excitation-conduction that may disrupt flight operation

(9) A person shall not have disorder of impulse formation or excitation-conduction that may disrupt flight operation.

4 Digestive system (excluding oral cavity and teeth)

(1) A person shall not have a disease or dysfunction in digestive system and peritoneum that may disrupt flight operation.

In addition, the Civil Aviation Bureau's "Manual for Aviation Medical Examination" (issued on March 2, 2007; Kokukujo No. 531, revised partially on October 3, 2014), to which the designated aviation medical examiners shall refer in order to judge the suitability for

performance of aviation duties, states as follows (excerpts).

1-5 Endocrine and Metabolic Diseases

1. *Disqualifying Conditions*

2-3 Diabetes mellitus that requires insulin or oral glucose-lowering agents on a regular basis

2. *Examination Procedures and Precautions*

3-2 If the applicant is suspected of having glucose metabolism, he/she should be examined for diabetes mellitus.

3. *Evaluation Precautions*

4-4 It is recommended that blood glucose level be controlled using the HbA1c[5] *target value (Guideline issued by the Japan Diabetes Society) as the reference in order to suppress the progression of microvascular complications of diabetes mellitus.*

4. *Notes*

5-1 If the applicant has diabetes mellitus that required treatment with drugs other than Thiazolidine derivatives, biguanides, sugar absorption inbitor and DPP4 inhibitor, and has a blood glucose level appropriately controlled, he/she may apply for the judgment of the Minister of Land, Infrastructure, Transport and Tourism by submitting medical reports including the change over time in blood glucose level and HbA1c level, presence of absence of complications (Neuropathy, Ophthalmopathy, and Nephropathy), and the details of treatments.

5-4 If the applicant comes under the criteria described in subparagraphs 5-1 to 5-2 above, provided he/she is doing well after a sufficiently long follow-up period, with conditions not expected to progress, he/she may thereafter be granted qualification by a designated examiner by order of the Minister of Land, Infrastructure, Transport and Tourism.

1-8 Sleep Disorders

2. *Disqualifying Conditions*

2-2 Other sleep disorders that may interfere with the performance of airman

---

*5 The HbA1c is developed when hemoglobin (Hb) within red blood cells joins with glucose in the blood, which reflects the average blood glucose level in the past 1 to 1.5 months at the time of measuring. Measuring the HbA1c in blood provides a method of getting an overall picture of the condition of diabetes mellitus.

.

duties

3. Examination Procedures and Precautions

3-1 The applicant should be interviewed and questioned about whether or not snoring or respiratory arrest during sleep had been pointed out by those around, and whether he/she has excessive sleepiness during the daytime. If sleep disorder is suspected from the interview, tests such as the Epworth sleepiness scale (ESS) should be performed and the condition should be judged in a comprehensive manner based on the results. If, as a result, sleep apnea syndrome is suspected, the condition should be carefully examined by performing overnight polysomnography (PSG) and, if necessary, by maintenance of wakefulness test (MWT).

4. Evaluation Precautions

4-3 With regard to the use of sleep inducing drugs such as zolpidem tartrate or zopiclone for a sleep disorder, if it is confirmed by a designated examiner or an industrial doctor who is well-informed about aviation medicine that the applicant has no addition or dependence to the drug and that he/she does not experience sleepiness or reduced concentration 48 hours after a trial use of the drug; he/she may use the drug. However, the applicant must not perform airman duties within 48 hours after taking the drug. Use of drugs (including melatonin) other than the above two drugs is a cause for disqualification.

3-1 Abnormal Blood Pressure

2. Disqualifying Conditions

2-1 Hypertension

3-8 Abnormal Rhythm

2. Disqualifying Conditions

2-2 Non-sustained or sustained supraventricular tachycardia or atrial flutter, or history of either of these conditions

3. Examination Procedures and Precautions

3-1 Applicant's condition, such as a history of loss of consciousness should be investigated carefully in an interview.

3-2 If arrhythmia is detected on ECG, it should be confirmed by an examination such as Hoter ECG.

3-3 An applicant with bradycardia should be carefully examined for the presence of sick sinus syndrome.

5. Notes

5-2 An applicant with any of the disqualifying conditions listed in 2 above who does not meet the criteria may apply for the judgment of the Minister of land, Infrastructure, Transport and Tourism by submitting a medical records (e.g., blood pressure change over time) including the details of treatments, as well as the results of examinations such as rest ECG, exercise ECG, Holter ECG, echocardiography, and if necessary, radioisotope examination.

5-3 If the applicant comes under the criteria described in subparagraphs 5-1 to 5-3 above, provided he/she is doing well after a sufficiently long follow-up period, with conditions not expected to progress, he/she may thereafter be granted qualification by a designated examiner by order of the Minister of Land, Infrastructure, Transport and Tourism.

4-1 Gastrointestinal Diseases

2. Disqualifying Conditions

2-4 Liver cirrhosis

2-7 Benign disease of digestive tract (esophageal or gastric varix, non-scarred gastric or duodenal ulcer, inflammatory bowel disease except during remission phase, etc.)

3. Examination Procedures and Precautions

3-1 If any of the diseases described in subparagraph 2 above is suspected, detailed examination should be performed by blood test, imaging test, etc.

3-2 In case of chronic hepatitis or liver cirrhosis, attention should be paid to varix and bleeding tendency by taking into account the risk of sudden incapacitation.

4. Evaluation Precautions

4-4 With regard to an applicant with liver cirrhosis, he/she is qualified if the condition does not require treatment, is without varix and is classified as Child-Pugh score A.

4-6 When the proton pump inhibitor or H2 blocker is administered after the diagnosis of reflux esophagitis, he/she is qualified if it is confirmed that the condition is within the range that does not affect the performance of airman duties, and that the adverse effects are observed.

5. Notes

5-2 An applicant with esophageal or gastric varices who is in a stable condition and has an extremely low risk of bleeding may apply for the judgment of the

Minister of Land, Infrastructure, Transport and Tourism by submitting clinical records of the primary disease and endoscopic findings.

5-4 An applicant who is in a stable condition while being treated for chronic hepatitis or liver cirrhosis may apply for the judgment of the Minister of Land, Infrastructure, Transport and tourism by submitting clinical records including the details of treatments, imaging, liver function, as well as the results of blood test such as a coagulation system test and blood cell count.

5-5 If the applicant comes under the criteria described in subparagraphs 5-1 to 5-4 above, provided he/she is doing well after a sufficiently long follow-up period, with conditions not expected to progress, he/she may thereafter be granted qualification by a designated examiner by order of the Minister of Land, Infrastructure, Transport and Tourism.

2.9.2.3 Past Medical History for Standards

Given the medical standards described in 2.9.2.1 and 2.9.2.2, the past medical history of the captain should have been declared by himself and confirmed by the designated aviation medical examiners and other respectively about whether to affect his performance of airman duties, when those diseases were diagnosed for the first time and he applied for aviation medical examination.

2.9.3 Information on Medicines

2.9.3.1 Medicines Prescribed to the Captain

The medicines prescribed to the captain until the day of the accident were as follow:

(a) Tambocor (Anti-arrhythmic agent)
(b) Bepricor (Anti-arrhythmic agent)
(c) Xarelto (Anticoagulant agent)
(d) DEPAZ (Anti-anxiety agent)
(e) Methycobal (vitamin B)
(f) Pariet (Therapeutic agent for peptic ulcer)
(g) Novorapid (Insulin)
(h) Lantus (Insulin)
(i) Lendormin D (sleep inducing drugs)
(j) Azilva (Antihypertensive agent, AII receptor antagonist)

2.9.3.2 Standards for Medicines Prescribed to the Captain

The Civil Aeronautics Act stipulates as follows:

Article 70 (Intoxicants etc.) No member of the aircrew shall engage in air navigation services while he/she is under the influence of alcohol or drugs or other chemical agents which are likely to impair in anyway his/her ability to perform normal operations of aircraft.

In addition, "Guidelines for the Handling of Medical and Pharmaceutical Products Used by Aircrews" (issued on March 30, 2005; Kokukujo No. 491, partially revised on October 3, 2014; Kokukujo No. 518; hereinafter referred to as the "Medicine Handling Guidelines") established by the Flight Standards Division, Aviation Safety and Security Department, Civil Aviation Bureau, Ministry of Land, Infrastructure, Transport and Tourism states as follows (excerpts):

2. Principle of Using Medical and Pharmaceutical Products

If an aircrew uses any of the medical and pharmaceutical products, he or she shall be required to comply with provisions of Article 70 and 71 of the Civil Aeronautics Act and make an appropriate self-judgment. However, regarding the side effects of the medical products in use, if required, it shall be confirmed by the designated aviation medical examiners (designated doctors) or industrial doctors of airlines (aviation industrial doctors) about whether those products conform to the standards for aviation medical examination including a judgment on the criteria of use of those medicines, pursuant to the provisions of "3. Operational Guidelines for Use of Medical and Pharmaceutical Products". In addition, other than the case mentioned above, it is desirable that aircrews get advice from the designated doctors or aviation industrial doctors regarding the cases where it is difficult to make a self-judgment on the influence from the use of their medical products on their mind and body.

Designated doctors or aviation industrial doctors shall appropriately explain or give advice to aircrews in accordance with the guideline if asked to confirm or give advice on the use of medical and pharmaceutical products, when they shall need to explain about the following three main items.

- *Possibility that the diseases, for which the medical products are used, would hinder the performance of aviation duties*
- *Possibility that flight conditions (time difference, dehydration, hypoxia and others) would have effects on the response to treatment*
- *Possibility that medical products would develop the adverse effect to impair the safety of aviation*

Even if some crew members stop using medicine, there may be unsuitable for the performance of aviation duties for a certain period of time, because the adverse effect of the

medication would not be lost immediately after stopping taking the medicine.

However, medical drugs shall be used for remedies against diseases and aircrews shall have access to effective medical treatment and drugs, which make it possible for them to engage in the aviation duties. It is important to ensure the balance among the appropriate air aviation service standards, medical treatment and their diseases, which is the best for both aircrews taking medicine and the safety of aviation.

In addition, aircrew shall realize that their medical treatment may cause problem, make efforts so that these problems would not hinder the performance of aviation duties, and be mindful of the following matters.

- *When an ethical pharmaceutical is prescribed, aircrews shall receive an adequate explanation including its adverse effects, and keep the certificate of medication or its alternative.*
- *At the time of purchase of an over-the-counter-drug, aircrews shall understand the contents of the medicine explanatory documents and medicine information attached and keep them, in addition, aircrews shall have the drug stores and others issue the documents (receipts or others) containing information on the purchase dates, the name and the number of the purchased medicines, the name of the drug stores (these documents will be necessary to issue a sales certificate in the event that there are some adverse effects and it is necessary to apply for the relief system for sufferers from adverse drug reactions).*
- *Aircrew shall not use the medical and pharmaceutical products whose adverse effects cannot be understood.*
- *Aircrews shall not use the medical and pharmaceutical products that have not passed a year since their marketing approval because their safety related to the performance of aviation duties have not been fully confirmed.*
- *Aircrews shall also use the medical and pharmaceutical products prescribed and purchased abroad in accordance with laws and regulations of Japan and the guidelines.*

3. Operational Guidelines for Use of Medical and Pharmaceutical Products

It is impossible that the guidelines for use of medical and pharmaceutical products indicate whether it can consist with safety flight or not, regarding all the medical and pharmaceutical products. Concerning the widely used typical medical and pharmaceutical products and those used in aviation environment, the guidelines explain about the effect of such products on the performance of aviation duties classifying those products into the following four groups in accordance with the degree of effects on the performance of aviation duties.

A. Medical and pharmaceutical products that are considered safe when used during the

performance of aviation duties

B. Medical and pharmaceutical products that require individual confirmation by a designated doctor or aviation industrial doctor well-versed in aviation medicine when used during the performance of aviation duties

C. Medical and pharmaceutical products that require a judgment on the conformity to the standards for medical examination by the Minister of Land, Infrastructure, Transport and Tourism

D. Medical and pharmaceutical products that are unsuitable / non-conformity

If it is difficult for the designated doctor to make judgment on the conformity to the standards for medical examinations about the aircrew who are taking medicine, the aircrew shall be judged as unsuitable /non-conformity by the designated doctor, and he/she shall apply for the judgment of the Minister of Land, Infrastructure, Transport and Tourism, submitting derailed on current status and treatments.

(Omitted)

B. Medical and Pharmaceutical Products That Require Individual Evaluations by a Designated Doctor or the Aviation Industrial Doctor When used during the Performance of Aviation Duties

If an aircrew uses any of the medical and pharmaceutical products listed below, he or she must not engage in the performance of aviation duties unless, from the viewpoint of the effects of such products on the normal operation of aircraft and conformity to the standards for medical examinations, unless a designated doctor or an aviation industrial doctor well-versed in aviation medicine confirms the degree of diseases for which drugs are used, their side effects and others.

(Omitted)

○ *Antihypertensive agent*

If an aircrew uses any of antihypertensive agents listed below, it must be confirmed by a designated doctor or an aviation industrial doctor that the blood pressure value does not exceed the standard by the use of the medicine and that there is no side effect from the antihypertensive agent in use two weeks after the dosage regimen of the drug has been maintained.

(Omitted)

(5) AII receptor antagonist

In case of reducing the dose of antihypertensive agent, only when it can be confirmed that a careful follow-up is made, and there is no change in the conditions, the flight stop period should not be provided specifically (blood pressure measurements shall be conducted at least every two weeks to confirm that the measured value shall not exceed the standard).

(Omitted)

○ *Sleep agent (sleep inducing drug)*

It is known that zolpidem tartrate, zopiclone and triazolam are ultrashort-acting, but their absorption and metabolism differ greatly depending on individuals. Triazolam is not unsuitable for the performance of aviation duties since it may have side effects on the central nervous system when administered with alcohol.

