

AI2021-2

**AIRCRAFT SERIOUS INCIDENT
INVESTIGATION REPORT**

**PEACH AVIATION LTD.
J A 8 0 5 P**

February 18, 2021

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.

AIRCRAFT SERIOUS INCIDENT INVESTIGATION REPORT

AIRCRAFT DISABLED TO CONTINUE TAXIING DUE TO DAMAGED NOSE LANDING GEAR PEACH AVIATION LTD. AIRBUS A320-214, JA805P AT FUKUOKA AIRPORT, JAPAN AROUND 08:11 JST, MARCH 24, 2018

January 12, 2021

Adopted by the Japan Transport Safety Board

Chairperson TAKEDA Nobuo

Member MIYASHITA Toru

Member KAKISHIMA Yoshiko

Member MARUI Yuichi

Member NAKANISHI Miwa

Member TSUDA Hiroka

1. PROCESS AND PROGRESS OF THE INVESTIGATION

1.1 Summary of the Serious Incident	<p>On Saturday, March 24, 2018, an Airbus A320-214, registered JA805P, operated by Peach Aviation Ltd., was forced to stop on the runway with its nose wheel turned sideways after landing at Fukuoka Airport as a scheduled flight 151. Consequently, the aircraft was unable to continue taxiing.</p>
1.2 Outline of the Serious Incident Investigation	<p>The occurrence covered by this report falls under the category of “landing gear is damaged and thus flight of the subject aircraft could not be continued” as stipulated in Article 166-4, item (viii) of the Ordinance for Enforcement of the Civil Aeronautics Act (Ordinance of Ministry of Transport No. 56 of 1952) prior to revision by the Ministerial Ordinance on Partial Revision of the Ordinance for Enforcement of Civil Aeronautics Act (Ordinance of Ministry of Land, Infrastructure, Transport and Tourism No. 88 of 2020), and is classified as a serious incident.</p> <p>On March 24, 2018, the Japan Transport Safety Board (JTSB) designated an investigator-in-charge and two other investigators to investigate this serious incident.</p> <p>An accredited representative and an advisor of the French Republic, as the State of the design and manufacturing company of the aircraft involved in this serious incident, and an accredited representative of Taiwan where the outsourcing aircraft maintenance company is located, participated in the investigation.</p> <p>On March 30, 2018, factual information obtained from the fact-finding investigation of the Apex pin disconnected from the nose landing gear was submitted to the Civil Aviation Bureau of Japan.</p> <p>Comments were invited from parties relevant to the cause of this serious incident and the Relevant States.</p>

2. FACTUAL INFORMATION

<p>2.1 History of the Flight</p>	<p>According to the statements of the flight crew members, the records of flight data recorder (FDR) and cockpit voice recorder (CVR), and the radar track records, the history of the flight is summarized as follows.</p> <p>On March 24, 2018 around 08:11 in Japan Standard Time (JST: UTC+9 hours; unless otherwise stated, all times are indicated in JST in this report on a 24-hour clock), an Airbus A320-214, registered JA805P, operated by Peach Aviation Ltd. (hereinafter referred to as “the Company”) as a scheduled flight 151, landed on Runway 16 at Fukuoka Airport, with the Pilot in Command (PIC) in the left seat as the PM*1 and the First Officer (FO) in the right seat as the PF*1. At this time, the weather at Fukuoka Airport was fine and there was no problem in landing at the Airport.</p> <p>The Aircraft normally landed firstly with its main landing gear touching down on the runway, followed by its nose landing gear. The speed was 123 kt and the heading was 158° when the main landing gear touched down on the runway. After the main landing gear touched down, the Aircraft started to reduce the speed as the thrust reverser was applied and the autobrake was activated.</p> <p>The FO (PF) felt small vibration when the speed was reduced to about 100 kt. When the brake operation was switched to manual to continue to reduce the speed, the vibration became larger at a speed of about 60 kt, and further larger at a speed of about 40 kt.</p> <p>For this reason, the FO handed over the control of the Aircraft to the PIC. The PIC operated the steering in order to enter the taxiway, but was not able to change the traveling direction. And as the vibration became larger, he stopped the Aircraft on the runway by applying the brake. The Aircraft halted on the runway with a heading of about 15° to the left from the centerline of Runway 16, and consequently was unable to continue taxiing.</p> <p>In addition, there were no abnormalities confirmed in the exterior inspection performed by the FO and the steering operation was normal while taxiing at the departure airport, Kansai International Airport,</p> <p>This serious incident occurred on March 24, 2018 around 08:11 on runway at Fukuoka Airport (33° 35' 01" N, 130° 27' 08" E).</p>
<p>2.2 Injuries to Persons</p>	<p>None</p>
<p>2.3 Damage to the Aircraft</p>	<p>(1) Extent of damage: Slightly damaged</p> <p>With regard to the nose landing gear, the nose wheels were turned about 90° clockwise to the axis, and the following damages were confirmed.</p> <ul style="list-style-type: none"> • Tires and wheels: Both left and right of them damaged • Torque links: Apex pin (described later) disconnected, the upper and lower torque links separated and dented

