Australian Government
Australian Transport Safety Bureau

Landing gear separation involving Piper PA28, VH-JXR

Mangalore Airport, Victoria, 7 January 2013

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Addendum

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Landing gear separation involving Piper PA28, VH-JXR

What happened

VH-JXR

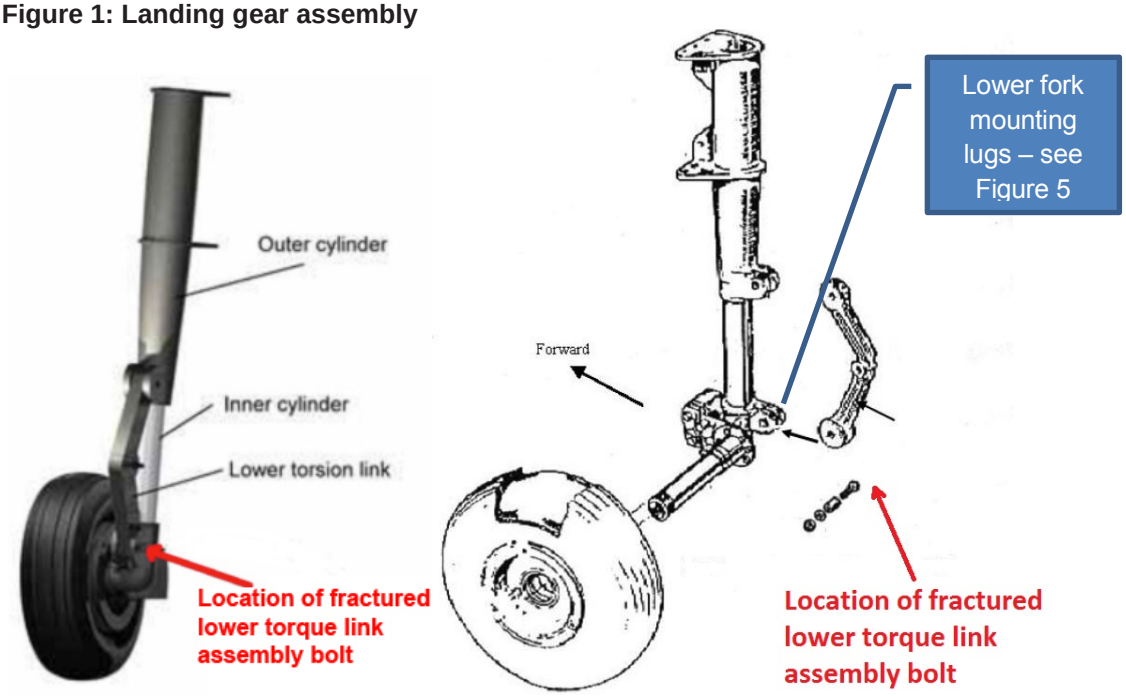
Source: Operator

On 7 January 2013 at 0900 Eastern Daylight-saving Time[1] a Piper PA28, registered VH-JXR, departed Mangalore Airport, Victoria on a navigation training exercise. The student pilot experienced a slight vibration prior to rotation, otherwise the takeoff was normal. The student pilot was the only person on board.

An instructor on the ground watched the aircraft depart and observed an object trailing behind the aircraft. The instructor advised the student via the radio and instructed the student to return and perform a low-level pass so that they could ascertain what the object was. Following the low-level pass, the right main wheel and inner cylinder of the landing gear assembly were observed to have detached from the upper cylinder and to be hanging off the brake line (Figure 1). After a second low-level pass, it was observed that the wheel had completely detached.

The instructor advised the student to hold over the airfield to burn off fuel and allow time for a plan to be formulated. After several hours and with emergency services in attendance, the student was instructed to make a normal approach to runway 36. The aircraft touched down on the runway and slid off to the side coming to rest on the grass. The student was uninjured, however the aircraft was substantially damaged.

Figure 1: Landing gear assembly



Source: *AAIB*

[1] Eastern Daylight-saving Time (EDT) was Coordinated Universal Time (UTC) + 11 hours.

Engineering examination

The right landing gear assembly and lower torque link bolt were subsequently located and forwarded to the ATSB for examination. The examination of the right landing gear assembly revealed that the lower torque link attachment bolt (Figure 2) had fractured through the final thread. This fracture had allowed the inner cylinder to become detached from the torque link[2] and to fall from the outer cylinder when the aircraft became airborne.

