

AA2016-1

**AIRCRAFT ACCIDENT
INVESTIGATION REPORT**

**KOREA PILOT SCHOOL
N 1 7 6 C D**

February 25, 2016



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

Norihiro Goto
Chairman,
Japan Transport Safety Board

Note:

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

AIRCRAFT ACCIDENT INVESTIGATION REPORT

AIRCRAFT DAMAGE CAUSED BY FORCED LANDING
KOREA PILOT SCHOOL
OPERATED BY PRIVATELY CONTRACTED PILOT
CIRRUS SR20, N176 CD (THE UNITED STATES)
NISHIKATA, IBUSUKI CITY, KAGOSHIMA PREFECTURE, JAPAN
At ABOUT 14:30 JST, OCTOBER 12, 2014

February 12, 2016

Adopted by the Japan Transport Safety Board

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

SYNOPSIS

<Summary of the Accident>

On Sunday October 12, 2014, around 14:30 Japan Standard Time (JST: UTC + 9 hrs. all times are indicated in JST on a 24-hour clock), the Cirrus SR20, registered N176CD, owned by the KOREA PILOT SCHOOL, was damaged during forced landing in a grass field at Nishikata, Ibusuki city, Kagoshima prefecture, because the engine halted while it was ferried from Saipan International Airport to Gimpo International Airport in the Republic of Korea.

Only the pilot who had been contracted to ferry the aircraft was on board but there were no casualties.

The aircraft was destroyed but there was no outbreak of fire.

<Probable Causes>

It is highly probable that the accident was occurred as a result of the engine of N176CD halt during the flight and not being able to start in the air, resulting in the damage of the aircraft during the forced landing.

As for the engine halt, it is somewhat likely that the exhaustion of fuel of the rear ferry tank that was being used caused the engine to power loss, and although the Pilot opened the fuel selector valve of the front ferry tank which still had remaining fuel, the fuel selector valve of the rear ferry tank was not closed which led to the air from the empty rear ferry tank entering into the fuel line prompted by the suction of the engine driven fuel pump; subsequently, hindering the supply of fuel.

It is somewhat likely that the engine could not start in the air, since the contained air in the fuel line caused a difficulty of the suction of the engine driven fuel pump, and that the inadequate functioning of the auxiliary fuel pump could not remove swiftly the contained air that was hindering the fuel suction of the engine driven fuel pump.

The abbreviations used in this report are as follows:

FAA : Federal Aviation Administration, the U.S. Department of Transportation
GCA : Ground Controlled Approach
NTSB : National Transportation Safety Board, the USA
POH : Pilot's Operating Handbook
VOR : Very High Frequency Omni-directional radio range
VORTAC : VOR and Tactical Air Navigation

Unit Conversion List

1 lb : 0.4536 kg
1 ft : 0.3048 m
1 nm : 1.852 km
1 kt : 1.852 km/h
1 in : 2.54 cm
1 gal : 3.785 ℓ

1 . PROCESS AND PROGRESS OF THE AIRCRAFT ACCIDENT INVESTIGATION

1.1 Summary of the Accident

On Sunday October 12, 2014, around 14:30 Japan Standard Time (JST: UTC + 9 hrs. all times are indicated in JST on a 24-hour clock), the Cirrus SR20, registered N176CD, owned by the KOREA PILOT SCHOOL, was damaged during forced landing in a grass field at Nishikata, Ibusuki city, Kagoshima prefecture, because engine halted while it was ferried from Saipan International Airport to Gimpo International Airport in the Republic of Korea.

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The aircraft was destroyed but there was no outbreak of fire.

1.2 Outline of the Accident Investigation

1.2.1 Investigation Organization

On October 13, 2014, the Japan Transport Safety Board (JTSA) designated an investigator-in-charge and an investigator to investigate this accident.

1.2.2 Representatives from the Relevant State

An accredited representative of the United States of America, as the State of Design and Manufacture of the aircraft involved in the accident, participated in the investigation.

1.2.3 Implementation of the Investigation

October 14 through 16, 2014	On-site investigation, aircraft examination and interviews
February 10, 2015	Aircraft Investigation
April 29, 2015	The overhaul inspection of the auxiliary fuel pump (conducted under the oversight of NTSB at the facilities of the manufacturer)

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

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

1.2.5 Comments from the Relevant State

Comments were invited from the relevant State.

2. FACTUAL INFORMATION

2.1 History of the Flight

On Sunday, October 12, 2014, around 05:37, the Cirrus SR20, registered N176CD (hereinafter referred to as “the Aircraft”), owned by the KOREA PILOT SCHOOL, departed from Saipan International Airport and was heading to Gimpo International Airport in the Republic of Korea, for ferrying the Aircraft.

The flight plan of the Aircraft was as follows:

Flight rules: Visual flight rules,

Departure aerodrome: Saipan International Airport,

Estimated off-block time: 05:20, Cruising Speed: 150 kt,

Cruising Altitude: 6,000 ft,

Route: NATSS (reporting point) - G339 (air way) - HKC (Kagoshima VORTAC)
- A582 (air way) - SEL (Anyang VOR)

Total estimated elapsed time: 12 hours 30 minutes,

Fuel onboard expressed in endurance: 15 hours 35 minutes,

Persons onboard: 1,

The history of the flight up to the accident is summarized as follows, according to the air traffic control (ATC) communication records, the ATC direct line communications records, and the radar tracking records of the Kanoya Terminal control Facility (hereinafter referred to as “Kanoya Radar”), as well as the statements of the pilot and the air traffic controller (hereinafter referred to as “controller”).

2.1.1 History of the Flight Leading to the Forced Landing Based on ATC Communication Records, ATC Direct Line Communications Records and the Radar Tracking Records of the Kanoya Radar

- 14:13:50 The Aircraft commenced to contact with Kagoshima Terminal Control Facility (hereinafter referred to as “Kagoshima Radar”) and reported that it was flying at an altitude of 10,000 ft. Kagoshima Radar acknowledged this.
- 14:19:30 The Aircraft was flying northbound, at magnetic bearing 250° about 12 nm from Kanoya Airfield and was descending from an altitude of 9,900 ft at groundspeed about 110 kt.
- 14:19:53 Kagoshima Radar instructed the Aircraft to confirm the present altitude. The Aircraft reported that it required radar vector to the nearest airport due to an emergency situation. Kagoshima Radar initiated coordination with Kanoya Radar on whether the closed runway due to the typhoon approaching can be opened if the Aircraft that is 11 nm west requested an emergency landing.
- 14:22:00 The Aircraft was flying eastbound at magnetic bearing 274° about 10 nm from Kanoya Airfield and was descending from an altitude of 7,800 ft at groundspeed about 90 kt.

14:23:40 The Aircraft requested Kagoshima Radar a radar vector for landing at RJFY (the location indicator of Kanoya Airfield) and for the frequency of the air traffic control tower of the airfield.
Kagoshima Radar reported Kanoya Radar that the Aircraft was requesting the frequency of the air traffic control tower. Kanoya Radar requested Kagoshima Radar to relay to the Aircraft the message to contact Kanoya Radar with its frequency.

14:24:30 Kagoshima Radar reported the Aircraft the communication frequency of Kanoya Radar, and the Aircraft read back the frequency.
The Aircraft was flying south-eastbound, at magnetic bearing 266° about 9 nm from Kanoya Airfield and was descending from an altitude of 5,100 ft at groundspeed about 30 kt.

14:25:15 The Aircraft did not contact Kanoya Radar and requested Kagoshima radar for a rescue helicopter.

14:29:46 The groundspeed of the Aircraft became 0 kt at magnetic bearing 255° about 12 nm from Kanoya Airfield.

2.1.2 Statements of the Pilot and Controller

a. Pilot

The Pilot had 27 times of experiences in ferrying an aircraft equipped with multiple ferry tanks, and subsequent to the ferry in September, this was the second time he ferried the same type of aircraft.

He received the explanation in advance of the ferry from the mechanic who installed the ferry tanks and the operation procedure was carrying as the Ferry System Checklist which was created based on the “SR20/22 ferry fuel system operations instructions” which set out how to obtain the special airworthiness certificate.

Prior to the take-off, the Pilot filled the tanks inside the left and right wings with a total of 56 gal, the front ferry tank with 38 gal, the rear ferry tank with 70 gal, in total 164 gal of fuel. Against the flight plan of 12 hr 30 min, it was a quantity that enabled 15 hr 35 min of flight, with a flight plan of fuel consumption 10.5 gal per hour.

The Pilot embarked alone, started the engine, confirmed that the fuel supply from each tank was normal, and took off from Saipan International Airport for Gimpo International Airport under instrument flight rules.

The Pilot took off using the right wing tank, and after about 25 minutes levelled off at an altitude of 6,000 ft and confirmed again that the fuel supply from each tank was normal. Thereafter, he used the left wing tank for about 30 minutes, and then one hour after take-off switched to the rear ferry tank. According to the Pilot, the left and right wing tank had 20 gal of fuel remaining at this stage, and the fuel consumption was about 9.5 gal per hour for the rest of the cruising.

During the cruising the Aircraft reached an altitude of 10,000 ft and was flying smoothly helped by the tailwind. Right before reaching Tanegashima Island, the Aircraft flew into the clouds, but the air current was calm and it was not raining.

At around 14:19, when the Pilot was thinking about switching the fuel tank as he approaches the Reporting Point of KINKO near Kinko bay, he suddenly felt the engine sound surging with a growl. At the same time the indication of the fuel flow gage began to fluctuate significantly, and the altitude that was maintained through autopilot suddenly began to drop. The

Pilot judging the rear ferry tank fuel was low, then switched to the front ferry tank which he was planning to use next, but the surging did not stop, and about 15 to 20 seconds later, the engine sound stopped and the indication of the fuel flow gage was showing zero.



Photo A The Fuel Flow Gage and RPM Indicator

The propeller was wind milling at about 1,500 rpm, and in order to make the engine restart, the auxiliary fuel pump was put in the BOOST position. In accordance with the checklist of the Pilot Operating Handbook (hereinafter referred to as “POH”), the emergency procedures of airstart was carried out; however the situation did not change. Next, the fuel tank was switched to the right wing tank which had some fuel left, then the fuel tank was switched to the left wing tank, and the emergency procedures of airstart was carried out with each wing tanks, but the engine failed to restart.