With regard to the use of zolpidem tartrate and zopiclone, it must be confirmed by a designated examiner or an industrial doctor that the applicant has no addition or dependence to these drugs and that he/she does not experience sleepiness or reduced concentration 48 hours after a trial use of the drug. However, the applicant must not perform aviation duties within 48 hours after taking the drug. It is desirable for the designated examiner or the industrial doctor who are asked to confirm or give advice on the use of drugs to record to that effect in the medical records and others.

On the other hand, the use of melatonin is not permitted.

The use of sleep inducing drugs other than the two mentioned above are not permitted.

C. Medical and Pharmaceutical Products That Require the Judgment by the Minister of Land, infrastructure, Transport and Tourism regarding the Conformity to the Standards for Medical Examination

It should be noted that the following medical and pharmaceutical products are prescribed for treatment of a specific disease state. Therefore, in the aviation medical examination, not only the problems concerning the use of medical and pharmaceutical products but also the paragraph on relevant diseases must be referred to.

If an aircrew uses any of the medical and pharmaceutical products listed in paragraph C, he or she must stop engaging in the performance of aviation duties at the same time of starting to take those listed medical products, and if non-conformity is confirmed, he or she must apply for the judgment of the Ministry of Land, Infrastructure, Transport and Tourism before his / her resuming the performance of aviation duties.

The medical and pharmaceutical products listed below are only part of examples and there are many other medical products that fall under the paragraph C. Even if those products are not described in this section, if an aircrew takes or plans to take the medical products whose side effects are not confirmed or are concerned, and if it is not sure or could be confirmed to have the side effects of such products on the normal operation of aircraft, the designated doctors should not issue an aviation medical certificate to the aircrew, and the aircrew should apply for the judgment of the Minister of Land, Infrastructure, Transport and Tourism.

○ *Anti-arrhythmic agent (excluding amiodarone)*

○ *Antidiabetes agent*

Oral glucose-lowering agents (use in combination with β blocker is contraindicated in aviation medicine: Drugs other than those prescribed in B.

○ *Anticoagulant agent*

D. Medical and Pharmaceutical Products That are Unsuitable for the Performance of Aviation Duties

As the following medical products are not suitable for the performance of aviation duties, the use of those drugs are not permitted.

○ *Insulin*

○ *Anti-anxiety agent*

2.9.3.3 Medical Products Prescribed to the Captain and their Conformity to the Standards

From 2.9.3.1 and 2.9.3.2, the medical products prescribed to the captain included (D) that are unsuitable for the performance of aviation duties, (C) that require aircrews to stop engaging in the performance of aviation duties when starting to take those medical products, and to apply for the judgment by the Minister of Land, infrastructure, Transport and Tourism before resuming the performance of aviation duties, and (B) that require individual evaluations on their effects on the performance of aviation duties.

However, it could not be confirmed whether the captain had taken those prescribed medical products on the day of the accident.

2.9.4 Captain's Application for Aviation Medical Certificate

In the "Item No. 14: Medical History and Others" of the application form the captain submitted to apply for the aviation medical certificate, where applicants should answer about the existence of various diseases and conditions such as diabetes, endocrine disorder and metabolic disorder (hyperlipidemia, hyperuricemia), allergic diseases (asthma, allergic diseases), excessive daytime sleepiness, indication of snoring, mental disorder or disorder of nervous system, attempt of suicide, impaired consciousness including epilepsy, paralysis and fainting, all were marked "No".

In addition, the "Item No. 15: It shall be described (body parts, cause of disease, the time and period) as detailed as possible, if applicable", which has some comments fields such as "Hospital stay or surgical operation", "Medical and pharmaceutical products that are regularly used currently (including external medicine and sleeping pill)" and others, but there were no comments in all of those fields.

Besides, the aviation medical certificate was issued to the captain since the aviation

medical examination, which the captain took without declaring his medical history and others, did not reveal any abnormality regarding the test items checked in the examination.

2.9.5 Thorough Confirmation of the Self-reported Medical Information for the Aviation Medical Examination

In response to the accident of a private owned aircraft (AA2007-6-3 Aircraft Accident Investigation Report by the Japan Transport Safety Board (JTSB)), in December 2007, the Civil Aviation Bureau, Ministry of Land, Infrastructure, Transport and Tourism made it known to the designated aviation medical examiners that they should have applicants fully realize the importance of self-reported medical information for the aviation medical examination and strive to confirm applicants' self-reported medical information by grasping the medical history and their regular medication as much as possible when interviewing the applicants, and so on. Furthermore, upon receiving from the JTSB the factual information on the aviation medical examination for the captain, which was obtained in the accident investigation of the aircraft operated by the Independent Administrative Institution Civil Aviation College (hereinafter referred to as "the College") (AA2013-9-1 Aircraft Accident Investigation Report by the JTSB), in 2011, the Civil Aviation Bureau, Ministry of Land, Infrastructure, Transport and Tourism (MLIT) further requested the College, the designated domestic air carriers, the Japan Aircraft Pilot Association, the Scheduled Airlines Association of Japan, the Japan Coast Guard, the National Police Agency, and the Fire and Disaster Management Agency to commit to newly making it known thoroughly that all the relevant aircrews belonging to these organizations and institutions, from the viewpoint of the effects of such products on the normal operation of aircraft and conformity to the standards for medical examinations, must comply with Medicine Handling Guidelines when using medical products. Moreover, the Civil Aviation Bureau, Ministry of Land, Infrastructure, Transport and Tourism also requested the designated aviation medical examination facilities and aviation medical examiners to endeavor to make the Medicine Handling Guidelines known to aircrews at the time of aviation medical examination and medical consultations from now.

2.10 Information on Fire, Fire-fighting and Rescue

According to the Regional Fire Bureau of Nara Prefecture, at 12:17, they received an emergency call from a local resident saying "an object like an aircraft had fallen into the mountain, and black smoke was trailing from the site". 20 fire vehicles and others, and 63 personnel were dispatched and started search, rescue and fire-fighting operations at 12:24. Fire was confirmed on a part of the airframe, and fire-fighting operation was carried out with

powder fire extinguisher. At 17:32, the fire was extinguished. Any survivor in need of help was not found.

2.11 Other Necessary Matters

2.11.1 Permission under Civil Aeronautics Act

The captain was granted permission to operate the Aircraft registered in the United States of America in Japan, pursuant to the proviso of Article 127 (Use of Foreign Aircraft within Japan) of the Civil Aeronautics Act. In addition, in accordance with Article 11 paragraph (1) of the same Act, the Aircraft may not be operated without a valid airworthiness certificate specified under Article 10 (airworthiness certificate), however, for a flight without an airworthiness certificate (Temporary Use of Foreign Aircraft within Japan), the captain obtained permission to operate the Aircraft under the proviso of Article 11 paragraph (1) of the same Act.

The relevant articles of laws and regulations are as follows:

Civil Aeronautics Act (excerpts)

Article 10 (Airworthiness Certification) The Minister of Land, Infrastructure, Transport and Tourism shall, upon application, grant airworthiness certification for aircraft (omitted).

(2) No aircraft may be granted airworthiness certification under the preceding paragraph, unless it has Japanese nationality; provided, however, that the same shall not apply to any aircraft as specified by Cabinet Order.

Article 11 No person may operate an aircraft unless it has a valid airworthiness certificate; provided, however, that the same shall not apply to any person when permitted performing test flights etc. by the Minister of Land, Infrastructure, Transport and Tourism.

Article 127 (Use of Foreign Aircraft within Japan) No aircraft having the nationality of any foreign state (omitted) *shall be used for any flights between points within Japan; provided, however, that the same shall not apply when permitted by the Minister of Land, Infrastructure, Transport and Tourism.*

Cabinet Order for Enforcement of the Civil Aeronautics Act (Order of the Ministry of Transport No. 421 of September 16, 1952) (excerpts)

Article 1 Aircraft specified under the proviso of Article 10 paragraph (2) of the Cabinet Order for Enforcement of the Civil Aeronautics Act is in the following category.

(i) Aircraft granted permission under the proviso of Article 127 of the Civil Aeronautics Act (omitted)

The "Conditions of Permission" in the proviso of Article 11 paragraph (1), under which the captain was granted permission to operate the Aircraft, contains the following descriptions (excerpts).

(Other than those specified in the above and this column, the matters described on the backside of the certificate shall be complied with.)

In addition, there are the following descriptions on the backside of the certificate (excerpts).

1. *A copy of this permit should be displayed in the aircraft shall at all time when operating under this permit.*
5. *The aircraft should be operated only by crew holding appropriate certificates or licenses issued or validated by the State of Registry.*

2.11.2 Information on Pilot Qualification and Training

(1) Convention on International Civil Aviation (Chicago Convention)

The Annex 1 to the Chicago Convention contains the following descriptions about the class and type of aircraft.

2.1.3 Class and type rating

2.1.3.1 Class ratings shall be established for aeroplanes certificated for single-pilot operation and shall comprise:

a) single-engine, land;

b) single-engine, sea;

c) multi-engine land;

d) multi-engine sea; (Omitted)

2.1.3.2 Type ratings shall be established for;

a) aircraft certificated for operation with a minimum crew of at least two pilots; (Omitted)

c) any aircraft whenever considered necessary by the Licensing Authority

(2) Japan

The Civil Aeronautics Act stipulates as follows:

Article 25 (Rating on Competence Certification) The Minister of Land, Infrastructure, Transport and Tourism shall indicate aircraft categories ratings according to competence certification for airline transport pilots, commercial pilots, private pilots, licensed airline transport pilot, flight engineers, first class aircraft maintenance technicians, second class aircraft maintenance technicians, first class aircraft line maintenance technicians, or

second class aircraft line maintenance technicians under the preceding article, pursuant to the provisions of the Ordinance of the Ministry of Land, Infrastructure, Transport and Tourism.

(2) The Minister of Land, Infrastructure, Transport and Tourism may indicate class or type ratings of aircraft according to competence certification set forth in the preceding paragraph pursuant to the provisions of the Ordinance of the Ministry of Land, Infrastructure, Transport and Tourism. (Omitted)

The Ordinance for Enforcement of the Civil Aeronautics Act stipulates as follows:

Article 53 (Rating on Competence Certificate) A rating pertaining to aircraft categories under Article 25 paragraph (1) of the Act and a rating pertaining to aircraft classes under paragraph (2) of the same Article shall be granted based on the aircraft used for the practical examination. In this case, the class of aircraft shall correspond to the category of aircraft listed in the upper column of the following table, and shall each be the class of aircraft listed in the lower column of the same table.

Aircraft category	*Aircraft class*
Airplane	*Land, single-engine, piston* *Land, single-engine, turbine* *Land, multi-engine, piston* *Land, multi-engine, turbine* *Sea, single-engine, piston* *Sea, single-engine, turbine* *Sea, multi-engine, piston* *Sea, multi-engine, turbine*
(Omitted below)	

(2) In the case of the preceding paragraph, if the class of aircraft that is used in the practical examination is the class listed in the upper column of the following table, for the purpose of competence certification for an airline transport pilot, commercial pilot and private pilot and flight engineer qualification (only when the category of the class of aircraft for the rating is aeroplane or balloon), the class of aircraft for the rating shall be the class listed in the lower column of the following table.

Aircraft class used field examination	*Certification aircraft class*
Land, single-engine, piston, or *Land, single-engine, turbine*	*Land, single-engine, piston, and* *Land, single-engine, turbine*
(Omitted below)	

(Omitted)

Article 54 A rating pertaining to aircraft types pursuant to Article 25 paragraph (2) of the Act shall be granted in accordance with the following divisions based on the aircraft used in the practical examination.

(i) In the case of a pilot qualification, for an aircraft model which requires two pilots to operate it or the model specified by the Minister of Land, Infrastructure, Transport and Tourism, the applicable aircraft model

(Omitted)

In Japan, pilots can operate the Aircraft engaging in aircraft operations within the scope of service in accordance with each qualification, if they have a competence certification of private pilots (airplane), commercial pilots (airplane) or airline transport pilots (airplane) with a class rating of a single-engine turbine, since the Aircraft is not an aircraft that requires type rating. In addition, it is possible to obtain the aircraft class rating for a single-engine turbine (land) even when an aircraft with a single-engine piston (land) is used in the practical examination of a competence certificate. And moreover, a pilot must not perform instrument flights etc. unless he / she obtains an instrument flight certificate.

(3) The United States of America

In the United States of America, the State of Registry of the Aircraft, the pilot qualification and training are stipulated as described in "1 The United States of America" of the "Attachment 1: Provisions Concerning Overseas Pilot Qualifications and Trainings", which is summarized as below.

(a) Aircraft that require type rating

(b) Addition trainings (classroom lectures and flight) for complex aircraft (retractable landing gear, flaps and variable pitch propellers), however, no need with a specific flight experience of a complicated airplane.

(c) Additional training (classroom lectures and flight) for high performance aircraft (aircraft with power output of 200 horsepower or more), however, no need with a specific flight experience of a high performance aircraft.

(d) Additional trainings (classroom lectures and flight training) required for a pressurized airplane that allows flight at high altitude (above the average sea level of 25,000 ft or more), however, no need with a specific flight experience or flying career of a pressurized airplane.

According to (a), type ratings shall not be required for the Aircraft with the

maximum take-off weight of 12,500 lb or less, which needs to have only the class rating of the single-engine land.

On the other hand, as the Aircraft falls under the airplane classes, (b), (c) and (d), if a pilot does not have a specific flight experience or flying career, it is necessary for the pilot flying the Aircraft as its PIC to take classroom lectures and flight trainings (with in-flight training, simulated flight equipment, or flight training equipment) about the aircraft from certified instructors for applicable classes, and those lesson and training records shall be logged in the flight diary.

(4) The French Republic (EU)

The European Aviation Safety Agency (EASA) of the Europe Union (EU), to which the French Republic, the State of Design and Manufacture of the Aircraft joins, stipulates aircraft pilot qualifications and trainings as in the "2 EU" of the "Attachment 1: Provisions Concerning Overseas Pilot Qualifications and Trainings", which is summarized as below.

