AI2023-6

AIRCRAFT SERIOUS INCIDENT
INVESTIGATION REPORT

Asahi Airlines Co., Ltd.
J A 8 0 A P

September 28, 2023

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 prevent future accidents and incidents. It is not the purpose of the investigation to apportion blame or liability.

TAKEDA Nobuo
Chairperson
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.

《Reference》

The terms used to describe the results of the analysis in "3. ANALYSIS" of this report are as follows.

i) In case of being able to determine, the term "certain" or "certainly" is used.
ii) In case of being unable to determine but being almost certain, the term "highly probable" or "most likely" is used.
iii) In case of higher possibility, the term "probable" or "more likely" is used.
iv) In a case that there is a possibility, the term "likely" or "possible" is used.

AIRCRAFT SERIOUS INCIDENT INVESTIGATION REPORT

CASE WHERE ANY OTHER PART OF THE LANDING GEARS OF THE AIRCRAFT WERE DRAGGED DURING LANDING

ASAHI AIRLINES CO., LTD.

CESSNA 172S, JA80AP

YAO AIRPORT, YAO CITY, OSAKA PREFECTURE

AT ABOUT 11:58 JST, OCTOBER 18, 2022

September 8, 2023
Adopted by the Japan Transport Safety Board
Chairperson TAKEDA Nobuo
Member SHIMAMURA Atsushi
Member MARUI Yuichi
Member SODA Hisako
Member NAKANISHI Miwa
Member TSUDA Hiroka

1. PROCESS AND PROGRESS OF THE SERIOUS INCIDENT INVESTIGATION

1.1 Summary of the Serious Incident	On Tuesday, October 18, 2022, a Cessna 172S, JA80AP, operated by Asahi Airlines Co., Ltd., executed a go-around due to an instable attitude during the continuous touch-and-go training for the trainee, with a captain as an instructor on board, and the underside of the aft fuselage contacted on the surface of Runway27 at Yao Airport. On board the aircraft were the instructor and the trainee, who were not injured.
1.2 Outline of the Serious Incident Investigation	The occurrence covered by this report falls under the category of "Case where any other part of the landing gears of the aircraft were dragged during landing" as stipulated in item (iii), Article 166-4 of the Ordinance for Enforcement of the Civil Aeronautics Act of Japan (Ordinance of Ministry of Transport No. 56 of 1952), and is classified as a serious incident. On October 21, 2022, the Japan Transport Safety Board (JTSB) designated an investigator-in-charge and an investigator to investigate the serious incident. Although the serious incident was notified to the United States of America as the State of Design and Manufacture of the aircraft involved in the serious incident, the State did not designate its accredited representative, etc.

	Comments on the draft Final Report were invited from the parties relevant to the cause of the serious incident and the Relevant State.

2. FACTUAL INFORMATION

2.1 History of the Flight	According to the statements of the captain, who was the instructor (hereinafter referred to as "the Instructor"), the trainees and the air traffic controller (hereinafter referred to as "Yao Tower") of the Yao Airport Traffic Control Tower, who was on duty at the time of the serious incident, the history of the flight is summarized below. The trainee, who was undergoing training to obtain a commercial pilot certificate, was not good at crosswind landings, thus offered the following training plan in the briefing with the Instructor before the training. In addition, the maximum value of the crosswind component that the trainee had ever experienced when landing on the runway was 5 kt. ・On that day, a right crosswind component to Runway 27 was about 10 kt, so this should be taken as an opportunity to practice the crosswind landing, and a larger number of landings (10 times) should be planned. ・Of the ten planned landings, the first five will be normal landings, and in order to simulate a landing at the time of inoperative engines, the last five will be the power-off accuracy approaches, in which the engine power is set to idle on the downwind leg to approaches. Taking the following into consideration, the Instructor agreed to conduct the training according to the plan provided by the trainee. ・The crosswind component was about 10 kt, but it was less than the crosswind limit value (15 kt) in the touch-and-go training specified in the STP: Standard Training Procedure, which the company established as the standard operating procedure for conducting training. ・During the winter season when the trainee will take the practical examination, the prevailing wind direction[*1] is the north wind, so it would be possible to conduct the landing training in an environment similar to that of the practical examination. On October 18, 2022, at 10:39 (JST: UTC+9h, unless otherwise stated all times are indicated in JST on a 24-hour clock), the aircraft took off from Yao Airport for training, with the Instructor sitting in the right pilot seat and the trainee sitting in the left pilot seat, and after conducting flight operations in the training area, from around 11:00, it started the continuous touch-and-go training using Runway 27 at Yao Airport. Of the five power-off accuracy approaches planned in the last half of the continuous touch-and-go training, up to the fourth, the aircraft