*1 “PF” and “PM” are the terms to identify roles of the pilots for an aircraft operated by two pilots. PF stands for the Pilot Flying, the pilot primarily responsible for aircraft maneuvering. The PM stands for the Pilot Monitoring, the pilot primarily responsible for cross-checking the PF’s operations and conducting duties other than flying.

Nut, Lock plate, Shur-lok washer, Washers (two) and Bolt (yellow parts seen in Figure 3) missing

- Proximity sensor, Target support: Fractured
- Steering actuator: Impact marks on the cylinder



(Left)

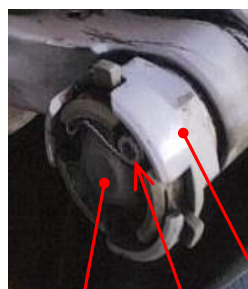
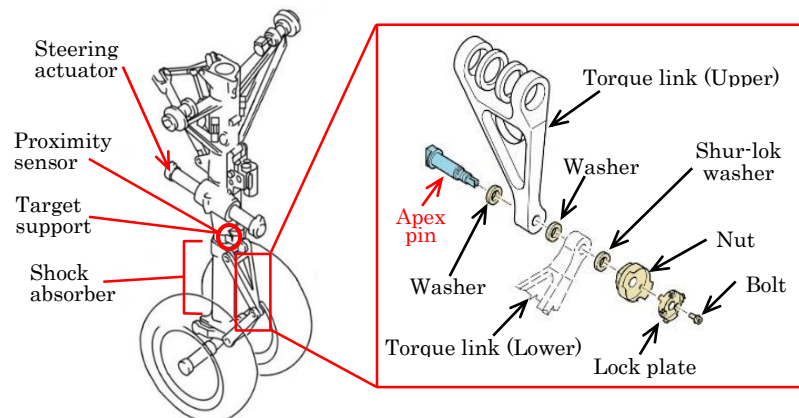


(Right)

Figure 1: Damages to the tires

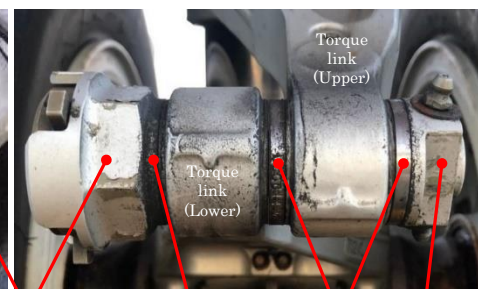


Figure 2: Damages to the nose landing gear



Lock plate

Bolt



Nut

Shur-lok washer

Washer

Apex pin

Figure 3: Parts around torque links

(2) Apex pin

The Apex pin (hereinafter referred to as “the Pin”) to connect the upper and lower torque links of the NLG was recovered on the runway at Fukuoka Airport. Crest of the threads of the recovered Pin were found damaged and corroded (see Figure 4).

Those parts of the Pin assembly, such as Nut, Lock plate, Shur-lok washer, Washers (two) and Bolt were not retrieved in search around the runway at Fukuoka Airport. In addition, they were not found during the check on the runway, the taxiway and the apron of the departure airport, Kansai International Airport.

The flight crew members have no more control of the nose wheel steering in the event that the upper and lower torque links are separated due to missing the Pin.