(a) The class ratings for the Aircraft is limited to "TBM SET" that is the Socata TBM series aircraft with one pilot, simple turboprop.

(b) The prerequisites to commence the initial training of TBM shall be to meet the following experiences and requirements and have an instrument flight certificate.

- Flight time 200 hours, and 70 hours of experience as captain of aircraft
- The applicant must have a certificate of completion of the theoretical knowledge of the Approved Training Organization (ATO), have passed the theoretical knowledge of airline transport pilot (airplane) (ATPL (A)), or have a certificate of completion of the theoretical knowledge of the ATPL (A) issued in accordance with the Annex 1 to the Chicago Convention or the ATPL (A) issued in accordance with the Annex 1 to the Chicago convention for commercial pilot certificate (airplane) and instrument flight certificate in addition to the pilot license of sub-part H.

(c) The initial training of TBM700 shall be comprised of 30 hours of classroom lectures, 10 hours of in-flight training (7 times in total), and seven hours of post-in-flight-training briefing that contain the following contents.

- Slow flight;
- Approach to stall in different configurations;
- Full stall in different configuration and recoveries;
- Aircraft performances;

- Avionics suite and associated functions; flight envelope protection, PBN, RNAV approaches, ---;
- Descent on a 5% slope in approach and landing configuration followed by go around;
- Emergency procedures.

(d) Applicants for class and type rating issuance must complete the ATO training courses, and must pass the pilot competence review within six months from the start of the training.

(5) Information from design and manufacturer

The design and manufacturer neither has an Approved Training Organization (ATO) nor dispatches instructors to the clients, but have made a contract with one of ATOs in each of the French Republic and the United States to provide their supports.

Every ATO located in the EASA areas can provide trainings in accordance with the provisions of "the Annex 1 to the Chicago Convention, Part FCL, Subpart H, Section 2" and "OE GM". In the United States of America, there is no FAA requirements for TBM trainings, but generally the insurance companies require pilots to take trainings according to their flight experiences, and usually request pilots to obtain the minimum flight time by taking flight trainings with a pilot on board, who has a TBM flight experience. The ATOs provide trainings pursuant to laws and regulations established by the national or local governments.

2.11.3 Information on the Captain

(1) Statement of Employee A of the Brokerage Service Company

As the captain was going to purchase the Aircraft, the Employee A (pilot) went to the United States of America (USA) to pick up the Aircraft. After returning from the USA, the Employee A delivered the Aircraft to the captain at the Airport, got on board the Aircraft, and gave advice on the pilot's operating procedure when the captain was flying. When delivering the Aircraft to the captain, the Employee A handed out the Pilot's Operating Handbook (POH) approved by the EASA and the copy of the Japanese translation of the Flight Manual of the same type aircraft. The captain seemed to have little understanding of the pilot operations for the Aircraft, although the captain said that he had ever flown the same series of the Aircraft for about one hours several years ago on the purpose of test flight to purchase TBM 850. The Employee A had been on board the Aircraft together with the captain eight times up to the accident, but had never provided the captain with the trainings in the form of

classroom lecture. However, the Employee A gave advice mainly on the turbine engine and the rudder trim for more than 20 hours on the phone.

The captain was intended to change the State of Registry of the Aircraft from the USA to Japan after obtaining the airworthiness certificate with the American registry, and he was flying the Aircraft with the permission for "Temporary Use of Foreign Aircraft within Japan" until the airworthiness certificate was obtained.

As being equipped with a single engine with high power output, the Aircraft is very more likely to yaw to the left at take-off, when the yaw trim be set at the take-off position. The Aircraft would yaw to the right to the travelling direction and its speed would slow gradually when the Aircraft is shifted to cruise flight without returning the yaw trim position from the take-off position. At this time, the ball of the slip indicator (see Figure 18) is moving to the left, indicating the Aircraft is sideslipping, but it is difficult to notice it because the Aircraft is stable.

The first flight with the captain was conducted on June 19, 2017, when they flew the traffic pattern at the Airport. Before take-off, the Employee A explained that the electrical yaw trim actuator should be operated by the switch on the control wheel. The captain had long experience in operating the aircraft equipped with piston engine, but it was first time for the captain to operate the aircraft equipped with turbine engine, and thus he also seemed to be unfamiliar with the trim switch on the control wheel.

Being careful not to exceed 100% of power output, the captain took off by targeting 80 to 90% of power output. At an altitude of 1,000 ft and at a speed of 180 kt, the captain started to say that the Aircraft would not make a turn, before long accelerated the speed close to 200 kt, descended to about 500 ft due to unstable altitude, and flew to about 4 nm south of the Airport to be out of the traffic pattern. When the Employee A told the captain to decrease the power since it was too strong, the altitude also decreased and once to 300 ft, but the captain managed to land. They made take-offs and landings four times. As the captain insisted that the Aircraft would not turn in the direction as he liked, the Employee A had a mechanics inspect the Aircraft, but there were no abnormalities in the Aircraft. Later, the Employee A realized that the captain had not returned the position of the yaw trim from the take-off position.

On June 20, 2017, the second flight with the captain was also conducted to fly the traffic pattern at the Airport, and they made take-offs and landings four times. The captain climbed with 60% of the torque immediately after take-off, maintained 110 kt at level flight, and was able to turn the Aircraft in the direction as he liked. On

June 23 in 2017, upon the third flight with the captain, they took off from the Airport, conducted air work, and landed at the Airport.

On July 15, in 2017, the captain conducted a navigation flight by the Aircraft to go to Izu-Oshima Iland, the Employee A was on board only on the outward journey flight. At that time, even though the Aircraft was flying at FL150 and heading 090° in the autopilot heading mode, the actual heading was directed at about 120°, and the speed was going to decrease less than 100 kt. Therefore, the Employee A took the control of the Aircraft and tried to make a turn to the left by lowering the nose of the Aircraft, but the control wheel was too heavy to make a turn, and realized that the captain had forgot to return the position of the yaw trim when looking at the slip indicator whose ball was greatly moved to the left. On the homeward journey flight from Izu-Oshima Iland, the two persons consisting of the captain and a passenger (wife of the captain) were on board the Aircraft. Later, the Employee A heard from the captain that the captain did not forget to return the position of the yaw trim, but felt scary touching carelessly the aileron trim. The passenger was always on board the flight with the captain to give advice and change frequencies, etc.

In the morning on August 11, 2017, after a long time, they were to fly IFR, and the Employee A took the aft seat. But the captain could not fly the instructed flight route, thus the Employee A advised the captain to cancel the IFR. As the captain was not able to properly press the radio transmission button, there was no response from ATC. When the Employee A advised the captain to properly push the radio transmission button, there was a response from ATC. As the captain often forgot to return the position of the yaw trim, the Employee A advised about it, and at last the Aircraft was able to turn as the captain liked. But as there were clouds in the sky, the captain seemed to be confused not knowing what and how to do by himself; he could not answer when the Controller asked him what he wanted to do, and suddenly saying that he would return to the Airport, decided to return. TCA advised the captain about the heading, but he could not respond to the advice. Before long, as the passenger in the right pilot seat rose out of the seat saying “please change the control”, the Employee A took the pilot seat to control the Aircraft and landed at the Airport. In the flight, it seemed that the captain's ability to fly came to a limit.

In the afternoon on the day, as being asked by the captain to conduct a function check on the radio equipment, the Employee A performed a test flight, but there were no abnormalities in the radio equipment. In that flight, the Employee A confirmed about what would happen when climbing in the autopilot mode without returning the

position of yaw trim from the take-off as the captain often did, and found that the ball of the slip indicator moved gradually to the left and the nose of the Aircraft turned to the right by 30° to 40° from the heading set. In the condition where the ball was greatly moved to the left and the autopilot was disengaged, the Aircraft was not able to turn left, even though the control wheel was turned left. And then the Employee A returned the position of the yaw trim for centering the ball, which allowed the Aircraft to turn left.

On August 13, 2017 (one day before the accident), the captain was able to fly using Visual Flight Rules (VFR) to Kochi with the Employee A on board the Aircraft and returned without any problems.

On the day of the accident, it was decided to fly IFR to Fukushima immediately before the flight. As being told that they might stay overnight, the Employee A declined to join the board since it was not convenient for him. The Employee A prepared for the Aircraft to fly, submitted the flight plan, and gave advice around three times on torque, temperature, yaw trim to the passenger who had the knowledge equivalent to a private pilot. The Employee A shut the door tight, and as being asked by the captain to watch the engine start from behind the cockpit, watched it carefully putting his face from the window.

The Employee A made a check list including the check on the yaw trim after take-off, since the captain often forgot to return the position of the yaw trim after moving it to the take-off position before take-off. The Employee A had handed out this check list to the captain before July 15. However, the captain used the check list only at the time of engine start and engine shut out.

The Aircraft was equipped with two units of Garmin GNS 530W GPS system, which was the same navigation system installed in the aircraft Piper PA-46-350P that the captain previously operated, (hereinafter referred to as the Previous Aircraft). The captain used to fly IFR in the autopilot mode. Usually, the captain input the flight-planned route and the instructed altitude before take-off, and engaged the NAV (Navigation) mode soon after take-off. And when the heading was instructed, the captain switched to the HDG (Heading) mode. At the time of altitude change, the captain used the VS (Vertical Speed) mode, often set at 2,000 to 2,700 fpm both in descents and climbs, and the Employee A had never seen the captain using the IAS (Indicated Air Speed) mode. The captain often flew the Aircraft at 80 to 90% of power output at the time of take-off and climb, and at about 80% of power output at cruising.

As the captain seemed to have no confidence in his flight operation of the Aircraft,

it might have been too early for the captain to fly alone, but the Employee A could not stop him when the captain, the owner of the Aircraft said he wanted to fly at any cost.

(2) Statement of the captain's Acquaintance A

The Acquaintance A had a wide range of experience in piloting small to large aircraft, and was on board the second flight for training the captain. When the Acquaintance A was seeing the captain accelerating the speed close to 200 kt, expecting that the Aircraft would not be able to turn at this speed, just as he had expected, the captain overshot during a turn from the base leg to the final approach. After taking over the control of the Aircraft from the captain, the Acquaintance A felt that large pressure was required to apply to the right rudder, as the torque of the Aircraft was large. But the Acquaintance A was able to make a turn in the traffic pattern at 160 kt.

The captain had 40 years of pilot experience. The Acquaintance A had flown basic IFR with the captain 20 or 30 years ago, when there was no problem. On the day of the accident, the Acquaintance A made conversation with the captain, who appeared to be fine as usual, and did not find any tardiness in his response.

(3) Differences in the pilot operation between the Previous Aircraft and the Aircraft

The Previous Aircraft was a pressurized airplane and had the same type navigation system as described in (1), but mainly there are the following differences in the pilot operation between the Previous Aircraft and the Aircraft.

(a) The maximum take-off weight is 4,300 lb for the Previous Aircraft and 6,579 lb for the Aircraft.

(b) The VA (Maneuvering speed as described in 2,11,5(1)) is 133 KIAS (at a weight of 4,300 lb) for the Previous Aircraft and 158 KIAS for the Aircraft.

(c) The engine and take-off power is 350 horsepower for the Previous Aircraft with a piston and 700 horsepower for the Aircraft with a turboprop.

(d) The yaw trim control is a manual wheel on pedestals for the Previous Aircraft and an electric switch on the control wheel for the Aircraft.

(e) Regarding the take-off position of yaw trim, there is no position in the Previous Aircraft but there is the one in the Aircraft.

(f) Regarding aileron trim, it is impossible for the Previous Aircraft to adjust it during the flight as it is fixed one, but possible for the Aircraft to control by the electric switch on pedestals.

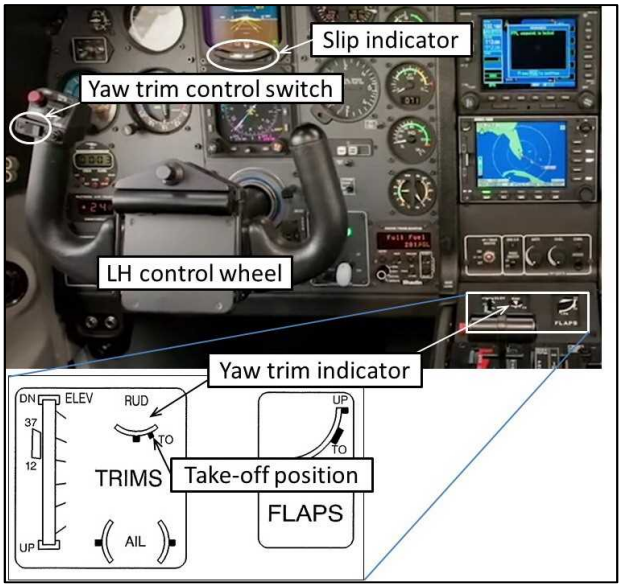


Figure 18: yaw trim control

2.11.4 Information on Yaw Trim

(1) Yaw trim control

The trim control switch is a 3 point switch placed in both control wheels, and can be moved from the neutral position to the left or right, which operates the yaw trim tub to the left or right by electrically activating the yaw trim actuator in the vertical fin near the yaw trim tub.

The yaw trim indicator is on pedestals located between the right and left cockpit seats together with the elevator trim, aileron trim, and the flap indicator. The take-off position of the yaw trim is indicated as "TO" near the movable limit on the right side. The yaw trim can only be controlled by the pilot's operation, and the autopilot does not have any control of the yaw trim, therefore, the yaw trim setting must be carried out appropriately by the pilot.

(See Figure 18: yaw trim control.)

