AI2018-4

AIRCRAFT SERIOUS INCIDENT INVESTIGATION REPORT

PRIVATELY OWNED
J A 4 0 1 0

June 28, 2018

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.

Kazuhiro Nakahashi
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 SERIOUS INCIDENT

INVESTIGATION REPORT

UNABLE TO MOVE ON RUNWAY

DUE TO DAMAGES ON NOSE LANDING GEAR

AT FUKUSHIMA AIRPORT, JAPAN

AT AROUND 14:00 JST, JUNE 27, 2017

PRIVATELY OWNED

PIPER PA-46-310P, JA4010

June 8, 2018
Adopted by the Japan Transport Safety Board
Chairman Kazuhiro Nakahashi
Member Toru Miyashita
Member Toshiyuki Ishikawa
Member Yuichi Marui
Member Keiji Tanaka
Member Miwa Nakanishi

1. PROCESS AND PROGRESS OF INVESTIGATION

1.1 Summary of the Serious Incident	On Tuesday, June 27, 2017, a privately owned Piper PA-46-310P, registered JA4010, damaged the nose landing gear during its landing roll on runway 01 at Fukushima Airport, therefore, the aircraft became unable to move on the Runway.
1.2. Outline of the Serious Incident Investigation	This event fell under the category of "Case where the landing gear is damaged and thus flight of the subject aircraft could not be continued" as stipulated in item 8, Article 166-4 of the Ordinance for Enforcement of Civil Aeronautics Act (Ordinance of Ministry of Transport No. 56 of 1952), and was classified as a serious incident. On June 27, 2017, the Japan Transport Safety Board (JTSB) designated an investigator-in-charge and an investigator to investigate this serious incident. An accredited representative of the United States, as the State of Design and Manufacture of the aircraft involved in this serious incident, participated in the investigation.

	Comments 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 pilot (hereinafter referred to as "the Pilot") and passenger, the history of the flight is summarized as follows.  Photo 1: Aircraft involved in the Serious Incident At 13:18 Japan Standard Time (JST: UTC + 9hrs, unless otherwise stated, all times are indicated in JST on a 24-hour clock) on June 27, 2017, a privately owned Piper PA-46-310P, registered JA4010, took off Honda Airport bound for Fukushima Airport for a familiarization flight with the Pilot in the left seat and a passenger in the right seat. When the aircraft landed on runway 01 at Fukushima Airport after conducting ILS approach both the Piot and the passenger confirmed that the landing gears were locked in the extended position using three green lights respectively. The indicated airspeed of the aircraft is 85 kt during approach when conducting normal landing, and the Pilot confirmed that the indicated airspeed was 81-82 kt just before the threshold of runway 01. The speed when the aircraft touched down was unknown, but the aircraft landed without large impact at around the end of the aiming point marking. Since there was a long distance from the touchdown point to the taxi-way T4 where the Pilot planned to vacate the runway, the Pilot did not apply the brakes and was using only the rudder pedals to keep rolling on the runway centerline. The aircraft, after running straight on the runway for a while, gradually started drifting from the runway center line towards the right and at the same time its nose was going to go down. Since all three green lights to indicate fully extended position of the landing gears had stayed illuminating, the passenger judged the nose tire went flat then he said “Nose tire, Flat tire”. The Pilot pulled up the control column to make the nose up, however, the nose kept going down. Finally, the Pilot heard the noise of propeller blades hitting the runway. Afterward, the aircraft moved on the runway under the condition its lower part of the forward fuselage was contacting the runway, it stopped intersection between the runway and taxiway T4. After reporting to an Air Traffic Service Flight Information Officer at Fukushima Airport Mobile Communication Station that the nose landing gear of the aircraft had been damaged and the aircraft had to stop on the runway, the Pilot and passenger evacuated from the aircraft. Besides, the Pilot found no anomaly while performing the exterior inspection before the flight.

