AIRCRAFT ACCIDENT INVESTIGATION REPORT

CRASH
PRIVATELY OWNED
SCHEMPP-HIRTH ARCUS M
(MOTOR GLIDER, TWO-SEATER), JA11AM
BIEI TOWN, KAMIKAWA COUNTY, HOKKAIDO PREFECTURE
AT ABOUT 09:39 JST, OCTOBER 12, 2021

February 27, 2026
Adopted by the Japan Transport Safety Board

Chairperson	RINOIE Kenichi
Member	TAKANO Shigeru
Member	DOZONO Masato
Member	SODA Hisako
Member	TSUDA Hiroka
Member	MATSUI Yuko

1. PROCESS AND PROGRESS OF THE AIRCRAFT ACCIDENT INVESTIGATION

1.1 Summary of the Accident	On Tuesday, October 12, 2021, a privately owned Schempp-Hirth Arcus M, JA11AM, crashed while turning immediately after taking off from the Biei Glider Field, in Biei Town, Kamikawa County, Hokkaido Prefecture. There were two pilots on board the glider and both of them suffered fatal injuries. The glider was destroyed, but no fire broke out.
1.2 Outline of the Accident Investigation	On October 12, 2021, the Japan Transport Safety Board (JTSB) designated an investigator-in-charge and an investigator to investigate the accident. An accredited representative of the Federal Republic of Germany, as the State of Design and Manufacture of the glider and engine involved in the accident, participated in the investigation. Comments were not invited from the persons relevant to the cause of the accident because the two pilots on board the glider were fatally injured in this accident. Comments on the draft Final Report were invited from the Relevant State.

2. FACTUAL INFORMATION

2.1 History of the Flight

According to the statement of a witness of a fellow pilot who helped the two glider pilots to prepare for their flight with the glider, and the record (track information) of the GPS device installed in the glider and the dashcam footage from the vehicle travelling around the accident site, the history of the flight is summarized as follows: (see Figure 1).

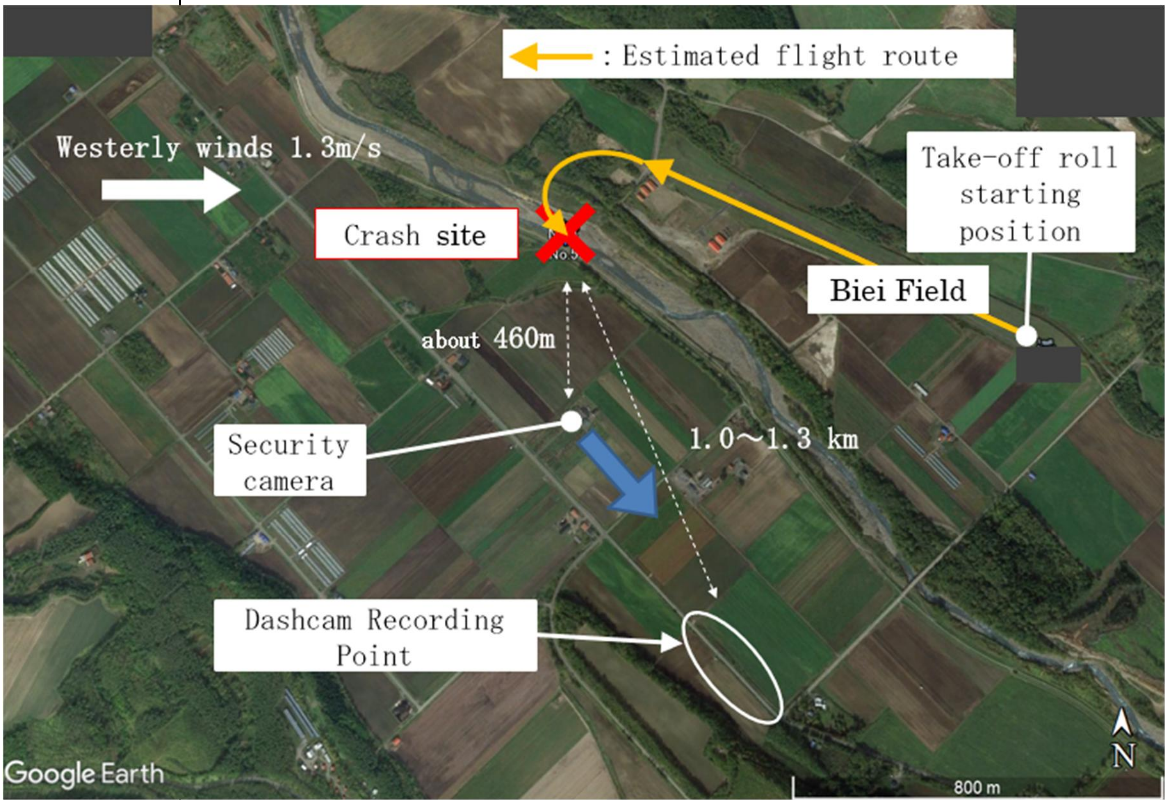

Figure 1: Locations of the Biei Glider Field, Security Camara and Dashcam Recording Point

At about 08:00 Japan Standard Time (JST: UTC+9 hr: unless otherwise stated all times are indicated in JST) on October 12, 2021, Pilot A and their colleagues began preparing for the flight in a privately owned Schempp-Hirth Arcus M, JA11AM. Pilot A moved the glider from the hangar to the apron and conducted a five-minute engine test run.