[*1] "Prevailing wind direction" refers to the wind direction most frequently observed at a point monthly or through the year.

approached at higher landing approach path angle (hereinafter referred to as “the Path Angle”) (the aircraft was off the original path upward at the time of heading for the runway), and in two of those approaches, the aircraft executed a go-around at an altitude of about 200 ft according to the judgement by the trainee. In addition, in two times of landed, the Instructor assisted the trainee in piloting (see 2.7 (4) described later).

The trainee made corrections in the fifth power-off accuracy approach in the last half so as to prevent the Path Angle from becoming higher, contrary to this, the Path Angle became too low, therefore, the trainee made corrections on the Path Angle by flying on some undershooting path (flying inside of the base leg) (see Figure 1).

Figure 1: Estimated Flight Route

At this point the Instructor was assisting the trainee with the controls. This landing was the final landing according to the plan, but the Instructor felt no pressure to complete the training with this landing.

The trainee made the power-off accuracy approach at the lowest Path Angle ever experienced and was realized that it would not reach the aiming point mark, which is the touchdown point specified in the STP. However, since it was the final landing, the trainee liked to land oneself somehow, in addition, as the Instructor was assisting the trainee, the trainee thought the landing might be possible even in this situation with the Instructor’s skill, hesitated to execute a go-around, and continued the landing approach, leaving the go-around decision to the Instructor.

As the Path Angle of the aircraft was low and the trainee was attempting to pitch the nose up, the Instructor continued to assist by intermittently pushing the control column forward (forward pressure) intermittently from the second half of the base leg.

When the aircraft passed the runway threshold, the indication of the Precision Approach Path Indicator (PAPI) showed four reds, indicating a low Path Angle. Therefore, the Instructor judged that it would not reach the aiming point marked as the touchdown point. However, the Instructor continued the approach, as believing that even though the touchdown point had been shifted, it would be effective for the trainee, who was struggling to make a crosswind landing, to experience the touchdown and know where to touch down at that Path Angle.

When the flare was initiated, the sink rate was low and the airplane went into a floating state, as it did temporarily in level flight, but the Instructor continued to maintain floating, thinking that touchdown would be possible even after floating.

The Instructor initiated the touchdown procedure when he could no longer maintain floating, but the sink rate increased rapidly at an altitude

	of approx. 2 to 3 meters above the ground, and the pitch angle of the aircraft became greater than normal, so the Instructor himself pushed the throttle forward to execute a go-around. The Instructor did not call out “I have” or “GO-AROUND”. Even after the go-around, the aircraft did not stop sinking, and its main landing gear touched the ground before climbing, and then it climbed. At this point, the Instructor recognized that the main gears had touched down, but did not recognize a tail strike. The go-around position was short of the aiming point marking and to the left (on the south side) of the runway centerline. The trainee did not recall the altitude, but heard the sound, “pang, gong” coming from the rear of the aircraft as if it had hit something as the Instructor executed a go-around prior to touchdown. At that time, Yao Tower was in charge of the tower control position for the five continuous touch-and-go trainings in the second half. The wind direction at that time was 350° to 010°, and the wind velocity was 8 to 13 kt, and the north wind became stronger with time. Yao Tower had the impression that the pilot of the aircraft was having difficulty controlling the aircraft, as the aircraft was flying a little wobbly on the base leg, and executed a go-around several times. When the serious incident occurred, the aircraft was approaching slightly inward from the previous flight path and was in a situation where it was not clear whether to align with Runway 31 or Runway 27. Yao Tower has thought that the aircraft might execute a go-around as it was flying wobbly until just before touchdown. After the go-around, the trainee took over the controls, and the aircraft made a normal landing at 12:04. Post-flight inspection of the aircraft revealed that the skin abrasion seen on the underside of the aft fuselage and the tie-down ring[*2] was fractured at the root and lost. In addition, this tie-down ring was found on the Runway 27 aiming point marking, and abrasion marks were found on the nearby runway surface, which appeared to have been caused by contact with the aircraft. The serious incident occurred on Runway 27 at Yao Airport (34°35’46” N, 135°36’09” E) at about 11:58 on October 18 2022.
2.2 Injuries to Persons	None
2.3 Damage to the Aircraft	(1) Extent of damage of the aircraft: Minor damage (2) Damage to the aircraft (see Figure 2) Lower sides of the rudder: Cracks in the outer skin (Length: Left 3.0 cm, Right 4.5 cm) Underside of the aft fuselage: Abrasion mark of 3.9 cm in length and 2.8 cm in width