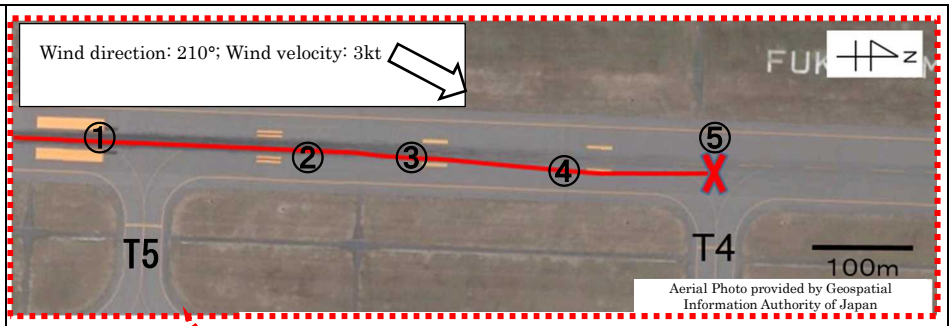

Photo 2: Estimated ground track on Runway by GPS Record (See Table 1)

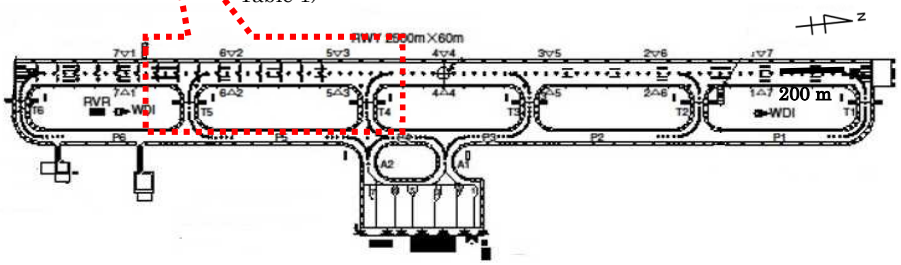

Figure 1: Airport Overview (added to an excerpt from Aeronautical Information Publication)

This serious incident occurred at about 1,088m (37°13'31"N, 140°25'42"E) from the threshold of runway 01 of Fukushima Airport at about 14:00 on June 27, 2017.

2.2 Injuries to Persons	None
2.3 Damage to the Aircraft	Extent of damage to the aircraft : Slightly damaged - Nose landing gear actuator rod end bearing : broken - Nose landing gear actuator piston rod : bent - Engine mount frame : cracked - Propeller blades : bent - Lower surface of engine cowling : damaged
2.4 Personnel Information	Pilot: Male, Age 48 Commercial Pilot Certificate (Airplane) October 28, 2011 Pilot competency assessment Expiry of practicable period for flight: December 6, 2017 Type rating for Multi-engine (Land): December 27, 2011 Class 1 aviation medical certificate: Validity: January 19, 2018 Total flight time: 897 hours 07 minutes Flight time in the last 30 days: 4 hours 55 minutes Total flight time on the type of aircraft: 233 hours 59 minutes Flight time in the last 30 days: 4 hours 55 minutes
2.5 Aircraft Information	(1) Aircraft type: Piper PA-46-310P Serial number: 46-8408077 Date of manufacture: August 27, 1984 Certificate of airworthiness: Dai-2016-485 Validity: November 20, 2017 Category of airworthiness: Airplane Normal N

Total flight time: 3,044 hours 04 minutes
Flight time since the last periodical check (100-hour inspection on March 18, 2017) 45 hours20 minutes

(2) It is highly probable that, at the time of occurrence of this serious incident, both of the weight and position of the center of gravity of the aircraft were within the allowable range.

2.6 Meteorological Information

Weather information provided by an Air Traffic Service Flight Information Officer at Fukushima Airport at 13:55

Wind direction 210°; Wind velocity 3kt; Temperature 22°C, QNH 29.90 inHg

2.7 Additional Information

(1) Information on the airport

Fukushima Airport has a runway with a length of 2,500 m, a width of 60 m, and the runway direction of 01/19. Its surface is paved with asphalt-concrete.

(2) Approach and landing

The Flight Manual of the aircraft includes the following descriptions in "Section 4: Normal Procedures." (Excerpt)

16. Approach and landing

a. Normal Procedures (not shown in the Performance Table)

When a runway length is sufficiently longer than the required length, the normal approach and landing method can be used. Set the engine power that is required to maintain the desired approach path angle and descend on the final approach course at 85 KIAS. The flap angle during the approach and landing as well as speed at the time of the touch down on the runway should be selected depending on the condition of the runway surface, wind, and aircraft weight. It is generally desirable to touch down at the speed as low as possible that is acceptable to the landing conditions. The landing distance when this method is applied is not described in the Performance Table because it varies from one landing to another landing.

Based on the scratches of the propeller blades of the aircraft on the runway surface, the speed of the aircraft when its blades hit the surface is estimated to be about 45 kt.

