Air Accident Investigation Unit Ireland

SYNOPTIC REPORT

INCIDENT
Avions de Transport Régional
ATR 72-201, EI-REI
Dublin Airport
30 March 2013

An Roinn Iompair
Turasóireachta agus Spóirt

Department of Transport,
Tourism and Sport

Foreword

This safety investigation is exclusively of a technical nature and the Final Report reflects the determination of the AAIU regarding the circumstances of this occurrence and its probable causes.

In accordance with the provisions of Annex 13[1] to the Convention on International Civil Aviation, Regulation (EU) No 996/2010[2] of the European Parliament and the Council, and Statutory Instrument No. 460 of 2009[3], safety investigations are in no case concerned with apportioning blame or liability. They are independent of, separate from and without prejudice to any judicial or administrative proceedings to apportion blame or liability. The sole objective of this safety investigation and Final Report is the prevention of accidents and incidents.

Accordingly, it is inappropriate that AAIU Reports should be used to assign fault or blame or determine liability, since neither the safety investigation nor the reporting process has been undertaken for that purpose.

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[1] **ICAO Annex 13**: International Civil Aviation Organization, Annex 13 to the Convention on International Civil Aviation, Air Accident and Incident Investigation.

[2] **Regulation (EU) No 996/2010** of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation.

[3] **Statutory Instrument (SI) No. 460 of 2009**: Air Navigation (Notification and Investigation of Accidents, Serious Incidents and Incidents) Regulations 2009.

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In accordance with Annex 13 to the Convention on International Civil Aviation, Regulation (EU) No 996/2010 and the provisions of SI 460 of 2009, the Chief Inspector of Air Accidents, on 30 March 2013, appointed Mr Leo Murray as the Investigator-in-Charge to carry out an Investigation into this Incident and prepare a Report.

Aircraft Type and Registration:	ATR 72-201, EI-REI
No. and Type of Engines:	2 Pratt & Whitney PW 124B
Aircraft Serial Number:	267
Year of Manufacture:	1991
Date and Time (UTC[4]):	30 March 2013 @ 15.43 hrs
Location:	Dublin Airport (EIDW)
Type of Operation:	Public Transport - Scheduled
Persons on Board:	Crew - 4 Passengers - 57
Injuries:	Crew - Nil Passengers - Nil
Nature of Damage:	Minor
Commander's Licence:	Airline Transport Pilot Licence (Aeroplanes) issued by the Irish Aviation Authority (IAA)
Commander's Details:	Male, aged 54 years
Commander's Flying Experience:	8,586 hours, of which 5,815 were on type
Notification Source:	Dublin Airport Authority Operations
Information Source:	AAIU Field Investigation, and AAIU Report form submitted by the Commander

[4] **UTC**: Coordinated Universal Time, coincident with local time on 30 March 2013.

SYNOPSIS

The aircraft was operating a scheduled passenger flight from Edinburgh (EGPH) to Dublin (EIDW). Following a normal touchdown, a severe nose wheel shimmy was experienced as the aircraft decelerated below 40 kts. Subsequent inspection of the nose leg assembly revealed that the nose landing gear (NLG) torque link apex pin assembly was missing.

1. FACTUAL INFORMATION

1.1 History of the Flight

The aircraft was engaged on a scheduled passenger flight carrying 4 crew and 57 passengers. A pre-departure inspection was carried out at EGPH with no defects noted. Following a routine flight, an approach and normal touchdown was made on Runway (RWY) 10. During the landing roll, the flight crew felt a severe shimmy from the nose wheel and stopped the aircraft on the runway. The Airport Fire Service (AFS) attended and confirmed that all tyres appeared to be properly inflated. The aircraft was taxied slowly onto Taxiway B3, clear of the active runway and the engines were shut down. With the aircraft secure, the passengers were deplaned and transported by bus to the terminal building. There were no injuries.

An Inspection on the taxiway revealed the NLG torque link apex pin to be missing (**Figure No. 1**).

