AA2015-7

AIRCRAFT ACCIDENT INVESTIGATION REPORT

PRIVATELY OWNED
J A 4 1 7 5

July 30, 2015

Japan Transport Safety Board

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

Norihiro Goto
Chairman,
Japan Transport Safety Board

Note:

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

AIRCRAFT ACCIDENT INVESTIGATION REPORT

DAMAGE TO AIRCRAFT DUE TO OVERRUN

PRIVATELY OWNED GULFSTREAM AEROSPACE AG-5B, JA4175

CLIFF ON THE SOUTH SIDE OF TAJIMA AIRPORT

AT ABOUT 12:56 JST, JULY 21, 2013

July 24, 2015

Adopted by the Japan Transport Safety Board

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

SYNOPSIS

<Summary of the Accident>

At around 12:56 (JST: UTC +9hr, unless otherwise stated, all times are indicated in JST on a 24-hour clock) on Sunday, July 21, 2013, a privately owned Gulfstream Aerospace AG-5B, registered JA4175, overran the runway and dropped from a cliff on the south side of Tajima Airport when landing on runway 19 at Tajima Airport, causing damage to the aircraft.

A pilot and two passengers were on board the aircraft, but no one was injured.

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

＜Probable Causes＞

In this accident, it is highly probable that when the aircraft, which had a decreased engine power during the flight, made an emergency landing in the tailwind, it had approached at high speed without controlling engine power, and without the proper operations in place, leading to overrun the runway and falling over the cliff, causing damage to the airframe.

With regard to the approach of the aircraft at high speed without engine power controls in place, and without proper operations, it is highly probable that these had occurred because the knowledge and skills of the pilot were not at an appropriate level, resulting in his inability to calmly handle the situation according to the correct procedures.

With regard to the decrease in engine power, it is somewhat likely that inappropriate use of the sealing tape led to foreign substances entering the fuel selector valve, thereby obstructing fuel supply to the engine. However, the exact cause could not be determined.

The main abbreviations used in this report are as follows:

BKN:	Broken
FAA:	Federal Aviation Administration, US Department of Transportation
KIAS:	Knots Indicated Airspeed
NTSB:	The United States National Transportation Safety Board
RPM:	Revolutions Per Minute
SCT:	Scattered
VFR:	Visual Flight Rules

Unit conversion

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

1. PROCESS AND PROGRESS OF THE AIRCRAFT ACCIDENT INVESTIGATION

1.1. Summary of the Accident

At around 12:56 (JST: UTC +9hr, unless otherwise stated, all times are indicated in JST on a 24-hour clock) on Sunday, July 21, 2013, a privately owned Gulfstream Aerospace AG-5B, registered JA4175, overran the runway and fell under a cliff on the south side of Tajima Airport when landing on the runway 19 at Tajima Airport, causing damage to the airframe.

A pilot and two passengers were on board the aircraft, but no one was injured.

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

1.2. Outline of the Accident Investigation

1.2.1 Investigation Organization

On July 22, 2013, the Japan Transport Safety Board designated an investigator-in-charge and two other investigators to investigate this accident.

1.2.2 Representatives of the Relevant State

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

1.2.3 Implementation of the Investigation

July 22, 2013: On-site investigation and interviews

July 23, 2013: Airframe examination

July 24 and 25, 2013: Interviews

September 20, 2013 through September 24, 2014: Examination of engine and fuel system parts, and function tests

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

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

1.2.5 Comments from the Relevant State

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

2. FACTUAL INFORMATION

2.1. History of the Flight

The privately owned Gulfstream Aerospace AG-5B, registered JA4175 took off from Fukui Airfield for Tottori Airport at 12:09 on July 21, 2013, to conduct a familiarization flight with the pilot in the left front seat and two passengers in the right front seat and the left rear seat respectively.

The flight plan of the Aircraft was outlined below:

Flight rules: Visual Flight Rules (VFR)

Departure aerodrome: Fukui Airport
Estimated off-block time: 12:10
Cruising speed: 100 kt
Cruising altitude: VFR
Route: Fukui, Kyogamisaki
Destination aerodrome: Tottori Airport
Total estimated elapsed time: 1 hour 20 minutes
Fuel loading expressed in endurance: 3 hours 20 minutes
Persons on board: 3

The history of the flight of the Aircraft, up to this accident, according to the ground-to-air communication records and the statements of the Pilot, passengers, and witnesses, is summarized as follows.

2.1.1 Flight history based on ground-to-air communication records

12:41:48 The Pilot made a request to Tajima Remote*1 to make an emergency landing at Tajima Airport (hereinafter referred to as "the Airport") due to engine malfunction.

12:45:51 The Pilot informed to Tajima Remote on the Aircraft's altitude (2,100 ft) and airspeed (85 kt), and reported that the situation was, "whether or not we can somehow make it to Tajima."

12:49:39 The Pilot reported to Tajima Remote on the Aircraft's altitude (1,600 ft) above Kumihama (approx. 10nm northeast of Tajima Airport), and reported that the situation was, "whether or not we can somehow bring the Aircraft there (whether or not we can reach the Airport). It may be difficult."

12:51:24 The Pilot reported to Tajima Flight Service*2 that the Aircraft's altitude was 1,300 ft, and that it had flown over the mountains south of Kumihama.

12:54:34 Tajima Flight Service informed of the wind direction and wind velocity to the Aircraft, which was on its final approach leg.

12:54:43 The Pilot responded that he had acknowledged the wind direction and wind velocity.

About 12:56 The person-in-charge of operations at Tajima Flight Service visually confirmed the overrun of the Aircraft, and called it, but he had no response.

2.1.2 Statements of the Relevant Persons

(1) Pilot

The Pilot had inspected the Aircraft at Fukui Airport and verified that there were no abnormalities. He had also checked that both the left and right fuel tanks were full and not contaminated with water, and that the lubricating oil level was correct.

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*1 "Tajima Remote" is an air assistance station where air traffic information officers of the Osaka Airport office provide the necessary flight information for aircraft flying in the Tajima Airport area, and communicates control approval, and other instructions to aircraft taking off and landing at the same airport.

*2 "Flight Service" refers to a radio station that is set up for communications relating to aircraft and aviation assistance, at places such as airfields, heliports, and glider fields.

The Aircraft took off from Fukui Airport at 12:09.

The Pilot flew mostly along the coastline. Just before the Swiss Village, which was visible on the left, he switched the fuel selector valve*3 from right to the left as part of normal operations, as 30 minutes had passed since the take-off. Immediately after that, at an altitude of 2,400 ft, he felt changes in the engine sound accompanied by slight vibrations near the engine cowling; hence, he changed his destination to the Airport.