(3) Distance from runway approach end

The distance from the runway threshold corresponding from① to ⑤ on Photos 2 is as follows:

No.	Situation of Aircraft and Scratches on runway	Distance from Runway Threshold (m)
①	Touchdown point	460
②	Tire marks deflected to the right	740–
③	Scratches by propeller blades	756–
④	Paint marks by the nose landing gear door	811–

⑤	Stop position	1,088

Table 1: Distance from Runway Threshold

(4) Information on damage

Both of two propeller blades of the aircraft were bent backward. The right door of the nose landing gear was opened outward wider than normal, and the scratch marks were found on the inner forward surface of the door. The scratch marks were found on the entire outer surface of the nose landing gear left door.

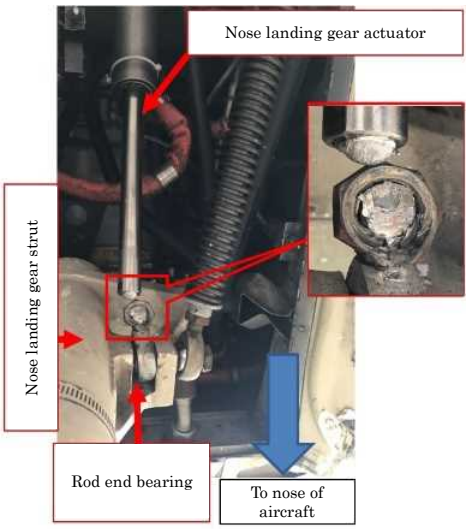

Photo 3 Damage on Nose landing gear

In addition, the scratch marks were found on the entire lower surface of the engine cowling in front of the nose landing gear well.

The rod end bearing at the tip of the actuator (nose landing gear actuator) to move the nose landing gear up and down was fractured. The landing gear was in its down position even though the piston rod was bent. The engine mount frame at around the nose landing gear actuator mounting section was cracked.

(5) Broken rod end bearing

The rod end bearing was bent and fractured at an angle of about 90-degree on its lock nut section. In addition, the sliding section did not move smoothly.

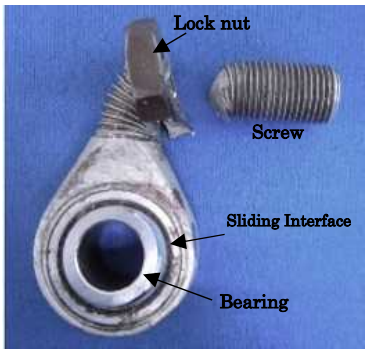

Photo 4 Rod End Bearing
(Photo taken by National Institute for Materials Science)

The Report of the National Research and Development Agency, National Institute for Materials Science, which requested the surface of the broken section, states that the breaking of the rod end bearing is not attributable to the metal fatigue, but to the ductile fracture caused by the bending load (Destruction with deformation due to excessive loading load). The process of the rod end bearing rupture is described as follows: The rod end bearing was buckled due to the compression load followed by the breaking of the bearing due to the excessive bending load. In addition, regarding that the movement on sliding section has not been smooth, the report states that it is not deniable that rust has developed in sliding interface.

(6) Landing gear

The landing gears of the aircraft are retractable and composed of the main landing gears under the left and right main wings and the nose landing gear under the nose section of the fuselage, the nose landing gear extends from backward to forward when extending it.

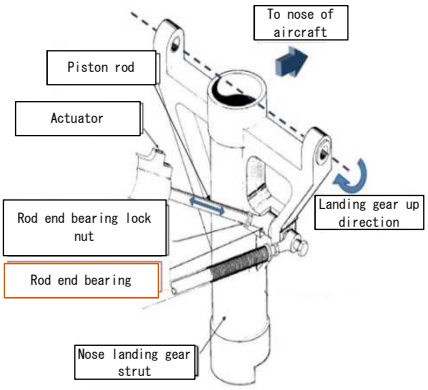

Figure 2: Nose Landing Gear Structure

Operating each landing gear and keeping its position is controlled respectively by its individual actuator. The landing gear control lever actuates the electrical hydraulic pump, and the piston rod of the actuator on every landing gear extends or retracts. In the case of landing gear extension, when the piston rod fully extends, the switch piston inside each actuator is activated and the piston rod is held.