[*2] “Tie-down ring” means a ring on the airframe side and is used to tie-down the airframe to the spot with a rope or the like when the aircraft parks at the spot at the time of severe winds.

Underside of the rudder:

Abrasion mark of 4.5 cm in length and 2.8 cm in width

Tie-down ring: Fractured at its root

Left side: Abrasion mark of 3.2 cm in length, 1.1 cm in height

Right side: Abrasion mark of 2.0 cm in length, 0.3 cm in height

The abrasion mark on the left side was roughly scraped off, while that on the right side was just peeled off the paint.

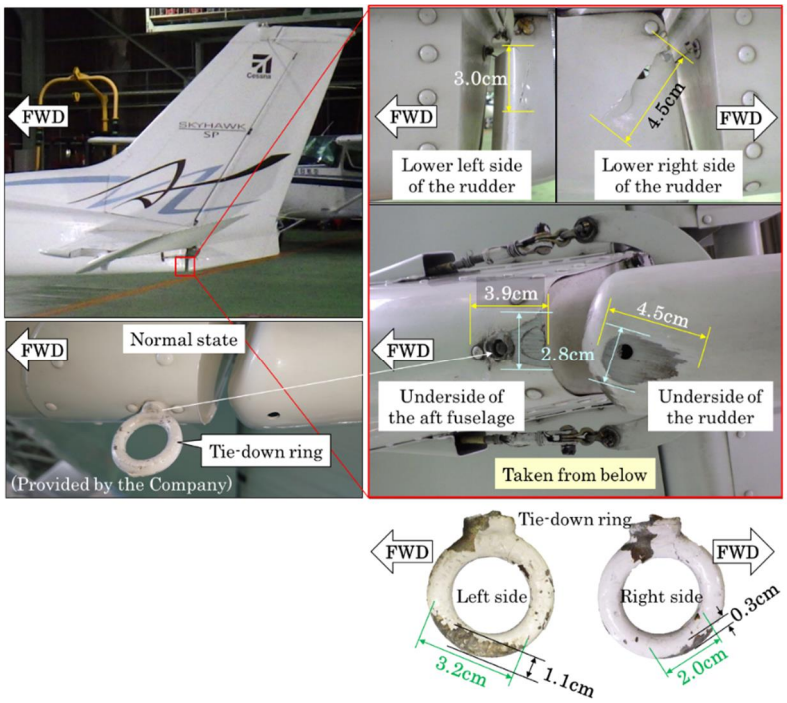


Figure 2: Damage to the Aircraft

(3) Condition of the Runway Surface

The abrasion marks on the runway surface were found at about 280 m west of the threshold of Runway 27 and about 8 m to the left (the south side) of the runway centerline. And the tie-down ring of the aircraft was found about 47 m forward (west side) of the abrasion marks, on the aiming point marking about 17 m to the left of the runway centerline (see Figure 3 and Figure 4).