Figure 2: The Glider in Flight Preparation

Pilot A then filled the glider's fuel tanks until they were full. Once the glider had been towed to the take-off roll start position, Pilot A took the front seat and Pilot B took the rear seat. The engine was started, warmed up, and its operation was confirmed.

At about 09:38, the glider took off from the southeast end of the Glider Field toward north-west by self-launching*1 for a leisure flight. The glider passed near the northwest end of the runway and began to turn left as it climbed, but the engine sound suddenly stopped as the glider made a turn to about 90°. Normally, in case of engine shut down in flight, the aircraft must descend to maintain the flying airspeed, however, the glider continued the left turn with no sign of descending even after the engine sound stopped. The glider then entered a left spin at about 100 m AGL, nosediving. The spin stopped after one turn, and when the nose started to be slightly raised, the glider crashed into the Biei River (see Figure 3).

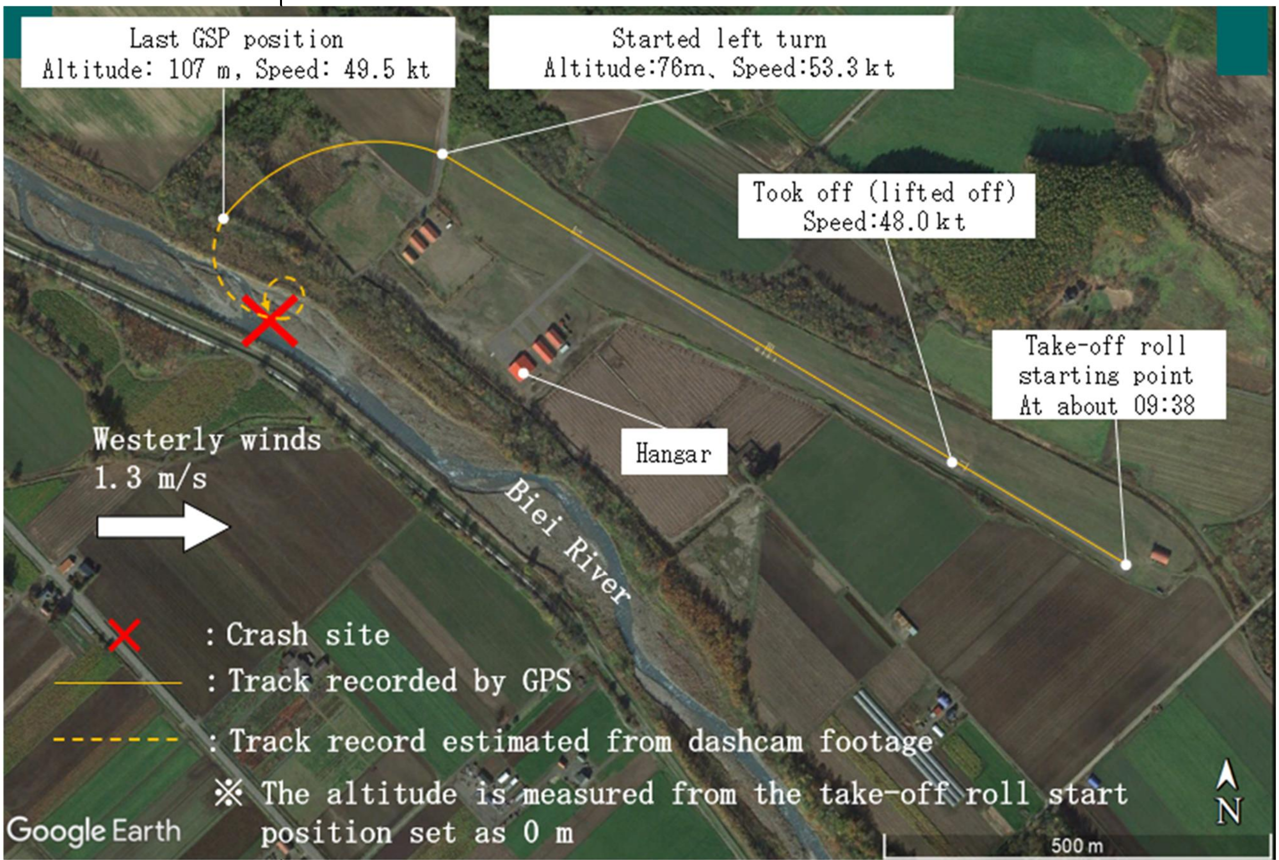

Figure 3: Estimated Flight Route

The witness at the Glider Field arrived at the riverbed where the glider had crashed and found it had crashed into the Biei River. Pilot A and Pilot B were unconscious, and the glider's engine had stopped. The arriving fire brigade rushed Pilot A and Pilot B to hospital, where they were pronounced dead.