The Pilot set the engine power at full throttle, and thought that the sound and vibration might be related to the fuel selector valve. Therefore, he switched the fuel selector valve to the right again. However, there was no change in the situation, and the slight vibrations continued the same as before.

Moreover, the engine RPM which had been at 2,400 – 2,500 rpm, began to decrease gradually. The cruising airspeed had been at about 110 – 120 kt before that, and the Pilot began to descend gradually while maintaining this speed, to prevent it from falling below 80 kt.

After informing the change in destination to Tajima Remote, the Pilot flew toward the Airport while considering an emergency landing location if the worst should happen. Although he adjusted the mixture lever and throttle lever, there were no changes in the engine condition, and the number of revolutions continued to drop. Although he should have carried out emergency procedures in the event of engine malfunction relying only on his memory, he could not remember clearly which switch he had operated, how he had operated them, and the results of operation.

The engine RPM fell to less than 1,900 at an altitude of 1,200 ft above Kumihama, and the Pilot received the Airport information from the Tajima Flight Service that the wind was coming from the north at 15 kt, and to use the runway 01.

As the Pilot would have to fly in a long traffic pattern in order to land at the runway 01, he considered that it would not be possible to reach the runway, and requested to enter the runway 19 which he could enter on the direct final leg*4.

The Aircraft approached the runway 19 of the Airport sideways from the northeast direction. On the final approach, there was a moment when the engine vibrations became bigger, but the Aircraft somehow managed to reach the Airport. The Pilot took the tailwind into account in his approach speed, set the approach speed at 70 kt with 8 kt additive to the normal approach speed, and attempted to make a no-flap approach (an approach with the flaps up). The terrain clearance was approximately 6 – 7 m around the threshold of the runway.

The Pilot avoided the building that was located east of the runway, and attempted to align the runway directly, but turned the control wheel quickly as it overshot. Although he thought that the airspeed was about 70 kt, he had no room to check the airspeed indicator. There was not enough remaining length on the runway, and the Pilot felt that it was not possible to make a go-around*5 based on the state at which engine power had been falling

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*3 "Fuel selector valve" refers to the valve that is operated by the pilot in order to prevent the fuel tank on either the left or right main wing from becoming depleted. The pilot switches the valve left and right periodically, and the engine is supplied with fuel from the tank on the side that the pilot has selected.

*4 "Final leg" refers to the route on the extension of the approach of the center line on the landing runway.

*5 "Go-around" refers to the situation when an aircraft that is making the approach toward a runway for a landing reattempts the landing.

up to that point. He remembered touching down near a point past the halfway-point of the runway. Just before touchdown, he had cut off the mixture lever and stopped the engine. The impact on touch down had been quite big, to the extent that the propeller blade hit the ground and the nose landing gear became deformed. After touching down, the Pilot attempted to reduce speed on the grass west of the runway and at the slope near the hill, as there was not enough space until the boundary of the Airport. However, he failed to regain control of the Aircraft, which crashed into the guardrails of the service road, bounced over them, and then crashed into the top of the forest below the cliff.

After that, the nose of the aircraft slid slowly downward along the trunk while facing downward, but none of the persons on board were injured. After turned off the switches. and got out of the Aircraft, the Pilot found that fuel was leaking from the broken wings; accordingly, he evacuated the two passengers and moved away from the Aircraft.

(2) Passenger A

Passenger A, who holds a private pilot certificate was seated in the right front seat.

The engine speed of the Aircraft had been decreased, accompanied by vibrations. The Pilot moved the throttle lever to full-open (the foremost position for maximum power), and the engine speed eventually fell to about 1,800 rpm.

Passenger A heard the information from Tajima Flight Service stating that the wind at the Airport was a north wind at 15 kt. As the Aircraft have no room to fly along with the traffic pattern, it approached the runway directly. The Aircrafts speed increased on the final leg, and Passenger A felt that it had been about 80 – 85 kt at the threshold of the runway. He did not look closely at the airspeed indicator ; he was unaware of its speed.

(3) Witness A

Witness A, who holds a commercial pilot certificate, was onboard an aircraft standing by taxi for departure on the north apron (refer to Figure 1: Estimated Flight Route) for a flight, when he received information regarding an aircraft making an emergency landing from Tajima Flight Service. He turned his aircraft toward the direction of the final approach leg of the runway 19 and helded there.

After a while, the Aircraft appeared directly above the hangar on the right side the Witness A, accompanied by a loud engine sound. It approached at a crossing angle of about 45° with the runway, and appeared to align with the runway directly near the west side of the north apron. Witness A felt that its speed at that point had been about twice the approach speed of typical small single-engine aircraft (70 kt), and appeared to be maintaining an altitude for passing the threshold of the runway; accordingly, he thought that the Aircraft was not attempting to land, but was doing a low pass[*6] at high speed.

The Aircraft appeared to align with the runway directly upon entering it. However, after he saw the Aircraft maintaining its altitude and flying at high speed, it went outside his field of vision and he could not see it anymore.

*6 "Low pass" refers to flying through over a runway at a low altitude.

(4) Witness B

Witness B is engaged in fire-fighting work at the Airport. Upon receiving information about the Aircraft's emergency landing, he was mobilized and standing by at the north apron on the north side of the Airport.

The Aircraft approached the runway diagonally from the east side, and passed directly over Witness B. After that, despite aligning with the runway directly for a while, it was overshooting on the west side.

Witness B had been paying attention to the engine sounds because the Aircraft was making an emergency landing due to engine malfunction. However, the engine did not appear to be coming to a stop or moving in any way, and Witness B remembered hearing a constant engine sound.

Witness B entered the runway in a fire truck, and watched the situation as he followed the Aircraft. After veering off to the left side of the runway, the Aircraft next turned toward the right, and appeared to be heading toward the center line of the runway. However, there was some distance between the truck and the Aircraft; therefore Witness B could not see the location where it touched down.

Thereafter, Witness B discovered that the guardrails of the service road were broken, but could not see any sign of the Aircraft nearby. Consequently, he assessed that the Aircraft had crashed into the mountain valley, and reported the accident to the fire department.

This accident occurred among the mountains about 150 m south of the end of the runway 19 of the Airport (35°30'20"N, 134°47'11"E). The time of the occurrence of this accident was about 12:56 on July 21, 2013.

(See Figure 1: Estimated Flight Route)

2.2. Injuries to Persons

No one was injured.

2.3. Damage to the Aircraft

2.3.1 Extent of Damage

Destroyed.