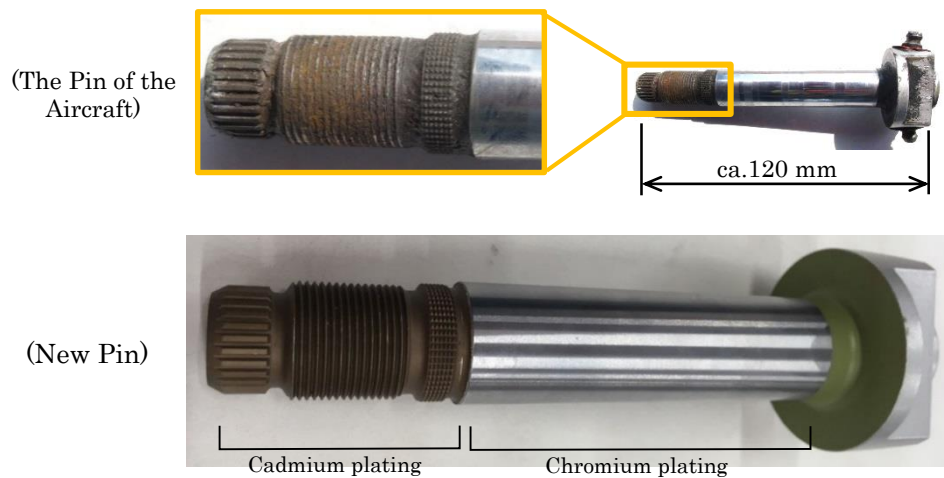


Figure 4: Apex pin

2.4 Personnel Information

(1) PIC: Male, age 65

Airline transport pilot certificate (airplane)	May 14, 1993
Type rating for Airbus A320	November 11, 2011
Class 1 aviation medical certificate	Validity: July 11, 2018
Total flight time	19,028 hours 24 minutes
Total flight time on the type of aircraft	4,650 hours 54 minutes

(2) FO: Male, age 24

Commercial pilot certificate (airplane)	December 18, 2014
Type rating for Airbus A320	June 27, 2017
Instrument flight certificate	March 20, 2015
Class 1 aviation medical certificate	Validity: January 24, 2019
Total flight time	487 hours 59 minutes
Total flight time on the type of aircraft	244 hours 43 minutes

2.5 Aircraft Information

(1) Aircraft type:	Airbus A320-214
Serial number:	5304
Date of manufacture:	October 4, 2012
Airworthiness Certificate:	No. DAI-2015-189
Validity:	During a period in which the aircraft is maintained in

	<p>accordance with the maintenance program (Peach Aviation Ltd.) approved based on Civil Aeronautics Act since July 8, 2015</p> <p>Flight time since the last periodic check (a periodic heavy maintenance check conducted on May 24, 2017) 2,694 hours 55 minutes</p> <p>(2) When the serious incident occurred, the weight and the center of gravity of the Aircraft were within the allowable ranges.</p>
<p>2.6 Meteorological Information</p>	<p>The Aviation Routine Weather Report (METAR) for Fukuoka Airport were as follows:</p> <p>08:00 Wind direction 160° ; Wind velocity 10 kt; Prevailing Visibility 10 km or more Cloud: Amount FEW (1/8 – 2/8); Cloud base 3,000 ft; Temperature 9°C; Dew point 5°C; Altimeter setting (QNH): 30.20 inHg</p>
<p>2.7 Additional Information</p>	<p>(1) The incident site</p> <p>The position of the Aircraft complete stop was about 1,700 m from the threshold of Runway 16. The Aircraft stopped slightly left from the runway centerline with its heading veered about 15° to the left. Its nose wheel turned about 90° clockwise to the aircraft axis. (see Figure 5)</p> <div data-bbox="422 1008 1348 1254" data-label="Image"> </div> <p>Figure 5: Serious Incident Aircraft (at the time of the serious incident)</p> <p>The mark of nose landing gear tires and scratch mark continued to the position of the Aircraft complete stop from about 130 m astern of the stop position.</p> <p>The Pin was recovered on the runway about 350 m ahead of the main gear touchdown point (about 850 m astern of the position of the Aircraft complete stop) (see Appended Figure 1).</p> <p>(2) The results of A320 fleet inspections by the Company</p> <p>After the serious incident, the Company performed A320 fleet inspections on the Pin for other 17 aircraft, among which six aircraft were confirmed to have the corroded pin threads that were all replaced with new products. The extent of the corrosion for those removal pins were not all the same, but these pin threads were neither damaged nor deformed.</p> <p>(3) Lubrication and inspection of the Pin</p> <p>① Lubrication and inspection of the Pin</p> <p>The inspection of the Pin is specified in the maintenance</p>

requirements established by the Company in accordance with the Aircraft Maintenance Manual of the design and manufacturing company (hereinafter referred to as “Design manufacturer”) of the Aircraft as follows.