(2) Autopilot functions

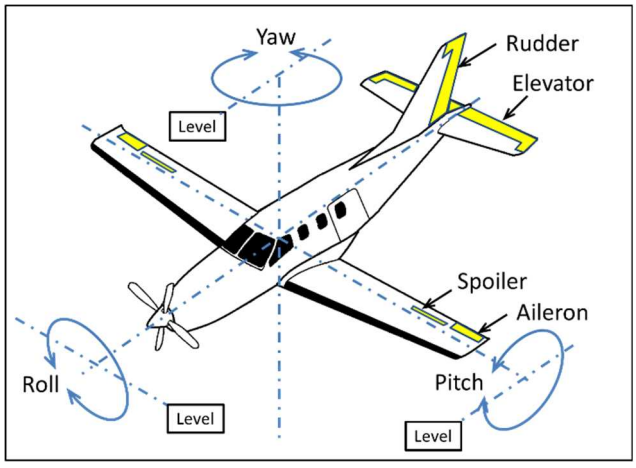


Figure 19: control of the Aircraft

With the autopilot that automatically controls the elevators for pitch control (up and down), ailerons and spoilers for roll control (right and left), the Aircraft can fly on a set course. The Aircraft features the following modes, such as the ALT mode for selecting the altitude to move up and down, the VS mode for selecting the climb rate, and the IAS mode for selecting the speed, but is not equipped with the auto throttle. Therefore, it is impossible to select several modes of the Aircraft

at the same time. There is the HDG mode for selecting the left and right movement of the Aircraft's heading, and the NAV mode for selecting the course, in addition, the yaw damper, which can be engaged independently of the autopilot. The yaw damper minimizes motion about the vertical axis caused by turbulence and is engaged to make a balanced turn. The yaw damper can be automatically engaged (activated) when selecting the autopilot button, starts to control the yaw servo under the floor of the cabin. When the yaw damper is disengaged, regardless of the use of other autopilot mode functions, pushing the yaw damper button allows the yaw damper to engage.

(See Figure 19: control of the Aircraft)

(3) Descriptions of the POH

The POH of the Aircraft contains the following descriptions as the indicator and procedure for the yaw trim (excerpts).

CHECK-LIST PROCEDURE

AFTER STARTING ENGINE

11 - "AP/TRIMS MASTER" switch・・・・・・・・・・・・・・・・ ON

- Yaw trim・・・・・・・・・・・・・・ L／R, then ADJUSTED

BEFORE TAKEOFF

12 - Trims

- Yaw ・・・・・・・・・・・・・・・・・・・・・・・・ ADJUSTED

AMPLIFIED PROCEDURE (in which some procedures are added to the CHECK LIST PROCEDURE)

AFTER STARTING ENGINE

11 - "AP/TRIMS MASTER" switch・・・・・・・・・・・・・・・・ ON

- Yaw trim・・・・・・・・・・・・・・ L／R, then ADJUSTED

Adjust the indication in green range TO (TAKEOFF).

BEFORE TAKEOFF

12 - Trims

- Yaw ・・・・・・・・・・・・・・・・・・・・・・・・ ADJUSTED

However, there are no descriptions about the yaw trim in the check list procedure for "***TAKEOFF***"", "***CLIMB***" and "***CRUISE***".

(4) Descriptions of the check list that the captain used

The following descriptions are included in the check list of the Aircraft that was prepared by the Employee A, as described in 2.11.1(1) (excerpts).

It is noted that the Employee A described the yaw trim as the rudder trim.

TAKEOFF

RUDDER TRIM ・・・・・・・・・・・・・・・・・・・・ SET FOR T/O

AFTER TAKEOFF

RUDDER TRIM ・・・・・・・・・・・・・・・・・・・・・・・・ SET

2.11.5 Flight limitations of the Aircraft

(1) Airspeed limitations

The POH of the Aircraft contains the following descriptions (excerpts).

SECTION 2 LIMITATIONS

2.2 - AIRSPEED LIMITATIONS

	SPEED	KCAS	KIAS	REMARKS
V_{MO}	Maximum operating speed	271	266	Do not intentionally exceed this speed in normal flight category
V_A	Maneuvering speed	160	158	Do not make abrupt or full control movements above this speed

(2) Information on ultimate load

The POH of the Aircraft contains the following descriptions (excerpts).

2.6 - OPERATION LIMITS

FLIGHT LOAD FACTOR LIMITS

Flaps up: $-1.5 \leqq n \leqq +3.8g$

The following descriptions are included in the EASA, TYPE-CERTIFICATE DATA SHEET (NO.EASA.A.10 for TBM700) (excerpts).

B.II. EASA Certification Basis

2. Airworthiness Requirements	*FAR-23, Amendment 34, dated 01-Jan-1988*

The following descriptions are included in the Federal Aviation Regulations of the United States of America (FAR Part 23) (excerpts).

Sec. 23.303

Factor of Safety

Unless otherwise provided, a factor of safety of 1.5 must be used.

Sec. 23.305

Strength and deformation.

(a) The structure must be able to support limit loads without detrimental, permanent deformation. At any load up to limit loads, the deformation may not interfere with safe operation.

(b) The structure must be able to support ultimate loads without failure for at

least three seconds. However, when proof of strength is shown by dynamic tests simulating actual load conditions, the three second limit does not apply.

Based on the information mentioned as above, 3.8 G of positive ultimate flight load factor limits multiplied by a safety factor 1.5 gives 5.7 G of positive ultimate flight load factor limits at the time of retracting the flaps of the Aircraft.

2.11.6 Propeller Effect of Single-Engine Airplane

When a single-engine airplane with the propeller rotating clockwise like the Aircraft sharply increases the engine power output during the take-off, the effects of engine and propeller rotation force cause the airplane to have the following flight characteristics.

(1) Effect of the propeller slipstream

The rotation of an aircraft propeller gives a corkscrew or spiraling rotation to slipstream (propeller slipstream), which flows along the fuselage, and strikes the left side of the vertical fin, giving force to yaw the aircraft's nose to the left in case of the propeller rotating clockwise. And the resultant force exerted from this propeller slipstream becomes stronger as the airspeed of the airplane is slow and the propeller rotation speed is fast like at the time of take-off.

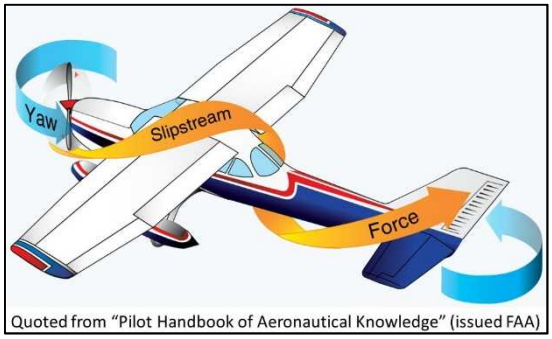


Figure 20: propeller slipstream

(2) Effect of torque reaction

As the rotating force of the engine allows the propeller to revolve in one direction, torque reaction works and an equal force is trying to rotate the aircraft in the opposition direction around the axis of the aircraft, and the left side of an aircraft with the propeller rotating clockwise is being forced down by torque reaction. This force exerted from torque reaction becomes also stronger as the airspeed of the airplane is slow and the propeller rotation speed is fast.

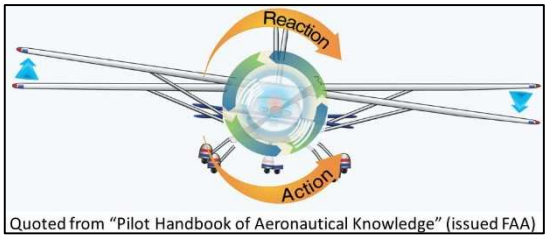


Figure 21; torque reaction

(3) Effect of P-Factor

In addition to the force mentioned above, when an aircraft is flying with a high

Angle of Attack (AOA) and at high power settings, the relative wind of the downward moving propeller blade in the right side is greater than the relative wind of the upward moving propeller blade in the left side; and as the thrust produced in the right side becomes greater, causing a yawing moment toward the left. The larger the number of rotations is and the higher the AOA is, the stronger this force becomes. This unbalanced thrust between the right and left propeller blades is called P-factor, which greatly affects the attitude of the aircraft, when the aircraft is flying at high power settings and at low speed.

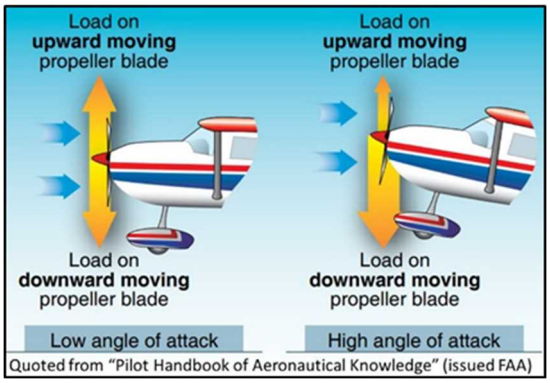


Figure 22: P-Factor

2.11.7 The Captain's Flight Condition Three Days before the Accident

The captain planned to fly IFR for the purpose of familiarization flight from the Airport to Kobe Airport, on August 11, 2017, three days before the accident, and the Aircraft took off from the Airport. But the Aircraft returned to the Airport because there was a malfunction in the radio communication equipment, thus this was classified as an irregular flight by the Civil Aviation Bureau of the Ministry of Land, Infrastructures, Transport and Tourism.

Based on the radar track records for air traffic control of the Kansai radar approach control, the estimated flight route of the Aircraft at that time was as shown in Figure 23. For the blue dashed flight-planned route, the Aircraft, while straying, followed such a route as could enter the Positive Control Area.

(See Figure 23: estimated flight route of the Aircraft in the morning on August 11.)

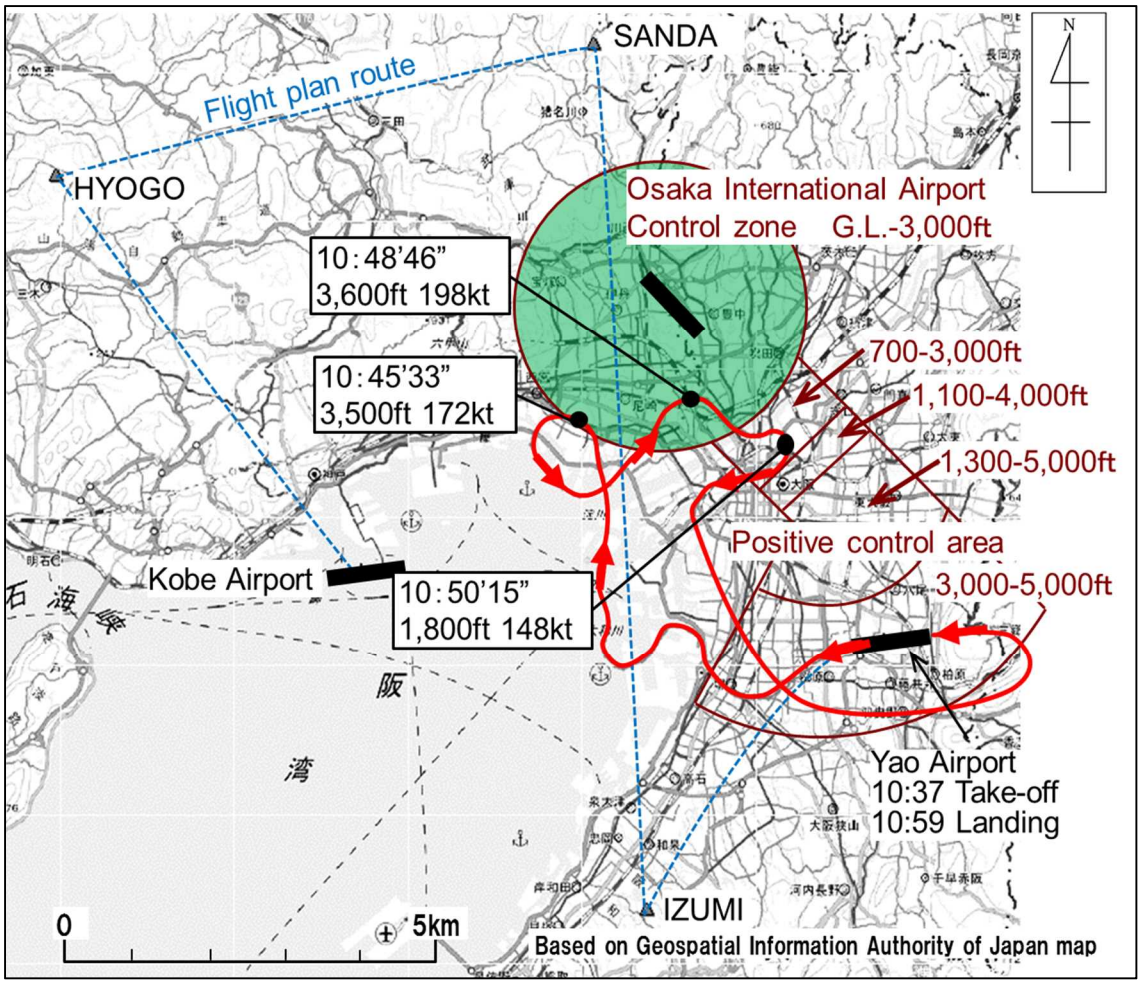


Figure 23: estimated flight route of the Aircraft in the morning on August 11

2.11.8 Information on Air Traffic Instructions

The Civil Aeronautics Act stipulates as follows (excerpts):

Article 96 (Air Traffic Instructions) Any aircraft shall, in an air traffic control area or an air traffic control zone, be navigated in accordance with instructions which are given by the Minister of Land, Infrastructure, Transport and Tourism, in consideration of ensuring safe and smooth air traffic, with regard to the order, time or method of takeoff or landing, or the flight method.

(Omitted)

(3) Any aircraft shall, when engaging in any of the following flights, engage in such flight after having communicated with the Minister of Land, Infrastructure, Transport and Tourism pursuant to the provision of Ordinances of the Ministry of Land, Infrastructure, Transport and Tourism in order to receive instructions from the Minister of Land, Infrastructure, Transport and Tourism under provisions of paragraph (1).