2.3.2 Damage to the Aircraft Components

(1) Fuselage: Damaged
(2) Main wings: Left main wing damaged, Right main wing broken
(3) Tail wing: Damaged
(4) Engine: Damaged
(5) Propeller: Damaged
(6) Landing gear: All Landing gears broken

(Refer to Photos: Accident Aircraft)

2.4. Other Damage

(1) Broken guardrails on the service road of the Airport

(2) Several broken trees in the mountains south of the Airport

2.5. Personnel Information

Pilot Male, Age 64	
Private pilot certificate (Airplane)	
Type rating for single-piston engine (land)	March 20, 1987
Class 2 aviation medical certificate	
Validity	June 9, 2014
Total flight time	532 hours 16 minutes
Flight time in the last 30 days	0 hours 0 minutes
Total flight time on this type of aircraft	170 hours 35 minutes
Flight time in the last 30 days	0 hours 0 minutes
Number of takeoffs and landings in the last one year	5 times

The number of takeoffs and landings that the Pilot had made in the 180 days up to the day before the date of the accident on July 20 was two times.

2.6. Aircraft Information

2.6.1 Aircraft

Type	Gulfstream Aerospace AG-5B
Serial number	10069
Date of manufacture	August 23, 1991
Certificate of airworthiness	No.Dai- 2012-415
Validity	November 5, 2013
Category of airworthiness	Airplane Normal N or Utility U
Total flight time	524 hours 18 minutes
Flight time since last periodical check	5 hours 06 minutes

(100-hour inspection performed on October 8, 2012)

(See Figure 2: Three Angle View of Gulfstream Aerospace AG-5B)

2.6.2 Engine

Type	Lycoming O-360-A4K
Serial number	L-32960-36A
Date of manufacture	August 23, 1991
Total time in service	524 hours 18 minutes
Flight time since last periodical check	5 hours 06 minutes

(100-hour inspection performed on October 8, 2012)

2.6.3 Weight and Balance

At the time of the accident, the weight of the Aircraft was estimated to have been about 2,160 lb, and the center of gravity was estimated to have been at 88 in aft of the reference line. Both of these values were estimated to have been within the allowable range (The maximum takeoff weight: 2,400 lb. The center of gravity range corresponding to the weight at the time of the accident: 85 in to 92.5 in).

2.6.4 Fuel and Lubricating Oil

The fuel was aviation gasoline 100, and the lubricating oil was Phillips X/C MIL-L-22851 for piston-engines.

2.7. Meteorological Information

(1) Routine aerodrome weather report at the Airport

13:00 Wind direction: 020° (Wind direction variable 340° - 050°).

Wind velocity 9 kt

Visibility: 35 km

Cloud: Amount FEW*7, Type Cumulus, Cloud base 2,500 ft

Amount SCT*8, Type Cumulus, Cloud base 3,500 ft

Amount BKN*9, Type Unknown, Cloud base Unknown

Temperature: 31°C; Dew point: 20°C

Altimeter setting (QNH): 29.82 inHg

(2) Wind Direction and Wind Speed at the Airport

The data from the two minute average interval wind indicator*10 on the runway 19 around the time of the accident is given below.

Table 1: Records of Wind Direction and Wind Velocity

Time	12:51	12:52	12:53	12:54	12:55	12:56	12:57
Average wind direction (Magnetic bearing)	010	010	015	015	010	010	010
Maximum instantaneous wind velocity (kt)	13	15	15	12	12	12	12
Average wind velocity (kt)	10	11	9	8	9	9	9

2.8. Accident Site and Detailed Damage Information

2.8.1 Condition of the Accident Site

The Airport is surrounded by mountains, and has an elevation of about 176 m. The paved runway has a length of 1,200m and width of 30m, and each end has a stopway that is 60 m long.

The runways also has designation markings 01/19 showing magnetic bearing, center line markings, and a halfway marking.

The site of the accident was about 150 m south from the runway 19 end of the Airport, below a cliff with an elevation difference of about 26 m with the surface of the Airport.

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*7 "FEW" refers to a situation in which the visible proportion of sky that is covered by clouds is 1/8 – 2/8 of the entire sky.

*8 "SCT" refers to a situation in which the visible proportion of sky that is covered by clouds is 3/8 – 4/8 of the entire sky.

*9 "BKN" refers to a situation in which the visible proportion of sky that is covered by clouds is 5/8 – 7/8 of the entire sky.

*10 "Two-minute average wind indicator" refers to an aerovane that indicate average wind direction and wind speed for the past two minutes at an interval of every six seconds.

The Aircraft stopped with its nose pointing in a south-southeast direction amongst the trees under the cliff.

A contact mark of the right main wing tip of the Aircraft was left on with the runway 01 threshold marking. The stopway area of runway 19 had marks on the ground where the propeller blades and the tip of the right main wing made contact with the ground, as well as marks from all the landing gear tires. In addition to marks on the ground, marks were left by three tires in the grass field continuing from the stopway area to the service roads. The guardrails of the service road around the Airport, on the extension of the tire marks, were bent, and the left and right landing gears as well as nose landing gear that had fallen from the Aircraft remained around this area.

(See Figure 1: Estimated Flight Route)

2.8.2 Detailed Damage Information

(1) Fuselage: The skin of the fuselage was deformed, and the underside had scratch marks. The frame where the landing gear is mounted was significantly damaged.

(2) Main wings: The right main wing separated from the fuselage, and the underside of the wing tip had scratch marks. The left main wing was significantly damaged.

(3) Tail wing: Damaged, significantly deformed.

(4) Engine: Damaged, engine mount section was broken.

(5) Propeller: Of the two propeller blades, the tip of one was bent backward and damaged, while the other did not incur any damage.

(6) Landing gear: All three landing gears were broken from the mounting structure part, and were separated from the airframe.

(See Photos: Accident Aircraft)

2.9. Tests and Research

2.9.1 Examination of Airframe and Engine Systems

The filters for the each system (lubrication, fuel, inlet air) of the engine of the Aircraft were examined. There were no abnormalities, and it was verified that the engine oil was not contaminated with metal objects or other foreign objects.

The condition of the electricity distribution wires and ignition plug in the engine ignition system were examined, and no abnormalities were found. The condition of the filter of the engine carburetor, valve, and other parts, as well as the remaining fuel inside, were examined, and no abnormalities were found.

