AA2019-9

AIRCRAFT ACCIDENT
INVESTIGATION REPORT

JAPAN COAST GUARD
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October 31, 2019

Japan Transport Safety Board

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

Nobuo Takeda
Chairman
Japan Transport Safety Board

Note:

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

AIRCRAFT ACCIDENT INVESTIGATION REPORT

DAMAGE TO AIRFRAME DURING LANDING
JAPAN COAST GUARD
TEXTRON AVIATION 172S, JA395A
AT CHITOSE AIRFIELD, JAPAN
AROUND 13:22 JST, AUGUST 21, 2018

October 11, 2019
Adopted by the Japan Transport Safety Board
Chairman Nobuo Takeda
Member Toru Miyashita
Member Yoshiko Kakishima
Member Yuichi Marui
Member Yoshikazu Miyazawa
Member Miwa Nakanishi

1. PROCESS AND PROGRESS OF THE AIRCRAFT ACCIDENT INVESTIGATION

1.1 Summary of the Accident	On Tuesday, August 21, 2018, a Textron Aviation 172S, registered JA395A, operated by Japan Coast Guard suffered damage to the airframe by the touchdown accompanying a severe impact when landed at Chitose airfield. There were two passengers on board other than the examinee (captain) and no one was injured.
1.2 Outline of the Accident Investigation	The Japan Transport Safety Board designated an investigator-in-charge and an investigator on August 22, 2018 to investigate this accident. The occurrence of the accident was notified to the United States of America as the State of Design and Manufacturer of the aircraft involved in this accident, however, the state did not designate an accredited representative. Comments on the draft report were invited from the parties relevant to the cause of this accident and the relevant State.

2. FACTUAL INFORMATION

2.1 History of the Flight	According to the statements of the examinee, the instructor and the inspector of airman licensing, and flight data monitoring (FDM), the history of the flight is summarized as follows: The aircraft took off from Chitose airfield for Sapporo airfield at 11:57 JST (JST: UTC+9 hours; unless otherwise noted, all times are indicated in JST in this report on a 24-hour clock) for the practical pilot competence examination flight associated with the rating change for pilot certificate, with the examinee sitting in the left pilot's seat as a captain, the instructor in the right pilot's seat and the inspector of airman licensing in the right rear seat. After completing examination in subjects associated with take-off and landing at Sapporo airfield, the aircraft conducted other examination subjects in civil training and

testing airspace, and then headed for Chitose airfield.

When reporting about the return of the flight to Chitose air base of Japan Coast Guard, the examinee was notified that Chitose airfield was in Instrument Meteorological Conditions (IMC).

After checking ATIS information of New Chitose airport adjacent to Chitose airfield, the examinee requested PAR*1 RWY 18L approach to air traffic control.

The examinee commenced the descent for Chitose airfield from a pressure altitude of 1,500 ft at an approach angle of 2.7° by PAR RWY 18L approach , had the runway in sight at a pressure altitude of about 500 ft and passed over the runway threshold (THR) at an airspeed of about 72 kt with full flaps.