(i) Takeoff from an aerodrome pertaining to an air traffic control zone, and a climb in

the said control zone after takeoff

(Omitted)

(iv) Flight under instrument flight rules in an airspace designated in the public notice by the Minister of Land, Infrastructure, Transport and Tourism within an air traffic control area for a climb following the flight listed in paragraph (1) or a descent preceding the flight listed in paragraph (2) (hereinafter referred to as "approach control area")

(v) Flight under instrument flight rules in an air traffic control area, other than those listed in the preceding paragraph

(Omitted)

(4) Any aircraft shall, during a flight listed in each item under the preceding paragraph, listen to instructions from the Minister of Land, Infrastructure, Transport and Tourism under provisions of paragraph (1).

In AIM-J effective for 2018 January 1 to June 30 (serviced by the Japan Civil Aviation Bureau, published by Japan Aircraft Pilot Association), there are the following descriptions.

412 (Confirmation of Clearance) The ATC clearance is authorized by the MLIT (ATC facility) in accordance with the flight plan submitted by an operator. An amended or restricted flight plan may sometimes be authorized on account of traffic or airport conditions in order to prevent a midair collision and to maintain an orderly traffic flow.

An ATC clearance also, is renewed when a partially amended flight plan is authorized clearance and ATC instruction; however, a pilot in command is directly responsible for, and is the final authority as to the safe operation of that aircraft. Therefore, a pilot in command should notify, and confirm or request to amend the clearance when it is regarded as improper or difficult to comply with in terms of the aircraft performance or operational safety.

2.11.9 Information on Emergency Locator Transmitter

The emergency locator transmitter (ELT) installed in the Aircraft was recovered from the accident site on September 15, 2017, and an examination was conducted at the agent of the ELT manufacturer. The ELT had been activated for 248 hours 39.5 minutes and the battery voltage was below the specified value. There was no abnormality found in the function test using an external power supply. The G switch was activated normally, but the distress signals of the Aircraft were not received.

As described in 2.7, the ELT antenna installed in the fuselage aft was detached.

2.11.10 Information on Flight Recorder

The Aircraft was not equipped with a device (flight recorder) for recording the situation of the aircraft operation.

3. ANALYSIS

3.1 Qualifications of Personnel and Others

The captain had an airman competence certificate and an aviation medical certificate of Japan.

However, as described 2.4, the captain did not have any appropriate certificates or licenses issued or recognized by the United States of America, the State of Registry of the Aircraft, which was deemed as the condition of permission under the proviso of Article 11 paragraph (1) of the Civil Aeronautics Act.

In addition about the aviation medical certificate, as described in 2.9.4, the captain did not declare his medical history and prescribed medical products for treatment in the submitted application form for the aviation medical certificate.

3.2 Airworthiness Certificate

The Aircraft had a valid airworthiness certificate of the United States of America, and had been maintained.

3.3 Relationship with Meteorological Conditions

As mentioned in 2.6, it is highly probable that the meteorological conditions near the accident site at the time of the accident was not related to the accident.

3.4 Circumstances of the Flight

As described in 2.1, the Aircraft took off from the Airport at 11:57 and was flying IFR to Fukushima Airport for the purpose of leisure flight, with the captain in the left pilot seat and the passenger in the right pilot seat.

As described in 2.1.1 and 2.1.2, it is highly probable that the Aircraft received a clearance for ASUKA SIX DEPARTURE, and was instructed to contact with Kansai Approach after the take-off and maintain an altitude of 2,500 ft, and then the Aircraft took off, but it did not call to Kansai Approach immediately after the take-off, and climbed while deviating southward from the SID flight path. It is also highly probable that after 11:59:49, when receiving from Kansai Approach an instruction to turn right to heading 010°, the Aircraft was flying in accordance with the instruction from the Controller not following the SID flight path. As described in 2.11.3 (1), it is somewhat likely that the captain was climbing by engaging the autopilot mode such as HDG mode and the VS mode, however, it could not be identified.

It is highly probable that the Aircraft had been flying stably according to ATC instruction until it received the instruction to fly directly to ASUKA from Kansai Departure at 12:05:14;

however, after that, the Aircraft was flying east toward ASUKA while its heading started to swing at 12:05:54, but it was actually flying southeast 30° to 40° to the right deviating from the desired direction toward ASUKA after 12:08:13. It is highly probable that despite actually its flying southeast, the Aircraft responded to the inquiry from Kansai Departure saying its heading was 070° that was about the direction toward ASUKA; and at 12:11:30, the Aircraft received the instruction to fly heading 070° at FL160 and continued climbing beyond FL160, but changed its heading to the east. It is highly probable that without receiving a clearance, the Aircraft deviated the instructed course, climbed up to an altitude of 17,200 ft at 12:11:54, and started to descend after receiving the Japanese instruction to promptly descend to FL160 at 12:12:10, though it did not respond to the instruction.

It is highly probable that the Aircraft requested radar vectors at 12:12:42, but cancelled IFR flight immediately after that; at this point, the Aircraft gave up flying IFR to Fukushima Airport and decided to return to the Airport by VFR. At 12:13:48, the Aircraft started to turn right while descending, received instruction to contact with Kansai TCA at 12:14:19, and requested Kansai TCA to provide radar vectors to the Airport at 12:14:46, but did not respond to the calls from Kansai TCA after 12:14:56. AT 12:15:22, the Aircraft descended rapidly while turning right, passed an altitude of 13,000 ft, and at 12:15:53, the Aircraft disappeared from the radar after being confirmed last at 8,700 ft above near the crash site. Judging from these facts, it is highly probable that the Aircraft got into situations where it was not able to control the aircraft, and was rapidly descending while turning at 12:14:56 when the Aircraft stopped its radio response. It is probable that the Aircraft descended at a ground speed of about 257 kt in a about 8,300 fpm rate of descent in a descent angle of about 18°, because the Aircraft descended an altitude of 4,300 ft and flew 2.21 nm in distance for 31 seconds from 12:15:22 to 12:15:53. As described in 2.6.2 and 2.11.5, it is probable that even with a tailwind of 12 m/s (about 23 kt), the ground speed of the Aircraft would greatly exceed a maneuvering speed of 160 KCAS. In this case, it is probable that rapid or excessive pilot operations should not have been conducted.

3.5 Circumstances at the time of the Crash

It is highly probable that that the Aircraft disintegrated in mid-air and a fire broke out in the air, judging from the following eyewitness accounts, such as “the Aircraft with one wing catching on fire and nearly half of the airframe enveloped in flames” “the Aircraft being enveloped in white smoke and orange flame”, “something large parts came off, immediately after white smoke rose and fire started from around its wing”, and “it was already on fire” as described 2.1.3, and the following facts that an object, which was seemed to be the Aircraft,

was separated into at least two and emerged from the low cumulus layer trailing black smoke, and went falling down, as described in 2.1.4, and that the main wreckage of the Aircraft that was separated into the main components, the right wing, the left wing, the fuselage aft, the horizontal stabilizer and the vertical stabilizer, was scattered within the range of about 200 m in north-south and about 100 m in the east-west, as described in 2.7. It is probable that the fire in the Aircraft blazed high in the sky, since one of objects burned explosively.

As described 2.1.5, 2.6.4 and 2.11.1, it is probable that because the permission, which the Aircraft was carrying, concerning the proviso to paragraph 1 of Article 11 of the Civil Aeronautics Act was found and recovered about 1.6 km east-southeast of the crash site, the permission was flown apart in the sky after the mid-air breakup, blown away about 1.6 km getting on the west-northwest, and dropped down to the ground.

It is somewhat likely that because the traces of fire were confirmed only in the main components and the right wing of the Aircraft, the two objects described in 2.1.4 were the main components and the right wing, and the two columns of black smoke seen after the crash were trailing from these two objects.

As described in 2.7, it is highly probable that the Aircraft crashed at acute angle and strongly impacted the ground while facing north-northwest in upside down with its nose down, because the main components of the Aircraft were found being crashed with its nose facing north-northeast in upside down, and the trees located to the opposite side of them were cut down halfway with the elevation angle about 60°.

3.6 Situation at the Time of Mid-Air Breakup

It is highly probable that the left wing had been broken in the air before a fire broke out, because as described 2.7 and 2.8 (2), it was found that the left wing was broken halfway near R8 and its root side was burned severely, but its wing tip side was found about 130 m away from the main components and there was no trace of fire.

As described in 2.8 (1) and (2), judging from the following facts that there were black

scratch marks on the upper part of the fuselage and the upper front of the cabin door, that the left wing leading edge equipped with black rubber deicing boots was damaged and dented by the impact from the front, and that the spar was bent upward at an angle of 45° or more and broken, it is highly probable that the left wing was bent upward and broken near the R8, then the leading edge impacted the upper part of the fuselage. Judging from the facts that the fuselage was 136 cm in width, and the damaged and dented part of the left wing leading edge was about 180 cm in length, it is highly probable that the left wing leading edge impacted the upper part of fuselage at an angle of 41° backward to the lateral axis (cos-1(136/180)≒41°).

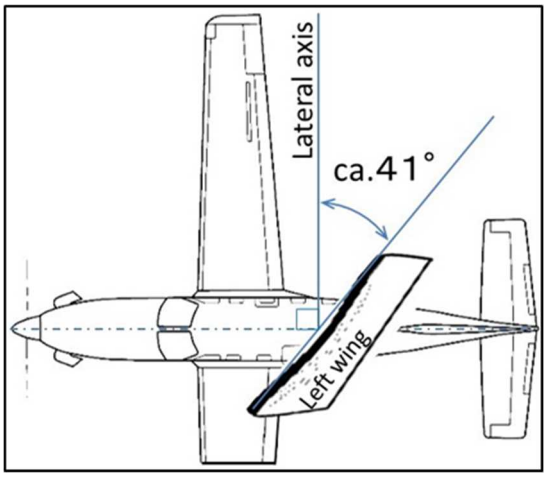


Figure 24: situation of the collision between the fuselage and left wing

As described in 2.8 (4) and (5), judging from the facts that the horizontal stabilizer was bent upward, and the vertical stabilizer was detached upward, it is highly probable that the dorsal fins of the horizontal stabilizer and the vertical stabilizer were detached upward from the fuselage. Regarding the fact that both empennages were found near the left wing, it is probable that the rupture of the left wing and the falling off of both empennages occurred at almost same time. It is probable that the aft fuselage was also broken at almost same time, but regarding the fact that the aft fuselage was found closer to the main components, it is somewhat likely that the aft fuselage was not detached completely from the main fuselage for a while.

As described in 2.8 (3), judging from the facts that the right wing was broken around R8, and was found about 40 m away from the main components; furthermore, there was the trace of fire entirely on the right wing, it is probable that the right wing was broken after a fire broke out in the air. In addition, judging from the facts that the fitting part between the front spar and the fuselage was broken, and the aft spar was bent backward and broken around the root part, it is probable that the right wing was detached backward in the fitting part between the front spar and the fuselage. On the other hand, judging from the facts that the fractured surface of the right wing was severely burned, and the wing root side from the fuselage to around R8 was not found, it is somewhat likely that the wing root side was destroyed by fire in the air.

It is highly probable that the Aircraft lost control during flight, nosedived while turning, and disintegrated in mid-air, resulting in the crash.

3.7 Fire

As described in 3.6, it is probable that a fire broke out after the left wing of the Aircraft was broken upward and impacted the upper part of the fuselage; therefore, it is somewhat likely that when the left wing was broken and impacted the upper part of the fuselage, the fuel in the fuel tank loaded inside of the left wing was discharged into the main components, and ignited. Regarding the reason for the ignition of the fuel, it is somewhat likely that sparks and engine emission, which were generated when the electric wiring was cut, might trigger the ignition, however, it was impossible to identify the causes due to heavy damage to the airframe.

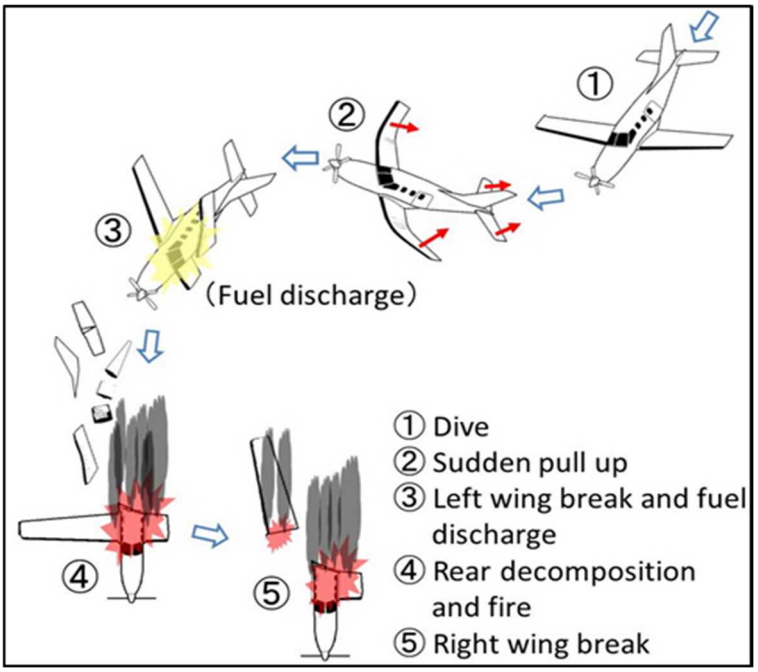


Figure 25: conditions of crash and fire

3.8 Condition of Engine at the Time of the Accident

As described in 2.8 (6), judging from the damaged conditions of engines and propellers, it is highly probable that when the Aircraft crashed and external force was applied to the engine, its compressor, power turbine and propellers were rotating slowly. In addition, judging from the facts that there was no trace or sign that the engine had any abnormalities before crashing and impacting, and as described in 2.1.3, that there was a statement that an eyewitness heard a high sound of engine noise, it is probable that the engines were functioning until the mid-air breakup of the Aircraft; however, as the Aircraft disintegrated in mid-air and the fuel was not able to be supplied to the engine any more, which caused the engine revolutions per minute (rpm) to decrease, then the Aircraft impacted the ground.