The Pilot declared the emergency that the engine power was lost, and requested to Kagoshima Radar for a radar vector to the nearest airport. Since he was unfamiliar with the airport name, he requested a radar vector using the location indicator RJFY which was indicated on the navigation display; however, the intention was not immediately conveyed.

The Pilot looked at the indication on the navigation display and turned the Aircraft to eastward. However, since the radar vector did not start immediately, and the headwind was strong while the Aircraft was descending, he judged that the Aircraft would not reach the airport, and decided to turn around and fly towards the west of Kinko bay.

When the Aircraft decent to below 3,000 ft, it came through the cloud; accordingly, the coast line could be seen; therefore, it headed towards the land. The Pilot saw the harbour quay and decided to accomplish a forced landing on there. He tried to get into the down wind leg, however due to the strong wind, he judged that it was not possible to land safely, therefore he activated the emergency parachute system in front of the hill that emerged ahead of him.

The Aircraft continued descent with the parachute deploy, and at around 14:30, the nose touched the ground in a field, and stopped after forward shifting, and then turning upside down. The Pilot immediately escaped to the outside, and confirmed that there is no injury. Besides, he confirmed fuel flowing out from the vent of the Aircraft that had turned over. Subsequently, the

Aircraft moved over the field due to the strong wind in the parachute, and stopped in a bamboo forest about 50 m away.

b. The Controller of the Kagoshima Radar

At around 14:20, the controller of Kagoshima Radar noticed the altitude of the Aircraft had dropped on the radar display, and upon confirming the status, received its declaration of emergency; accordingly, he received a request for a radar vector to the nearest airport. From the subsequent communication and looking at the location indicator, it has been confirmed the request was made for the radar vector to Kanoya Airfield. Since Kanoya Airfield had closed off its runway due to a typhoon approaching, the controller coordinated the radar vector of the Aircraft involved in the emergency, and then reported the frequency for it.

Thereafter, the Aircraft requested a rescue helicopter; consequently, the controller conveyed Kanoya Radar of this request.

The accident occurred in a grass field at Nishikata, Ibusuki city, Kagoshima prefecture (31° 17' 4" N, 130° 36' 30" E) at around 14:30, on October 12, 2014.

(See Figure 1: Estimated Flight Route, Figure 2: Forced Landing Site Layout, Photo 1: Forced Landing Site, Photo 2: Accident Aircraft)

2.2 Injuries to Persons

No one was injured.

2.3 Damages to the Aircraft

2.3.1 Extent of Damage

Destroyed

2.3.2 Damages to the Aircraft Components

- a. Engine: engine cover damaged, engine mount deformed, and partially destroyed
- b. Propeller: blades deformed
- c. Wing : left wing destroyed, left and right ailerons damaged
- d. Fuselage: disengagement of left and right doors, detachment of left and right outer skins due to the emergency parachute deployment
- e. Empennage : right horizontal tail damaged, vertical tail damaged

(See Photo 2: Accident Aircraft)

2.4 Damage to Objective other than the Aircraft

Damage of crops and bamboo forests falling down

(See Photo 1: Forced Landing Site)

2.5 Personnel Information

Pilot Male, Age 39

Commercial pilot certificate (airplane)

August 24,2007

Type rating for Multi-engine and Single -engine Piston Land

Instrument flight certificate

May 2, 2007

Class 1 aviation medical certificate

Validity

October 31, 2015

Total flight time	3,969 hr 48min
Flight time in the last 30 days	134 hr 24 min
Total flight time on the type of Aircraft	64 hr 12 min
Flight time in the last 30 days	64 hr 12 min

2.6 Aircraft Information

2.6.1 Aircraft

Type	Cirrus SR20
Serial number	1048
Date of manufacture	June 30, 2000
Special Airworthiness Certificate	August 14, 2014
(The Aircraft was equipped with ferry tanks, and had the permission to fly at 3,625 lbs, which was above the maximum take-off weight of 3,000 lbs)	
Category of airworthiness	the Aircraft Normal N
Total flight time	1,855 hr 30 min
Flight time since last periodical check (Annual inspection: April 24, 2014)	62 hr 36 min

2.6.2 Engine

Type	Continental IO-360 - ES
Serial Number	357183
Date of manufacture	April 12, 2000
Total time in service	1,855 hr 30 min

2.6.3 Weight and Balance

When the accident occurred, the weight of Aircraft was estimated to have been 2,797 lbs and the position of the center of gravity was estimated to have been 142.4 in after from the reference datum (100 in forward of firewall). Both of them were estimated to have been within the allowable limits (the maximum take-off weight of 30,000 lbs, and 142.0 - 147.8 in corresponding to the weight at the time of the accident).

(See Figure 3: Three Angle View of Cirrus SR20)

2.7 Meteorological Information

- a. The information regarding Typhoon No.19 announced by the Forecast Department, the Japan Meteorological Agency at 12:40 on Oct, 12 was as follows:

The large scale and powerful Typhoon No.19 was proceeding north-northwest at about 20 km/h while being around about 240 km west of Amami Oshima. The center of the typhoon was expected to reach a radius of 160 km within the circle entered around Kirishima city, Kagoshima prefecture. The maximum wind velocity was predicted to be 35 m/s (70 kt).

- b. The Aerodrome routine meteorological report of the Kanoya Airfield positioned 22 km east of the the Aircraft around the time of the engine halt was as follows:

14:00 Wind direction 80 degrees ; Velocity 25 kt/ Maximum velocity 45 kt,

Prevailing visibility: 2,500 m,: Present weather phenomena: Rain shower, mist

Cloud Amount: 2/8, Type: Stratus, Cloud base :1,000 ft

Amount: 6/8, type: Cumulus, Cloud base: 1,500 ft

Amount: 8/8, Type :Cumulus, Cloud base: 2,500 ft

Amount: 2/8, Type: Towering Cumulus, Cloud base: 2,500 ft

Temperature 23° C; Dew point 22° C,

A towering cumulus is observed overhead and is moving westbound.

- c. The observation value of Ibusuki Automated Weather Station, JMA which is 4.8 km south-southwest of the forced landing site (the velocity has been converted from m/s into kt) was as follows:

14:30 light rain, temperature 23.6°C, wind direction east-south east

Velocity 12 kt, maximum velocity 25 kt

(See Figure 4: Surface Weather Chart and Radar Composite Chart)

2.8 Accident Sight Information

The Aircraft accomplished a forced landing on a grass field on a hill located north of Ibusuki city in Kagoshima prefecture using an emergency parachute, and then moved over the fields due to the parachute which filled with wind, and stopped inside a bamboo forest about 50 m away.

The right wing tip part was left on the grass field. However on the field the Aircraft had moved across, there were its marks and also the left door that had fallen off.

The nose of the Aircraft touched the ground in the mortar-shaped bamboo forest and it had stopped toward the nose on the west side in a forward bent posture with the tail lifted up by bamboos.

(See Figure 1: Estimated Flight Route, Figure 2: Forced Landing Site Layout, Photo 1: Forced Landing Site, Photo 2: Accident Aircraft)

2.9 Aircraft Condition on the Accident Site

The investigation result of the forward tilt Aircraft in the bamboo forest was as follows:

a. Engine

a) As regards the exterior of the engine body, the engine mount and the engine cover had deformed, and partially broken, but there was no other damage.

b) There was no damage as regards the ignition, lubricating oil, intake, exhaust and engine control systems.

c) When the auxiliary fuel pump switch was put on the PRIME position, the pump started operating and the indication of fuel flow gage rose, and fuel spouting from the fuel injection nozzle. However in the BOOST position, the operating sound of the pump was weak, the fuel flow gage showed zero, and there was no spouting of the fuel from the fuel injection nozzle (Fuel was put in the right wing tank only, which was in a higher position than the engine. The operation confirming was conducted in a situation where the fuel could flow out into the engine due to gravity.).

d) The engine driven fuel pump showed no irregularities with the exterior, the connecting section with the engine and drive shaft. The drive shaft was able to rotate.

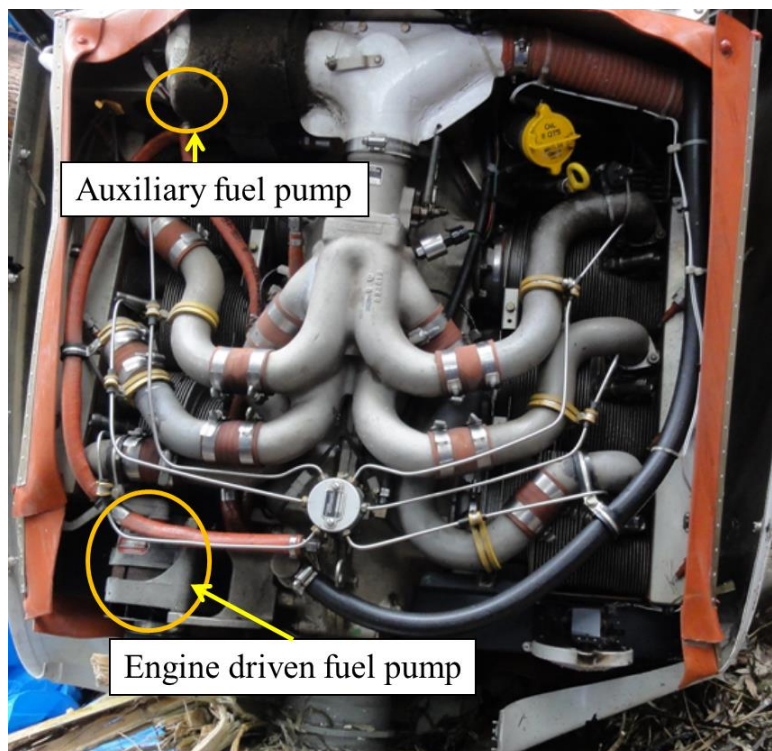


Photo B: The Status of the Engine

b. Fuel tanks and lines

The fuel supply system ranging from the tanks in the left and right wings, front and rear ferry tanks, and inside the engine cylinders did not show any abnormalities.

On the Aircraft, a front ferry tank was placed on the right pilot seat and a rear ferry tank was placed on the rear seats, in addition to the tanks in the left and right wings, and none of the tanks and pipes showed any signs of fuel leakage.