The witness did not observe any signs of ill health in Pilot A or Pilot B when exchanging greetings with them on the day of the accident.

The flight on the day of the accident was the first time that Pilot A had flown the glider from the front seat.

The accident occurred at about 09:39 on October 12, 2021, about 750 m west of the Biei Glider Field in Biei Town, Kamikawa County, Hokkaido Prefecture (43° 31' 53 " N, 142° 33' 21" E).

*1 “Self-launching” means that a motor glider launches using equipped own engine.

2.2 Injuries to Persons	Pilot A sustained fatal injuries (cerebral contusion and fracture of the lower right tibia). Pilot B sustained fatal injuries (cerebral contusion).
2.3 Damage to the Glider	(1) Extent of damage: Destroyed (2) Damage to parts of the Glider (see Figure 4) ・Cockpit: The canopy was damaged, front and rear seat buckets were damaged, and the front seat flap lever was bent and stuck. ・Fuselage: Broken in the center, and its lower surface was broken from the nose to near the main landing gear. ・Wings: The underside of the left wing was damaged and the tip of the right wing was broken. (No damage was found at the wing-fuselage joint.) ・Power plant: Collapsed toward the tail ※ The actuator that extends and retracts the power plant was in the fully extended position (engine operating position) ・Propeller: All blades (two blades) had dents almost in the center on the rear surface. ・Main landing gear: Steel tube (strut) was broken and buckled. No failure was found in the control system. And there were no abnormal combustion and internal destruction in the engine, but the continuity checks on the airframe side of the engine ignition system (between the wiring connectors and the engine control unit) revealed a disconnection.