3.9 Yaw Trim

As described in 2.7, it was confirmed at the accident site that the trailing edge of the yaw trim tab of the Aircraft was open about 3 cm to the left side from the trailing edge of the rudder. As described in 2.8.(5), this value was close to the maximum movable width, it is highly probable that the Aircraft was flying with the yaw trim set at the take-off position until it crashed.

3.10 Relation between Yaw Trim Position and Aircraft Control

As described in 2.11.4 (1), the yaw trim of the Aircraft can be controlled only manually, it is necessary to control the yaw trim manually or by rudder pedals in order to center the ball of the slip indicator. As described in 2.11. 6 (1), setting the position of the yaw trim of the Aircraft at the take-off position makes it possible to counteract the effect of the propeller slipstream that becomes stronger as the airspeed is slow and the propeller rotation speed is fast, as at the time of take-off; and if the position of the yaw trim is not returned from the take-off position, when the airspeed is fast and the propeller rotation is slow, the effect of the right rudder becomes excessive, giving force to yaw the aircraft's nose to the right as well as to tilt the aircraft to the right.

As described in 2.11.3 (1), it was confirmed that when the Aircraft climbed in the autopilot mode without returning the position of yaw trim from the take-off position, the ball of the slip indicator moved gradually to the left. It is highly probable that this was because the effect of the propeller slipstream was reduced, and the effect of the rudder due to the position of the yaw trim increased.

In addition, at this time, when the ball of the slip indicator moved gradually to the left, the Aircraft flew yawing to the right by 30° to 40° from the heading set and decreased its speed. Regarding the fact that the Aircraft flew yawing to the right, it is probable that the Aircraft's autopilot tried to prevent the nose from yawing toward the right and maintain the heading by turning its nose to the left, but the ailerons had reached to the limit. Regarding the fact that the Aircraft decreased the speed gradually, it is highly probable that the autopilot, whose throttle was constantly set to an ALT mode, tried to maintain the altitude by raising the nose, because the drag increased during sideslip.

Furthermore, as described in 2.11.3 (1), the Employee A said that he maneuvered and confirmed, in condition where the ball was greatly moved to the left and autopilot was disengaged, the aircraft was not able to turn left, even though the control wheel was turned left. Regarding this matter, it is probable that because the pilot didn't adjust the yaw-trim, the ball went to the left, and a roll effort to the right was added, and the aircraft was in asymmetrical flight and turn to the right as the autopilot had been disconnected. It is probable that the pilot had applied a large force to the left to stop the movement to the right roll, and he recognized it as impossible to turn to the left.

It is somewhat likely that the Aircraft had been flying stably until it received the instruction to fly directly to ASUKA from the Controller at 12:05:14, because it was flying in the autopilot HDG mode. Until then, the Aircraft was flying heading 090° in accordance with the Controller's instruction to fly heading 090°, but the Aircraft's heading was facing 30° to 40°

to the right, since the position of the yaw trim was placed in the take-off position. It is somewhat likely that the Aircraft's heading started to swing at 12:05:54, because upon receiving the Controller's instruction to fly directly to ASUKA, the captain noticed that the Aircraft's heading was greatly different from the direction to ASUKA, disengaged the autopilot, and tried to turn the nose to the left manually.

It is somewhat likely that at 12:08:13, the Aircraft changed the heading, deviating 30° to 40° from the direction toward ASUKA, because the control wheel was not able to be turned left despite the captain's trying to turn left. It is somewhat likely that the captain answered the direction to ASUKA when being asked about its heading by the Controller, because the captain recognized the direction to ASUKA and intended to head toward ASUKA. Regarding the fact that the Aircraft was able to turn left at 12:11:54, it is also somewhat likely that the effect of the propeller slipstream was increased, because the rudder pedals was temporally used, or the situation became close to at the time of the take-off by decreasing the speed to increase power, however, it was impossible to identify it.

It is somewhat likely that at 12:13:48, the Aircraft started to turn right while descending, because the Aircraft was going to make an inverting turn in order to return to the Airport. Regarding the fact that the Aircraft was not able to respond to the calls from the Controller at 12:14:56, it is somewhat likely that during communications made 10 seconds before the calls, the Aircraft got into such a situation where the captain was not able to control the Aircraft, because the right turn and nosedive could not be stopped as the attitude could not be maintained, the airspeed increased, which increased influence from the yaw trim and the rudder placed in the wrong position. As described in 3.6, it is highly probable that the left wing was bent upward and broken, the horizontal stabilizer, the vertical stabilizer and the dorsal fins were detached upward; and therefore, it is somewhat likely that as described in 2.11.5 (1), because the airspeed exceeded a maneuvering speed due to nose-diving, the captain rapidly pulled up in order to make a turnaround of the situation, resulting in mid-air breakup as exceeding the ultimate flight load factor limits, as described in 2.11.5.

3.11 Pilot Competency of the Captain

As described in 2.1.2, not only the captain of the Aircraft neglected the responses in air traffic control, deviated from the instructed altitude, and delayed in read-back, but also he was not able to fly IFR in accordance with the instruction from the Controller about the heading and the altitude. Judging from these facts, it is highly probable that the captain did not have the pilot competence to fly IFR.

In addition, as described in 2.11.3 (1) and 2.11.4, the Aircraft was very more likely to yaw to the left at the time of take-off, and in the procedure, it was supposed to place the position of

the yaw trim in the take-off position when taking off. The Employee A prepared a check list including the reset of the yaw trim at the time of the after-take-off-check, since the captain often forgot to return the position of the yaw trim from the take-off position after taking off. It is highly probable that the captain forgot to return the position of the yaw trim at the time of the accident. As described in 2.11.3 (1) and 2.11.7, especially three days before the accident, the captain forgot to return the yaw trim position despite flying IFR, straying over the built-up areas, and therefore, the Employee A took over the control of the Aircraft from the captain to make a landing.

As described in 2.11.4 (1), the yaw trim can only be controlled by the pilot's operation, and the autopilot does not have any control of the yaw trim, therefore, the yaw trim setting must be carried out appropriately by the pilot.

It is highly probable that the captain was not able to control the Aircraft, because he forgot to return the position of the yaw trim from the take-off position, did not notice on the way, and did not return the position of the yaw trim to the end. It is highly probable that the captain could have noticed that he had not returned the yaw trim position if he conducted the after-take-off-check; and even if he did not conduct the after-take-off-check, he could have noticed that he had forgot to return the position of the yaw trim position by checking with the slip indicator or the yaw trim indicator; however, it is somewhat likely that the captain did neither conduct the after-take-off-check nor check with the slip indicator and the yaw trim indicator. Furthermore, the captain often conducted an unusual flight as he forgot to return the position of the yaw trim many times before; it is somewhat likely that this is because the captain did not understand the influence from the yaw trim placed in the wrong position, and did not master the operation for checking and returning the position of the yaw trim.

As described in 2.11.3 (3), the main differences in the pilot operations between the Previous Aircraft and the Aircraft were weight, speed, power, trim operation, and others. As described in 2.11.3 (1), it is probable that the captain had hardly mastered the operation of the Aircraft including the yaw trim operation, the aileron trim operation, the handling of the radio, and further the normal procedure of the engine start. It is probable that the Employee A had been on board the Aircraft together with the captain eight times up to the accident to give advice on the operation of the Aircraft; and he provided the captain with the advice on the pilot operation for more than 20 hours on the phone; however, there was no record indicating that the captain received classroom lectures and training by an appropriate instructor.

It is somewhat likely that the Aircraft lost control during flight, because the captain did not have pilot skills and knowledge necessary for the operation of the Aircraft, and was not able to perform proper pilot operations.

3.12 Pilot Qualifications in Japan

As described 2.11.2 (1) and (2), the competence certificate in Japan is in accordance with the standards in the Annex 1 to the Chicago Convention. Therefore, with regard to the aircraft not requiring the type rating, if the aircraft meet each class rating, pilots can be entitled to operate the aircraft within the scope of services in accordance with each qualification, regardless of the characteristics of each aircraft. In addition, it is possible to obtain the aircraft class ratings for a single-engine piston (land) and a single-engine turbine (land) even when an aircraft with a single-engine piston (land) is used in the practical examination of a competence certificate. On the other hand, in the United States of America, as described in 2.1.2 (3), in order to operate the Aircraft as PIC, in addition to a class rating for a single-engine airplane, additional trainings such as classroom lectures and flight training required for operating complex airplanes, high-performance airplanes and pressurized aircraft that allow flight at high altitude. In addition, generally the insurance companies require pilots to take trainings according to their flight experiences, and usually request pilots to obtain the minimum flight time by taking flight trainings with a pilot on board who has a TBM flight experience. Furthermore, as described in 2.11.2 (4) and (5), the EASA imposes the specific educational training requirements for flying TBM700, since TBM700 is a unique and simple turboprop airplane with the characteristics different from other simple-engine aircraft. In accordance with the requirements as above, the ATOs provide educational trainings for pilots. It is highly probable that the captain should have mastered the necessary pilot skills and knowledge by taking these trainings or the equivalent.

In order to prevent pilots from flying without skills and knowledge necessary for operating the respective aircraft, it is necessary for the Civil Aviation Bureau of the Ministry of Land, Infrastructures, Transport and Tourism to instruct the pilots to master the skills and knowledge required for operating the aircraft which the pilots have never flown before, even in case of operating the aircraft not requiring the type rating.

3.13 Permission for Temporary Use of Foreign Aircraft within Japan

As described in 2.4, the captain did not have any appropriate certificates licenses issued or validated by the United States of America, the State of Registry of the Aircraft; and therefore, it is certain that the captain did not comply with the conditions of the permission regarding the Aircraft under the proviso to paragraph 1 of Article 11 of the Civil Aeronautics Act.

Article 11 of the Civil Aeronautics Act requires an aircraft to obtain a valid airworthiness certificate. However the Minister of Land, infrastructure, Transport and Tourism grants permission by imposing certain conditions on the temporary domestic use of foreign aircraft that has not an airworthiness certificate issued by Japan. As described in 2.11.1, on the

backside of the certificate, there is a description stating "5. *The aircraft should be operated only by crew holding appropriate certificates or licenses issued or validated by the State of Registry.*" It is probable that this is based on the responsibility of the State of Registry for airworthiness certification and competence certification under the Chicago Convention, which is required for any aircraft engaged in international aviation; and this condition is written to eliminate the risk that the pilots, who has only domestic certificates, might operate a foreign aircraft without any significant safety knowledge such as the system of the State of Registry, the flight manual of the aircraft and the operating limitations, ant others. When operating an aircraft with the permission under the proviso to paragraph 1 of Article 11 of the Civil Aeronautics Act, the pilot shall comply with the conditions described in the permission.

3.14 Conformity to the Standard for Medical Examinations

As described in 2.9.2.3, the past medical history of the captain should have been declared by himself and confirmed by the designated aviation medical examiners and other respectively about whether to affect his performance of airman duties, when those diseases were diagnosed for the first time and he applied for the aviation medical examination. In addition, as described in 2.9.3.3, the medical products prescribed to the captain included (D) that are unsuitable for the performance of aviation duties, (C) that require aircrews to stop engaging in the performance of aviation duties when starting taking those medical products, and to apply for the judgment by the Minister of Land, infrastructure, Transport and Tourism before resuming the performance of aviation duties, and (B) that require individual evaluations on their effects on the performance of aviation duties. However, as described in 2.9.4, the captain did not declare his medical history and prescribed medical products in the submitted application form for the aviation medical certificate, and the aviation medical certificate was issued to the captain since the aviation medical examination did not reveal any abnormality regarding the test items checked in the examination. It is highly probable that the captain had suffered diseases that might affect the performance of aviation and the medical and pharmaceutical products were prescribed to him, when he was operating the Aircraft at the time of the accident. Therefore, it is somewhat likely that these diseases and prescribed medicines might have an affect on his performance of aviation duties and judgment; however, it could not be clarified because the captain and the passenger were fatally injured.

In aviation Medical examination, it is difficult to make an appropriate judgment on whether to conform to the standards of aviation medical examination unless applicants declare their medical history and information accurately. When those diseases, as described in 2.9.2, were diagnosed for the first time, it is probable that the captain should have declared the medical information such as his treatment status and therapeutic medicine to the designated

aviation medical examiners, and according to the doctors' instructions, he should have taken required additional examinations, and if necessary, he should have applied for the judgment of the Minister of Land, Infrastructure, Transport and Tourism. In addition, as described in 2.9.2, after declaring the medical information, it is highly probable that the captain should not have engaged in the performance of aviation duties until the conformity to the standards for medical examinations was confirmed.

As described in 2.9.5, aircrews shall comply with the Medicine Handling Guidelines when using medical products, which were notified by the Civil Aviation Bureau, Ministry of Land, Infrastructure, Transport and Tourism, and their past medical history and prescribed medicine must be accurately self-reported in order to apply for the aviation medical examination, and if non-conformity is suspected, they must stop to engage in the performance of aviation duties, and must receive instructions from the designated aviation medical examiners and others, even if his/her aviation medical certificate is still valid, which the captain should have followed.

3.15 ELT

As described in 2.11.9, it is highly probable that the ELT installed in the Aircraft had been working normally and the battery voltage dropped while the ELT continued to operate for a long time. As described in 2.7, it is probable that the distress signals of the Aircraft were not received, because the ELT antenna installed in the fuselage aft was detached.

3.16 Flight Recorders

As described in 2.11.10, the Aircraft was not equipped with a flight recorder, therefore, the factual information on the Aircraft including in-flight conversations, which was necessary for the accident investigation, was limited.

3.17 Fire, Firefighting and Rescue Operations

As described in 2.10, it is highly probable that the firefighting and rescue operations concerning this accident was carried out appropriately.