- Lubrication of the Pin shall be performed every 500 cycles or 121 days (greasing up for the chromium section).
- Visual inspections shall be performed after removing the Pin every 5,000 cycles.
- Visual inspections shall be performed every 6 years.

On May 19, 2017, the inspection of the Pin was performed in a outsourcing aircraft maintenance company in Taiwan (hereinafter referred to as “Company A”) during the heavy maintenance check subcontracted by the Company. A visual inspection was performed after removing the Pin, and found that there was no abnormality, therefore, the Pin was re-installed.

In addition, most recently, the Pin of the Aircraft was greased on February 6, 2018 by the Company at Kansai International Airport.

When the serious incident occurred, the Pin’s total time in-service was 16,598 hours, the cycles were 10,496, and the duration of service was five years and five months, and during this time, visual inspections after removing the Pin were performed three times in total (two times by the domestic outsourcing aircraft maintenance company in charge of the heavy maintenance check and one time by Company A). Besides, the Pin’s total time in-service was 2,694 hours and the cycles were 1,441 since the last visual inspection in the Company A.

② Aircraft Maintenance Manual of Design manufacturer of the Aircraft

The removal and installation procedures related to the inspection of the Pin were specified in the Aircraft Maintenance Manual of Design manufacturer of the Aircraft. With regard to the lubrication during installation of the Pin, it specified the parts to be lubricated with grease, however, neither the greasing methods nor the region for lubricating each part.

(4) Detailed investigation of the Pin

The detailed investigation of the Pin of the Aircraft was performed by the Design manufacturer of the Aircraft and the Manufacturer of its nose landing gear, which gave the following findings.

① Microscopic observation of the threaded area of the Pin

- Crest of the threads have been found damaged and flattened. The maximum height measured is 0.202 mm when the specification requirement is greater than 0.613 mm.
- The threads were deformed indicating that the nut was pulled out of the Pin without the nut rotating.
- Rust was confirmed within the threads.

It was confirmed that many threads of the Pin were seriously

damaged due to the developed corrosion.

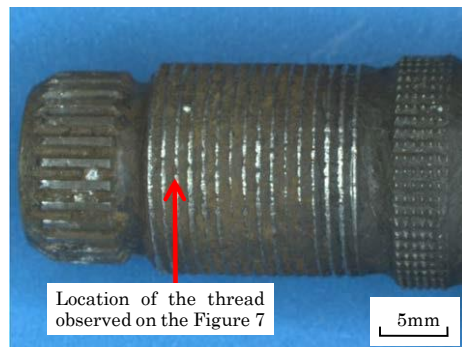


Figure 6: Enlarged photo of the Pin threads

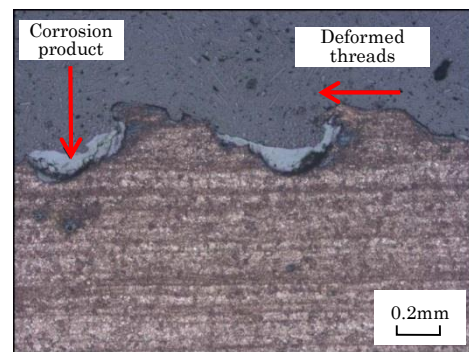


Figure 7: Micrograph showing the cross-section of Pin threads

② Corrosion / damage to the Pin threads

- a) Regarding the corrosion protections of the Pin threads, there are two ways: greasing and cadmium plating. If one of those is not properly applied, the risk of corrosion development is increased. In addition, the lubrication with grease is to prevent any damage to the cadmium plating during the Pin assembly and disassembly by reducing friction between the threads of the Pin and of the nut.
- b) It was confirmed that there was no trace of grease on the Pin threads of the Aircraft. From the experience of the Manufacturer of the nose landing gear, the thread region keeps a shiny and wet aspect when it is greased. Therefore, it is somewhat likely that the lubrication of the Pin threads during re-installation was not sufficient.
- c) Marks of damage were observed on the painted surface under the head of the Pin (see Figure 8).
- d) Abnormal wear marks were observed on the Pin chromium section (see Figure 9).