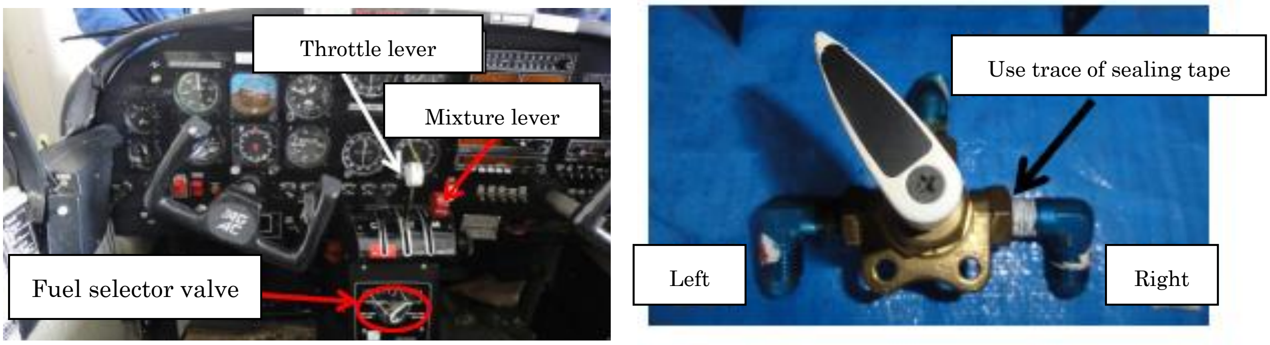

Photo 1: Fuel selector valve of the Aircraft

When the left-right switching function of the fuel selector valve was being checked, the valve handle shaft became stuck; accordingly the valve could not be switched. In addition, it was verified that sealing tape had been used at a screwed portion of connection joint.

This sealing tape was made of teflon, but the aircraft maintenance manual of the aircraft contained no instruction about using the sealing tape for repair or maintenance work.

With regard to repair and maintenance work, the maintenance records of the Aircraft after it was manufactured were checked, but there were no records concerning the fuel selector valve. The relevant parties involved in the maintenance of the Aircraft did not make any statements about the related repair/maintenance work.

Typically, sealing tape is used to stop water leakage in water piping works and others. (Photo 2), and is not used on pipe fittings to stop fuel or hydraulic fluid leakage in aircraft maintenance works. According to the manual providing instructions for use from the manufacturer of the sealing tape, when it is not used properly on pipe fittings (winding the tape in the opposite direction from the direction of the screw, or leaving the tape sticking out from the edge of the screw), fragments of the sealing tape may enter the pipe and cause equipment malfunction or failure.

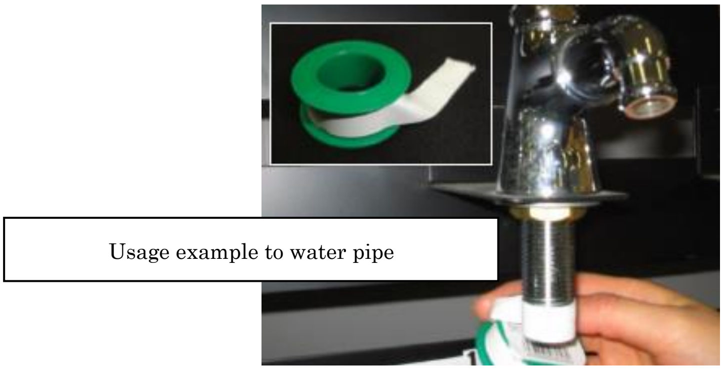

Photo 2: Usage example of Sealing tape on water pipe

2.9.2 Teardown Examinations of the Magnetos*11 and Fuel Selector Valve

With cooperation from the United States National Transportation Safety Board (NTSB), examinations were conducted by breaking down the magnetos and the fuel selector valve. The results of the examinations are given below.

The internal examinations and functional tests were conducted on the two magnetos, but no abnormalities were found.

The fuel selector valve on which the handle shaft was stuck showed no abnormalities when its internal parts were examined by X-ray. However, the result of the examination conducted by breaking it down showed that the internal parts of the valve handle shaft and the selector valve were crimped. When it was resolved from this crimp state of compression, and then function tests were conducted on the fuel selector valve, no abnormalities were found.

In the examination conducted by breaking down the parts, it was found that the sealing tape had been used on all the three screw portions of joint on the valve.

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*11 "Magneto" refers to the magneto generator that is a part of the aviation piston-engine ignition system, and which is powered by the engine's revolutions to generate high voltage for ignition. (Two units are installed in an engine.)

Moreover, teflon fragments that are thought to have originated from the sealing tape, as well as deteriorated lubricant that is thought to have originated from grease (lubricant) used on the handle shaft were found on the outlet port of the fuel selector valve. (Photo 4)

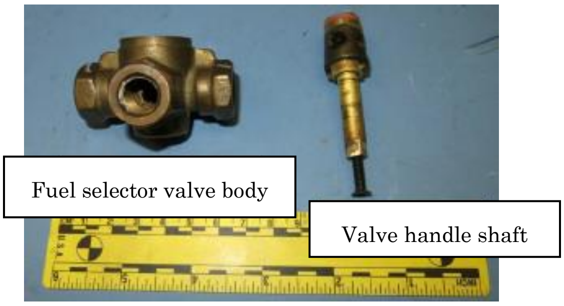

Photo 3: Examination of Fuel Selector Valve　Photo 4: Substances adhered to the Valve outlet port

2.10. Additional Information

2.10.1 Normal Operation

Airspeed during normal operation, based on the Pilot Operating Handbook of the Aircraft, is given below. (Excerpts)

4−2　AIRSPEED FOR NORMAL OPERATIONS

Landing Approach (Flaps Up) ・・・・・・・・・・・・・・・・・・ 72 KIAS

Landing Approach (Flaps Down) ・・・・・・・・・・・・・・・ 70 KIAS

2.10.2 Emergency Operation

(1) Airspeed during emergency operation

Information on emergency operation is given below, based on the Pilot Operating Handbook. (Excerpts)

3−2　AIRSPEED FOR EMERGENCY OPERATIONS

Engine Failure After Takeoff ・・・・・・・・・・・・・・・ 72 KIAS

*Maximum Glide speed[*12] ・・・・・・・・・・・・・・・・・・ 72 KIAS*

Precautionary Landing (Flaps UP) ・・・・・・・・・・・・・・ 72 KIAS

Precautionary Landing (Flaps DOWN) ・・・・・・・・・・・ 70 KIAS

(2) Engine failure

Information on engine failure during flight is given below, based on the Pilot Operating Handbook. (Excerpts)

3−3−2.　Engine Failure During Flight

(a) Airspeed	*72 KIAS*
(b) Carburetor Heat	*ON*
(c) Fuel Selector Valve	*Switch TANKS*
(d) Mixture	*RICH*

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*12　"Maximum Glide speed" refers to the speed that can maximize gliding distance while minimizing glide angle.