4 Conclusion

4.1 Summary of the Analysis

(1) The captain had an airman competence certificate and an aviation medical certificate of Japan, however, he did not have any appropriate certificates or licenses issued or recognized by the United States of America, the State of Registry of the Aircraft, in addition, the captain did not declare his medical history and regular medication in the submitted application form for the aviation medical certificate. (3.1)*6

(2) It is highly probable that the Aircraft was flying east toward ASUKA while its heading started to swing at 12:05:54, it was actually flying southeast 30° to 40° to the right from the desired direction toward ASKA after 12:08:13. (3.4)

(3) It is highly probable that the Aircraft got into situations where it was not able to control the aircraft, and was rapidly descending while turning at 12:14:56 when the Aircraft stopped response. (3.4)

(4) It is probable that the descend rate was about 8,300 fpm, the ground speed was 257 kt and the descent angle was about 18° immediately before it disappear from the radar. (3.4)

(5) It is probable that the ground speed of the Aircraft would greatly exceed a maneuvering speed of 160 KCAS where rapid or excessive pilot operations should not have been conducted. (3.4)

(6) It is highly probable that a the Aircraft disintegrated in mid-air and a fire broke out in the air. (3.5)

(7) It is highly probable that the Aircraft crashed at acute angle and strongly impacted the ground while facing north-northwest in upside down with its nose down. (3.5)

(8) It is highly probable that during the mid-air breakup, the left wing was bent upward and broken near the R8 and impacted the upper part of the fuselage. It is probable that the aft fuselage was broken and the both empennages were detached from the fuselage. It is probable that the right wing was detached backward in the fitting part with the fuselage after fire broke out. It is highly probable that the Aircraft was lost control during flight, nosedived while turning, and disintegrated in mid-air, resulting in the crash.(3.6)

(9) It is somewhat likely that when the left wing was broken and impacted the upper part

---

*6 The numbers at the end of each sentence in this paragraph indicate the main item number of "3 ANALYSIS" which is related to the description.

of the fuselage, the fuel in the fuel tank loaded inside of the left wing was discharged into the main components, and ignited. Regarding the reason for the ignition of the fuel, it is somewhat likely that sparks and engine emission, which were generated when electric wiring was cut, might trigger the ignition, however, it was impossible to identify the causes due to heavy damage to the airframe. (3.7)

(10) It is probable that the Aircraft disintegrated in mid-air and the fuel was not supplied to the engine any more, which caused the engine rpm to decrease, then the Aircraft impacted the ground. (3.8)

(11) It is highly probable that the Aircraft was flying with the yaw trim set at the take-off position until it crashed. (3.9)

(12) It is somewhat likely that the Aircraft got into a situation where the captain was not able to control the Aircraft, as the right turn and nose-dive could not be stopped due to the increased influence from the yaw trim and the rudder placed in the wrong position. (3.10)

(13) It is somewhat likely that because the airspeed exceeded a maneuvering speed due to nose-diving, the captain rapidly pulled up in order to make a turnaround of the situation, resulting in mid-air breakup as exceeding the ultimate flight load factor limits. (3.10)

(14) It is highly probable that the captain did not have the pilot competence to fly IFR in the aircraft. (3.11)

(15) It is highly probable that the captain was not able to control the Aircraft, because he forgot to return the yaw trim position from the take-off position, did not notice it, and did not return the position of the yaw trim to the end. (3.11)

(16) It is somewhat likely that the captain did neither conduct the after-take-off-check nor check with the slip indicator and the yaw trim indicator. In addition, the captain often conducted an unusual flight as he forgot to return the position of the yaw trim many times before; it is somewhat likely that this is because the captain did not understand the influence from the yaw trim placed in the wrong position, and did not master the operation for checking and returning the yaw trim position. (3.11)

(17) It is probable that the captain had hardly mastered the operation of the Aircraft. In addition, there was no record indicating that the captain received classroom lectures and trainings by an appropriate instructor. It is somewhat likely that the Aircraft lost control during flight, because the captain did not have pilot skills and knowledge necessary for the operation of the Aircraft, and was not able to perform proper flight operations. (3.11)

(18) In case of the competence certificate in Japan, with regard to the aircraft not requiring the type rating, if the aircraft meet each class rating, pilots can be entitled to operate the aircraft within the scope of services in accordance with each qualification, regardless of the characteristics of each aircraft. In addition, it is possible to obtain the aircraft class ratings for a single-engine piston (land) and a single-engine turbine (land) even when an aircraft with a single-engine piston (land) is used in the practical examination of a competence certificate. (3.12)

(19) In order to prevent pilots from flying without skills and knowledge necessary for operating the respective aircraft, it is necessary for the Civil Aviation Bureau of the Ministry of Land, Infrastructures, Transport and Tourism to instruct the pilots to master the skills and knowledge required for operating the aircraft which the pilots have never flown before, even in case of operating the aircraft not requiring the type rating. (3.12)

(20) The captain did not have any appropriate certificates or qualifications issued or recognized as valid by the State of Registry of the Aircraft; and therefore, it is certain that the captain did not comply with the conditions of the permission regarding the Aircraft under the proviso to paragraph 1 of Article 11 of the Civil Aeronautics Act.(3.13)

(21) When operating an aircraft with the permission under the proviso to paragraph 1 of Article 11 of the Civil Aeronautics Act, the pilot shall comply with the conditions described in the permission. (3.13)

(22) The past medical history of the captain should have been declared by himself and confirmed by the designated aviation medical examiners and other respectively about whether to affect his performance of airman duties, when those diseases were diagnosed for the first time and he applied for aviation medical examination. The captain did not declare his medical history and prescribed medical products in the submitted application form for the aviation medical certificate, and the aviation medical certificate was issued to the captain since the aviation medical examination did not reveal any abnormality regarding the test items checked in the examination. (3.14)

(23) It is highly probable that the captain had suffered diseases that might affect the performance of aviation and the medical and pharmaceutical products were prescribed to him, when he was operating the Aircraft at the time of the accident. Therefore, it is somewhat likely that these diseases and prescribed medicines might have an affect on his performance of aviation duties and judgment; however, it could not be clarified because the captain and the passenger were fatally injured. (3.14)

(24) It is highly probable that the captain should not have engaged in the performance of aviation duties until the conformity to the standards for medical examinations was

confirmed. (3.14)

(25) Aircrews shall comply with the Medicine Handling Guidelines when using medical products, which were notified by the Civil Aviation Bureau, Ministry of Land, Infrastructure, Transport and Tourism, and their past medical history and prescribed medicine must be accurately self-reported in order to apply for the aviation medical examination, and if non-conformity is suspected, they must stop to engage in the performance of aviation duties, and must receive instructions from the designated aviation medical examiners and others, even if his/her aviation medical certificate is still valid, which the captain should have also followed. (3.14)

(26) It is probable that the distress signals of the Aircraft were not received, because the ELT antenna installed in the fuselage aft was detached. (3.15)

(27) The Aircraft was not equipped with a flight recorder, therefore, the factual information on the Aircraft including in-flight conversations, which was necessary for the accident investigation, was limited. (3.16)

4.2 Probable Causes

In the accident, it is highly probable that the Aircraft lost control during flight, nose-dived while turning, and disintegrated in mid-air, resulting in the crash.

It is somewhat likely that the Aircraft lost control during flight, because the captain did not have pilot skills and knowledge necessary for the operation of the Aircraft, and was not able to perform proper flight operations.

5 SAFETY ACTIONS

5.1 Safety Actions Taken by the Civil Aviation Bureau, Ministry of Land, Infrastructure, Transport and Tourism

(1) Thorough confirmation of self-reported contents at the time of aviation medical examination

On October 25, 2018, the opinion of the Japan Transport Safety Board (JTSB) in view of the Aircraft Accident (AA2018-8-1) of the helicopter operated by the Nagano Fire and Disaster Prevention Aviation Center, the Civil Aviation Bureau, Ministry of Land, Infrastructure, Transport and Tourism decided as follows.

It is necessary that the Civil Aviation Bureau, Ministry of Land, Infrastructure, Transport and Tourism thoroughly instruct aircrews to accurately make a self-report on their medical information to apply for the aviation medical certification, and if non-conformity is suspected, they must not engage in the performance of aviation duties, and must receive instructions from the designated aviation medical examiners and others, even if his/her aviation medical certificate is still within validity period.

In response to the opinion from the JTSB as above, the Civil Aviation Bureau, Ministry of Land, Infrastructure, Transport and Tourism ensured that pilots should comply with the following matters by notifying them through their organizations in a printed document that was also published on the homepage of the Ministry of Land, Infrastructure, Transport and Tourism; the past medical history and prescribed medicine must be accurately self-reported at the time of the aviation medical examination; and if non-conformity is suspected, aircrews must stop to engage in the performance of aviation duties, and must receive instructions from the designated aviation medical examiners and others, even if his/her aviation medical certificate is still valid. In addition, the Civil Aviation Bureau, Ministry of Land, Infrastructure, Transport and Tourism requested the operators (including the Fire and Disaster Management Agency, the National Police Agency, the Japan Coast Guard, and others) to provide guidance to the their pilots, and also requested them to strengthen the instructions at the aviation safety seminars.

Other than those mentioned as above, the Civil Aviation Bureau, Ministry of Land, Infrastructure, Transport and Tourism decided to work on the following matters; to prepare a leaflet listing drugs that require the confirmation by designated

aviation medical doctors for their use and make it known; to request the designated aviation medical doctors to ensure that at the time of aviation medical examination, the interview with applicants shall be made for a clear comprehension of their medical history and others; to take into account the comments from experts and consider measures to ensure that the medical history and others are accurately self-reported by pilots.

5.2 Safety Actions to be Taken by the Civil Aviation Bureau, Ministry of Land, Infrastructure, Transport and Tourism

(1) Pilot skills and knowledge

In case of the competence certificate in Japan, with regard to the aircraft not requiring the type rating, if the aircraft meet each class rating, pilots can be entitled to operate the aircraft within the scope of services in accordance with each qualification, regardless of the characteristics of each aircraft.

In order to prevent pilots from flying without skills and knowledge necessary for operating the respective aircraft, it is necessary for the Civil Aviation Bureau of the Ministry of Land, Infrastructures, Transport and Tourism to instruct the pilots to master the skills and knowledge required for operating the aircraft which the pilots have never flown before, even in case of operating the aircraft not requiring the type rating.

6 RECOMMENDATIONS

6.1 Recommendations to the Minister of Land, Infrastructure, Transport and Tourism

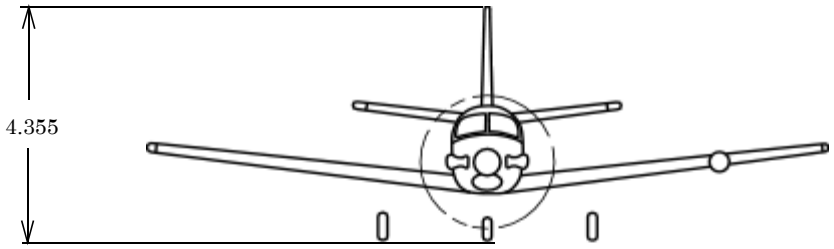
In this accident, it is somewhat likely that the Aircraft lost control during flight, because the captain did not have pilot skills and knowledge necessary for the operation of the Aircraft, and was not able to perform proper flight operations. In case of the competence certificate in Japan, with regard to the aircraft not requiring the type rating, if the aircraft meet each class rating, pilots can be entitled to operate the aircraft within the scope of services in accordance with each qualification, regardless of the characteristics of each aircraft.

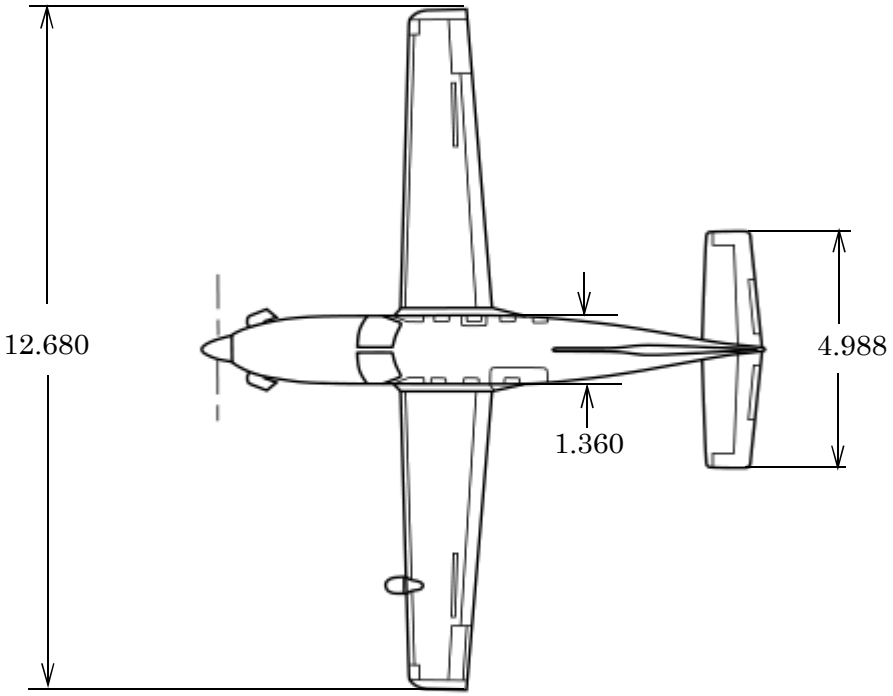
Therefore, in view of the identified matters of the accident investigation, in order to ensure the safety of aviation, the Japan Transport Safety Board recommends to implement the following measure pursuant to the provision of Article 26 of the Act for Establishment of the Japan Transport Safety Board to the Ministry of Land, Infrastructure, Transport and Tourism.

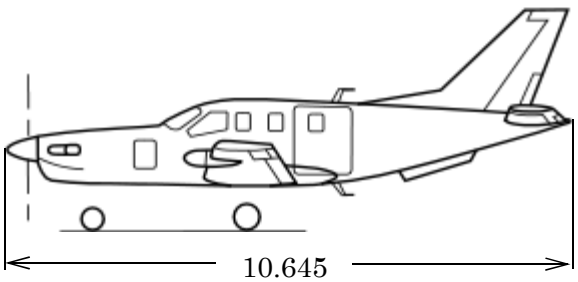
In order to prevent pilots from flying without skills and knowledge necessary for operating the respective aircraft, it is necessary for the Civil Aviation Bureau of the Ministry of Land, Infrastructures, Transport and Tourism to instruct the pilots to master the skills and knowledge required for operating the aircraft which the pilots have never flown before, even in case of operating the aircraft not requiring the type rating.