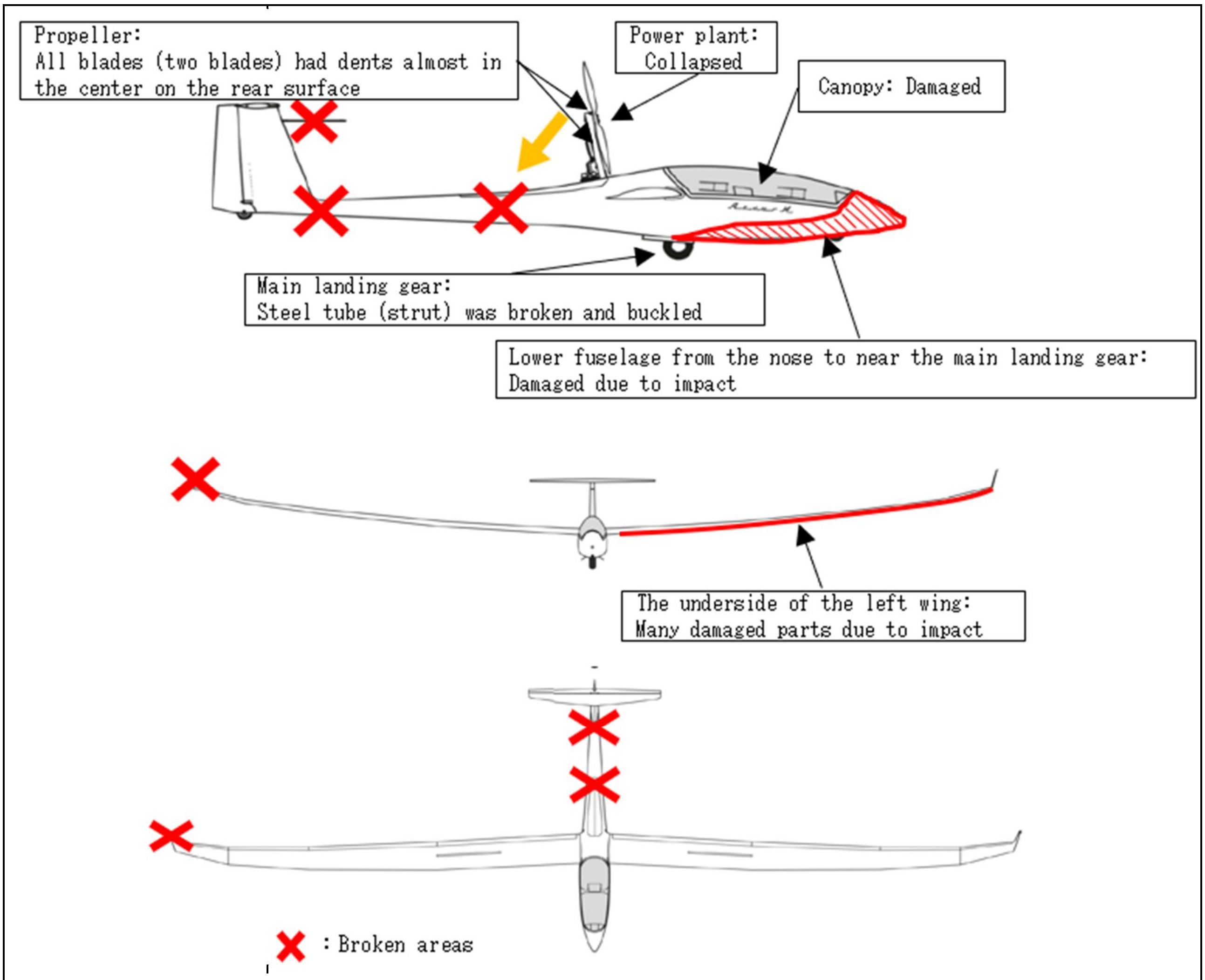

Figure 4: Damage to the Glider

2.4 Personnel Information	(1) Pilot A: Age 69 Private pilot certificate (Glider) August 27, 1974 Pilot competency assessment Expiration date of piloting capable period: March 16, 2022 Type rating for Motor Glider August 27, 1974 Class 2 aviation medical certificate Validity: February 6, 2022 Total flight time 3,320 hours 54 minutes Total flight time on the type of aircraft (From November 21, 2017) 465 hours 35 minutes Total flight time in the last 30 days 4 hours 59 minutes (2) Pilot B: Age 68 Private pilot certificate (Glider without Tow Hook) February 13, 2014 Class 2 aviation medical certificate Validity: June 12, 2022 Total flight time 3,758 hours 18 minutes Total flight time on the type of aircraft (From November 14, 2016) 390 hours 55 minutes Total flight time in the last 30 days 20 hours 35 minutes
2.5 Glider	(1) Type: Schempp-Hirth Arcus M,

Information	Serial number: 229, Date of manufacture: January 25, 2021 Airworthiness Certificate: No. 2021-38-09 Validity: September 18, 2022 Total flight time 15 hours 25 minutes (2) Engine Type: Solo type 2625-02i (Two-stroke-engine) Serial number: 479/288, Date of manufacture: September 20, 2020 Total time in service 2 hours 44 minutes At the time of the accident, the weight of the glider was estimated to be approximately 750 kg and the position of its center of gravity was estimated to be approximately 242 mm; both were within the allowable range (maximum take-off weight: 850 kg; allowable center-of-gravity range: 95 to 290 mm).
2.6 Meteorological Information	According to the photos of the accident site taken after the accident and the statement of the witness, it was clear in the Glider Field at the time of the accident, and according to the statement of the pilot of the glider who took off from the Glider Field before the accident, the atmospheric conditions after the take-off were calm. Weather observations at Biei Regional Meteorological Observatory of the Asahikawa Local Observatory, located about 7 km northwest of the accident site, around the time of the accident were as follows 09:40 Wind direction: West, Wind velocity: 1.3 m/s, Temperature: 13.0 °C
2.7 Additional Information	(1) Dashcam Footage A dashcam installed in a vehicle travelling near the accident site recorded about four seconds of events immediately before the crash, from the glider's take-off and then spinning into a nosedive. (2) Security Camera Recordings The security camera installed in the building near the accident site recorded the sound of the glider's engine in flight, and an impact sound about 10 seconds after the engine sound stopped. (3) GPS Device Information The flying airspeed recorded by the GPS device of the glider*2 was accelerated to the climb speed (51 kt) specified in the glider's flight manual (hereinafter referred to as the "Flight Manual") about 11 seconds after the glider took off. After that, the glider maintained generally in the range of 50 to 52 kt, centered on the relevant climb speed, with no particular change until the record was stopped (41 seconds after the take-off). The flight altitude (altitude is measured from the take-off roll start position set as 0 m) climbed at a certain climb rate after the take-off of the glider. The altitude when the glider started the left turn (29 seconds after the take-off) was recorded as 76 m, 106 m 39 seconds after the take-off, and lastly 107 m 2 seconds after that, the record was stopped (see Figure 5).

*2 The flying airspeed recorded by the GPS device is the ground speed (km/h). For comparison with the stall speed specified in the Flight Manual, the data read from the GPS device was converted to knots (kt), corrected for the temperature and altitude at the time of the accident, and the value converted to indicated airspeed (IAS) was used.

	According to the analysis of the GPS device information, the average bank angle during the left turn was about 24°. (4) Take-off Procedures of the Glider According to the Flight Manual, it is recommended that after take-off, the aircraft should climb at a flying airspeed of 51 kt with the flap setting of "+2". In addition, according to the Flight Manual, the stall speed of the glider at the time of the accident was 46 kt with wings-level flight, and 48 knots at a bank angle of 24°. When the glider's flap lever positions were checked after the crash, both the front and rear seats were found to be at "+2" that is used for climb after take-off.(However, in order to prevent the scattering and loss of aircraft components, the aircraft was moved from the crash site prior to the commencement of the initial investigation; therefore, the flap lever positions at the time of the crash were not directly confirmed.). (5) Aerodynamic Performances of Motor Gliders with Retractable Engine (Flight Characteristics) "The Glider Flying Handbook (FAA-H-8083-13, 2013)" published by the FAA (Federal Aviation Administration) states the following actions to be taken in the event of engine failure during the climb after take-off of motor gliders with a top-mounted retractable engine just like the glider. *Regardless of the type of engine failure, the pilot's first responsibility is to maintain flying airspeed and adequate control of the glider. If power failure occurs, lower the nose as necessary to maintain adequate airspeed. Pilots flying self-launching gliders with a pod-mounted external engine above the fuselage need to lower the nose much more aggressively in the event of total power loss than those with an engine mounted in the nose. In the former, the thrust of the engine during full power operations tends to provide a nose-down pitching moment. If power fails, the nose-down pitching moment disappears and is replaced by a nose-up pitching moment due to the substantial parasite drag of the engine pod high above the longitudinal axis of the fuselage.* *Considerable forward motion on the control stick may be required to maintain flying airspeed. If altitude is low, there is not enough time to stow the engine and reduce the drag that it creates. Land the glider with the engine extended. Glide ratio in this configuration is poor due to the drag of the extended engine and propeller.* (Omitted) *If the power failure occurs during launch or climb, time to maneuver may be limited. Concentrate on flying the glider and selecting a suitable landing area. Remember that the high drag configuration of the glider may limit the distance of the glide without power. Keep turns to a minimum and land the glider as safely as possible.* (Omitted)