(e) Master Switch *ON*
(f) Auxiliary Fuel Pump *ON*
(g) Throttle *OPEN 1/4 INCH*
(h) Ignition Switch *BOTH*
(i) Starter *ENGAGE if propeller is stopped*

3－5－2. Engine failure during flight

When partial failure occurs for the engine, the pilot must make the decision to make an emergency landing, or to continue flying to the nearest airfield with the remaining engine power. In the event of a complete failure, set gliding speed to 72 KIAS immediately, and look for a landing field. (Omitted)

3－10－1. Landing Without Engine Power

In the case of an engine failure, if the engine cannot be restarted immediately, maintain a gliding speed of 72 KIAS, and choose the most suitable landing field. When choosing a landing field that is not an airfield, the factors that should be taken into consideration are terrain, obstruction, and wind direction.

To reduce the risk of a fire, turn the fuel selector valve and the ignition switch to "OFF". It is recommended to full down the flaps before touching down. After the flaps are DOWN, turn the master switch to "OFF".

3－10－2. Precautionary Landing with Engine Power

In the event of a partial engine failure, the pilot can also choose to make a preventive emergency landing at a location that is not an airfield. When selecting the landing field, the pilot must consider terrain, obstruction, and wind direction.

(3) Response during engine failure (Power loss)

With regard to the pilot's response when engine power loss, the following information is provided in the "*Hikouki Soujyu Kyouhon*" (*Aircraft Operation Textbook*) (p. 238. Published by the Japan Aerospace Technology Foundation, Third Edition, under the editorial supervision of the Civil Aviation Bureau of the Ministry of Land, Infrastructure, Transport, and Tourism.) (Excerpts)

(a) Check the engine instruments.

(b) Even if no abnormalities are found in the indications of the engine instruments, commence preparations to return to the airfield. (Omitted)

Changes in engine power serve as advance warning of serious danger to come; in short that the engine will come to a stop. If the engine has come to a complete stop, the aircraft will not be able to continue flying; therefore, an emergency landing must be made. Consequently, if the pilot notices changes in the engine power, he or she must envision possible situations up till the emergency landing, and it is vital to fly the aircraft toward an airfield or a safe emergency landing field.

The aircraft must maintain a specific altitude and speed in order to fly safely and make an emergency landing. Hence, the pilot must not neglect taking measures to maintain an appropriate airspeed, and not let altitude lose unconsciously when engine power changes.

(4) Airspeed during an emergency landing

With regard to airspeed during an emergency landing, the following information is provided in the "*Hikouki Soujyu Kyouhon*" (p.249). (Excerpts)

A common phenomenon that occurs among inexperienced pilots and trainees is to forget to take airspeed into consideration due to their strong desire to land at an airfield as soon as possible. Consequently, they might end up reaching the emergency landing field at a speed that is too high for them to touch down safely.

An airspeed that is too high is as dangerous as an airspeed that is too low. It can cause a tragedy when the landing distance exceeds the planned length by too much a margin, and crashes into the point beyond that.

2.10.3 Gliding Performance

(1) Gliding Performance of the Aircraft

Information on gliding performance is given below, based on Pilot Operating handbook of the Aircraft. (Excerpts)

3-9 Gliding

When the flaps are raised and the propeller is in propeller windmilling, the best glide angle can be achieved at 72 KIAS. At this airspeed, altitude loss is minimized, and the aircraft is able to extend the distance from reaching the ground to the maximum. This distance is about 1.6 nautical miles per 1,000 ft of altitude.

(2) Maximum Gliding Distance

The following information and diagram (gliding distance based on gliding speed) are found in the (「*Airplane Flying Handbook*」 *2004* p.3-17) published by the US. Department of Transportation, Federal Aviation Administration (FAA). (Excerpts)

Any change in the gliding airspeed will result in a proportionate change in glide ratio. Any speed, other than the best glide speed, results in more drag. Therefore, as the glide airspeed is reduced or increased from the optimum or best glide speed, the glide ratio is also changed.

When descending at a speed below the best glide speed, induced drag[*13] *increases. When descending at a speed above best glide speed, parasite drag*[*14] *increases. In either case, the rate of descent will increase.*

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*13 "Induced drag" refers to the drag that accompanies the lift that is generated at the main wings.

*14 "Parasite drag" refers to the drag that works on the entire airframe, arising from the aerodynamic force that works on the airframe shape, fuselage, and main wings etc.

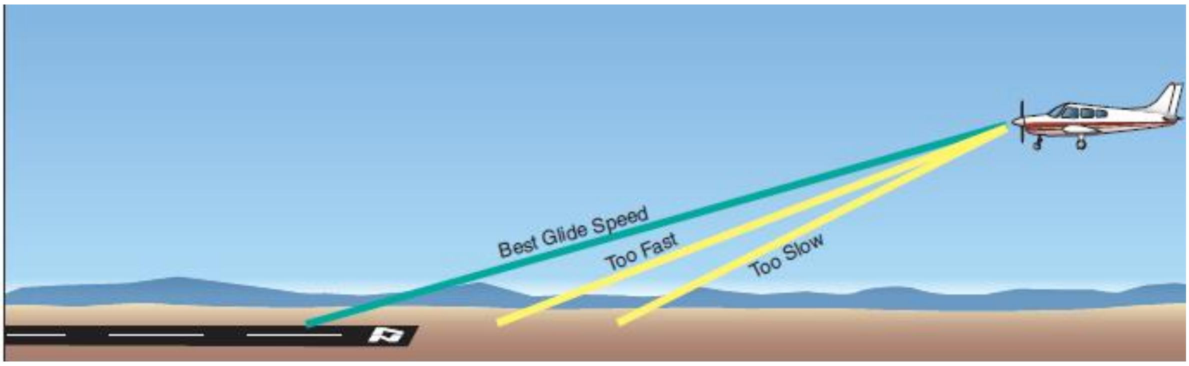

Figure: Gliding Distance Based on Glide Speed (「*Airplane Flying Handbook*」 *2004*. Published by FAA. p.3-17)

The figure above shows that when the aircraft's speed is "Too Slow" or "Too Fast" than the Best glide Speed, gliding distance will decrease.

2.10.4 Landing Distance*15

Information on landing distance is given below, based on Pilot Operating Handbook.

When the Aircraft landed in the flight configuration (engine idle , flaps down) and landing speed (70 kt) as provided in the Pilot Operating Handbook, in weather conditions with a tail wind of 15 kt, the landing distance would have been about 2,775 ft (about 846 m).