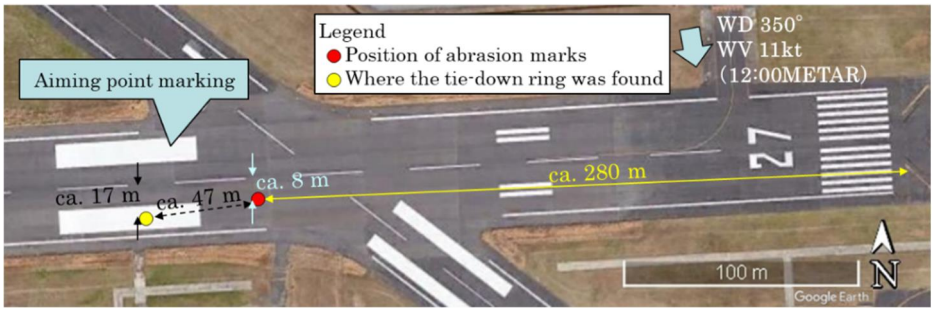
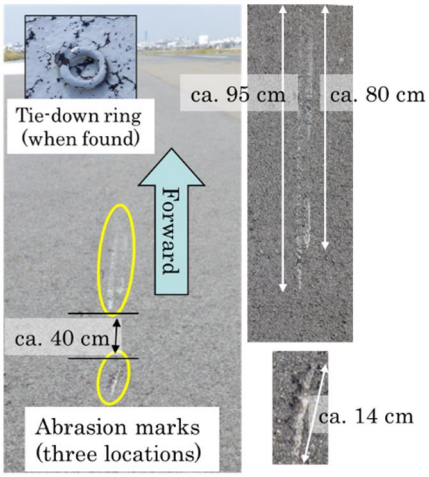


Figure 3: Runway Surface Condition

	A total of three abrasion marks were found on the runway surface. The closest (east side) one was about 14 cm long and 0.5 cm deep. The other two were left almost in parallel from about 40 cm west of the nearest mark in the same direction as the runway direction, the length was about 95 cm for the left (south side) mark, about 80 cm for the right side mark, and there was no depth in both (see Figure 4).  Figure 4: Abrasion Marks and Tie-down Ring
2.4 Personnel Information	(1) Instructor: Age: 53 Commercial pilot certificate (Airplane) December 5, 1994 Flight Instructor Certification December 4, 2008 Class 1 aviation medical certificate Validity: July 15, 2023 Total flight time 3,079 hours 49 minutes Total flight time on the type of aircraft 2,725 hours 50 minutes Flight time in the last 30 days 20 hours 57 minutes (2) Trainee: Age:28 Private pilot certificate (Airplane) April 12, 2022 Class 2 aviation medical certificate Validity: May 5, 2027 Total flight time 214 hours 44 minutes Total flight time on the type of aircraft 194 hours 50 minutes Flight time in the last 30 days 3 hours 59 minutes
2.5 Aircraft Information	Aircraft Aircraft type: Cessna 172S Serial number: 172S10848 Date of manufacture: November 17, 2008 Airworthiness certificate: No. Dai-2022-028 Validity: May 9, 2023 Total flight time: 3,495 hours 49 minutes When the serious incident occurred, the weight and the position of the center of gravity of the aircraft were within the allowable range.

2.6 Meteorological Information

(1) The aerodrome routine meteorological reports (METAR) for Yao Airport around the time of the serious incident were as follows:

Time of observation (hh:mm)	10:00	11:00	12:00
Wind direction (°)	340	320	350
Wind direction fluctuation	310V030	290V350	320V040
Wind velocity (kt)	5	9	11
Prevailing visibility (km)	10 or more		

(2) The values of the 2-minutes wind sensor for Yao Airport around the time of the serious incident were as follows:

Time of observation (hh:mm)	11:48	11:53	11:58
Wind direction (°)	360	010	360
Wind direction fluctuation	320V020	010V040	320V040
Wind velocity (kt)	11	9	13
Maximum wind velocity (kt)	13	15	18
Minimum wind velocity (kt)	7	6	9
Runway crosswind component (kt)	11	9	13

2.7 Additional Information

(1) Training for the Trainee

The trainee enrolled in the Company's Pilot Training Course in May, 2021. After obtaining the private pilot certificate, the trainee had continued the training for the commercial pilot certificate since March, 2022.

(2) STP

The STP is intended to ensure the standardization and safety of training for pilots who intend to obtain various qualifications related to airmen competence certifications by establishing standard operating procedure for trainings.