	According to a pilot who had flown with Pilot A and Pilot B at the Glider Field and had many years of experience of flying the same type of glider in this type of glider, rudder control becomes less effective between the time the engine is shut down in flight and the time it is retracted into the fuselage, however, this does not cause any concern regarding control. The Flight Manual states that on stalling, the vibration in the controls and in the cockpit becomes more pronounced, with controls getting less effective (spongy). In particular, when a stall occurs with the power plant extended, the vibrations in the control stick become more intense by the air current disturbance caused by the propeller. (6) Procedures for Spin Recovery The Flight Manual describes the spin recovery procedures as follows: *3.5 Spin recovery* (Omitted) *With the center of gravity in the mid to rearward position, a steady spinning motion is possible.After having applied the standard recovery method, the Arcus M will stop rotating after about ½ to ¾ turn, depending on the flap position.* *The loss of height - from the point at which recovery is initiated to the point at which horizontal flight is first regained - can be up to 250 m (590 ft) and the recovery speeds are between 130 and 210 km/h (70 – 113 kts, 81 – 130 mph).* (Omitted) (7) Procedures in the Event of the Time of Engine Failure According to the Flight Manual, the procedures in the event of engine failure are as follows: 1. *Engine failure on take-off* (Excerpt) *Ease the control stick forward immediately to obtain sufficient airspeed.* (Omitted) *If the safety of the selected landing procedure is improved, the propeller should at least be partly retracted – regardless of the position of the prop blades. Even with partly retracted engine the glide ratio will improve considerably.* (Omitted) *WARNING:* *With power plant fully extended, the rate of descend increases to a value of about 2.25 m/s (443 fpm) at 105 km/h (57 kt) and the L/D deteriorates to about 13 : 1!* In addition, another chapter in the Flight Manual states that with the power plant retracted, the glide ratio results in 49 : 1. 2. *Engine failure in flight* *Should the engine fail in flight, check* • *fuel quantity* • *fuel shut-off valve (OPEN?)*

Should it be impossible to restart the engine, land with the propeller retracted.

(Omitted)

3. *Failure of the electric power supply for the engine*

(Omitted)

The electric power for the engine control and fuel injection will then be only provided by the engine battery. As soon as the engine battery capacity is depleted the engine will stop running and the retraction of the engine is no more possible. (Page No.:appr.3.7.4)

(Omitted)

(8) Engine Data

With the aid of the Federal Bureau of Aircraft Accidents Investigation of the Federal Republic of Germany(hereinafter referred to as the "BFU"), the State of Design and Manufacture of the glider, , the data recorded on the glider's engine control unit was extracted and analyzed.

As shown in Figure 5, the unit recorded the engine RPM, the opening degree of the throttle valve and others. According to the data analysis results, after the glider started the take-off, the engine had been normally operating (engine RPM: about 6,200 rpm). However, after the engine RPM suddenly dropped from 4,949 rpm (3.4 seconds before data recording stopped) to 1,595 rpm (2.6 seconds before data recording stopped), the opening degree of the throttle valve rapidly increased (increased from 62% to 89% 2.1 seconds before data recording stopped). Besides it was recorded that the engine RPM dropped to 443 rpm (1.9 seconds before data recording stopped).

Furthermore, it appears that the engine data recording and GPS recording stopped at the same time.