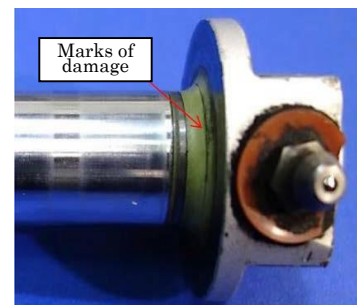


Figure 8: Damage to the paint under the head of the Pin

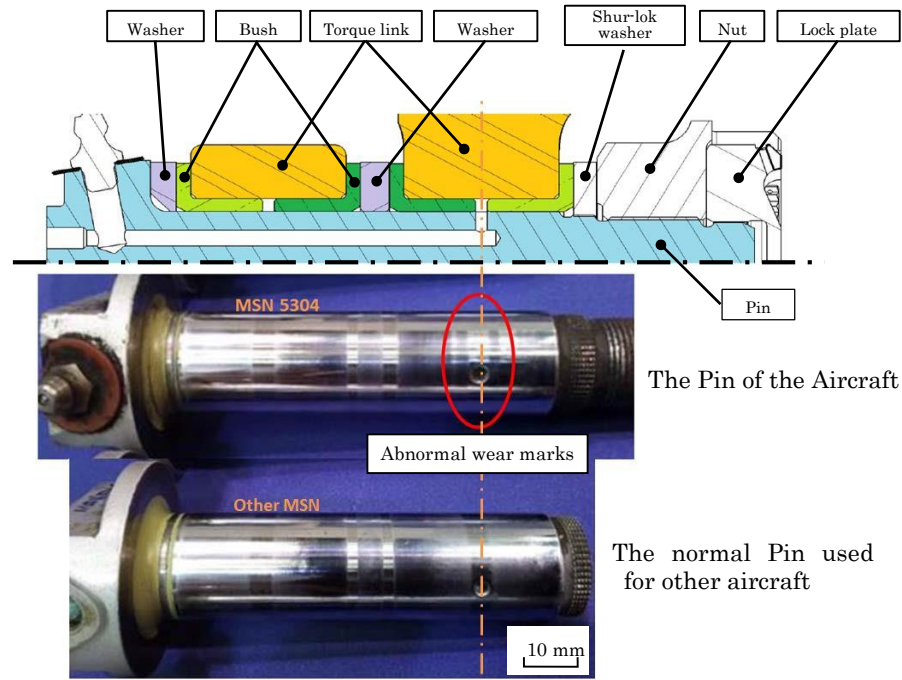


Figure 9: Comparison of the Pin wear marks

- e) The shur-lok splines were found fully filled with solid grease. When a new shur-lok washer was installed in the splines, the grease was pushed from the splines (see Figure 10). The installation of the shur-lok washer can prevent the rotation of the torque link joint from transmitting to the nut during operation of the shock absorber.

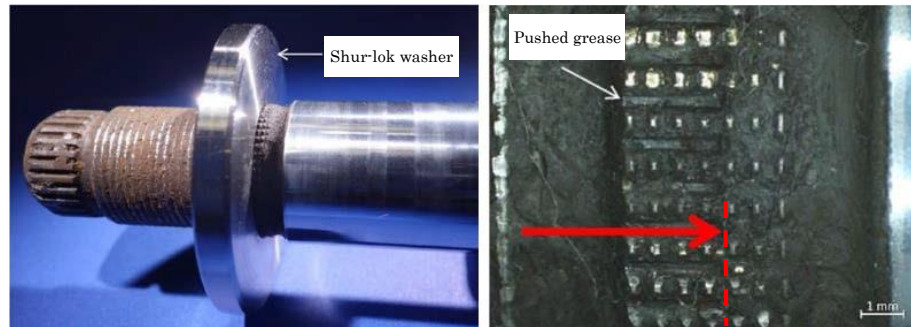


Figure 10: Old grease filling shur-lok splines
 (※The shur-lok washer was inserted to the red dash line.)

- ③ Occurrence of the similar serious incidents and investigation by the Design manufacturer of the Aircraft

After this serious incident, two other cases of the Pin disconnection happened to the same type of the Aircraft in Korea and China in April and November in 2019 respectively. The Pin threads were found corroded in these incidents, too. The inspections on the Pin of the A320 fleet in these States of Occurrence revealed that corrosion findings on the Pin and nut threads were not limited to these three incident

aircraft.