The STP describes the following (Excerpt)

6-1-6 GO AROUND POLICY

If there is any doubt about the approach and touchdown procedure, and in case of improper situation for safety, a go-around shall be executed. In case of judging that a safe landing may not be possible (it should execute a go-around), it is necessary to immediately call out "GO AROUND", and execute a go-around procedure. Criteria to judge that a safety landing may not be possible are as follows:

(Omitted)

4. In case that the axis of the airplane is, or is expected to be, significantly off the centerline of the runway.

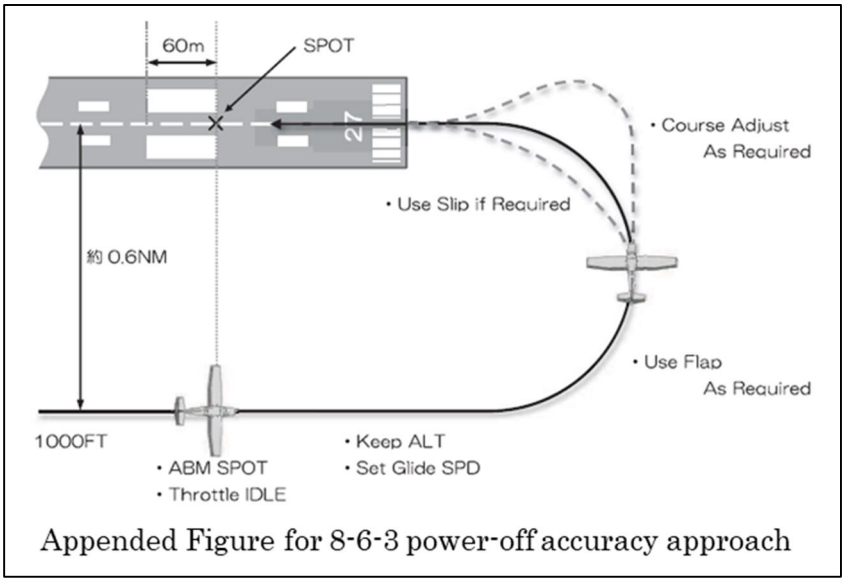
5. In case that a sideslip touchdown occurs or is expected.

6. In case that the pitch angle increases by 6° or more during a flare.

	7. In case that the airplane is in such conditions as high flare, ballooning, floating, violent bouncing, and porpoising. (Omitted) *12. In case that there is uncertainty or hesitation about continuing the approach.* *Not limited to the above, if there is any doubt about a safe landing a go around should be executed.* *6-9-3 CROSSWIND LANDING* *The maximum crosswind value demonstrated by the trainer during landing is 20 kt. According to the standard in the Operation Manual, the crosswind limits for training are as follows:* <table><tr><td rowspan="2">*BRAKING ACTION*</td><td colspan="2">*Crosswind limit values (kt)*</td></tr><tr><td>*TKOF, LDG (FLAP 10°)*</td><td>*LDG (10° to FLAPFULL)*</td></tr><tr><td>*GOOD*</td><td>*20*</td><td>*15*</td></tr><tr><td colspan="3">(Omitted)</td></tr></table> *During the final approach, the airplane establishes the correct WCA[*3] (Crab[*3]method) until close to the threshold, and from close to the threshold, the crosswind correction is made with aileron control to the windward side and opposite rudder input to align the longitudinal axis of the airplane with the centerline of the runway (Wing-low method[*4]).* *If the crosswind is particularly strong, the crab and wing-low methods can be used together, but the crab must be de-crabbed just before touchdown[*3].* (Omitted) *8-6-3 Power-off Accuracy Approach (ACCURACY LANDING / 180 SIDE APPROACH)* *Consider the runway as an emergency landing site and assume an emergency landing due to engine inoperative.* (Omitted) *〔Operating procedure〕* (Omitted) *5. The approach course shall be adjusted by judging on the glide angle.* *6. If the altitude is too high on final approach, a slight sideslip can be used to adjust the rate of descent.* *7. The airplane shall touch down on the point within a range of not more than 60 m from the specified touchdown point (SPOT).*

[*3] The "Crab" refers to a flying condition in a crosswind where the nose of the airplane is pointed into the wind to prevent the airplane from drifting away with the crosswind, and this flying operation is called the "Crab" method. At this point, the angle between the airplane's track and its heading is called the "WCA" (Wind Correction Angle). At touchdown, it is necessary to de-crab to establish the windward nose track so that the airplane's heading and track are aligned with the runway centerline. If the windward nose track is not aligned with the runway centerline, this is called the "A residual crab angle ".

