AAIB Bulletin No: 6/2005 **Ref: EW/G2004/11/11** **Category: 1.3**

Aircraft Type and Registration:	Piper PA-30 Twin Comanche, G-AVPS
No & Type of Engines:	2 Lycoming IO-320-B1A piston engines
Year of Manufacture:	1967
Date & Time (UTC):	30 November 2004 at 1345 hrs
Location:	Farley Farm Airstrip, Romsey, Hampshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Both propellers bent, both engines shock loaded, lower fuselage skin and landing gear mechanism damaged
Commander's Licence:	Private Pilot's Licence
Commander's Age:	76 years
Commander's Flying Experience:	3,000 hours (of which 1,300 were on type) Last 90 days - 20 hours Last 28 days - 15 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries

Synopsis

Shortly after the aircraft touched down on a grass runway, its landing gear collapsed. Although the green landing gear 'down locked' light was illuminated prior to landing, it is likely that the nose gear leg was not in fact down and locked. The investigation found that misalignment of landing gear components on Piper Comanche aircraft can cause the landing gear to remain unsafe, despite cockpit indications to the contrary, and that failure of the nose gear to lock down prior to touch down will result in failure of the transmission system and collapse of the main gear on landing.

History of the flight

The aircraft was being flown by its owner from Gloucester Airport to Farley Farm Airstrip for its annual inspection. The farm strip (Runway 04/26) is a well maintained grass runway approximately 750 metres long with a slight upslope to the northeast. On calm days it is normal practice to approach over a line of trees and land upslope on Runway 04. On the day of the accident the wind was approximately north-westerly at 5 to 7 kt resulting in a very light tailwind on Runway 04.

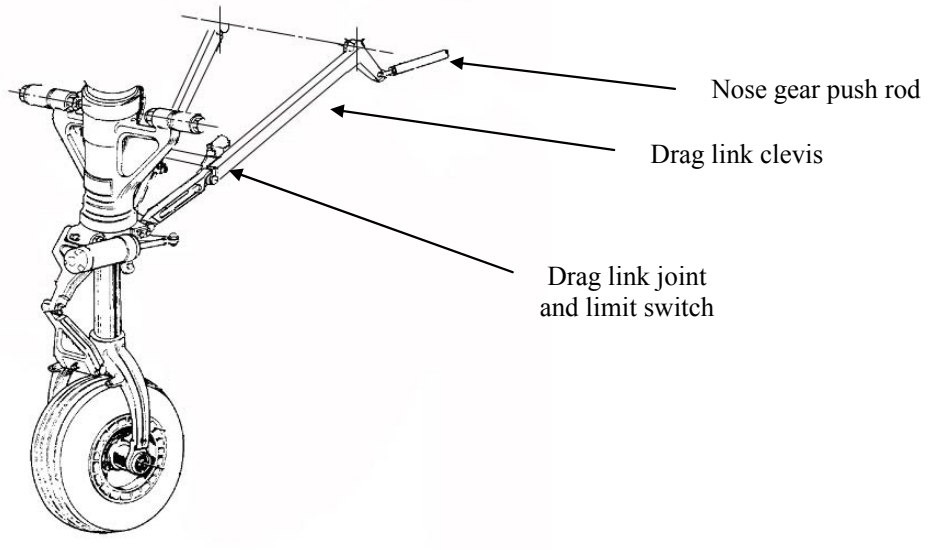
After flying over the airfield to assess surface conditions, the pilot lowered the landing gear and made an approach to land. He considered that he was too high on this occasion, and executed a go-around, without raising the landing gear. He was able to land from the second approach and estimates that he touched down, on the wet grass, approximately 250 metres from the Runway 04 threshold. The touch down appeared normal and the aircraft rolled along the grass runway on all three wheels. As the brakes were applied the landing gear collapsed and the aircraft came to rest in a level attitude. The pilot was uninjured and was able to vacate the aircraft unaided.

After the accident, the aircraft was removed from the runway and raised on jacks. Inspection revealed substantial damage to the landing gear actuating mechanism, which had probably occurred when the undercarriage collapsed after touchdown. The electric landing gear motor had been torn from the main spar, both propellers were bent and both engines were shock loaded. The pilot stated that the green landing gear 'down locked' light was illuminated before touchdown.