2.10.5 Private Pilot Competency Retention

As safety countermeasures for preventing accidents, the Civil Aviation Bureau of the Ministry of Land, Infrastructure, Transport, and Tourism issued a "Guidance on Private Pilot Competency Retention" (*Koku-ku-jyo* No. 2077, dated March 28, 2003) (hereinafter referred to as "the Guidance") that it is desirable for private pilots to encourage maintaining their competencies.

Specific measures for helping private pilots maintain their skills were presented to achieve this goal: participation in periodical safety workshops to help them increase safety knowledge and raise safety awareness, as well as satisfying the recent flight experience set out in the Guidance as part of efforts to prevent their flying skills from eroding. Of these, if a pilot's recent takeoff and landing experience—which are logged by flying the same category/class of aircraft as his/her license dictates—does not reach more than three times in the last 180 days, it is described that he/she should undergo practical training with an instructor on board on techniques which are presented as model case studies in the Guidance (takeoff and landing, basic flight operation, airwork such as stalling, and emergency operations such as basic instrument flight and procedures in the event of engine failure).

However, the Pilot had not undergone any practical training with an flight instructor on board in the past three years.

Moreover, on May 25, 2011, the Civil Aeronautics Act was partially amended, and the Specified Pilot Competency*16 Assessments system was introduced with the aim of maintaining

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*15 "Landing distance" refers to the horizontal distance that is required for the aircraft to come to a complete stop when it passes the end of the runway at an altitude of 50 ft (about 15 m) above the runway surface.

*16 The "Specific Pilot Competence Assessment" is a form of competency assessment conducted within two years preceding a flight on those holding a Pilot Competency Certificate issued by the Minister of land, Infrastructure, Transport and Tourism. The oral test covers the subjects of recent changes and the knowledge and leaning to be regularly reviewed. The practical test covers pre-flight procedure and basic competency such as traffic pattern flight and takeoff / landing, as well as knowledge on non-normal and emergency procedures.

and improving their competency. This system prohibits holders of pilot certificates from operating aircraft if they have not passed a specified Pilot Competency Assessment review on the knowledge and skills required to operate the aircraft conducted by a an Authorized Pilot Competency Assessment within two years prior to their flight.

This system was come into effect on April 1, 2014. The equivalent reviews have been implemented since April 1, 2012, and those who have undergone the equivalent assessment and passed were regarded as having passed the Specified Pilot Competency Assessment.

The Pilot had not undergone any equivalent assessment at the point when this accident occurred.

3. ANALYSIS

3.1. Qualification of Personnel

The Pilot held a valid airman competence certificate, and a valid aviation medical certificate.

3.2. Airworthiness Certificate of the Aircraft

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

3.3. Effect of Meteorological Conditions

As described in 2.7, the weather had been fine at the Airport at the time of the accident, and visibility was good. There were no clouds to be obstacle to approach area. It is probable that the tailwind had been at a maximum of about 15 kt at the runway 19.

Estimating from outside air temperature at the Airport, it is probable that outside air temperature at 2,400 ft when the engine malfunctions began malfunction was about 26°C and the difference with the dew point was also great; besides relative humidity had not been high. Moreover, according to the statement of the Pilot in 2.1.2(1), the Aircraft had been operating at a high power with engine RPM of 2,400 – 2,500 when it was cruising. Accordingly, it is highly probable that there would generally be a low possibility of engine malfunction arising from icing of the engine carburetor under such conditions.

3.4. Loss of Engine Power

As described in 2.9, there were no abnormalities with the Aircraft's engine carburetor or the ignition systems such as the magnetos.

Of the substances found at the outlet port of the fuel selector valve, it is probable that the fragments of teflon were torn pieces of from the sealing tape used that had entered the inside of the valve.

It is probable that the teflon fragments had affected the operation of the valve, obstructed fuel supply to the engine, and resulted in engine malfunction. However, the cause for the loss of engine power could not be determined.

As described in 2.9.1, the Aircraft maintenance manual of the Aircraft did not contain any instruction about using sealing tape; accordingly, it is probable that the use of sealing tape on the fuel pipe fitting of the Aircraft had not been appropriate.

Records of maintenance work that involved the use of sealing tape were not found in the maintenance records from the time after the Aircraft was manufactured, to the time of the accident. Consequently, the period when sealing tape was used on the Aircraft and the related maintenance work could not be determined.

3.5. Situation Leading Up to the Overrun by the Aircraft

3.5.1 Situations from the loss of engine power to the arrival at the Airport

As described in 2.1.2(1), after being aware of the engine malfunction, the Pilot had headed toward the Airport with engine power at the full throttle position. However, it is probable that he had gradually descent altitude while maintening cruising speed, in order to prevent it from falling below 80 kt.

It is probable that the Aircraft had been flown at about the same cruising speed while altitude was descent from the altitude of about 2,400 ft when the engine malfunction was noticed. By the time it passed the mountains south of Kumihama, altitude had been lost by about 1,100 ft to about 1,300 ft. Thereafter, it continued to descend by about 670 ft until it reached the Airport. The Airport was at an elevation of 578 ft, and it is probable that the Aircraft had arrived at the Airport by sliding in at an altitude of about 630 ft and a terrain clearance of about 50 ft, which was the typical altitude for passing the runway threshold.

It is probable that in the approximately 15 minutes from the time engine malfunction occurred and descent started to the time of arrival at the airport, the average rate of descent of the Aircraft had been low at about 120 ft/min.

3.5.2 Emergency Landing

(1) Approach course

As described in 2.1.2(1), the Pilot received the Airport information from the Tajima Flight Service that the wind was coming from the north at 15 kt, and to the use runway 01. However, it is probable that the Pilot considered that it would not be possible to reach the runway 01 as he would have to fly a long traffic pattern from the approach direction that the Aircraft was in; therefore, requested to land on the runway 19 and approached in a straight line under the tailwind conditions.

(2) Approach Speed

As described in 2.1.2(1), after engine power began to descend, the Pilot set it at full throttle. He descended while maintaining cruising speed, but as described in 2.10.1, he attempted to make a landing with no-flap condition at a speed adding tailwind component of 8 kt to the normal approach speed of 70 kt; however, he did not have composure to check the airspeed. Moreover, as described in 2.1.2(3), Witness A had stated that the final approach speed of the Aircraft had appeared to be about twice the typical approach speed for small single-engine aircraft (70 kt). Hence, Witness A had thought that the Aircraft did not attempt landing, but was doing a low-pass at high speed.

Based on these facts, it is probable the Pilot, thinking that the engine would come to a stop at any moment, had set the maximum position (full throttle) for engine power, and maintained an airspeed at about the same level as during cruising while losing altitude, in order to arrive at the Airport as soon as possible.