[*4] The “Wing-low” refers to a crosswind flight condition in which the airplane is kept from drifting by lowering the windward wing and applying the opposite rudder pressure to align the nose track with the runway centerline.



Appended Figure for 8-6-3 power-off accuracy approach

(3) Relationship between the Aircraft Abrasion Marks and Rudder Position

The difference in the direction of the abrasion marks between those on the underside of the aft fuselage of the aircraft and those on the underside of the rudder was confirmed. When the rudder was moved by aligning the directions of the two abrasion marks, the left rudder pedal position was about 5 cm forward, and the rudder angle at that time was about 12° to the left. And the angle between the longitudinal axis (nose direction) of the aircraft and the abrasion marks on the underside of the fuselage was about 8° to the left (see Figure 5).

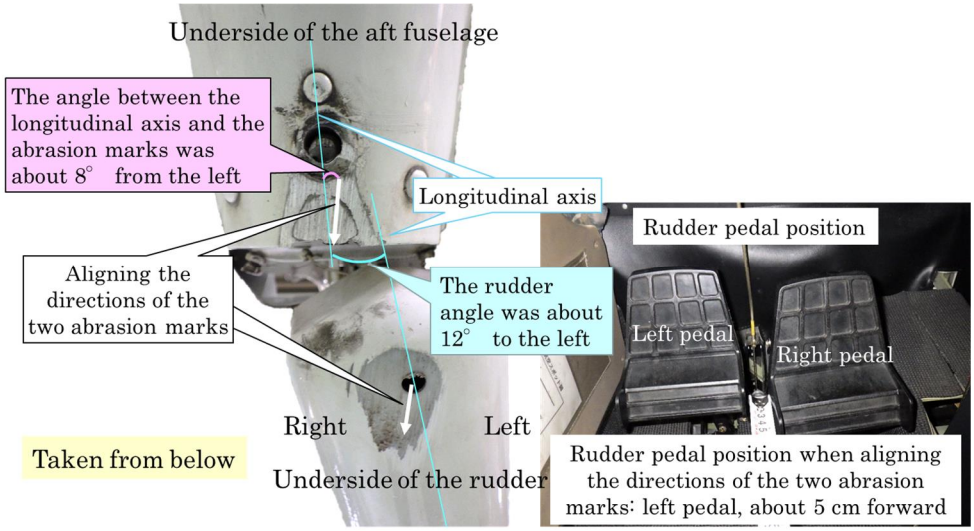


Figure 5: Abrasion Marks and Rudder Position

(4) Assist

Circular No. 17, "Prevention of Tail Strike during Landing" (Revised on February 1, 2019), issued by the Director of the Aircraft Operations Department of the Company, is contained the following description with respect to an Assist as follows:

2. Contents

(Omitted)

	④ Action guidelines for flight instructors during approach and landing *i) Callout* (Omitted) *ii) Advice* *After the callout, if the trainee's corrective maneuver does not go well, the flight instructor shall give appropriate advice and let the trainee make the corrective maneuver accordingly.* *iii) Assist* *After the advice, if the trainee's corrective maneuver does not go well, the flight instructor shall assist the control and make the corrective maneuver together with the trainee.* *iv) Take-over* *If the corrective maneuver by the Assist does not go well, the flight instructor shall take over the control and make the corrective maneuver alone. In addition, if the situation is deemed to be dangerous, the flight instructor shall take over control, notwithstanding points 1 to 3 above.* *v) Go-Around* (Omitted) *※ It is desirable to perform the actions in the order of i) → ii) → iii) → iv) → v), but the take-over and go-around shall be performed at any time as needed, regardless of the above order.* According to the trainee's statement, when the trainee feels the Instructor's input to the controls during an Assist, the trainee usually does not resist the Instructor's input to the controls, and when the control is over, the trainee regains control. The same was true in this serious incident. According to the Instructor's statement, during the Assist, the Instructor felt that the trainee was not aware that he was controlling the aircraft himself and felt that he should have called out clearly because it was difficult to tell which one was in control. (6) Record of flight data in the integrated flight deck The aircraft is equipped with an integrated flight deck (GARMIN G1000), which can display and record various flight data. The flight data logger of the system can record approx. 1,000 hours of flight data per 1 GB of the inserted SD card capacity. When the recording data reaches the SD card capacity, depending on its version of the system, the data will be overwritten in some version, and recording the data will be stopped in other version, but the software of the aircraft was the latter type version. The SD card inserted in the integrated flight deck has a capacity of 256 MB and only recorded the flight data from October 2016 to May 2017, thus not recording the flight data at the time of the serious incident.