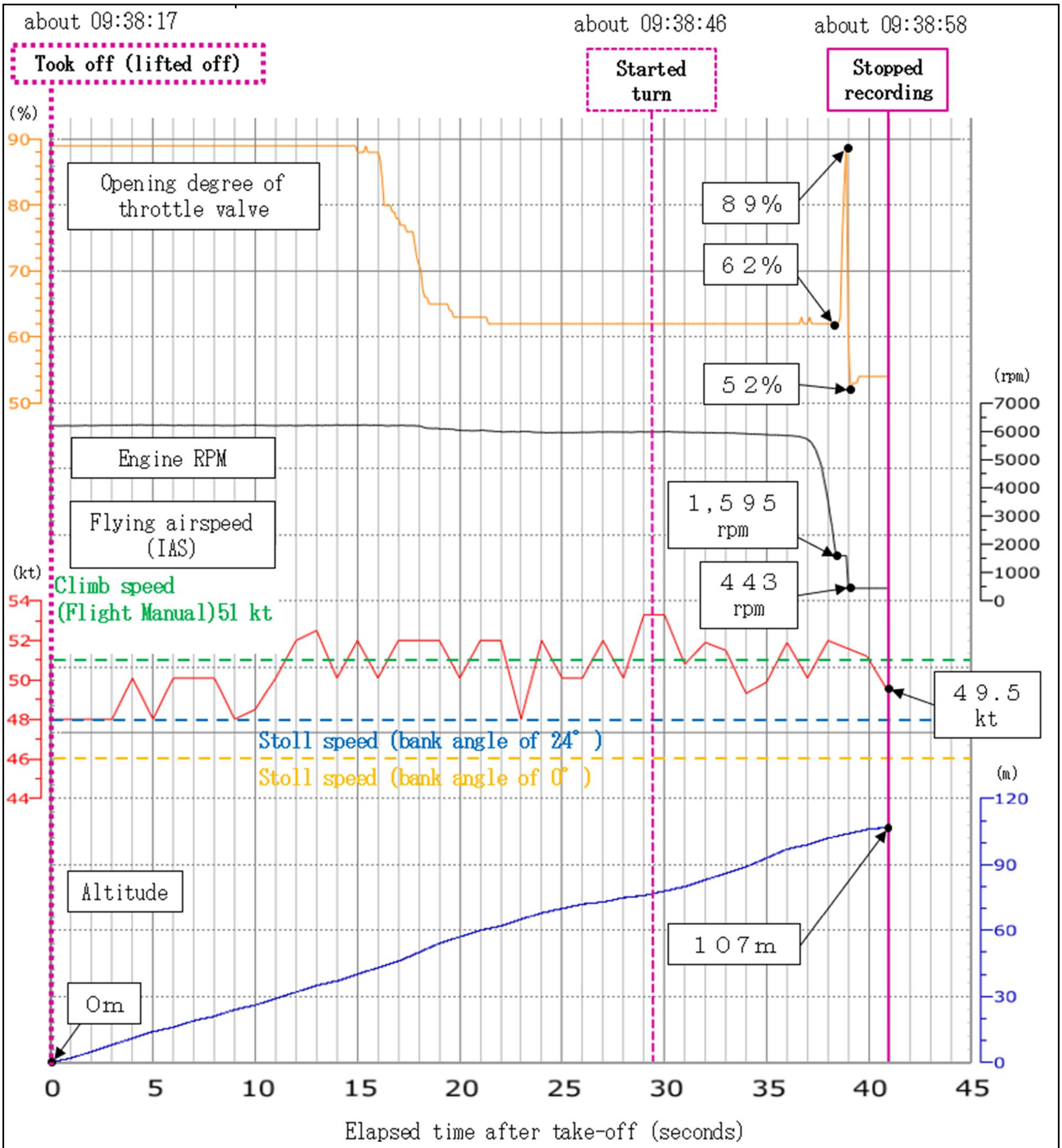

Figure 5: Changes in Flight Altitude, Flying Airspeed, Engine RPM, and Throttle Valve (for 41 seconds from take-off to the stop of recording)

3.ANALYSIS

(1) Situations before the Glider Hit the Ground (Video Analysis)

The JTSB concludes that the following situation is more likely to have occurred, based on an analysis of the time recorded on the GPS device, the dashcam footage and the audio recorded by the security camera.

At about 09:38:46	The glider started the first turn (climbing left turn)
09:38:56	The engine sound stopped
09:38:58	The last recorded data on the GPS device

(Flight altitude 107 m, Speed 50.5 kt)

09:38:59 The left wing of the glider was rapidly lowered and a spin occurred

09:39:05 The spin stopped

09:39:06 The glider hit the ground

The dashcam footage showed that after the take-off, the glider started the first turn (climbing left turn), and as the nose turned south-west, the left wing of the glider was rapidly lowered, a left spinning occurred, and the glider nosedived.

In addition, according to the statement of the witness, the glider did not have a nose down attitude until just before the left wing was lowered after the engine sound stopped.

It is probable that the flying airspeed dropped rapidly, the glider stalled and entered a spin because the nose remained stuck without lowering after the engine sound stopped. If the engine is operating normally, it is unlikely that the airspeed will drop rapidly, and it is also unlikely that the pilot would have deliberately reduced the output of the engine as the glider was climbing after the self-launch at the time the engine sound stopped. Therefore, it is more likely that the engine sound ceased due to an unintended drop in engine RPM.

On the other hand, the result of the glider examination revealed that the actuator for extending and retracting the power plant was in the fully extended position, and there were dents on the rear surface of the propeller blade, possibly resulting from a collision with the fuselage. Therefore, it is probable that the power plant of the glider had not been retracted into the glider's fuselage but remained in the same extended position as when the engine was started, until the glider crashed into the ground.