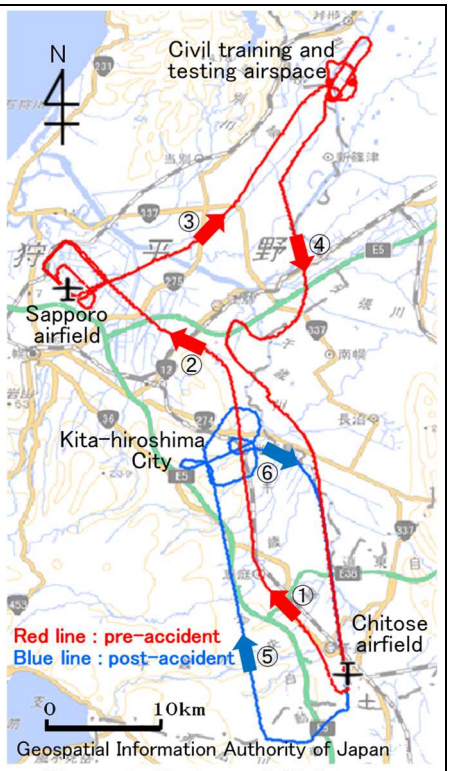


Figure 1 : Estimated flight route

The examinee considered a stable head wind at a velocity of a little stronger than 10 kt, kept the engine power to some extent, delayed the timing to close the throttle than usual and performed a flare maneuver*2. The aircraft touched down on the main landing gear (the first touchdown) at an air speed of about 62 kt and bounced after the touchdown. The examinee strived to retain the landing attitude because he had previously experienced a similar case. The nose bounced by the subsequent touchdown (the second touchdown); however, the examinee continued the landing because he presumed that the bounce would be settled. The instructor also presumed that the bounce would be settled. However, the examinee executed a go-around and the instructor also called "go-around" because the nose bounced more severely at the following touchdown (the third time) than the second touchdown. The examinee applied the engine maximum power to establish climb attitude and retracted the flaps.

The instructor was feeling that the aircraft was making a stable approach and landing as usual, and presumed that the nose that unintentionally bounced at the second touchdown would be settled. However, he judged that the bounce at the third touchdown was abnormal and eventually called "go-around".

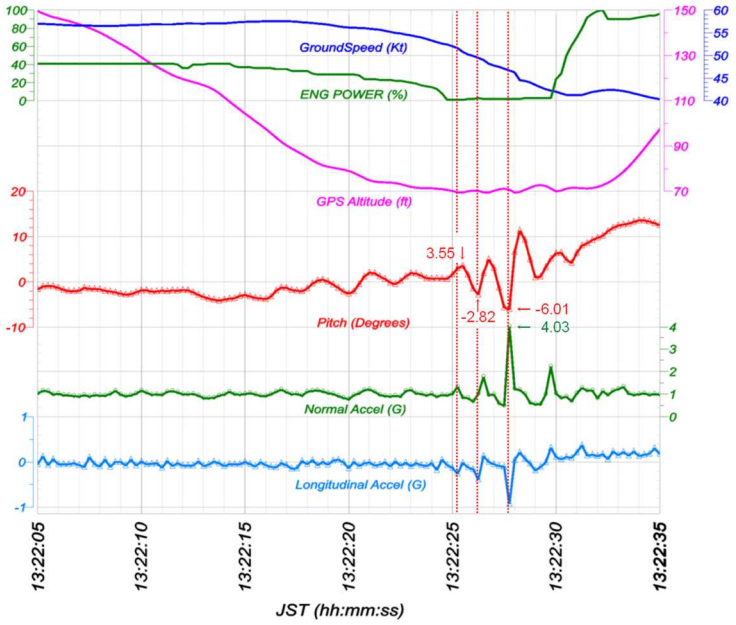
Then, the examinee requested air traffic control for radar vector and landed at Chitose airfield at around 13:58 by PAR RWY 18L approach again after holding over Kita-hiroshima City as instructed by air traffic control (see Figure 1).

The deformation on the outer skin of forward fuselage was found by the

*1 PAR (Precision Approach Radar) denotes a radar for precision approach that air traffic controllers use to guide aircraft to the point of touchdown on runway in three-dimensional way.

*2 Flare maneuver denotes a nose-up maneuver taken to reduce descent rate and speed at the time of touchdown.