The fuel selector valve of the wing tanks was set in the OFF position (hereinafter referred to as "CLOSE"); however, the fuel selector valves and the vapor return valve for the front and rear ferry tanks were all set in the ON position (hereinafter referred to as OPEN").

The remaining fuel of each ferry tank was as below: Right wing tank: 20 gal, left wing and front ferry tanks: 10 gal respectively, rear ferry tank: zero gal

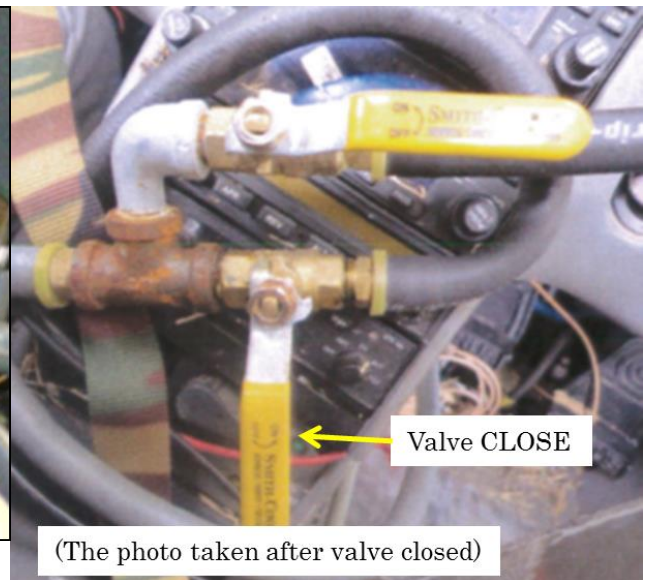
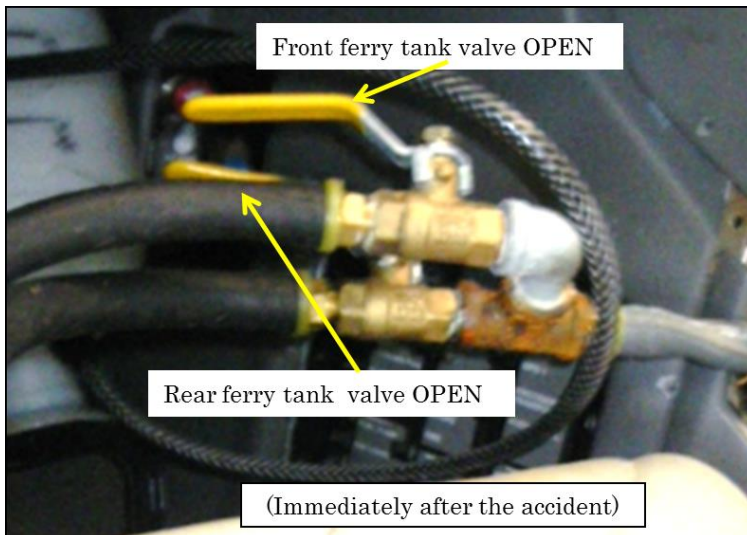
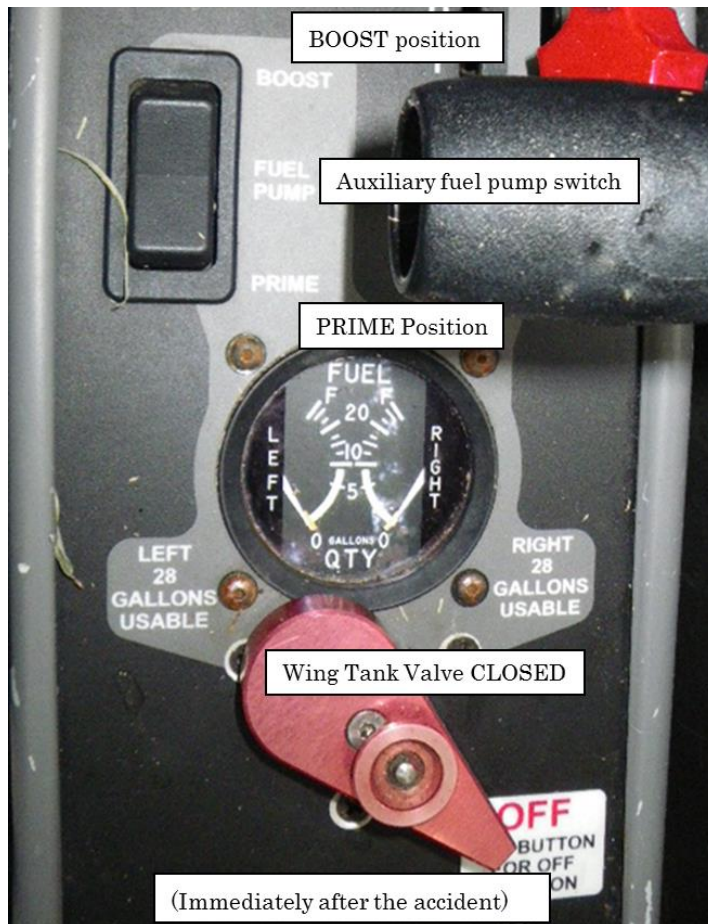


Photo C : The Status of the Fuel Selector Valve of each ferry tank

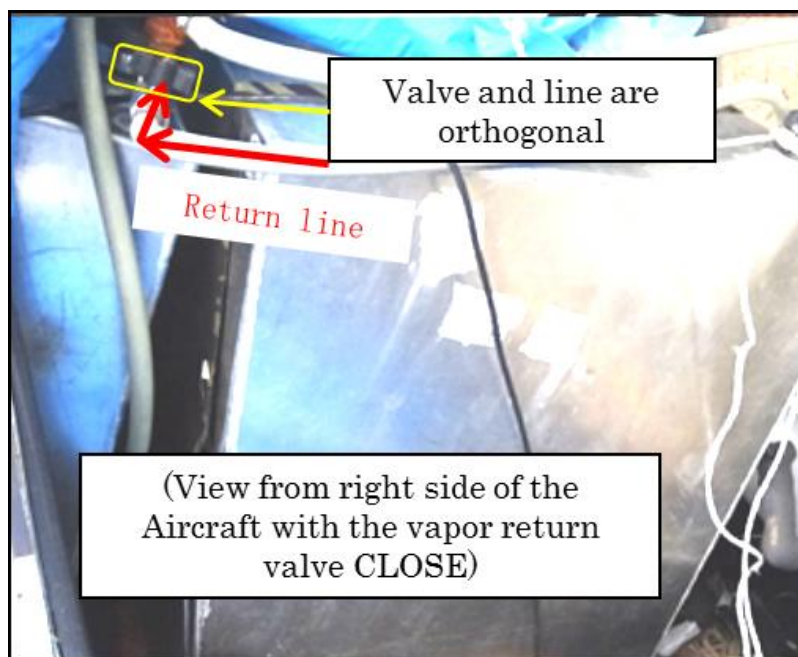
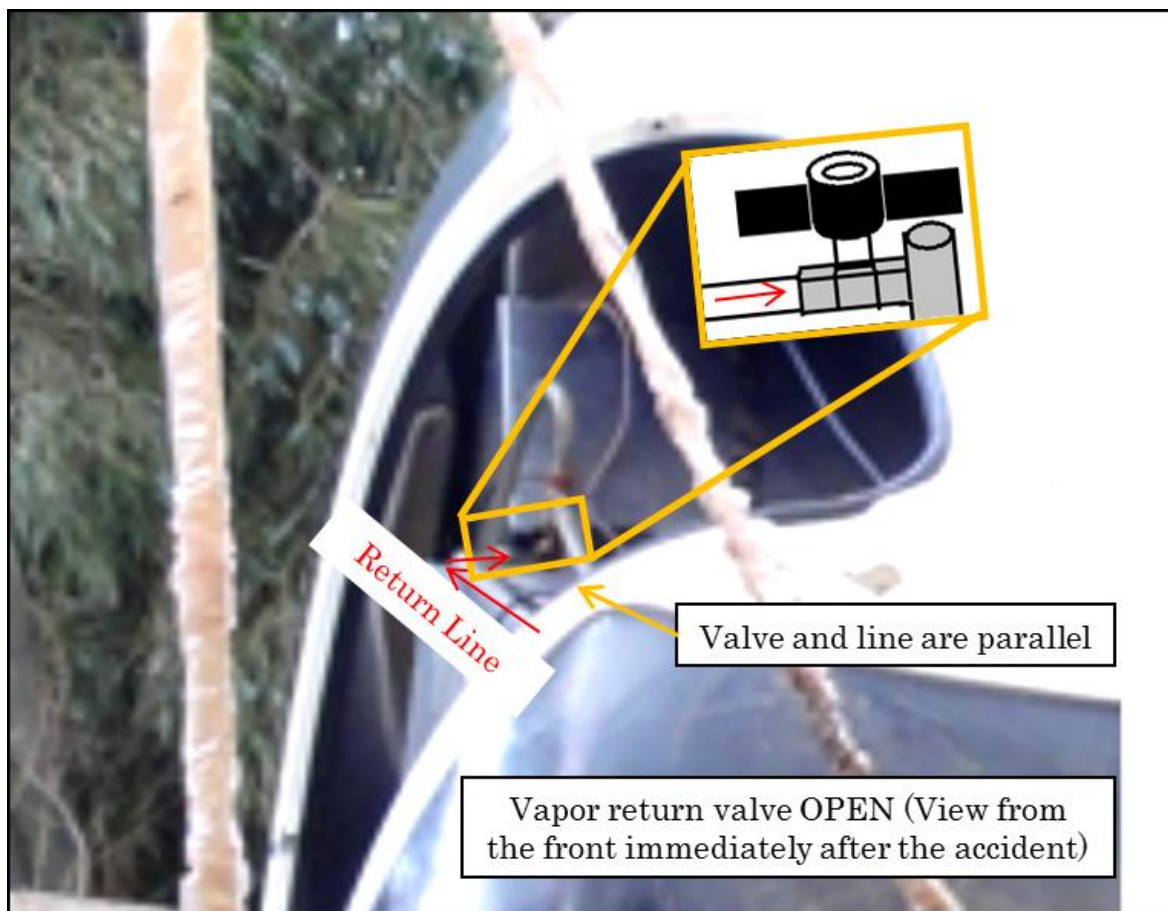


Photo D: The Status of the Vapor return valve of the ferry tank

2.10 Teardown inspection of the auxiliary fuel pump

The results of the teardown inspection of the auxiliary fuel pump conducted at the facilities of the manufacturer of the auxiliary fuel pump (hereinafter referred to as “the manufacturer”) under the oversight of the National Transportation Safety Board, the United States of America (NTSB) and the view of the manufacturer were as follows:

- a. During a visual check the pump and the motor did not show any irregularities.

