Piper PA-34-200T, G-BOSD, 28 February 2000 at 1250 hrs

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Aircraft Type and Registration:	Piper PA-34-200T, G-BOSD
No & Type of Engines:	2 Continental Motors Corp TSIO-360-E piston engine
Year of Manufacture:	1975
Date & Time (UTC):	28 February 2000 at 1250 hrs
Location:	Exeter Airport, Devon
Type of Flight:	Training
Persons on Board:	Crew - 2 - Passengers - None
Injuries:	Crew - None - Passengers - N/A
Nature of Damage:	Damage to both propellers and nose of aircraft, engines shock loaded
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	57 years
Commander's Flying Experience:	9,411 hours (of which 1,114 were on type) Last 90 days - 103 hours Last 28 days - 41 hours
Information Source:	Field Investigation. This Bulletin contains the report on a similar accident to G-BOSD, which occurred at Exeter on 19 June 1999

History of the flight

The aircraft had been engaged on an instrument rating examination flight, which was completed without incident. Whilst taxiing from the apron towards the runway holding point for a second detail the nose landing gear collapsed. The commander states that this occurred just after the nosewheel had bumped over a taxiway light. Damage was confined to the propellers and engines, which were shock loaded, and to the nose landing gear, gear doors and nose cone.

Previous occurrence

G-BOSD had suffered a similar incident, also during normal taxiing whilst some distance from the runway, at the same airport on 19 June 1999. That incident was reported on under file reference EW/C99/6/4 which is also reported on in this Bulletin. In the former case the nose gear down-lock

spring link was found to have been seized for some period of time before the accident, and this was considered the most likely cause.

Replacement of the drag brace assembly

During repair following this first accident, the nose landing gear mechanism was thoroughly inspected by the maintenance organisation, and an AAIB Inspector also viewed the aircraft during the repair and took the down-lock spring link parts away for metallurgical examination. The drag brace assembly was replaced with new parts obtained from Piper which arrived as an assembly with both halves of the drag brace assembled. Using the procedure contained in the Maintenance Manual, the over-centre of this new drag brace was measured l as 0.31 inches. The Manual states:

> 'The distance measured should be .300 or greater. If the measured distance is between .300 and .245 .005, the Customer Service representative should be notified and return the aircraft to service. However if the measured distance is less than .240 inch, DO NOT return the aircraft to service, and notify Vero Beach Customer Service.'

During the investigation of the 19 June 1999 incident, another Piper Seneca, G-BPON, experienced a nose landing gear collapse shortly after landing and this was investigated simultaneously. This was reported on as file ref. EW/G99/5/12, was published in AAIB Bulletin 8/99. Again, extensive investigation of the nose landing gear mechanism was carried out. The down-lock spring link had not been jammed, and no reason for the nose gear collapse was found.

Other cases of Piper Seneca unexplained nose landing gear collapse have been reported. There has been some conjecture that loads applied in normal operation could possibly cause a serviceable system to unlock.

Following investigation of the 19 June 1999 accident a further examination of the G-BOSD was made. The drag brace assembly, fitted new after the first accident, was undamaged and showed no evidence of contamination or other defects which might have affected its ability to go fully over centre. The down-lock spring link was damaged at the eye end due to the movement of the drag brace during the collapse, but it was in otherwise good condition, was not seized and had normal spring action. The drag links were found to weigh around 0.6 or 0.7 lb and a new down-lock spring link was found to exert a force of around 2 to 3 lb. Thus it was expected that a force applied to the centre bolt of the drag brace assembly of around 2 lb would cause the drag brace to move towards the unlocked condition.

Possibilities for unlocking the drag brace

A Piper Seneca III, which has a similar nose landing gear retraction system, was used to verify this. With the aircraft on jacks, by applying a spring balance to the centre bolt a load of between 2 and 3 lb was found necessary to move the drag brace. However, the drag brace could not be moved into the unlocked condition by forces, which could be applied by hand alone. Shaking the nose gear vigorously fore and aft was found to cause the drag brace to move by up to 1/8 inch without any external force being applied directly to the brace. It was noted that the geometry of the nose gear allowed normal ground static loads to apply forces tending to retract the gear. Therefore, without hydraulic pressure, some of the aircraft weight was applied to the nose gear, which was again vigorously shaken. It was then possible to move the drag brace into the unlocked position with light hand pressure. It was considered that the application of hydraulic pressure would be insufficient to

prevent collapse of the nose landing gear if the drag brace was unlocked. The shaking of the nose gear simulated the effect of striking a taxiway light while taxiing.

None of these tests could be considered definitive. It is considered that certain combinations of vertical acceleration on the drag brace; vertical and fore and aft loading on the nose wheel; and particular time histories of such loading could cause the drag brace of a serviceable system to become unlocked. This could allow the natural tendency of the nose gear to retract to overcome the hydraulic extension loads. The effect could be at its worst for particular conditions, which may occur most frequently during taxiing; possibly a small sharp step and possibly associated with a subsequent step down. It may be that increasing the over centre of the drag brace is not helpful, since when the nose gear is rotated aft it causes the drag brace to straighten. Inertia of the drag brace will tend to carry it through centre and, if the load at the nose gear is reversed, as it becomes perfectly straight it could unlock. This effect will be worse the more over centre exists. The down lock spring link exerts relatively little force, as is evidenced by the tendency of the links to move, but it does exert some force tending to maintain the down lock.

Safety recommendation

There is concern that the drag brace moves at all during taxi manoeuvres, since it constitutes the only effective down lock of the nose gear. It should be just over centre to minimise movement from loads exerted by the nose leg and should be positively locked to prevent it moving into the unlocked range. Given that this may not be achievable, a suitably large force should be exerted by the spring link or by other means to ensure it remains locked. The following Safety Recommendation is made:

Recommendation 2000-46

The FAA and the CAA, in conjunction with the New Piper Aircraft Company, should investigate the causes of reported cases of Piper Seneca nose landing gear collapse. Consideration should be given to design modification which should minimise movement of the drag brace resulting from loads applied to the nose landing gear, and to ensure sufficient force is applied to the drag brace to retain it in the locked condition.

Follow up action to recommendation

The New Piper Aircraft, Inc. are of the opinion that the nose landing gear collapsed as a result of possible improper rigging and installation. They have no plans to redesign the drag brace at this time.