The examination indicated that the failure of the bolt was due to single-point bending fatigue due to asymmetrical loading (bending from one side) (Figure 3).

Figure 2: Failed lower torque link attachment bolt

Source: ATSB

Figure 3: Bolt fracture surface

Source: ATSB

The bending failure mode of the lower torque link attachment bolt differed from its function of transferring bearing loads from the lower torque link onto the fork's lugs and so further investigation of the source of this asymmetric loading was carried out.

The mating, U-shaped, brake hose support bracket was mounted on to the lower fork lugs. There were circular brinelling[3] marks and flat-bottomed dishing[4] of both arms of the bracket. However, the dishing depth of the arms was not uniform, being deeper on the forward side of each bracket arm. This indicated an asymmetric loading state (Figure 4). Examination of the lower-fork mounting lugs showed that they were tapered and had been spot faced to accommodate the square faces of the torque link bolt and mating nut. The tapering of the mounting lugs resulted in a variable depth of the spot-faced area and was a source of asymmetry if the bracket was directly attached to them (Figure 5). The circular brinelling marks resulted from heavy contact with the corner shoulder of these spot-faced areas.

There was a witness mark on the bracket, indicating the presence of a washer-like component at some point in time. However, the examination concluded that the specified washer thicknesses were insufficient to prevent an asymmetrical loading state being present.

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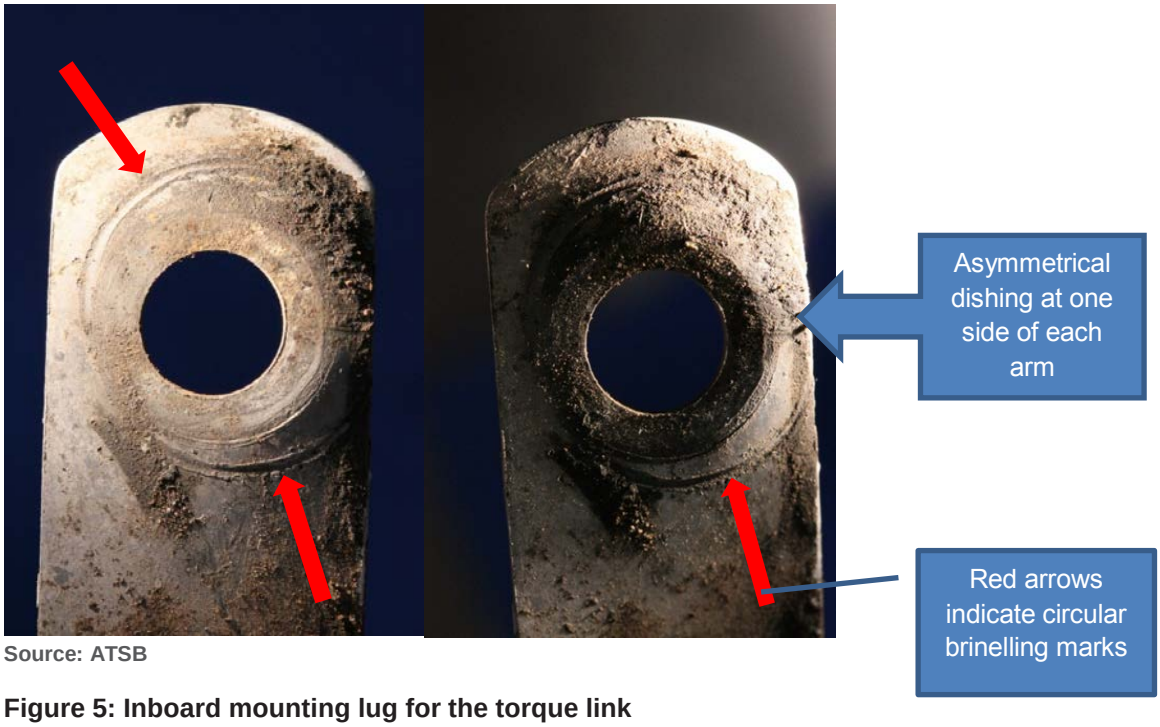
[2] The torque links not only prevent rotation between the inner and outer cylinder; they also provide a means of retaining the inner cylinder in place during flight.