- b. The results of the function test based on the normal acceptance test procedures were as follows:
- a) In the High Boost (PRIME) position, the relationship between the fuel pressure and fuel flow volume were within the special value (PASS). However, in the Low Boost (BOOST) position, the results were FAIL, even after two measurements.
 - b) As a result of the check after removing the cover of the electronic circuit section, the screw of the p-clamp (a P-shaped metal) attached to the variable resistor was loose, and then the contact part was wobbly. When the position of the p-clamp was moved slightly, the resistance reading would vary between 24 - 42 Ω .

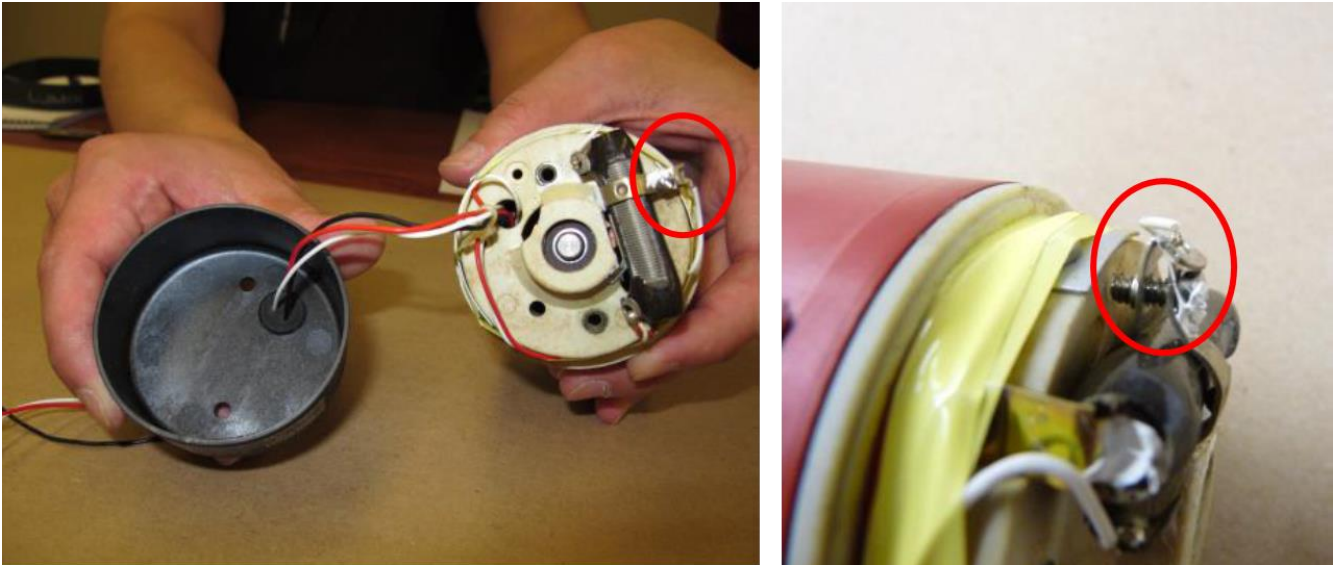


Photo E: Variable resistor unit mounting part that had loosened

- c) When the p-clamp was set at 21.9 Ω on variable resistor unit and a Low Boost function test was conducted, the results were within the special value.
- c. Conclusion

The resistance value fluctuated with the looseness of the screw of the p-clamp; therefore, the operation of the auxiliary fuel pump at BOOST position became irregular.

2.11 Additional Information

2.11.1 Fuel System

The Aircraft was equipped with ferry tanks by an aircraft maintenance company of the USA, and had obtained a special airworthiness certificate that allows flights exceeding the maximum takeoff weight from the Federal Aviation Administration (FAA). Moreover, the tanks were equipped by the mechanics of the aircraft maintenance company and had been inspected by FAA.

2.11.1.1 The Usage of Ferry tanks

- a. The Special Flight Permit Additional Operation Limitation attached to the Special Airworthiness Certificate had the following description as regards the ferry tanks.

31. The pilot shall be given a review of the installed temporary systems. The review shall be conducted by the installer and in accordance with the Operating Instructions and Installation details.

- b. According to the information obtained from the aircraft maintenance company of the USA that equipped the ferry tanks, the operation guideline in relation to the usage of the tanks

was prescribed as follows:

SR20/22 ferry fuel system operations instructions

Control, Operation Information:

1 Fuel system Control/Operation with temporary ferry tank system installed:

2 FERRY FUEL SELECTOR VALVE AND VAPOR RETURN VALVE OFF.

3 Use aircraft fuel system for normal takeoff and landings.

To use ferry fuel system:

1 Aircraft boost pump ON:

2 During climb, position the ferry fuel selector valve to ON position.

3 Turn ferry fuel vapor return valve ON.

4 Turn aircraft fuel selector valve OFF.

5 When fuel flow has been confirmed normalized, turn aircraft boost pump OFF.

To shut down ferry tank and return to aircraft fuel system:

1 Aircraft boost pump ON.

2 Aircraft fuel selector valve ON.

3 Ferry system vapor return valve OFF.

4 Ferry system fuel selector valve OFF.

5 When fuel flow has been confirmed normalized turn aircraft boost pump OFF.

6 Use aircraft fuel system as per Pilot Operating Handbook.

2.11.1.2 The outline of the fuel system

The fuel system of the Aircraft with the ferry tanks equipped is as shown in Diagram 1.

The left wing tank and the right wing tank are tanks that the Aircraft is originally equipped with, and are placed lower than the engine. These also have collector tanks which steadily supply fuel even when the aircraft become shaken. The fuel selector valve of the wing tanks has Right, Left and OFF positions, and are used to connect or separate the left or right wing tank to fuel supply lines and vapour return lines.

The front ferry tank and the rear ferry tank are placed higher than the engine. Each tank is equipped with a fuel selector valve that have OPEN and CLOSE positions, moreover, a vapour return valve with OPEN and CLOSE position is located in one section of the rear ferry tank.

In order to use the ferry tank, in accordance with the ferry fuel system operations instructions as described in 2.11.1.1 b, the fuel selector valve of the front or rear ferry tank has to be in OPEN position, the vapour return valve have to be in OPEN position and the wing tank selector valve which is the fuel system of the aircraft has to be in CLOSE position. Besides, when closing the ferry tank and returning to the aircraft fuel system, the wing tank fuel selector valve has to be positioned in RIGHT or LEFT, and the vapour return valve of the ferry tank has to be in CLOSE, and the fuel selector valves of the front and rear tank have to be in the CLOSE position.

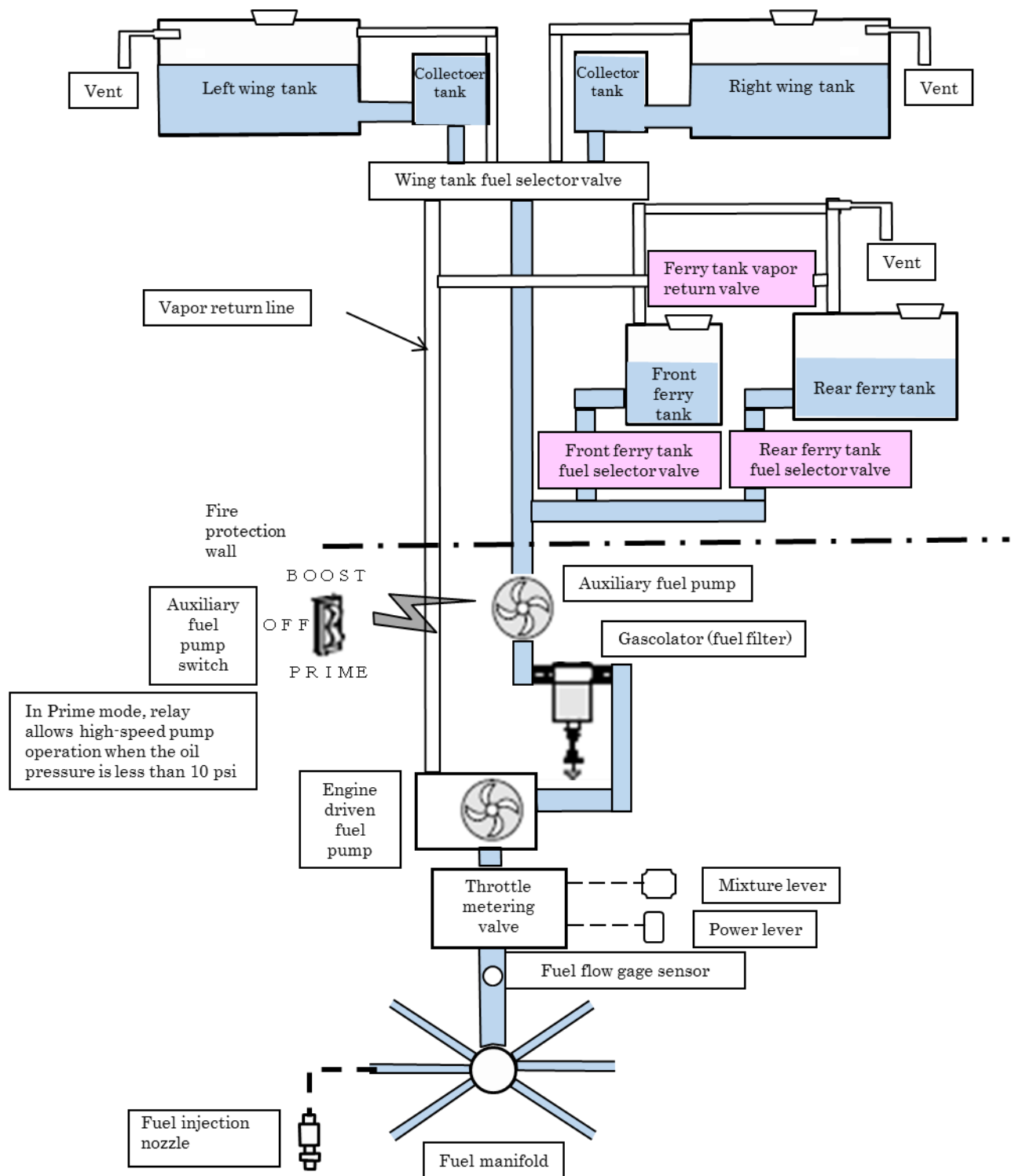


Diagram 1 The Fuel System

Moreover, when switching within the ferry tanks in the system aspect, for example when switching from the rear ferry tank to the front ferry tank, first the auxiliary fuel pump has to be ON, and the front ferry tank fuel selector valve has to be OPEN, then the rear ferry tank fuel selector valve has to be in CLOSE position, finally if there are no abnormalities then the auxiliary fuel pump is to be tuned OFF. As described in 2.11.1.1.b, this procedure is not written in the operation instructions, or other documents. And as described in 2.1.2 only been explained orally. However according to the Pilot, he had understood this procedure.