	mechanic during the exterior inspection after the flight, and also the deformation and others were found on the stringer of left forward fuselage by the detailed inspection later. The accident occurred on runway at Chitose airfield (42°47'56" N, 141°40'04" E) at around 13:22.
2.2 Injuries to Persons	None
2.3 Damage to Aircraft	Extent of damage to the aircraft: Substantially damaged (i) Outer skin of forward fuselage (both left and right):Deformed (ii) Stringer of forward fuselage (left): Deformed (iii) Stiffener in the engine room (both left and right): Deformed (iv) Stringer attaching rivet hole of left forward fuselage: Cracked (v) Fire wall: Deformed  Figure 2: Accident aircraft  Figure 3: Deformed outer skin of forward fuselage
2.4 Personnel Information	(1) Examinee Male, Age 37 Commercial pilot certificate (Airplane) July 11, 2007 Type rating for multi-engine land July 11, 2007 Instrument flight certificate (airplane) April 4, 2008 Class 1 aviation medical certificate Validity March 15, 2019 Total flight time 792 hours 32 minutes Flight time in the last 30 days 14 hours 00 minutes Total flight time on the type of aircraft 34 hours 30 minutes Flight time in the last 30 days 10 hours 00 minutes (2) Instructor Male, Age 43 Commercial pilot certificate (Airplane) September 1, 2000 Type rating for single-engine land September 1, 2000 Type rating for multi-engine land September 26, 2000 Instrument flight certificate (airplane) September 26, 2000 Flight instructor certificate (airplane) January 11, 2018 Class 1 aviation medical certificate Validity January 27, 2019 Total flight time 5,314 hours 38 minutes Flight time in the last 30 days 38 hours 10 minutes Total flight time on the type of aircraft 102 hours 31 minutes Flight time in the last 30 days 22 hours 15 minutes
2.5 Aircraft Information	(1) Type of aircraft Textron Aviation 172S Serial number 172S11735

	Date of manufacture August 26, 2016 Certificate of airworthiness No.DAI-2017-644 Validity February 1, 2019 (2) When the accident occurred, the weight and balance of the aircraft are estimated to have been within the allowable ranges.
2.6 Meteorological Information	Aviation special weather report at Chitose airfield(13:20) Wind direction 170°; Wind velocity 12 kt; Prevailing visibility; 10 km or more Cloud: Amount 1/8, Type: Stratus, Cloud base: 400 ft Amount 7/8, Type: Stratus, Cloud base: 600 ft Amount 7/8, Type: Stratus, Cloud base: 900 ft Temperature 20 °C; Dew point 19 °C ; Light shower rain Altimeter setting (QNH): 29.89 inHg Wind direction and wind velocity last reported by air traffic control were 180° and 13 kt.
2.7 Additional Information	(1) Information on FDM The aircraft was equipped with FDM installed in the center of the ceiling that is capable of recording the cockpit audio and images and the flight data including the vertical acceleration speed by built-in sensor (GPS/IMU) for about four hours, and the record at the time of the accident was retained in the device.  Figure 4: FDM (2) Record of FDM The fight data during the time of the accident recorded in the FDM is shown in Figure 5. Besides, the FDM recorded the loud sound of the landing gears at touchdown.  Figure 5: Record of FDM (3) Comparison with Landing Performed after Go-Around In order to clarify differences of approach between at the time of accident and after go-around, the pitch angle and the engine power recorded in FDM

from passing over the runway threshold until touchdown were compared, respectively.

The wind direction and wind velocity at the time of touchdown after go-around were 170° and 12 kt.