3. ANALYSIS

(1) Tail Contact with the Runway Surface

The JTSB concludes that it is probably that the aircraft executed a go-around because the sink rate increased rapidly at the time of the landing maneuver after the aircraft was floating, and the pitch angle of the aircraft became excessive, however, the aircraft did not stop sinking after executing the go-around, and the underside of the aft fuselage contacted the runway surface prior to climbing.

The sink rate increased rapidly at the time of the landing maneuver is likely because when the speed was reduced due to the continuing floating, the aircraft's nose was raised in order to land, resulting in a drop landing in somewhat stall. However, as the flight data of the aircraft (speed, altitude above the ground, pitch angle, engine power, wind direction and velocity, and time history, etc.) were not recorded, they were unable to be determined.

Regarding how the aircraft made contact with the runway surface, based on the characteristics of the abrasion marks on the runway surface and the aircraft fuselage, it is most likely that the underside of the tie-down ring touched and broke first, followed by the underside of the rudder and the aft fuselage.

The contact position was certainly about 8 m from the centerline of the runway to the leeward (left) side.

① Rudder Position at the time of contact with the runway surface

The reason why the left rudder pedal on the leeward side was about 5 cm forward when the underside of the rudder contacted the runway surface is most likely because the aircraft was making a wing-low approach with a right crosswind.

② Nose heading at the time of contact with the runway surface

As for the abrasion marks caused by contact with the rudder and the aft fuselage underside that were left on the runway surface, their directions were generally consistent with that of the runway, but the abrasion marks on the fuselage were at an angle of about 8° from the left side with respect to the nose heading.

The abrasion marks on the tie-down ring itself are more extensive on the left side than the right, and the surface has also been roughly scraped.

This indicates that the aircraft most likely made contact with the runway surface while side sliding to the left with a residual right crab angle (see Figure 6).

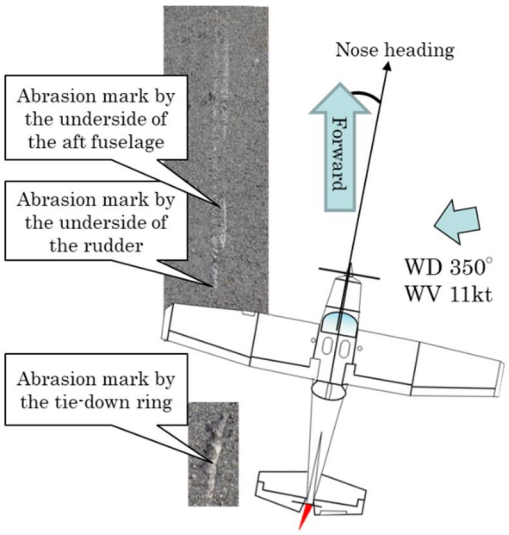


Figure 6: Situation at the Time of Contact with the Runway Surface

(2) Decision to Go Around

The JTSB concludes that it is highly probable that the aircraft went into floating state, thus meeting the go-around criteria. However, the Instructor thought that even after floating, the aircraft would be able to touch down without any trouble and liked the trainee to have a landing experience, therefore the Instructor most likely continued the approach without deciding to make a go-around.

On the other hand, since the approach was the final landing, the trainee strongly desired to land and left the decision on the go-around to the Instructor as being assisted by the Instructor, therefore it is probably that the trainee did not decide to execute a go-around.