The fuel that comes out from the selector valve of the wing tanks or ferry tanks will go through the auxiliary fuel pump, and being filtered by the gascolator, and then directed to the engine driven pump. The engine driven pump separates the vapour that has occurred within the fuel, and returns it to the fuel tank via the vapour return line, leaving only the fuel to be supplied to the engine via the throttle metering valve.

2.11.2 Emergency Procedures

The POH had the following description with regard to emergency procedures.

a. Maximum Glide Ratio (Excerpt)

Maximum Glide Ratio 10.9:1

When calculating the gliding distance from an altitude of 10,000 ft using this maximum glide ratio, it was about 18 nm.

b. Engine Failure in Flight (Excerpt)

If the engine fails at altitude, pitch as necessary to establish best glide speed. While gliding toward a suitable landing area, attempt to identify the cause of the failure and correct it. If altitude or terrain does not permit a safe landing, CAPS deployment may be required. Refer to Section 10, Safety Information, for CAPS deployment scenarios and landing considerations (Omitted)

1. *Best Glide Speed..... ESTABLISH*
2. *Mixture..... FULL RICH*
3. *Fuel Selector..... SWITCH TANKS*
4. *Fuel Pump..... BOOST*
5. *Alternate Induction Air..... ON*
6. *Ignition Switch.....CHECK, BOTH*
7. *If engine does not start, proceed to Engine Airstart or Forced Landing checklist, as required.*

c. Engine Airstart

The following procedures address the most common causes for engine loss. Switching tanks and turning the fuel pump on will enhance starting if fuel contamination was the cause of the failure.

Leaning the mixture and then slowly enriching mixture may correct faulty mixture control. (Omitted)

1. *Bat Master Switch ON*
2. *Power Lever ½" OPEN*
3. *MixtureRICH, AS REQ'D*
4. *Fuel Selector.....SWITCH TANKS*
5. *Ignition SwitchBOTH*
6. *Fuel Pump..... BOOST*
7. *Alternate Induction Air..... ON*

8. *Alt Master SwitchesOFF*
9. *Starter (Propeller not Windmilling)ENGAGE*
10. *Power Leverslowly INCREASE*
11. *Alt Master SwitchesON*
12. *If engine will not start, perform Forced Landing checklist.*

d. The Operation Emergency Parachute System

The Cirrus Airframe Parachute System (CAPS) should be activated in the event of a life-threatening emergency where CAPS deployment is determined to be safer than continued flight and landing. (Omitted)

• Caution •

Expected impact in a fully stabilized deployment is equivalent to a drop from approximately 10 feet.

Once the decision is made to deploy CAPS, the following actions should be taken:

(Excerpt)

1. Airspeed.....MINIMUM POSSIBLE

(Omitted)

2. Mixture (If time and altitude permit).....CUTOFF

(Omitted)

3. Activation Handle Cover.....REMOVE

(Omitted)

4. Activation Handle (Both Hands).....PULL STRAIGHT DOWN

(Omitted)

5. MixtureCHECK, CUTOFF

6. Fuel Selector.....OFF

Shutting off fuel supply to engine will reduce the chance of fire resulting from impact at touchdown.

7. Bat-Alt Master Switches.....OFF

8. Ignition Switch.....OFF

9. Fuel PumpOFF

10. ELT.....ON

11. Seat Belts and HarnessesTIGHTEN



Photo F Emergency Parachute System

2.11.3 Normal Procedures

The POH had the following description concerning the usage of the auxiliary fuel pump.

• Note •

Fuel BOOST should be left ON during takeoff and for climb as required for vapor suppression with hot or warm fuel.

3. ANALYSIS

3.1 Qualification of Personnel

The Pilot had a valid airman competence certificate and a valid aviation medical certificate.

3.2 Airworthiness Certificate

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

3.3 Relations to Metrological Conditions

As described in 2.1.2a, the Pilot has stated that as regards the meteorological conditions before the engine halt, the Aircraft flew into the clouds, but the air current was calm and it was not raining. Besides, since the engine of the Aircraft equipped with a fuel injection system and did not have the carbureted fuel injection system, it is highly probable that the engine did not halt due to freezing.

As described in 2.7, the maximum wind velocity in the vicinity of the forced landing area was 25 kt to 45 kt which is rather strong for a small aircraft. It is highly probable that the appropriate forced landing by gliding on to the sea or rough ground surface was difficult with engine inoperative.

3.4 Damage to the Aircraft

It is probable that the damage of each section of the Aircraft described in 2.3.2 was due to the deployment of the emergency parachute system or the impact with the ground following the forced landing. As the gliding was carried out normally until the deployment of the emergency parachute, it is highly probable that although the engine of the Aircraft had halted its control system had no abnormalities.

Moreover, as described in 2.9, the engine and the fuel system of the Aircraft had no irregularities excluding the auxiliary fuel pump. According to the teardown inspection results of the auxiliary fuel pump as described in 2.10, it is somewhat likely that the auxiliary fuel pump was not functioning properly being in the BOOST position. However, as described in 2.1.2.a, the Pilot has stated that he had turned the auxiliary fuel pump in the ON (BOOST) position, when attempting an airstart of the engine. Therefore, it is highly probable that during the flight, it was in the OFF position. For this reason, it is highly probable that the fact that the auxiliary pump was not functioning properly in BOOST position, did not contribute the engine halt.

3.5 Situation from the Engine Halt to the Forced Landing

3.5.1 Situation at the Time of Engine Power Loss Occurs

As described in 2.1.2 a, at around 14:19, when the Pilot was thinking about switching the fuel tank he suddenly felt the engine sound surging with a growl. Besides, one hour after take-off he switched to using the rear ferry tank and the fuel consumption was about 9.5 gal per hour for the rest of the cruising.

Given the above, it is highly probable that the rear ferry tank was used for about 7 hr 42 min, from 06:37 which was one hour after the take-off to 14:19 when the engine power loss began. Since the fuel usage would be about 73 gal, if the fuel consumption during the cruising was calculated at

about 9.5 gal per hour, it is highly probable that the rear ferry tank which had about 70 gal before the take-off would have been consumed up to this time. Therefore, it is highly probable that the engine power loss was caused by the fuel exhaustion of the rear ferry tank.

3.5.2 Situation of the Engine Halt

As described in 2.1.2 a when the engine power loss started, the Pilot determined that the rear ferry tank fuel was low; accordingly, he switched to the front ferry tank which he was planning to use next. However, the surging did not stop, and about 15 to 20 seconds later the engine sound stopped and the fuel flow gage was showing zero.

Given the above, it is highly probable that the Pilot attempted to handle the power loss by switching to the front ferry tank with adequate fuel, when it occurred. However, as described in 2.9.b the fuel selector valves of the front and rear ferry tanks were both open after the forced landing. Given the above, it is somewhat likely that at the time of the engine power loss, the Pilot opened the fuel selector valve of the front ferry tank but did not close the fuel selector valve of the rear ferry tank, which had no fuel left, which led to the air from the empty rear ferry tank entering into the fuel line prompted by the suction of the engine driven fuel pump subsequently, hindering the supply of fuel and resulting in the engine halt.

In addition, as described in 2.11.1.2, the procedure to switch between ferry tanks, such as switching from a rear ferry tank to front ferry tank is not written in the ferry fuel system operations instructions and other documents. It has only been explained orally. However, it is desirable that they are documented in order to prevent the misunderstanding of the procedure.

3.5.3 Situation of the Engine Airstart

As described in 2.1.2 a, the propeller was wind milling at about 1,500 rpm, and in order to make the engine restart, the Pilot put the auxiliary fuel pump in the BOOST position. In accordance with the checklist of the POH, the emergency procedure of airstart was carried out; however the situation did not change. Then, he switched to the right wing tank which had some fuel left; moreover, he switched to the left wing tank and carried out the emergency procedures of airstart with each wing tank, but he stated that the engine failed to restart.

Given the above, it is somewhat likely that the Pilot did not follow the procedure defined in the ferry fuel system operations instructions which is to close the ferry tank selector valves and vapour return valve, which was set for the purpose of returning to the Aircraft fuel system necessary to carry out the emergency procedures for the airstart, but he tried to make the engine restart while the fuel selector valves of the front ferry and rear ferry tanks were still open, and then without closing any of the valves of the ferry tanks, carried out on an engine airstart procedure using each wing tank, which is described as an emergency procedure in the POH.

It is somewhat likely that this initially caused the air from the empty rear ferry tank entering into the fuel line, eventually as shown in Diagram 2, due to gravity, the fuel in the front ferry tank which is positioned higher than the engine flowed into the fuel supply line of the rear ferry tank which had become empty. However, it is somewhat likely that due to previously contained air inside the fuel line caused a difficulty of the fuel supply.