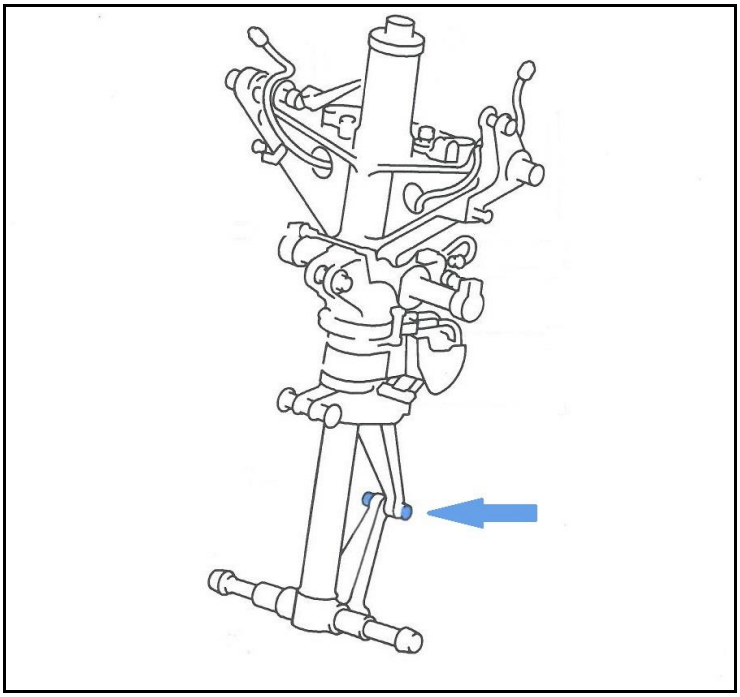

Figure No. 1: Location of torque link apex pin on nose leg assembly

The nose landing gear was photographed (**Photo No. 1**) and the aircraft was then towed to a hangar for further inspection.

Photo No. 1: Separated Torque Links

1.2 Inspection of nose landing gear

The AAIU inspected the aircraft later that day. The NLG torque link apex pin, washers, retaining nut and lock washer were missing which allowed the torque links to separate. When the upper link separated, it caused damage to the weight-on-wheel switch assembly and the loss of the switch targets and bracket. Following separation, the lower link caused damage to the inside of both nose landing gear wheels. The bushings installed at the end of each torque link, through which the pin is located, both remained in place.

Neither the torque link apex pin nor any of its associated hardware were found despite several searches by the AFS of the runway and the adjacent areas. The departure airport was also notified and a similar search conducted there also proved negative.

1.3 Nose landing gear assembly

The nose landing gear comprises, *inter alia,* the oleo leg strut and two torque link arms, which allow vertical movement of the axle whilst preventing sideways rotation. The torque link arms are joined together by means of a pin, which is located in bushings in each of the torque links. The pin assembly contains a number of shaped washers and a retaining nut, which is secured by means of a serrated (locking) washer (**Figure No. 2**).

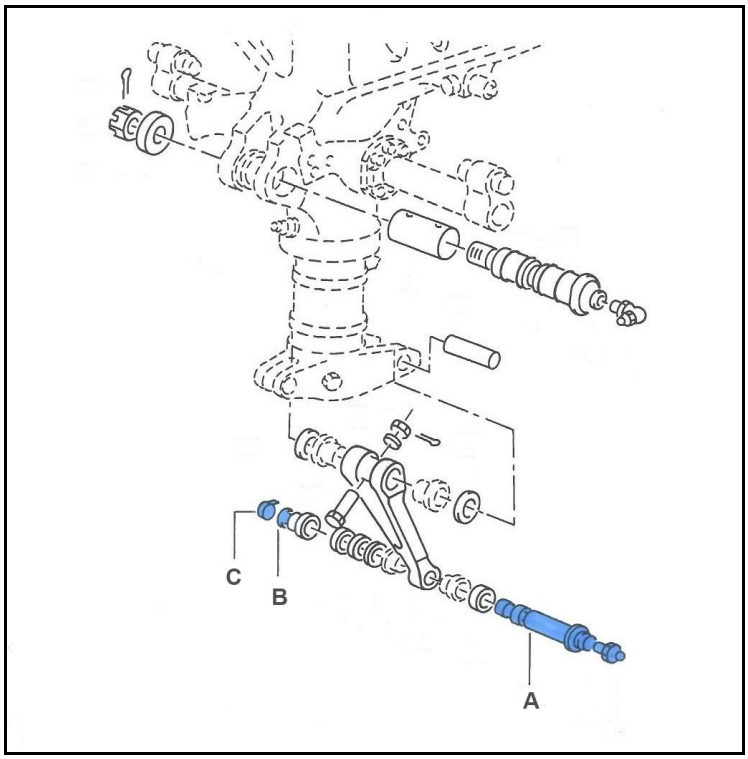

Figure No. 2: Detail showing torque link apex pin (A), retaining nut (B) and serrated (locking) washer (C).