For the reasons given above, it is more likely that the engine output was decreased in line with a drop in engine RPM when the glider made a left turn of about 90° while climbing after the self-launch, and that the glider then continued to turn without lowering the nose, causing a rapid loss of speed, and the glider stalled and entered a spin. And the spin stopped about one second before the glider crashed into the ground, but the glider most likely hit the ground surface with its nose slightly down and its wings in an almost horizontal position as unable to reduce its rate of descent (see Figure 6). At this point it is more likely that the nose section collided with the rock in the river, causing significant damage to the glider.

The reason that the spin stopped is probably because the pilot had applied a spin recovery method, since the Flight Manual describes that with the standard recovery, the glider will stop rotating after about ½ to ¾ turn, and even in the footage, the glider's spin generally stopped after one turn. As the spin of the glider immediately before the accident was a left turn, the right rudder should be applied for the spin recovery method. Therefore, the fracture of Pilot A's right lower tibia likely occurred when the glider hit the ground and the nose section was damaged while Pilot A was applying the right rudder during the recovery procedures. However, the details of the spin recovery procedures could not be determined, as both pilots sustained fatal injuries.

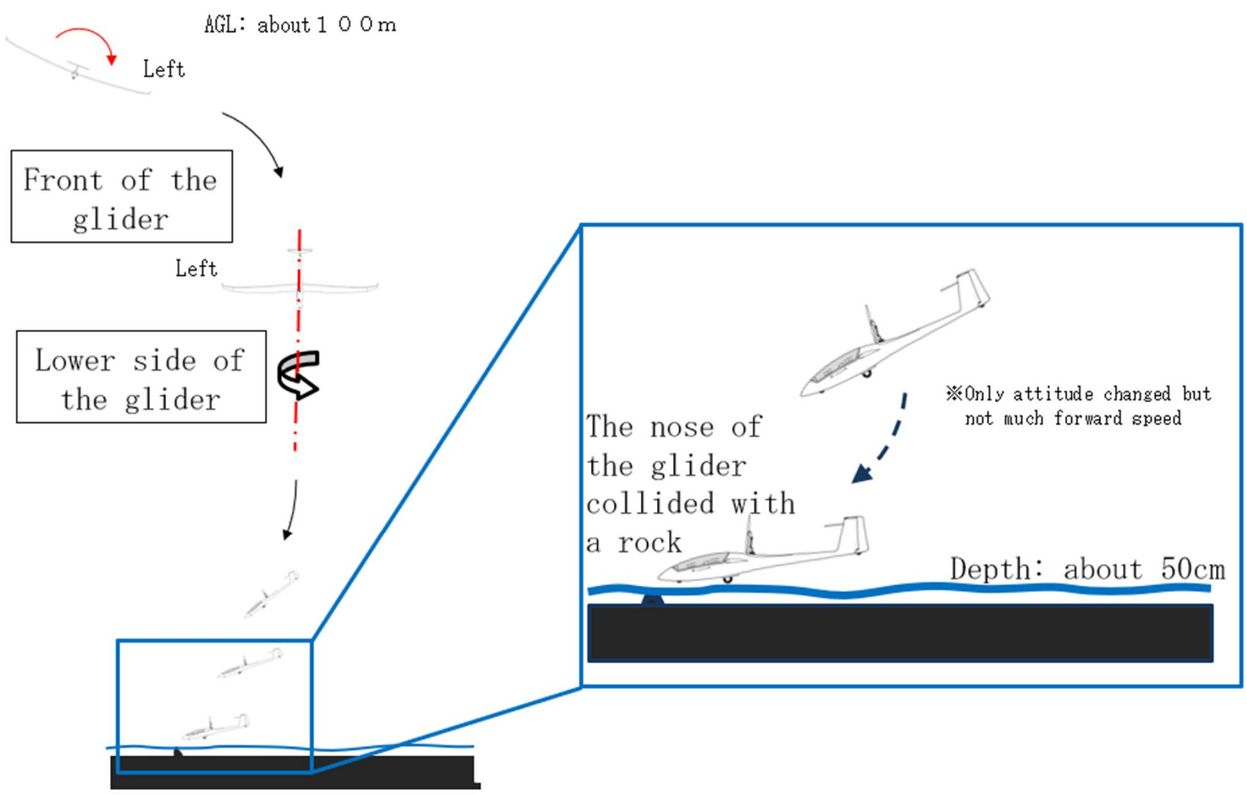

Figure 6: The Glider Movement after Entering a Spin

(2) About the Glider Entering a Spin

After analyzing the dashcam and security camera footage, the JTSB concludes that the nose began to drop about four seconds after the engine sound stopped (drop in engine power), and the glider had entered a spin.

The reason why the glider's nose did not drop after the drop in engine power is likely because there was a possibility of no time for the pilot to respond by dropping the nose between the pilot's recognizing the drop in engine power and the glider starting to stall, or likely because the elevator became less effective due to the nose-down moment caused by the drop in engine power, and the turbulent airflow produced by the propeller blades, therefore, despite the pilot's nose-down operation, the glider did not respond as intended.

On the other hand, the reason why the glider continued to turn left even after the drop in engine power is likely because the glider continued to turn left in an attempt to land at the Glider Field, since at about 100 m AGL, at which the glider's engine power drop probably occurred, the glider would be able to fly about 1,300 m even with the power plant extended. However, this could not be determined as all persons on board were fatally injured.