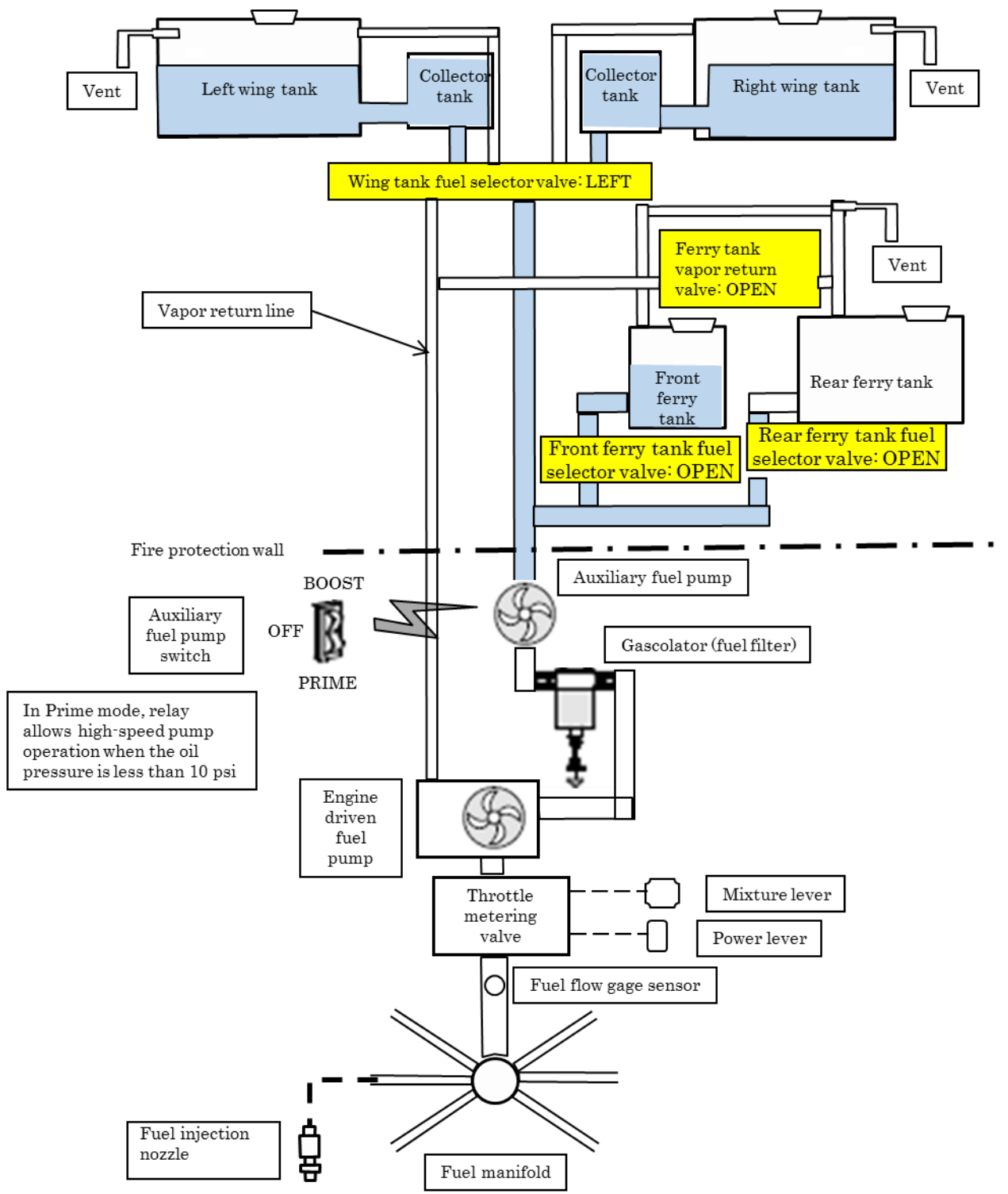


Diagram 2 The Fuel System at the Time of the Failure of Airstart

Moreover, as described in 2.10, since it is somewhat likely that the auxiliary fuel pump was not fully functioning with it being in an ON (BOOST) position at the time of the airstart, it is somewhat likely that the contained air inside the fuel line could not be removed swiftly.

From these, it is somewhat likely that the reason why the engine could not start in the air between the engine halt and the forced landing was that the engine became difficult to restart

due to the contained air inside the fuel line hindered the fuel suction by the engine driven fuel pump, and the inadequate functioning of the auxiliary fuel pump hindered the swift removal of the contained air that hinders the fuel suction of the engine driven fuel pump.

3.5.4 Situation of the Engine Halt to the Forced Landing

a. As described in 2.1.2.a, the Pilot declared the emergency after the engine halted, and requested for a radar vector to the nearest airport, which is Kanoya Airfield. However, since the radar vector did not start immediately, and the headwind from the east was strong while the Aircraft was descending, he judged that the Aircraft would not reach the Kanoya Airfield, and decided to turn around and fly towards the west of Kinko bay.

As described in 2.1.2 b the controller received a request for radar vector to the nearest airport. However, since Kanoya Airfield which is the nearest airport had closed off its runway due to a typhoon approaching, the controller coordinated with Kanoya Rader concerning the radar vector to the Aircraft involved in the emergency, and then report the frequency for the radar vector to the Aircraft.

It is probable that the controller was making some coordination for the radar vector to the Kanoya Airfield which was closed, while the Pilot flew towards Kanoya Airfield, finding the strong head wind, judged that the Aircraft would not reach the airport, and then decided to turn around.

It is highly probable that the Aircraft gliding stable in the cloud without falling into an abnormal attitude while conducting airstart of the engine and communication with the ATC, was an outcome of the Pilot having properly conducted instrument flying continuously under the difficult situation.

b. As described in 2.1.2 a, when the Aircraft decent to below 3,000 ft and came through the cloud and the coast line could be seen; therefore it headed towards the land. The Pilot saw the quay and decided to execute a forced landing on there. However, due to the strong wind, he judged that it was not possible to land safely; therefore, he activated the emergency parachute system in front of the hill that emerged ahead of him.

Given the above, it is highly probable that the Pilot chose a forced landing by using the emergency parachute system instead of a forced landing by gliding due to strong wind.

c. As described in 2.11.2 d, it is prescribed in POH that after the activation of the emergency parachute system, in order to prevent the outbreak of fire, the fuel selector valve is to be set in CLOSE. However, as described in 2.9 b, it was confirmed when the investigation of the Aircraft was conducted after the accident, the fuel selector valve of the wing tank was set in CLOSE, but the fuel selector valves of the front and rear ferry tanks were still set in OPEN. Since the fuel selector valves of the front and rear ferry tanks were not partially or half open but fully open, and the vapour return valve that requires reaching out a hand was also fully open, it is probable that the possibility of the Pilot's body touched the closed fuel selector valve of the tank and changed its position when he was trying to escape from the Aircraft after it inverted was low.

Given the above, it is somewhat likely that although the Pilot had set the selector valve of the wing tanks CLOSE at the time of activating the emergency parachute system, the ferry tank valves which were not mentioned in the POH had been left in OPEN since the engine power loss occurred.

- d. According to the statement of the Pilot described in 2.1.2 a, thereafter, it is probable that the nose touched the ground in the field forcing the Aircraft to overturn and after the Pilot escaped to outside, and confirmed he had not been injured, it moved over the field due to the strong wind in the parachute, and stopped in a bamboo forest about 50 meters away.
- e. According to As described in the statement of the Pilot in 2.1.2.a and as described in 2.7, as regards the weather of the accident site, there was a strong easterly wind due to the typhoon approaching, and it is probable that from the beginning of the engine power loss until its altitude became below 3,000 ft, the Aircraft was flying in the clouds.

Under these circumstances, it is probable that the Aircraft which could not maintain an altitude would not be able to carry out an instrument approach such as GCA vectored by the Kanoya Radar. In such condition, it is probable that the Aircraft was able to accomplish a forced landing in a limited space, and although the aircraft was damaged, no crews was injured because the emergency parachute system had functioned effectively.

However, if the weather had been good and there were no typhoons approaching, since the distance from where the engine halted to the Kanoya Airfield was about 12 nm as described in 2.1.1, and the maximum gliding distance of the Aircraft from the altitude of 10,000 ft was about 18nm as described in 2.11.2 a, it is somewhat likely that it could have achieved an emergency landing at Kanoya Airfield while gliding under radar monitor.

3.6 The Prevention of Emergency Landing During Ferry Operation

Generally, the following items can be considered in order to prevent the accidents related to the forced landing of a light single engine aircraft during ferry operation.

- a. Flight Plan

In any case of the engine failure and the Aircraft being accomplish a forced landing, it is necessary to organize a flight plan that will enable to execute a suitable emergency landing under the suitable weather conditions.

- b. Fight preparation

There is a need to follow the prescribed procedures of the Operation Instruction with regard to the operation of the ferry fuel system. In particular, the procedures for the emergency operation should be fully confirmed, and if there is no emergency procedure indicated about the ferry fuel system, then there is a need to shut down the ferry fuel system and make oneself fully understand how to handle the emergency procedure established for the aircraft system.

Moreover, as regards the pre-flight check of the aircraft, it is necessary to definitely check that there are no faults with an engine auxiliary components such as fuel pumps, and the fuel systems.

- c. Fuel management during the flight

To avoid any troubles occurring to the only one engine available, it is necessary to appropriately manage the fuel in order not to cause the exhaustion of the fuel tank in use.

4. PROBABLE CAUSE

It is highly probable that the accident was occurred as a result of the engine of the Aircraft halt during the flight and not being able to start in the air, resulting in the damage of the Aircraft during the forced landing.

As for the engine halt, it is somewhat likely that the exhaustion of fuel of the rear ferry tank that was being used caused the engine to power loss, and although the Pilot opened the fuel selector valve of the front ferry tank which still had remaining fuel, the fuel selector valve of the rear ferry tank was not closed which led to the air from the empty rear ferry tank entering into the fuel line prompted by the suction of the engine driven fuel pump; subsequently, hindering the supply of fuel.

It is somewhat likely that the engine could not start in the air, since the contained air in the fuel line caused a difficulty of the suction of the engine driven fuel pump, and that the inadequate functioning of the auxiliary fuel pump could not remove swiftly the contained air that was hindering the fuel suction of the engine driven fuel pump.