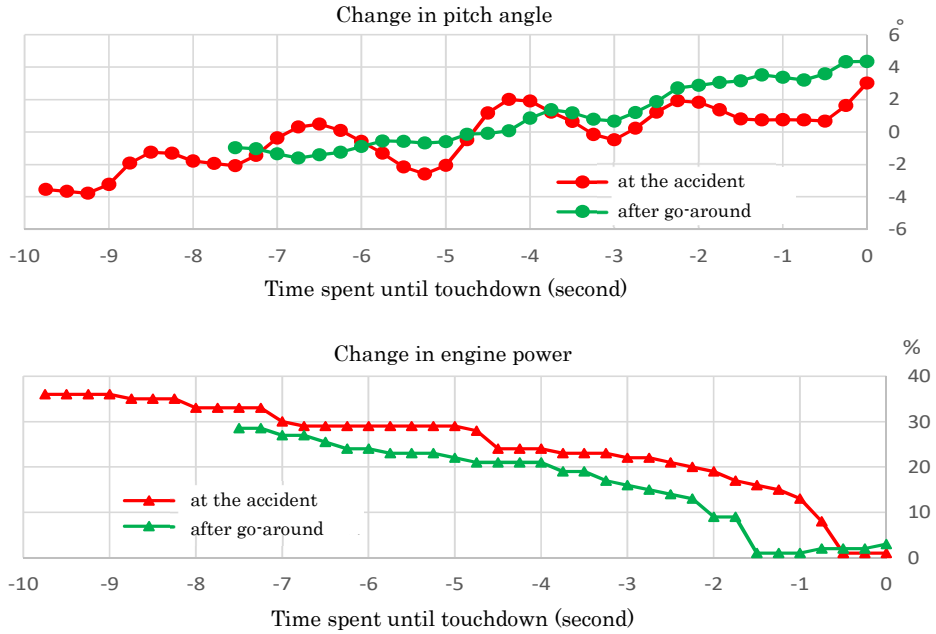


Figure 6: Situational comparison from passing over the runway threshold until touchdown

(4) Situation after passing over runway threshold

Based on the data recorded in the FDM at the time of the accident, the situation after passing over the runway threshold is illustrated in Figure 7 (the lean of arrows represents a pitch angle).

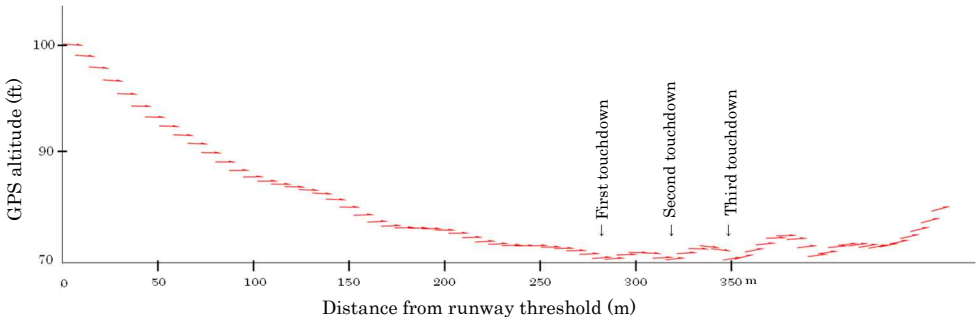


Figure 7: Situation after passing over the runway threshold

(5) Record of Drive Recorder

A drive recorder, which installed in the car that was waiting at the apron, recorded the aircraft bounced at the first touchdown and the main gear touched down after the nose gear touched down at the second touchdown and the third touchdown.

(6) Airplane Flight Manual of the Aircraft

The airplane flight manual of the aircraft states as follows:

3-3-12 Landing

Normal Landing

(1) Airspeed・・・・・・・・・・・・・・・・・・・・65 KIAS (wing flaps UP)

(2) Wing flap・・・・・・・・・・・・・・・・・・・・・・・・・・as desired

	(0^o-10^o below 110 KIAS, 10^o- FULL below 85 KIAS) *(3) Airspeed at the final approach・・・・・・・60-70 KIAS (flaps DOWN)* *(4) Touchdown・・・・・・・・・・・・・・・・・・・・・main wheels first* *(5) Landing roll・・・・・・・・・・・・・・・・・lower nose wheel gently* (7) Bouncing Airplane Operation Textbook published by the Japan Civil Aviation Promotion Foundation states a bouncing as following : *4.4.2 Mishandling during Landing Maneuver* (omitted) *(7) Bounce* *A Bounce occurs when an aircraft has touched down before taking an appropriate landing attitude. In other words, a bounce occurs when an aircraft has delayed in taking a landing attitude and as a result of an abrupt raise of attitude to a landing attitude immediately before touchdown, and the severity of bounce depends on the force when an aircraft lands on the runway.* (omitted) *In the event of a slight bounce without an abrupt change in a pitch attitude, maintain the direction, apply power to cushion the touchdown and smoothly maneuver to establish a landing attitude prior to the subsequent touchdown. Repeating this bounce generates movements as if a dolphin has jumped, which is called porpoise and is dangerous.* *When a bounce is severe, execute a go-around immediately. This is because there is a possible risk to enter a stall before the landing after the bounce.* (omitted) (8) Training and Education by Japan Coast Guard Prior to the subject practical examination, the training for change of the rating was conducted to examinees who experienced multi-engine land airplane in accordance with aircraft training regulation stipulated by Japan Coast Guard. There was no concern observed in the evaluation of the examinee in the training. In the ground school at the initial stage of the training for the rating change, Japan Coast Guard educated, as a general caution, to prepare for a subsequent touchdown by maintaining the attitude in the event of occurrence of a bounce, and to execute a go-around in the event of a severe bounce or entering a porpoise.