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1.4 Maintenance History

The nose landing gear assembly was installed on EI-REI on the 7 March 2012 at an approved maintenance facility while the aircraft was on C Check[5]. Since installation, the Operator did not perform any maintenance that involved the removal or installation of the torque link apex pin.

On 22 January 2013, the NLG primary indication light was noted to be flickering between locked and unlocked when the aircraft was on the ground. Following a similar report on 9 Feb 2013, the proximity switch was replaced with no further report of this defect being made.

On 20 February 2013, the nose wheels were replaced due to reports of shimmy on rotation.

On 2 March 2013, substantial vibration was reported from the nose and main landing gear during take-off and landing phases. Rectification work involved the replacement of both nose wheels and the four main wheels and the inspection of all brake units.

The loss of the torque link apex pin on EI-REI was the only instance of this type of event experienced by the Operator on its ATR fleet.

[5] **C Check**: Heavy maintenance check.

1.5 Events with Other Operators

The AAIU was informed by the French *Bureau d'Enquêtes et d'Analyses* (BEA), that two other events involving the loss of a torque link apex pin on ATR variants were under investigation. In the first case, which occurred in October 2011, incorrect assembly of a spacer component was identified. The second case, which occurred in France in March 2013, involved an ATR 72-500. That event appears to be very similar to the EI-REI event, in that the apex pin was noted missing following landing. In that case, significant corrosion was found on the threaded part of the link pin, which was recovered. The second event is the subject of investigation by the BEA.

1.6 Chocking Method

The Operator informed the AAIU that at outstations, different types (and sizes) of chock could be employed. When large wheel chocks were used and a chock was placed behind the right nose wheel, in certain situations, the chock could become lodged under the nut end of the apex pin. In such cases, considerable force was required to free the chock.

The Operator's Engineering Department recognised that this could be a problem at some outstations where the chocks used were larger than those used at the Operator's own bases. The Operator advised all bases to take extra care when chocking the nose wheels. Furthermore, on 23 April 2013, the Operator issued a detailed Ground Crew Instruction (GCI 2013-08) on the placement of wheel chocks following arrival:

> *'One designated member of the ground crew immediately places chocks forward and aft of the left (port side) nose gear wheel ensuring that each chock does not exceed past the inside of each wheel.'*

Also: *'When positioning chocks to the nose wheel of an ATR, special care must be taken to ensure no damage is caused to the nose wheel bay doors and in particular the apex bolt* [link pin] *which is present on the right of the torque links.'* [Emphasis is as per original document]

1.7 Fleet Inspection

Following the subject Incident, the Operator carried out a detailed visual inspection of the condition of the torque link apex pins on its ATR fleet. This inspection involved taking detailed photographs of the pin and attachment nut before and after removal, inspecting the torque link apex pin and its associated hardware and cataloguing any defects found.

This inspection revealed a number of apex pins with various levels of corrosion; degradation of the cadmium protection was noted (**Photo No. 2**). In response to this, the Operator added a supplementary maintenance program task with a 4-year interval to remove and inspect apex pins for corrosion (Engineering Order TS-32-0183) to be incorporated in the next revision of the ATR 72 and ATR 42 maintenance programmes.

Photo No. 2: Example of corrosion found on NLG torque link apex pin following fleet inspection

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1.8 Manufacturer's Recommendation

The Aircraft Manufacturer informed the Investigation that corrosion was found on a number of torque link apex pin threaded areas on other ATR aircraft. On 15 October 2014, the Manufacturer issued an Operator's Information Message (OIM) regarding the NLG torque link apex pin loss experienced on ATR 42 and ATR 72 aircraft.

The OIM states *inter alia*:

> *'Material loss due to corrosion was responsible for thread profile reduction. This reduction results in increased load on the remaining threads leading to their deformation and allowing the retaining nut to become separated from the pin. The origin of the corrosion is not fully identified.'*

This message recommended a one-off inspection of the NLG in accordance with MBD SB 631-32-221 to identify and prevent new cases and to gather feedback from operators if corrosion was found.