Figure 1 Estimated Flight Route

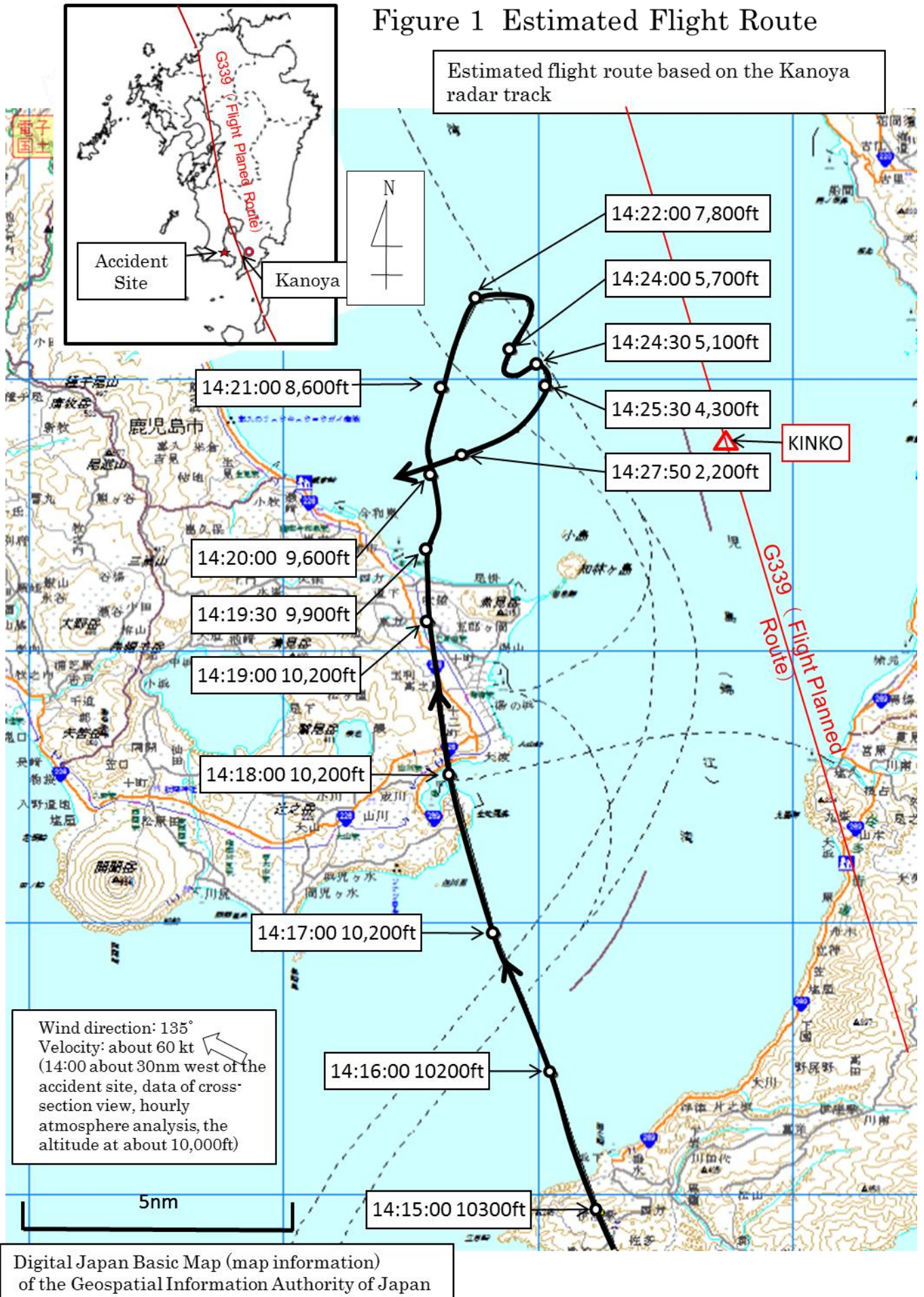
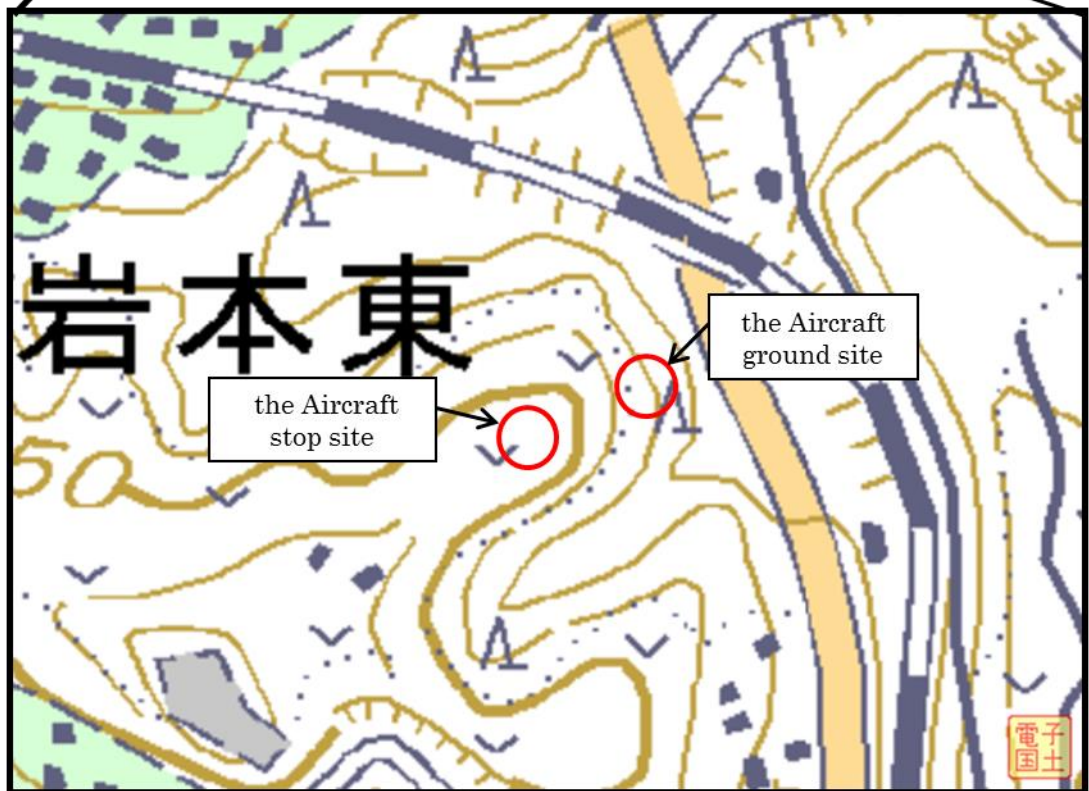
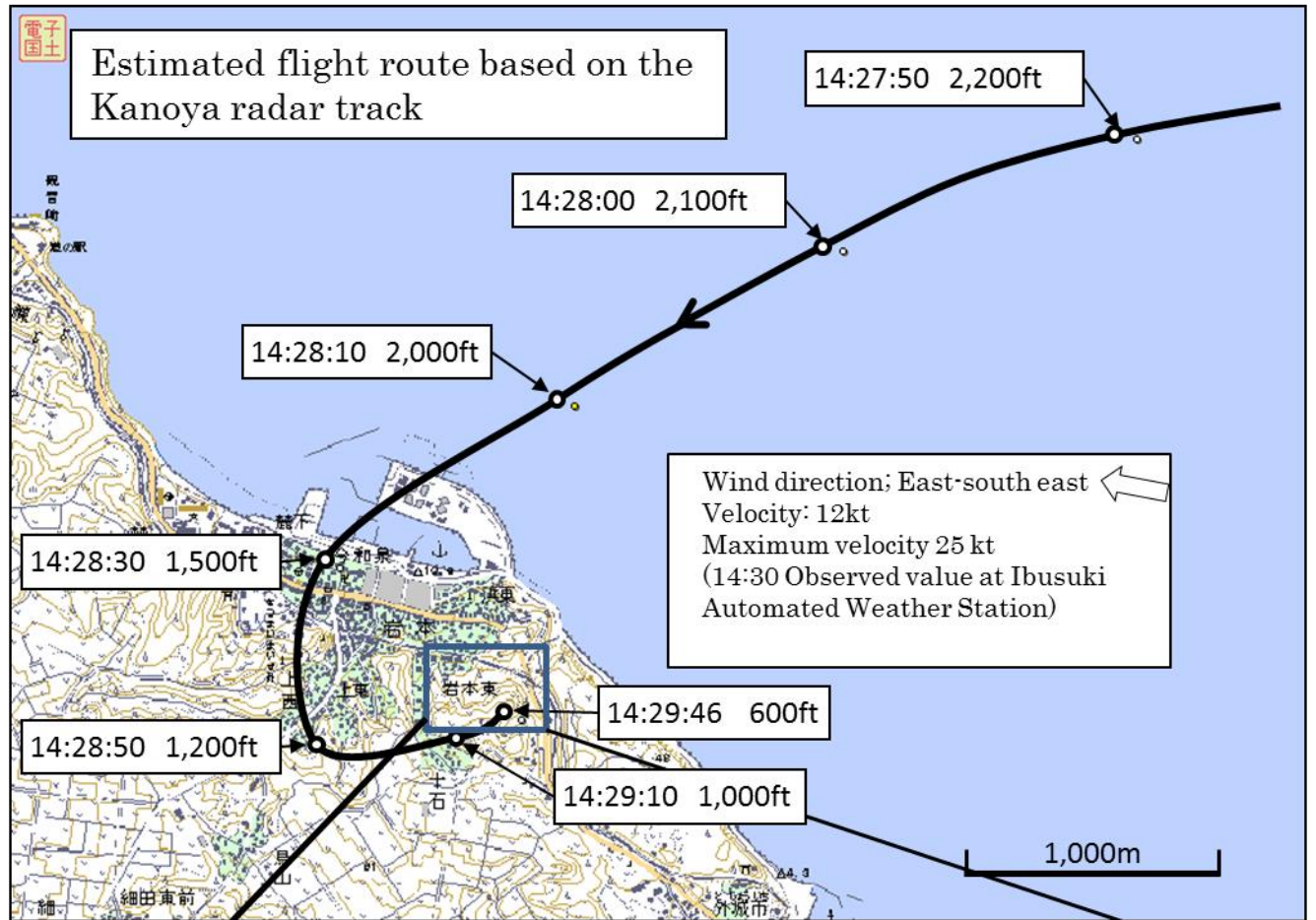


Figure 2 Forced Landing Site Layout



Digital Japan Basic Map (map information)
of the Geospatial Information Authority of Japan