The investigation on these issues revealed that repetitive installations and removals of the Pin and nut in production and subsequent maintenance work can damage and degrade the cadmium plating. Especially, after six years in service, it was confirmed that the cadmium plating was highly abraded, which reduced protection against corrosion.

According to the Design manufacturer of the Aircraft, the application of cadmium plating on the complicated surface shape such as the threads is industrially complex, therefore, the thickness of cadmium layer of the threads may not be uniform. The thin plated region will have a diminished protection against corrosion and their cadmium plating will be degraded more rapidly during installations and removals of the nut and the Pin. Besides, the cadmium plating may be damaged by the repetitive load generated by the vibration if there is rotational free play between the pin and nut. If the cadmium plating is damaged, the occurrence of corrosion cannot be suppressed even if grease is properly applied.

(5) The maintenance company who performed the previous heavy maintenance check on the Aircraft

The Company A, to whom the Company outsourced the heavy maintenance on the Aircraft, is a maintenance contractor specializing in maintenance of aircraft.

① Previous heavy maintenance on the Aircraft

According to the maintenance records concerning the maintenance work for the Aircraft's nose landing gear performed on May 19, 2017, the maintenance work related to the Pin of the Aircraft was performed in compliance with the maintenance requirements of the Company, and confirmed by the inspector and certifying staff of the Company A.

② Maintenance work of the Company A

In April, 2019, in the Company A, the aircraft accident investigators of JTSA conducted investigation including attendance at the inspection on the Pin of the A320 of the Company.

The same worker, inspector, and certifying staff as in the previous maintenance check on the Aircraft were engaged in the maintenance work. Before the maintenance work, they confirmed about the maintenance work to be performed as well as the maintenance manual to be used. They performed the maintenance work in accordance with the procedures and the contents specified in the maintenance manual. Besides, the grease specified in the maintenance manual was applied to the parts as instructed in the manual.

After the worker performed the maintenance work in each process, the inspector conducted the inspection.

(6) Service bulletin issued by the Design manufacturer

On April 9, 2020, based on the results of root cause investigation on the

	<p>similar incidents and inspections on their operating aircraft in Korea and China, the Design manufacturer of the Aircraft issued the Service Bulletin to the operators of the A320 Family fleet in order to recommend the inspections on the corrosion of the Pin and nut threads.</p> <p>This Service Bulletin specifies that the Pin and nut threads shall be inspected when four years have passed since the production of the aircraft or their installation in the aircraft, and the repetitive inspection shall be conducted every 18 months or four years depending on the result of the initial inspection.</p>
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3. ANALYSIS

3.1 Involvement of Weather	None
3.2 Involvement of Pilots	None
3.3 Involvement of Aircraft	Yes
3.4 Analysis of Findings	<p>(1) Malfunction of nose landing gear</p> <p>It is highly probable that the Aircraft was unable to continue taxiing with its nose wheel turned sideways about 90° because during landing roll, the upper and lower torque links, which transmit the steering operations to the nose wheel, were separated due to the disconnection of the Pin that connected both torque links, and the nose wheel was free to move in the horizontal direction with no more control of the steering.</p> <p>(2) Disconnection of the Pin</p> <p>It is highly probable that after the Aircraft landed at Fukuoka Airport, the Pin was disconnected during landing roll. From the detailed investigation on the disconnected Pin, it is probable that because the dimensional stability and mechanical strength of the threads were deteriorated by corrosion developed in the threads, the Pin assembly could not withstand the loading in a direction of pulling out the nut that occurred when the torque links moved in the horizontal direction during the steering operations, the threads were chipped away and deformed, and nut being torn, which led to the disconnection of the Pin. Where and when the nut was disconnected could not be determined because the nut and others were not retrieved.</p> <p>(3) Possibility of misassembly</p> <p>Scratch marks were observed on the painted surface under the head of the disconnected Pin, and it is somewhat likely that these marks indicate that the washer was not installed properly or torque links were assembled without installing the washer during the aircraft production or past heavy maintenance checks. After that, it is somewhat likely that as noticing the wrong torque link assembly, the washer was reinstalled rightly.</p> <p>It is highly probable that shur-lok washer had not been installed because the shur-lok splines were found fully filled with solid grease substrate. For this reason, it is somewhat likely that abnormal wear and friction marks</p>

were observed on the chromium section of the Pin because the position of the torque link bushes were not consistent with the nominal assembly of the Pin.