2. ANALYSIS

This was the first reported loss of an apex pin by this Operator. Following the Incident, the Operator identified a practice at outstations whereby large wheel chocks could be positioned in such a way that it was possible to lodge under the apex pin locking washer and while the chock was being removed, leading to its displacement.

Following this event, the chocking of the nose wheels was monitored closely to avoid damage to the NLG torque link assembly. No further instances were reported by the Operator.

The fleet inspection carried out by the Operator revealed a number of apex pins with various levels of corrosion present. The Operator put in place a repetitive inspection programme to examine torque link apex pin assemblies to prevent the possibility of such corrosion resulting in the loss of an apex pin.

The Manufacturer advised the Investigation that inspection of ATR aircraft revealed, in some instances, significant corrosion of the threaded portion of the apex pin. It is probable that such corrosion had some bearing on the loss of the serrated washer and nut thereby allowing the pin to migrate free. The root cause of the corrosion has not yet been determined; however, degradation of the cadmium protection was noted.

Despite several searches by the AFS, neither the missing link pin nor any of the retaining hardware was found. Without this evidence, it was not possible for the Investigation to reach a definitive conclusion regarding the loss of the torque link pin.

3. CONCLUSIONS

(a) Findings

1. The aircraft experienced a severe nose-wheel shimmy following landing.

2. Subsequent Inspection revealed that the nose landing gear (NLG) torque link apex pin and its associated retaining nut and washers were missing.

3. The nose landing gear assembly was installed on the 7 March 2012, at an approved maintenance facility, while the aircraft was undergoing heavy maintenance. Since installation, the Operator did not perform any maintenance that would have involved the removal or installation of the torque link apex pin.

4. The Operator identified a scenario whereby the misplacement of the nose wheel chock could lead to the displacement of the serrated (locking) washer.

5. The Operator issued a Ground Crew Instruction (GCI) to ensure the proper placement of chocks on its ATR fleet.

6. Following the event, the Operator carried out an inspection of the torque link apex pins on its ATR fleet. This inspection revealed a number of cases of significant corrosion to the threaded portion of the Torque link pins.

7. As the torque link apex pin was not recovered, it was not possible for the Investigation to reach a definitive conclusion regarding the particular loss of the pin from EI-REI.

8. A BEA Investigation into a similar event identified significant corrosion on the threaded portion of the apex pin.

9. Inspection of apex pins on other aircraft revealed in some instances significant corrosion on the threaded portion of the pin.

10. On 15 October 2014, the aircraft Manufacturer issued an Operators Information Message (OIM) regarding the NLG torque link apex pin loss on ATR 42 and ATR 72 type aircraft.

11. The root cause of the apex pin corrosion has not been determined; however, degradation of the cadmium protection on the threaded portion was noted.

(b) Probable Cause

1. It is likely that corrosion of the threaded portion of the apex pin had occurred such that the serrated washer and retaining nut separated from the link pin allowing the link pin to migrate free.

(c) Contributory Cause(s)

1. The susceptibility of the link pin material to corrosion at the threaded portion following degradation of the cadmium protection.

4. SAFETY RECOMMENDATIONS

This Investigation does not sustain any Safety Recommendations.

- END -

In accordance with Annex 13 to the Convention on International Civil Aviation, Regulation (EU) No 996/2010, and Statutory Instrument No. 460 of 2009, Air Navigation (Notification and Investigation of Accidents, Serious Incidents and Incidents) Regulation, 2009, the sole purpose of this investigation is to prevent aviation accidents and serious incidents. It is not the purpose of any such investigation and the associated investigation report to apportion blame or liability.

A safety recommendation shall in no case create a presumption of blame or liability for an occurrence.

Produced by the Air Accident Investigation Unit

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Department of Transport,
Tourism and Sport

Air Accident Investigation Unit,
Department of Transport Tourism and Sport,
2nd Floor, Leeson Lane,
Dublin 2, Ireland.
Telephone: +353 1 604 1293 (24x7): or
+353 1 241 1777
Fax: +353 1 604 1514
Email: info@aaiu.ie
Web: www.aaiu.ie