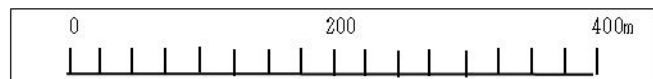


Figure 3 : Three Angle View of Cirrus SR20

Unit : m

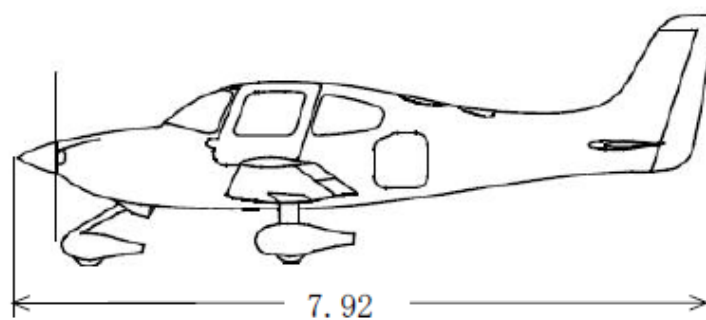
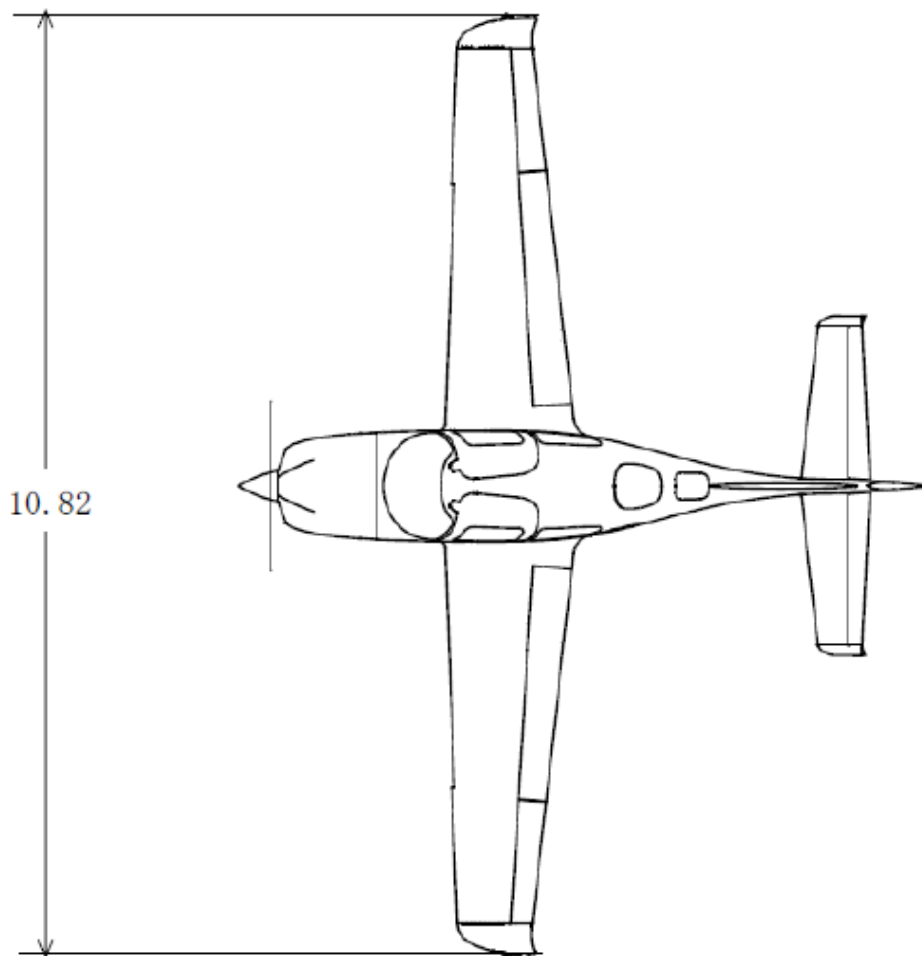
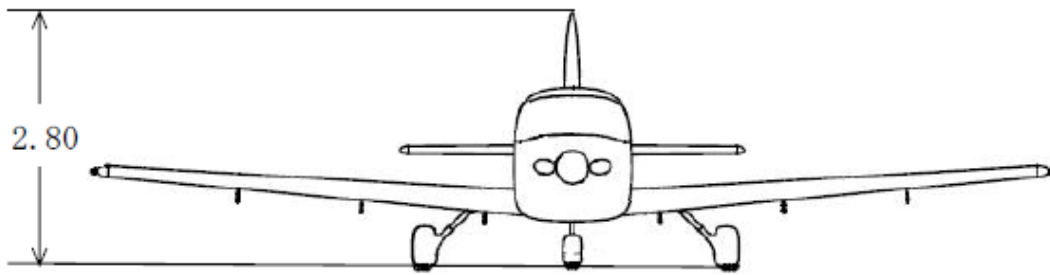
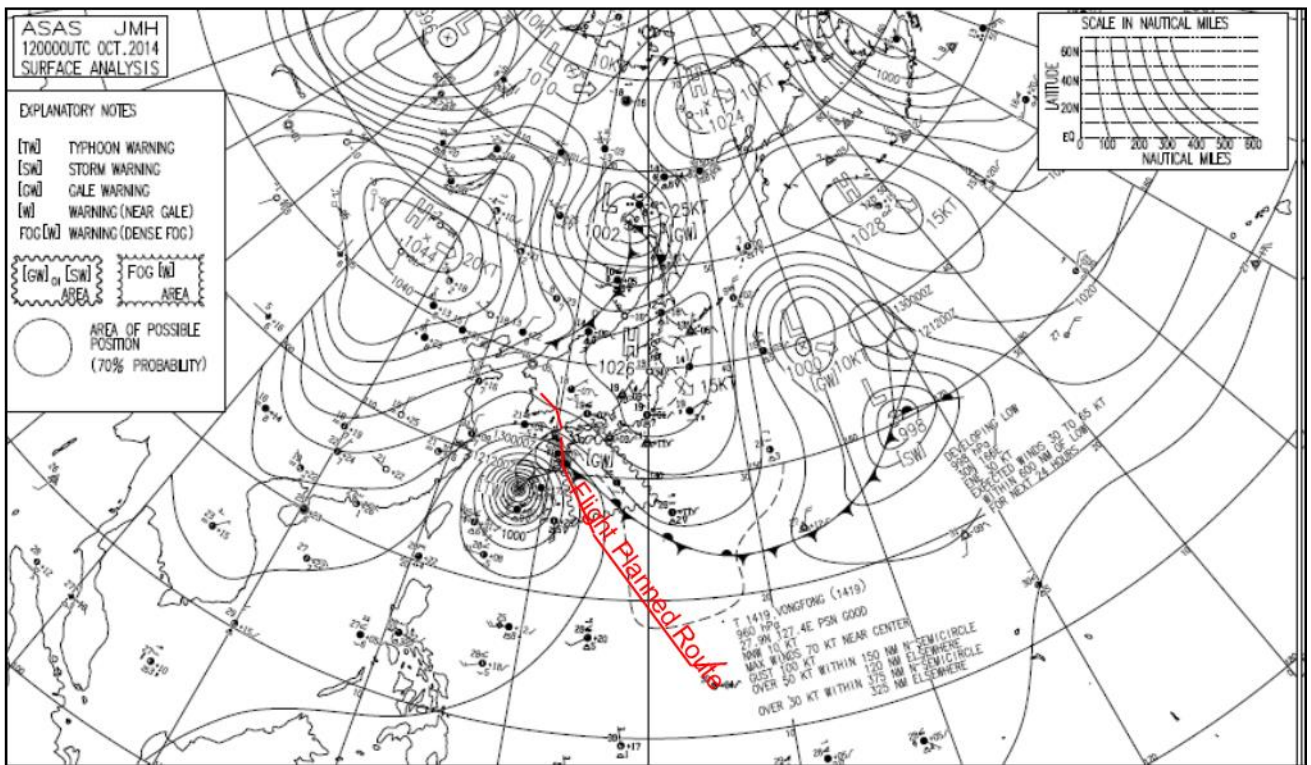
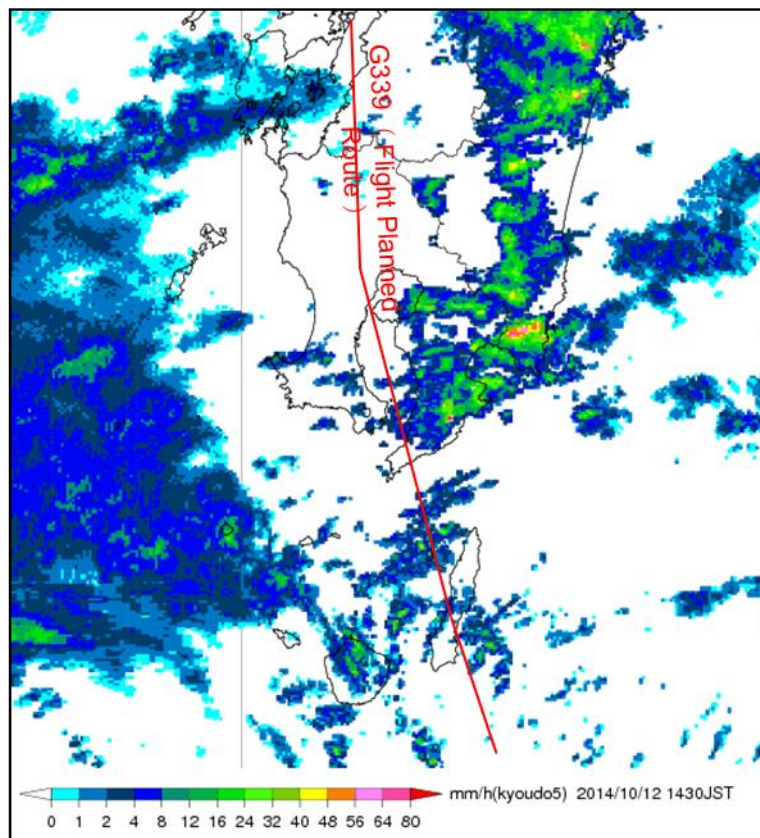


Figure 4: Surface weather chart and radar composite chart



Surface weather chart October 12, 09:00



Radar composite chart of October 12, 14:30

Photo 1 Forced Landing Site



Photo 2 : Accident Aircraft



Fuselage
outer board
detachment