(4) Corrosion development on the Pin threads

The duration of service of the Aircraft's Pin was five years and five months, and during this time, inspections were performed three times by removing and installing the Pin and nut. It is somewhat likely that the cadmium plating on the threads region were damaged due to the installations and removals of the Pin and nut that were performed repeatedly in accordance with the maintenance manual after the aircraft production.

In addition, it is somewhat likely that due to the absence of the shur-lok washer, the rotation of the joint between the upper and lower torque links generated during extract and retract movements of the shock absorber was transferred to the nut, which might repeatedly generate small friction on the Pin and nut threads, leading to the degradation of the cadmium plating.

It is probable that the corrosion of the Pin threads developed because the cadmium plating was damaged and the corrosion resistance of the threads of the Pin decreased.

(5) Factors which accelerated the corrosion development on the Pin

The Pin disconnection occurred about 10 months after the inspection performed in the Company A, and in this regard, it is probable that the following factors may contribute to the acceleration of the corrosion development on the Pin.

① Possible lack of lubrication with grease

In order to protect against corrosion, cadmium plating and greasing are applied on the Pin threads.

It is somewhat likely that the lubrication of the Pin threads during reinstallation at the heavy maintenance check by the Company A was not sufficient because there was almost no trace of greasing on the disconnected the Pin of the Aircraft.

It is somewhat likely that the Aircraft Maintenance Manual of Design manufacturer of the Aircraft did not specify clearly the method and region to be greased, which has become the factor that contributed to inappropriate lubrication.

② Possibility of misassembly

It is somewhat likely that due to the absence of the shur-lok washer, the gap between each part at the torque link joint became larger that facilitated water infiltration into the Pin and nut threads, in which the corrosion development was accelerated.

In addition, it is somewhat likely that when the inspection on the Pin was performed in the Company A on May 19, 2017, there had been already damage to the cadmium plating and small corrosion, however, in this case, it could have been such a degree that the replacement of the Pin was not required.

4. PROBABLE CAUSES

In this serious incident, it is highly probable that the Aircraft was unable to continue taxiing with its nose wheel turned sideways about 90° because during landing roll, the Pin that connected the upper and lower torque links was disconnected, and it had lost control of the nose wheel steering.

It is probable that the Pin disconnection occurred because the mechanical strength of the threads was deteriorated by corrosion developed on the Pin threads, the Pin assembly could not withstand the loading transmitting from the torque links to the nut during steering operations, and the nut was torn.

Regarding the corrosion development on the Pin threads, it is probable that the cadmium plating was damaged and the corrosion resistance was reduced because installations and removals of the Pin and nut were repeatedly conducted after the aircraft production, and the torque links were misassembled.

In addition, it is somewhat likely that during reinstallation at the heavy maintenance check on the Aircraft, the lubrication of the Pin threads was not sufficient and the torque links were misassembled, which contributed to the acceleration of the corrosion development on the Pin threads.

5. SAFETY ACTIONS

(1) Design manufacturer of the Aircraft

- ① Following this serious incident, the Aircraft Maintenance Manual was reviewed. As a result of this review, the Aircraft Maintenance Manual was updated by making the cleaning procedures in the detailed inspection on the Pin much clearer, and adding the inspection method regarding corrosion. Besides, the Pin installation procedures were updated to ensure that the grease application method and region were clarified.
- ② In the revised manual, it is required to clean carefully and dry all the Pin threads and splines, and to completely fill the threads and splines with reapplied grease.
- ③ To the A320 Family Operators, the “Technical Follow-Up” was issued to provide the information on this serious incident in detail and the revised Aircraft Maintenance Manual. In addition, the Service Bulletin was issued to recommend the Operators to perform an initial inspection of the Pin threads and recurrent A320 fleet inspections subsequently
- ④ As a terminating action, the Pin and nut with improved corrosion resistance will be developed on future.

(2) The Company

After the serious incident, the Company performed inspections on the Pin condition of their A320 fleet, and replaced the Pin suspected corrosion. Although inspections on the Pin threads and reapplication of grease used to be performed every six to ten months to monitor the status of the applied grease, after receiving the Service Bulletin mentioned as above, the inspection procedures were established in accordance with this Service Bulletin.

It was decided that the Pin inspection was established as an item for witness inspection by the Company’s inspector in case of outsourcing the heavy maintenance check to other company.

Appended Figure 1: Serious Incident Site