Moreover, as approach speed should be maintained at the prescribed value even when there is a tailwind, it is probable that the Pilot had mistakenly added the tailwind component to the usual approach speed. As he did not check the airspeed indicator under the situation, and had left the Aircraft at full throttle, it is probable that he had then probably approached at a higher speed than usual. In short, as described in 2.1.1, the Aircraft had been flying for about five minutes 20 seconds from Kumihama, located about 10 nm northeast from the Airport, to the Airport. During this time, its average ground speed had been 113 kt. In addition, as described in 2.7, the tailwind had been at an average of 9 kt when the Aircraft approached. Eventually, it is probable that its airspeed would have been above 100 kt even if the tailwind component had been deducted from average ground speed.

As described in 2.10.2(4) and 2.10.3(2), it is extremely important to control speed appropriately during an emergency landing. However, the Pilot did not reduce engine power even after arriving near the runway of the Airport, but attempted to make an emergency landing at high speed.

(3) Touch Down Operation

As described in 2.1.2(1), the Pilot did not carry out the necessary procedures for a landing even when arriving at the Airport. These included downing the flaps in order to make a landing, reducing approach speed, and maintaining an appropriate approach angle. Moreover, it is highly probable that he had landed at full throttle without controlling engine power.

It is probable that the Pilot had not operated the Aircraft properly as he approached from the side of the runway at high speed, in a tailwind, and could not in aligning the runway directly as he intended, leading to it exceeded the runway width, and repeatedly overshoot on the left and right.

Thereafter, as the Aircraft continued to move without slowing down, the tip of the right main wing of the Aircraft struck the runway surface at the end of the landing runway. The Pilot stopped the engine just before touching down. It is probable that although the Pilot stopped the engine just before touching down the Aircraft overran amidst difficult to control conditions after touching down on the stopway area, and crashed into the guardrails.

Based on the operations and judgments undertaken by the Pilot, and the recent flight performance described in 2.5, it is probable that when the accident occurred, the Pilot had little recent flight experience, and had not maintained the level of his flight knowledge and skills, which account for his not being able to handle the situation calmly and with the appropriate level.

According to the statement in 2.1.2, after crashing into the guardrails, though it is probable that the Aircraft had bounced violently and fallen down the cliff south of the Airport. It is probable that falling velocity had dropped while it was slipping down amongst the trees, and resulting in no injuries.

If the Pilot had down the flaps of the Aircraft and appropriately controlled speed and altitude when landing, as described in 2.10.4, it is highly probable that there would have been no trouble in its landing on a runway of the airport that was 1,200 m long, even if tailwind had been at a maximum speed of 15 kt and the landing distance had been about 846 m as prescribed in the Pilot Operating Handbook.

3.6. Handling Engine Malfunctions

The typical procedures to address an engine malfunction are as follows.

(1) Engine power of the Aircraft began to decrease while it was cruising, and it had not been in a desperate situation of an immediate crash. Accordingly, with the help of the passenger seated in the front right seat who held a private pilot certificate, if the Pilot had checked the engine instruments as described in 2.10.2(3), and after that, in consideration of the worsening engine malfunction situation, steadily carried out emergency operations by following the procedures laid out in Pilot Operating Handbook, as described in 2.10.2(1) and (2), it is probable that he would have been able to handle the situation composedly and with the appropriate procedures.

(2) As described in 2.10.2(2) and 2.10.3(1), when power decreases due to engine malfunction, the pilot is required to carry out the emergency operations described in Pilot Operating Handbook. If the engine does not recover, even after these procedures have been carried out, he or she must make a decision regarding whether or not to continue flying to the nearest airfield with the remaining engine power. In the event that power is completely lost, it is necessary for the pilot to search for a landing field while setting gliding speed at 72 KIAS in order to achieve maximum gliding distance. In the event that engine power is not recovered, rather than reducing altitude in order to maintain the previous cruising speed, in case the airspeed is between cruising speed and maximum gliding speed, it is necessary to first maintain altitude, and in consideration of an emergency landing in the event that engine power is completely lost, then fly to the nearest airfield or location that is suitable for an emergency landing.

Moreover, if it becomes impossible to maintain altitude by reducing airspeed to the maximum gliding speed, it would be necessary to reduce altitude while maintaining maximum gliding speed, and make an emergency landing at a point the aircraft is able to reach, in consideration of the Aircraft's gliding performance, as described in 2.10.3(1).

As described in 3.5.1, considering that the average rate of descent of the Aircraft, in the approximately 15 minutes from the time engine malfunction occurred and descent started to the time of arrival at the Airport, had been at the low rate of descent about 120 ft/min, if airspeed had been allowed to reduce to the maximum gliding speed without any attempts to maintain cruising speed after engine malfunction occurred, it is somewhat likely that the Aircraft would be able to maintain its flight altitude, flown in the usual traffic pattern, and landed on the headwind runway.

3.7. Flight Experience of the Pilot

As described in 3.5.2(3), at the time of the occurrence of the accident, it is probable that the Pilot had little recent flight experience, and had not maintained the level of his flight knowledge and skills with appropriate level. The flight experience of the Pilot on the day of accident occurrence, as described in 2.10.5, corresponded with the situation where he should undergone practical training with a flight instructor on board as prescribed by the “Guidance” However, this was not carried out. Moreover, although the Pilot could have voluntarily undergone an equivalent assessment of the Pilot Competency Assessment System prior to the enforcement of the system, he had not undergone the assessment. It is probable that it would have been desirable for the Pilot to put effort into maintaining the level of his knowledge and skills by voluntarily undergoing the equivalent assessment and actively attending practical training.