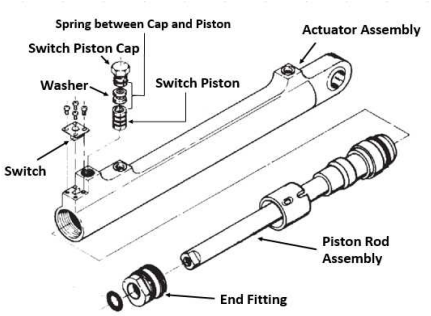

Figure 3: Actuator Structure

At the same time, when the switch interlocking with the switch piston would be activated, the supply of hydraulic pressure by the hydraulic pump has been stopped, and the three green lights on the instrument panel corresponding to each landing gear illuminate. A landing gear held in its down position is configured such that its extended position is not released unless the hydraulic pressure for retracting is supplied to the actuator and the switch piston is returned.

The position of each landing gear in its up and down position is set by adjusting the length of the rod end bearing on the actuator. (See Photo 5.)

(7) Maintenance on Rod End Bearing

Two nuts (Lock nut and Jam nut) are utilized when attaching a rod end bearing on a piston rod. In the Maintenance Manual of the same type of the aircraft, when the nose landing gear cannot be accommodated with the proper retracted position, it is allowable to use one nut (remove the jam nut) but the maximum length of the exposed threads shall be 0.28 in (approximately seven mm).

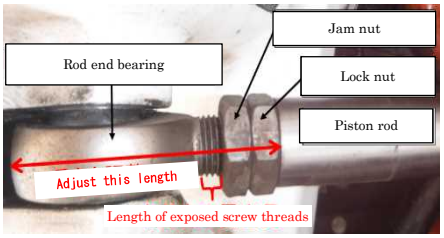

Photo 5 Length of Rod End Bearing (Other aircraft)

Only the lock nut was utilized and it is highly probable that the exposed length was close to the maximum allowable exposure length based on the numbers of threads of the exposed part.

	It is described in the Maintenance Manual of the same type of the aircraft that such maintenance as lubrication shall be carried out on the rod end bearing during the 100-hour inspection. It was confirmed by the Maintenance Records that the 100-hour inspection had been carried out. Moreover, it could not be confirmed by the record that the rod end bearing on the nose landing gear was replaced.

3. ANALYSIS

3.1 Involvement of Weather	No
3.2 Involvement of Pilots	No
3.3 Involvement of Aircraft	Yes
3.4 Analysis of Findings	(1) The aircraft had a valid airworthiness certificate and had been performed inspection and maintenance. (2) The ground speed of the aircraft when its propeller blades hit the runway surface is estimated to be about 45 kt. It is highly probable that the aircraft was reducing its speed despite the Pilot did not apply the brake on the aircraft. (3) It is highly probable that the aircraft became unable to move on the runway during the landing roll because the rod end bearing of the nose landing gear actuator was ruptured and consequently the nose landing gear was retracted. It is somewhat likely that the following sequence of events had occurred in the process until the rod end bearing had been ruptured: ① The nose landing gear strut had leant to backward from the normal gear down position. ② In addition to the impact load applied when the nose landing gear contacts the ground and the rearward load applied until the front wheel rotates (spin up) to the same circumferential speed as the forward speed, as the speed of the aircraft reduced during the landing roll, the load (the weight of the aircraft) applied on the nose landing gear increased and the compression load was applied to the actuator supporting the nose landing gear along its longitudinal direction. ③ Buckling and excessive bending load occurred on the rod end bearing. ④ After the thread on the rod end bearing was bent at an angle of about 90 degree, its connection section with the piston rod end was ruptured. ⑤ Since the support by the nose landing gear actuator ceased, it was pulled in and the aircraft became unable to move on the

	runway. Regarding that the nose landing gear was leant backward from the normal position of its extended position, it is somewhat likely that the rod end bearing was bent because the adjustment of its fully extended position had been improper or the movement of the sliding area of the rod end bearing was restricted while the piston rod was fully extended.

4. PROBABLE CAUSES

In this serious incident, it is highly probable that the aircraft became unable to move on the runway during the landing roll because the rod end bearing of the nose landing gear actuator was ruptured and consequently the nose landing gear was retracted.

Regarding that the rod end bearing ruptured, it is somewhat likely that the compression load was applied to the actuator along its longitudinal direction because the nose landing gear strut leant backward from its normal fully extended position.