3. ANALYSIS

3.1 Involvement of Weather	None
3.2 Involvement of Pilot	Yes
3.3 Involvement of Aircraft	None

3.4 Analysis of Findings	(1) The First Touchdown and Bounce It is highly probable that the aircraft passed over the runway threshold at an airspeed of about 72 kt and was descending at an unstable pitch angle. The aircraft started increasing its pitch angle about 3 seconds before its first touchdown followed by decreasing its pitch angle about 2 seconds before its touchdown, then it touched down at around airspeed of 62 kt with increasing its pitch angle again about 0.5 seconds before its touchdown. From the above it is highly probable that the aircraft bounced because it touched down with abruptly raising its attitude to a landing attitude immediately before its touchdown with high airspeed. (2) The Second Touchdown and Porpoise It is highly probable that the examinee who had previously experienced a bounce strived to maintain a landing attitude after a bounce by the first touchdown; however, he was unable to control the nose down properly, touched down on the nose gear and continued landing, that led the aircraft to enter porpoise condition where bounces were repeated because the pitch angle changed from 3.55° to –2.82°. Both the examinee and the instructor continued landing presuming that the bounce of the nose at the second touchdown would subside ; however, it is probable that they should have judged that safe landing was possibly infeasible to conduct at the time when the nose bounced, and should have immediately gone around. (3) The Third Touchdown and Occurrence of Damage to Airframe The aircraft entered porpoise condition at the second touchdown, then –6.01° of the pitch angle, +4.03 of the vertical acceleration (G) and the loud sound of the landing gear were recorded at the third touchdown, therefore, it is highly probable that the airframe was damaged by severe touchdown of the nose gear in pitch down attitude at the third touchdown. (4) FDM The accident aircraft was equipped with FDM, its record was useful to analyze the flight situation of the accident aircraft in detail in this accident investigation. FDM stores various kinds of flight data and the cockpit audio and image, and it is probable that the extraction of unsafe factors in regular flights and the confirmation of the training results and others are able to be done by analyzing such data. It is desired that Japan Coast Guard and other small aircraft operators positively encourage the introduction of FDM and effectively utilize it for enhanced safety.

4. PROBABLE CAUSES

In this accident, it is highly probable that the aircraft suffered damages because it entered porpoise condition after the bounce at the first touchdown, and touched down hard on the nose gear in pitch down attitude at the third touchdown.

5. SAFETY ACTIONS

After the accident, Japan Coast Guard has implemented following measures in order to prevent recurrence.

(1) Review of aircraft operation manual and training manual of Japan Coast Guard.

(i) to stipulate “airspeed” and “pitch attitude” as the criteria at touchdown

(ii) to stipulate go-around policy

(iii) to stipulate the responsibilities of examinees and instructors for safety at the time of practical examination

(2) Implementation of reeducation

(i) Reconfirmation of fundamental items of various elements including modified recurrence prevention measures has been implemented.

(ii) Education on abnormal touchdown has been implemented.

(iii) Training utilizing simulator has been implemented.

(3) Reconfirmation of other aircraft cases, due to prevent recurrence, by studying not only the abnormal touchdown cases but also widely other cases.