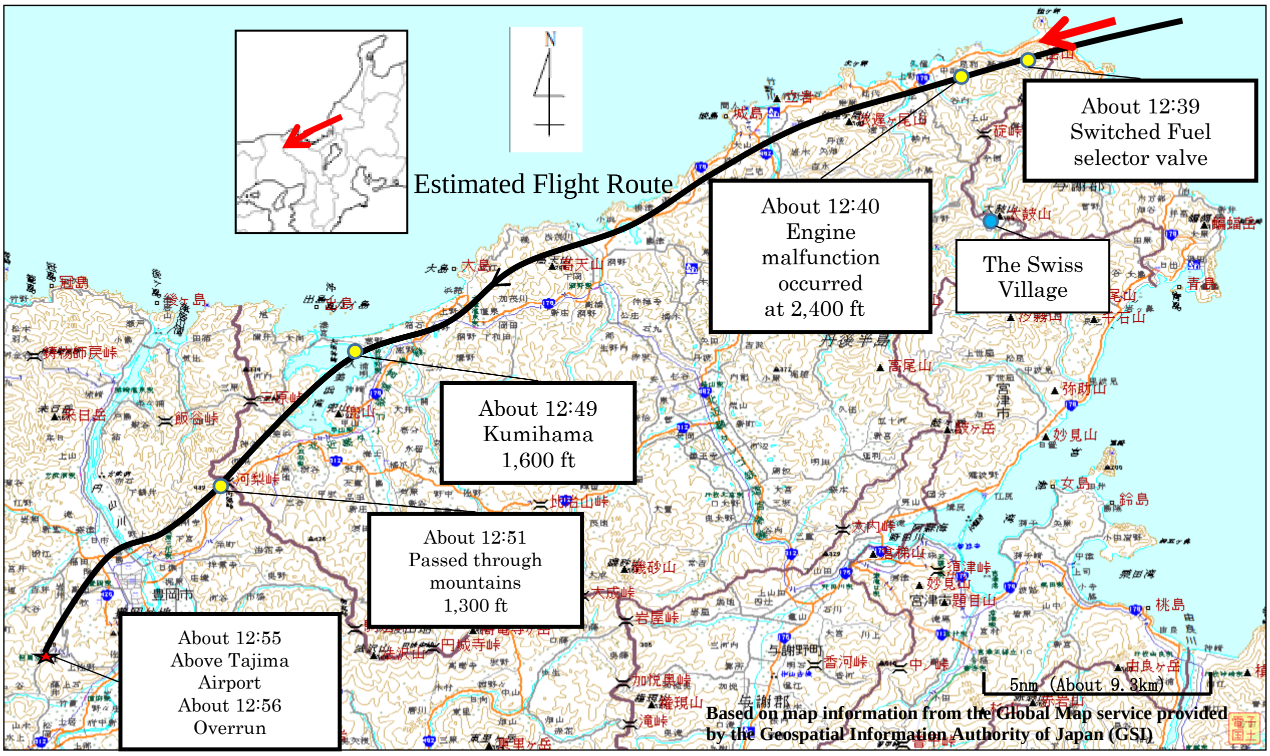
4. PROBABLE CAUSE

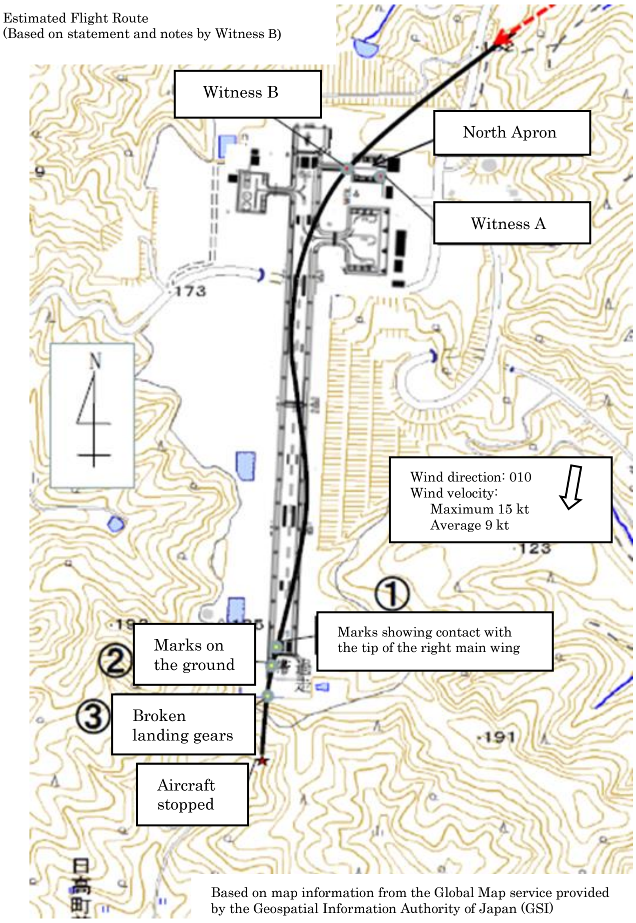
In this accident, it is highly probable that when the aircraft, which had a decreased engine power during the flight, made an emergency landing in the tailwind, it had approached at high speed without controlling engine power, and without the proper operations in place, leading to overrun the runway and falling over the cliff, causing damage to the airframe.

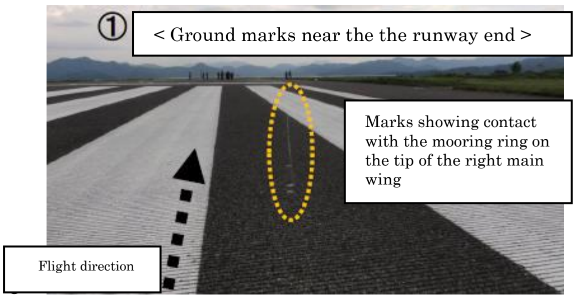
With regard to the approach of the aircraft at high speed without engine power controls in place, and without proper operations, it is highly probable that these had occurred because the knowledge and skills of the pilot were not at an appropriate level, resulting in his inability to calmly handle the situation according to the correct procedures.

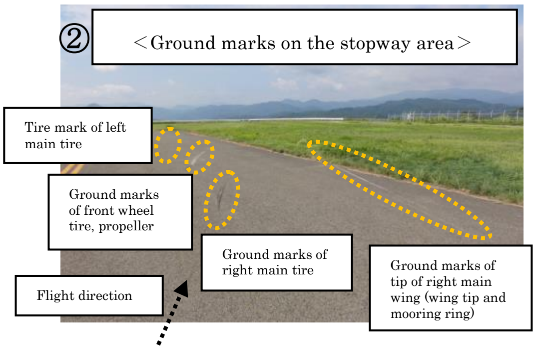
With regard to the decrease in engine power, it is somewhat likely that inappropriate use of the sealing tape led to foreign substances entering the fuel selector valve, thereby obstructing fuel supply to the engine. However, the exact cause could not be determined.

Figure 1: Estimated Flight Route









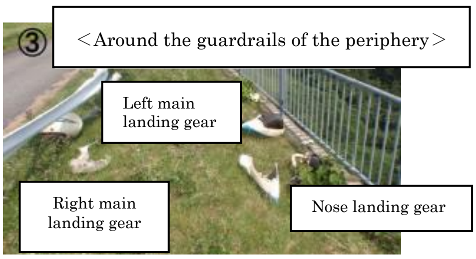


Photo: Accident Aircraft

Figure 2: Three Angle View of Gulfstream Aerospace AG-5B

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