It is most likely that the aircraft should have executed a go-around at the point when it met the go-around criteria. Although the aircraft did not meet the go-around criteria, the decision to execute a go-around could have been made in the following cases.

① When the indication of the precision approach path indicator (PAPI) was four reds indicating the Path Angle is low at the time of passing the runway threshold.

② When it was recognized to be largely away (about 8 m) from the runway centerline to the leeward side.

③ When it was recognized that with a residual crab angle prior to touchdown.

(3)Assist

Assist is the phase where the trainee proactively controls an airplane and the instructor makes corrections with the trainee. However, in this serious incident, after having sensed the Instructor was assisting, the trainee expected the Instructor to control the aircraft, and the Instructor was intended to fly the aircraft together with the trainee, but, on the other hand, the Instructor felt that the trainee did not appear to be conscious of controlling the aircraft. In addition, there were no callouts at the beginning and end of the Assist. From this, it is probable that the Instructor was intended to Assist the trainee, but the trainees came to realize that the initiative to control the aircraft had shifted to the Instructor.

An ambiguous Assist without any callouts, in which it is unclear whether the trainee or the instructor has the initiative of piloting an airplane, may more likely result in having harmful effects such that the trainees would expect (depend on) the Assist and continue the landing approach even beyond their skills.

To clarify whether the instructor or the trainee is the primary operator of the aircraft, it is necessary to clearly state the purpose and procedures for the Assist, such as the instructor calling out at the beginning of the Assist, even if it is only a small correction, and instructing the trainee in advance that he/she is the primary operator of the aircraft, even during the Assist.

(4) Flight Data Records on Integrated flight deck

The aircraft has a flight data recording capability, but no flight data had been recorded at the time of this serious incident. The recorded flight data is used for detailed analysis of flight conditions in aircraft accident, etc., investigations, and there are some cases is used by operators as a training tool, and thus the recording of flight data contributes to the safe operation of this type of aircraft.

It is desirable for the Company to maintain the flight data in a state where it can be recorded at any time.

4. PROBABLE CAUSES

The JTSB concludes that the probable cause of this serious incident was that during the training, even after the aircraft was flared, came into floating state to meet the go-around criteria, the approach was continued because the go-around decision was not made, and then the sink rate increased rapidly at the time of the landing maneuver, therefore, a go-around was executed, but, the aircraft did not stop sinking, probably causing the underside of the aft fuselage to contact the runway surface before it climbed.

The reason why the aircraft continued to approach without making a go-around decision after the aircraft met the go-around criteria was because the Instructor's intention to allow the trainee to experience a landing, even as the Instructor assisted the trainee in controlling the aircraft, was probably a contributing factor.

5. SAFETY ACTIONS

5.1 Safety Actions Required	(1) As described in the ANALYSIS, it is necessary for the Company to take following safety actions. ① If the go-around criteria are met, a go-around shall be executed. ② Clarify the purpose and procedure of the Assist in flight. (2) As described in the ANALYSIS, it is desirable for the Company to maintain a state in which flight data can be recorded at all times.
5.2 Safety Actions Taken after the Serious Incident	Safety Actions Taken by the Company after the Serious Incident (1) A notification from the Company's Director of Aircraft Operations has been issued to all Company pilots to instruct them to understand and comply with the Go-Around Policy (October 18, 2022). (2) The "Assist" has been newly redefined, specifying the following (November 24, 2022). ① When the trainee's corrective maneuver does not go well, the flight instructor shall assist the control and make the corrective maneuver together with the trainee. ② In principle, when assisting, the Assist should be for a short period of time, and callouts should be made before the Assist begins and after the Assist is completed. (3) The go-around criteria were reviewed and new ones were established (November 24, 2022). (4) A document has been issued to all company pilots alerting them to the floating (November 24, 2022). (5) Instructor retraining (completed on January 10, 2023) (6) The maintenance report (on the SD card inserted in the Garmin G1000 and the handling of the recorded flight data) was issued and the essential points etc. for the flight data records were set as follows (April 4, 2023)： ① SD card: A card with a capacity of 4 GB shall be used. ② Flight data: Download the data more than once per calendar year so as to maintain SD card space available for recording flight data.