If the engine failure occurs after take-off, the motor glider with a retractable engine will not only lose propeller thrust but will also tend to lose the flying airspeed rapidly due to the high drag produced by the stopped engine and propeller. Especially, during a turn, the greater the bank angle, the faster the stall speed, therefore, a stall condition can be reached at a faster speed than during straight level flight.

Given the above, it is more likely that, while the flying airspeed decreased rapidly, the glider's nose did not drop and the glider continued to turn, resulting in immediate stalling into a spin.

As stated in the "Glider Flying Handbook", in the event of engine failure during self-launching of the motor glider with a retractable engine, it is desirable that pilots should promptly lower the nose to prevent a rapid drop in airspeed. They should also perform the necessary procedures to maintain sufficient airspeed to avoid stalling, while restricting the amount of turn to a minimum*3.

In addition, when a motor glider with a retractable engine takes off by self-launching, it is desirable that the first turn shall be commenced by assuming engine failure in a climb and after gaining sufficient altitude to recover from a stall or spin.

(3) About Drop in Engine Power

The JTSB concludes as follows:

Based on the results of the analysis of the engine data recorded prior to the accident, the engine manufacturer and the engine control unit manufacturer presented the viewpoint that the drop in engine RPM was caused by an engine stalling＊4. According to this viewpoint, when the engine RPM dropped to 1,595 rpm, it is possible that the pilot's operation of the throttle lever caused the throttle valve to operate abruptly (the opening degree increased from 62% to 89%), resulting in an engine stalling and a further drop in engine RPM to 443 rpm (in general, in a two-cycle engine, abrupt throttle operation instantaneously increases the airflow rate, making it difficult to secure an appropriate fuel-air mixture in the combustion chamber and ultimately leading to a stall) (see Figure 5).

In addition, prior to the drop in engine RPM due to the engine stalling, the engine RPM rapidly decreased from approximately 6,200 rpm to 1,595 rpm 2.6 seconds before the data recording stopped. However, as no damage was found inside the engine of the aircraft after the accident, it is considered that this decrease was not attributable to the engine's internal mechanisms. Nevertheless, since the engine installed in the aircraft had been in use for only 2 hours and 44 minutes after manufacture, the possibility of an initial failure cannot be ruled out. The cause of the rapid drop in engine RPM to 1,595 rpm could not be determined.

It is considered that the engine stalled at approximately 09:38:56, about two seconds before the GPS device stopped recording.

(4) About the Possibility that the Power Supply has been Cut off

As described in the section entitled "Failure of the electric power supply for the engine" in the Flight Manual, the electric power is necessary for engine control and fuel injection.

When the battery-powered engine control unit and GPS device recordings were interrupted, it is possible that the electric power supply to the engine cut off, resulting in the engine shutting down.

However, upon receiving notification of this accident, eyewitness interviews were conducted first, and after the glider's crash, 30 hours passed before the examination of the glider began, in addition, it took a further 24 hours until the glider's battery was removed, resulting in an inability to confirm the battery charging status. Besides, the electrical continuity checks in the engine system revealed no damage to the battery or electric system, except for a break in the ignition system. Regarding this break in the ignition system, it cannot be ruled out that the cable was broken when the glider was moved from the crash site; thus, the time of the break in the ignition

*3 It is recommended in the "Flight Instructor Manual AEROPLANE" (ISSUE2:December 2006) published by the Commonwealth of Australia, Civil Aviation Safety Authority (CASA) as the actions to be taken in the event of an engine failure of the single-engine propeller aeroplane after take-off; in order to prevent increase in stalling speed due to turn, the aeroplane land within 30° either side; at the time of choice of landing area, the amount of turn should be restricted to the minimum dictated by obstacles ahead (pp. 39-40), which can be a guide for turning in the event of an engine failure immediately after take-off of self-launching gliders.

system could not be determined.

Consequently, the reason why the engine control unit and GPS device stopped recording could not be identified.

(5) The Pilot Flying the Glider at the Time of the Accident

The glider can be controlled from both the front and rear seats. The two pilots on board were qualified to fly the glider, and on the accident flight, it is possible that both of Pilot A and Pilot B were flying the glider at the time of the accident, therefore the pilot flying the glider at the time of the accident could not be identified.

4. PROBABLE CAUSES

The JTSB concludes that the probable cause of this accident was that it is more likely that when the glider, which is a motor glider with a retractable engine, made a climbing left turn after take-off using the engine start system, the engine shut down, and even after this, the glider continued to turn without its nose down, resulting in a rapid loss of speed and causing the glider to stall and enter a spin, which led to the crash.

5. SAFETY ACTIONS

As shown in the analysis, when a motor glider with a retractable engine takes off using the engine, the following must be considered, assuming the possibility of engine failure.

(1) In the event of engine failure during the climb after self-launching, the pilot needs to lower the nose and prevent a rapid loss of speed to maintain adequate airspeed, and the amount of turn should be restricted to minimum.

(2) Assuming engine failure during a climb after self-launching, the first turn should be initiated after sufficient altitude has been gained to enable recovery from a stall or spin as much as possible.