

BAe ATP, G-MANM

AAIB Bulletin No: 12/2000 Ref: EW/C99/5/5 Category: 1.1

Aircraft Type and Registration: BAe ATP, G-MANM

No & Type of Engines: 2 Pratt & Whitney PW-126 turboprop engines

Year of Manufacture: 1988

Date & Time (UTC): 13 May 99 at 1900 hrs

Location: Jersey Airport, Channel Islands

Type of Flight: Public Transport

Persons on Board: Crew - 5 - Passengers - 47

Injuries: Crew - None - Passengers - None

Nature of Damage: Right main landing gear torque links apex pin separated,
Damage to brake units

Commander's Licence: Airline Transport Pilot's Licence

Commander's Age: 53 years

Commander's Flying Experience: 12,691 hours (of which 811 were on type)
Last 90 days -
N/K
Last 28 days -
38 hours

Information Source: Aircraft Accident Report Form submitted by the pilot and
telephone enquiries

History of the flight

Following an uneventful flight, a normal touchdown, using 29° of flap, was made at Jersey. The aircraft decelerated normally after touchdown until the speed had dropped to about 60 kt at which point a severe vibration began. The landing roll was completed and the aircraft taxied clear of the runway where it was stopped and the engines shutdown; the passengers were then disembarked and taken by bus to the terminal.

Examination of aircraft

The aircraft was inspected on the taxiway and it was found that the apex pin from the right main landing gear torque links (see Figure 1) was missing and the wheels were misaligned by about 20° to the right. The pin was subsequently found on the runway together with the centre portion of the locking bolt, which had been retained sheared off in the pin end (see Figure 2), however, neither of the ends of the locking bolt nor the pin retaining nut was found. Subsequent engineering examination showed that the threads of the apex pin were very severely worn and distorted in shear towards the free end of the pin. The shear distortion was evidence that the nut had been stripped off the threads, leading to the shearing of the locking bolt.

As a result of this incident, the operator sought the advice of the landing gear manufacturer concerning additional inspections required for the incident aircraft type and, acting on the advice given, on 19 May 1999 the operator instituted a fleet-wide inspection to check the end float of all Main Landing Gear (MLG) apex joints and to replace the Apex Pin assemblies if necessary (see Figure 3). During this fleet inspection, one Apex Pin was found to have very severely worn threads and the fit of its associated nut was very slack on the pin threads. This pin and nut were sent to the landing gear manufacturer who established their thread forms and compared them with an 'as new' exemplar (see Figure 4). It was considered that the residual strength of the threads of the nut and pin combination was insufficient to withstand the loads generated by wheel shimmy, which would be likely to occur more severely with the increased apex joint clearances resulting from such thread wear.

Service history of the right main landing gear of G-MANM

At the time of this incident the main landing gear had done 10,389 landings since overhaul in 1993. The Apex Bolt which failed had last been adjusted 19/20 November 1998 as a result of reports of mainwheel shimmy. At that time the landing gear had done 9,666 landings, some 723 landings before this incident. Since the time of the Apex Pin adjustment, the aircraft had been subjected to two 600 hr routine checks.

History of the ATP main landing gear torque link joint

The design of joint used in this application (Figure 3) requires an apex pin end float of between 0 and 0.05 mm with the apex joint shimmed to give correct tracking of the wheels and this is achieved using a shim, behind the retaining nut, ground to a thickness for the individual joint. The correct adjustment of the joint requires no axial clamping of the nut against the side face of the torque links and, consequently, leaves the nut free to rattle on the pin threads when end load is not applied to the pin during aircraft ground manoeuvring; a freedom that will increase as the joint wears towards its, in service, end float limit of 0.15 mm. The pin and nut sent by the operator for thread profile determination indicated that such wear does take place, weakening the shear strength of the threads (Figure 4).

The Main Landing Gear of the ATP has a scheduled overhaul life of 12,000 landings. By July 1993, however, service experience had indicated, to the landing gear manufacturer, that the wear rate of the torque link apex joint was sufficiently high that it was necessary to introduce a 'Half Life' check on the adjustment of this joint. Although the landing gear manufacturer considered that this inspection was required every 6,000 landings, Operators, who preferred not to accept an additional 'out of phase' inspection if an alternative were available. After discussions, an inspection interval of 6,000 hours or a maximum of 9,000 landings was considered acceptable to both the Operators and the airframe and landing gear Manufacturers. At that time the development of wear

in this joint was not considered to be an air safety issue, nor was wear of the threads of the pin or retaining nut identified as a particular problem.

As a consequence, the landing gear manufacturer issued a Service Letter (ATP A 11) in July 1995 which referred to the optimum inspection period of 6,000 landings and advising inspections at an interval of 6,000 hours; however, no mention of a 9,000 landing limitation was made in this Service Letter. The Service Letter highlighted the new build and in-service end float limits of the Apex joint but did not draw any attention to the inherent likelihood of, in service, thread wear on the pin and nut owing to the absence of a pre-load on the threads in a high vibration area.

Although the general principle of this joint is similar to the design used on the landing gear of a similar aircraft type from a different manufacturer, on that installation there is a required pre-load on the nut, for which an adjustment check is scheduled at 1,000 landing intervals. There are other main landing gear installations with non-preloaded apex joints which have an inspection interval of 1,000 flight hours or 1 year and a nose gear installation with an interval of 7,000 flights or 3 years.

In 1998, a pin failure similar to this had occurred on a foreign registered aircraft, overseas, and the components were returned to the manufacturer for investigation. They concluded that the stripped threads on the pin had resulted either from overload applied via the torque links or as a result of overtightening of the nut.

Action following the incident to G-MANM but before that occurring to G-MANH

As a result of this incident, the Landing Gear manufacturer instigated a one-time inspection of the torque link apex joints of all ATP Main Landing Gears to determine the condition of the threads on both the nut and pin and to reject those combinations with significant wear. This inspection brought to light a further four apex pin/retaining nut combinations with unacceptably severe wear.

The landing gear manufacturer was in the process of formulating a Service Bulletin together with amendments to the Component Maintenance and Component Overhaul Manuals and, in agreement with the aircraft manufacturer, the Aircraft Maintenance Manual. However, before these amendments were implemented, a further, similar, incident occurred to G-MANH, another of the same operator's fleet, which is the subject of the AAIB Bulletin Report immediately following this one.