Appendix 1: Three Angle View of SOCATA TBM700

Unit: m







Attachment 1: Provisions Concerning Overseas Pilot Qualification and Training

1 The United States of America

Federal Aviation Regulations FAR §61.31(excerpts)

§61.31 Type rating requirements, additional training, and authorization requirements.

(a) Type rating required. A person who acts as a pilot in command of the following aircraft must hold a type rating for that aircraft:

(1) Large aircraft (except lighter-than-air).

(2) Turbojet-powered airplanes.

(3) Other aircraft specified by the Administrator through aircraft type certificate procedures.

(Omitted)

(e) Additional training required for operating complex airplanes

(1) Except as provided in paragraph (e) (2) of this section, no person may act as pilot in command of a complex airplane, unless the person has--

(i) Received and logged ground and flight training from an authorized instructor in a complex airplane, or in a flight simulator or flight training device that is representative of a complex airplane, and has been found proficient in the operation and systems of the airplane; and

(ⅱ) Received a one-time endorsement in the pilot's logbook from an authorized instructor who certifies the person is proficient to operate a complex airplane.

(2) The training and endorsement required by paragraph (e)(1) of this section is not required if the person has logged flight time as pilot in command of a complex airplane, or in a flight simulator or flight training device that is representative of a complex airplane prior to August 4, 1997.

(f) Additional training required for operating high-performance airplanes.

(1) Except as provided in paragraph (f) (2) of this section, no person may not act as pilot in command of a high-performance airplane (an airplane with an engine of more than 200 horsepower), unless the person has--

(i) Received and logged ground and flight training from an authorized instructor in a high-performance airplane, or in a flight simulator or flight training device that is representative of a high-performance airplane, and has been

found proficient in the operation and systems of the airplane; and

(ii) Received a one-time endorsement in the pilot's logbook from an authorized instructor who certifies the person is proficient to operate a high-performance airplane.

(2) The training and endorsement required by paragraph (f)(1) of this section is not required if the person has logged flight time as pilot in command of a high-performance airplane, or in a flight simulator or flight training device that is representative of a high-performance airplane prior to August 4, 1997.

(g) Additional training required for operating pressurized aircraft capable of operating at high altitude.

(1) Except as provided in paragraph (g)(3) of this section, no person may not act as pilot in command of a pressurized aircraft (an aircraft that has a service ceiling or maximum operating altitude, whichever is lower, above 25,000 feet MSL), unless that person has received and logged ground training from an authorized instructor and obtained an endorsement in the person's logbook or training record from an authorized instructor who certifies the person has satisfactorily accomplished the ground training. The ground training must include at least the following subjects:

(i) High-altitude aerodynamics and meteorology;

(ii) Respiration;

(iii) Effects, symptoms, and causes of hypoxia and any other high-altitude sickness

(iv) Duration of consciousness without supplemental oxygen;

(v) Effects of prolonged usage of supplemental oxygen;

(vi) Causes and effects of gas expansion and gas bubble formation;

(vii) Preventive measures for eliminating gas expansion, gas bubble formation, and high-altitude sickness;

(viii) Physical phenomena and incidents of decompression; and

(ix) Any other physiological aspects of high-altitude flight

(2) Except as provided in paragraph (g)(3) of this section, no person may act as pilot in command of a pressurized aircraft unless that person has received and logged training from an authorized instructor in a pressurized aircraft, or in a flight simulator or flight training device that is representative of a pressurized aircraft, and obtained an endorsement in the person's logbook or training record from an authorized instructor who found the person proficient in the

operation of a pressurized aircraft. The flight training must include at least the following subjects:

(i) Normal cruise flight operations while operating above 25,000 feet MSL;

(ii) Proper emergency procedures for simulated rapid decompression without actually depressurizing the aircraft; and

(iii) Emergency descent procedures.

(3) The training and endorsement required by paragraph (g)(1) and (g)(2) of this section are not required if the person can document satisfactory accomplishment of any of the following in a pressurized aircraft, or in a flight simulator or flight training device that is representative of a pressurized aircraft;

(i) Serving as pilot in command before April 15, 1991;

(ii) Completing a pilot proficiency check for a pilot certificate or rating before April 15, 1991;

(iii) Completing an official pilot-in-command check conducted by the military services of the United States; or

(iv) Completing an pilot-in-command proficiency check under Part121, 125,or 135 of this chapter conducted by the Administrator or by an approved pilot check airman.

2 EU

(1) Commission Regulation (EU) No 1178/2011

As for the pilot qualification and training of the aircraft, the European Aviation Safety Agency (EASA) of the European Union (EU) stipulates the matters related to the Aircraft in the "Commission Regulation (EU) No 11/78/2011 of 3 November 2011" as follows (excerpts):

SUBPART C

PRIVATE PILOT LICENCE (PPL), SAILPLANE PILOT LICENCE (SPL) AND BALLOON PILOT LICENCE (BPL)

SECTION 1

Common requirements (omitted)

FCL.205 Conditions

Applicants for the issue of a PPL shall have fulfilled the requirements for the class or type rating for the aircraft used in the skill test, as established in Subpart H.

(omitted)

SUBPART H

CLASS AND TYPE RATINGS

SECTION 1

Common requirements

FCL.700 Circumstances in which class or type ratings are required

(a) Except in the case of the LAPL, SPL and BPL, holders of a pilot license shall not act in any capacity as pilots of an aircraft unless they have a valid and appropriate class or type rating, except when undergoing skill tests, or proficiency checks for renewal of class or type ratings, or receiving flight instruction. (Omitted)

FCL.705 Privileges of the holder of a class or type rating

The privileges of the holder of a class or type rating are to act as pilot on the class or type of aircraft specified in the rating.

FCL.710 Class and type ratings - variants

(a) In order to extend his/her privileges to another variant of aircraft within one class or type rating, the pilot shall undertake differences or familiarization training. In the case of variants within a type rating, the differences or familiarization training shall include the relevant elements defined in the operational suitability data established in accordance with Part-21. (Omitted)

(c) The differences training shall be entered in the pilot's logbook or equivalent record and signed by the instructor as appropriate.

FCL.725 Requirements for the issue of class and type ratings

(a) Training course. An applicant for a class or type rating shall complete a training course at an ATO. The type rating training course shall include the mandatory training elements for the relevant type as defined in the operational suitability data established in accordance with Part-21.

(b) Theoretical knowledge examination. The applicant for a class or type rating shall pass a theoretical knowledge examination organized by the ATO to demonstrate the level of theoretical knowledge required for the safe operation of the applicable aircraft class or type. (Omitted)

(c) Skill test. An applicant for a class or type rating shall pass a skill test in accordance with Appendix 9 to this Part to demonstrate the skill required for the

safe operation of the applicable class or type of aircraft.

The applicant shall pass the skill test within a period of 6 months after commencement of the class or type rating training course and within a period of 6 months preceding the application for the issue of the class or type rating.(omitted)

SECTION 2

Specific requirements for the aeroplane category

FCL.720.A Experience requirements and prerequisites for the issue of class or type ratings - aeroplanes

Unless otherwise determined in the operational suitability data established in accordance with Part-21, an applicant for a class or type rating shall comply with the following experience requirements and prerequisites for the issue of the relevant rating: (omitted)

(b) Single-pilot high performance non-complex aeroplanes. Before starting flight training, an applicant for a first class or type rating for a single-pilot aeroplane classified as a high performance aeroplane shall:

(1) have at least 200 hours of total flying experience, of which 70 hours as PIC on aeroplanes; and

(2) (i) hold a certificate of satisfactory completion of a course for additional theoretical knowledge undertaken at an ATO; or

(ii) have passed the ATPL(A) theoretical knowledge examinations in accordance with this Part; or

(iii) hold, in addition to a license issued in accordance with this Part, an ATPL(A) or CPL(A)/IR with theoretical knowledge credit for ATPL(A), issued in accordance with Annex 1 to the Chicago Convention; (omitted)

(2) Explanatory Notes, EASA type rating and license endorsement list - flight crew regulations

As for the pilot qualification and training of the aircraft, the EASA stipulates the matters related to the Aircraft in the "Explanatory Notes, EASA type rating and license endorsement list - flight crew, 03 May 2018", as follows (excerpts):

2. Aircraft class rating

Aircraft class rating designations are incorporated within the list.

Aircraft within a class rating are not individually listed, except for all aircraft within the class rating SET and for other aircraft with specific provisions.

2.1 Class rating 'SET" for single pilot (SP) single-engine (SE) turbo-prop aircraft

The class rating 'SET" for SP SE turbo-prop aircraft is established within the lists. All aircraft within the class rating SET are listed individually in the table.

(Omitted)

3. EASA type rating and license endorsement lists (omitted)

④ *Aircraft variants*

1. Aircraft within class ratings (omitted)

Aircraft within the same class rating which are separated by a horizontal line in the tables require differences training, whereas those aircraft which are contained in the same cell require familiarization when transitioning from one aircraft to another. (Omitted)

DIFFERENCES AND FAMILIARISATION TRAINING

(a) Differences training requires the acquisition of additional knowledge and training on an appropriate training device or the aircraft.

(b) Familiarization requires the acquisition of additional knowledge. (Omitted)

2. Aircraft with type ratings

Where more than one aircraft model/name are listed in column ② under the same license endorsement, these aircraft are designated as variants of the same type of aircraft. This is indicated by 'X'in column ④. (Omitted)

⑤ *Complex*

The mark 'X' in column ⑤ indicates that an aircraft is categorized as complex motor-powered aircraft in accordance with the definition in the Basic Regulation.

⑥ *Single-Pilot(SP)/SP HPA/Multi-pilot(MP)*

Column⑥ indicates if an aircraft is certified for a minimum of one pilot (SP), classified as high-performance aeroplane (SP HPA) in accordance with Part-FCL requirements, or certified for a minimum of two pilots (MP). (Omitted)

⑦ *OE GM / OSD FC*

The mark 'X' in column ⑦ indicates the availability of Operational Evaluation Guidance Material (OE GM) or of an Operational Suitability Data Flight Crew (OSD FC) document.

OSD FC documents are established in accordance with the Part-21 aircraft type certification provisions, are held by the (S) TC holder and made available in accordance with Part-21, para.21.A.62.

Where no OSD FC documents exist, Operational Evaluation Guidance Material (OE GM) - Flight Crew may be established by the Agency to assist Competent Authorities, operators, training organizations, instructors and any other personnel involved in flight crew training and air operations. Contrary to OSD FC documents, OE GM documents do not establish any regulatory requirements and do not constitute Operational Suitability Data (neither mandatory nor non-mandatory elements). OE GM documents, explanatory notes, the EASA pilot type rating lists, as well as an OSD Contact list are published on the EASA website at

https://www.easa.europa.eu/document-library/operational-suitability-data

⑧ Remarks

The remarks column references available OE GM or OSD flight crew documents, a class rating determination, or any other pertinent information.

Manufacturer	*Aircraft model/name*	*License endorse-ment*	*Variants*	*Complex*	*SP/ SP HPA/ MP*	*OE GM/ OEB/ OSD FC available*	*Remarks*
①	②	③	④	⑤	⑥	⑦	⑧
All Manufacturer	*Single-engine turbo-prop engines*	*SET*	*X*	—	*SP*		*Class rating SET* *All aircraft within the class rating SET are listed individually in this table and require EASA classification.* *All aircraft within the class rating SET require differences training, unless indicated otherwise in the list.* *Revalidation for each SET aircraft must be accomplished individually, unless indicated otherwise in the list.*
SOCATA	*TBM 700A (TBM700)* *TBM 700B (TBM700)* *TBM 700C1(TBM700)* *TBM 700C2(TBM700)* *TBM 700N* *・TBM 850* (omit below)	*TBM SET*	*X*	—	*SP HPA*	*X*	*Class rating SET* *OE GM – FC TBM 700, dated 18 Jan 2018*

(3) OE GM regulations

As for the training of the Aircraft and the same type of the aircraft, the EASA stipulates the matters related to the initial training in the "Operational Evaluation Guidance Material (OE GM) - Flight Crew　SOCATA TBM 700", as follows (excerpts):

4.1 Prerequisites

Pilots must meet the following prerequisites before commencing TBM initial training.

- *Minimum experience:*

  as required in Part-FCL for "Non-complex / High performance / Single Pilot" aeroplanes; and

- *Meet HPA requirements; and*

- *Hold a valid Instrument Rating (IR)*

4.2 TBM 700 Initial Training

Appendix 1 provides GM for a training footprint of TBM 700 initial training.

(Omitted)

4.5 Training Areas

The following items should be includes in theoretical and practical training during TBM 700 initial or familiarization/differences training, as applicable:

- *Slow flight;*
- *Approach to stall in different configurations;*
- *Full stall in different configuration and recoveries;*
- *Aircraft performances;*
- *Avionics suite and associated functions; flight envelope protection, PBN, RNAV approaches, ---;*
- *Descent on a 5% slope in approach and landing configuration followed by go around;*
- *Emergency procedures.*

Appendix 1: TBM700 Initial Training

The following footprint provides GM for TBM 700 initial training.

TBM 700 Initial Training			
	CONTENT	DURATION	REFERENCE
Self –learning (Only for TBM 700 equipped with G1000 / G3000 suites)	G1000 G1000 Nxi G3000	50 hours	GARMIN Pilot's Guide GARMIN PC-trainer (GARMIN CD-ROM)
Ground Course	Description Limitations Normal procedures Performances Weight and balance Emergency procedures Cockpit training	30 hours	Pilot Operating Handbook (POH) GARMIN Pilot's Guide CBT Aircraft
Practical Training (Aircraft)	7 flights	10 hours	Aircraft
	Briefing / debriefing	7 hours	