[3] Brinelling is a material surface failure caused by contact stress that exceeds the material limit. This failure is caused by just one application of a load great enough to exceed the material limit. The result is a permanent dent or "brinell" mark

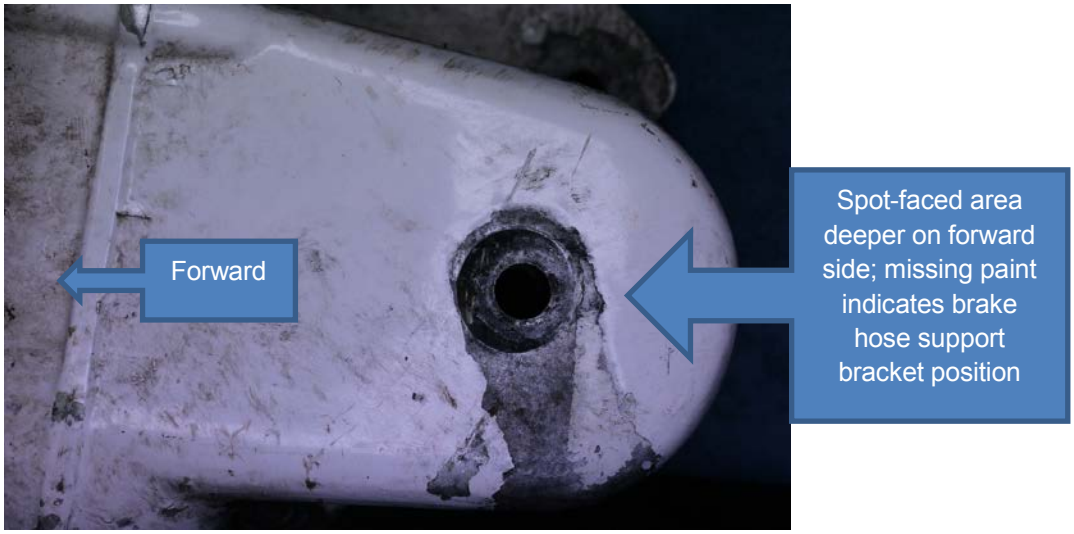
[4] Dishing is out-of-plane distortion.

Figure 4: Inside surfaces at each end of brake hose support bracket



Source: ATSB

Figure 5: Inboard mounting lug for the torque link



Maintenance

In September 2011, the Civil Aviation Safety Authority (CASA) issued an Airworthiness Directive (AD) AD/PA-28/35, which applied to the main landing gear torque links on all PA-28 aircraft with fixed landing gear. This AD required compliance with Piper Service Letter No. 1199, unless Piper Service Letter 600 had previously been complied with. Piper Service Letter No 1199 required the inspection of the 'old style' oval shaped torque links for cracks every 100 hours and replacement with the 'new style' rectangular square shaped torque links at 5,000 hours total time in service irrespective of condition.

JXR had a total time of 9,388 hours and the torque links had been replaced with the 'new style' torque links in accordance with the manufacturer's requirements. The last maintenance was performed 9.8 hours prior to the accident, however there was no requirement to inspect the torque link attachment bolts. The only maintenance requirement defined by the manufacturer, for the attachment bolts, was to carry out a lubrication of the lower torque link fitting every 100 hours. It was not known how long the bolt had been fitted, or when it was last disturbed.

Safety action

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. The ATSB has been advised of the following proactive safety action in response to this occurrence.

Operator

As a result of this occurrence, the operator has advised the ATSB that they are taking the following safety actions:

Replacement of torque link bolts

Since this incident, the aircraft operator has undertaken to replace all torque link attachment bolts during the next scheduled maintenance on any Piper PA-28 aircraft they operate.

Landings with a sideways loading

The operator advbised that they will be treating all landings where a sideways load may have occurred with caution.

General details

Manufacturer and model:	Piper PA28	
Registration:	VH-JXR	
Type of operation:	Training	
Occurrence category:	Accident	
Primary occurrence type:	Landing Separation	
Location:	Mangalore Airport, Victoria	
	Latitude: 36° 53.30'S	Longitude: 145° 11.05' E
Persons on board:	Crew – 1	Passengers – Nil
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Substantial	

About the ATSB

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The Bureau is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; and fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

About this report

Decisions regarding whether to conduct an investigation, and the scope of an investigation, are based on many factors, including the level of safety benefit likely to be obtained from an investigation. For this occurrence, a limited-scope, fact-gathering investigation was conducted in order to produce a short summary report, and allow for greater industry awareness of potential safety issues and possible safety actions.