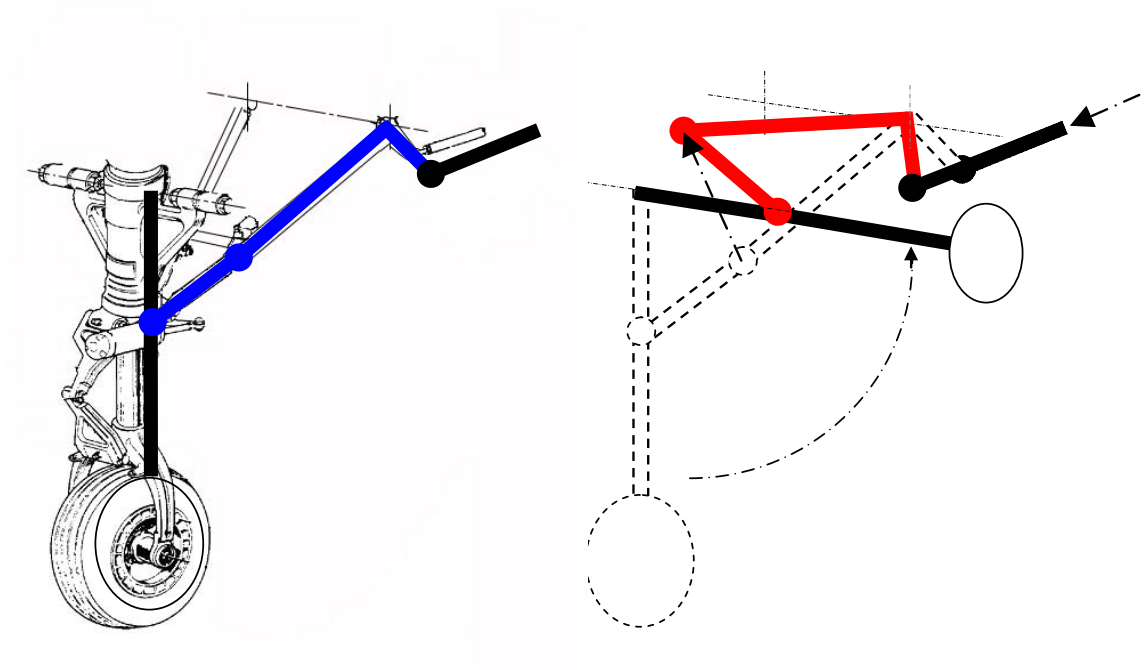
Landing gear description

The Twin Comanche landing gear is operated by a single electric motor driving a screw jack. The screw jack operates two 'Bowden' type cables to raise and lower the main gear and a push rod to actuate the nose gear. Limit switches are installed in the system to shut off the motor when the gear is fully extended or retracted. These switches also operate the green gear 'down locked' indicator light on the main instrument panel.

When the landing gear selector is placed in the down position, the screw jack pushes the main gear cables and pulls back the nose gear push rod. The push rod is connected to a drag link clevis, which forms the upper half of the two-piece nose gear drag link. As the push rod retracts, the drag link unfolds as shown below.



In normal operation, the drag link joint is driven slightly over centre (shown below in blue), and rearward forces on the nose gear leg are resisted by a mechanical stop in the drag link structure. If the drag link does not travel over centre, any rearward force will cause it to fold upwards (shown in red), resulting in a pull force on the screw jack. Because the screw jack is rigid when the electric motor is not running, the pull force will be transmitted directly to the motor itself, which is attached to the front of the wing spar where it passes beneath the cabin floor. The motor attachments, however, are not designed to resist landing forces directly.



If all of the limit switches close before all of the gear legs are fully down and locked, the motor will stop prematurely, even though the green "down locked" light is illuminated. Dirt collects readily on the nose gear drag link, and rigging tolerances are such that a small accumulation is sufficient to cause the nose gear limit switch to close before the nose gear drag link has locked over centre.

The nose gear limit switch is mounted above the drag link joint and is designed to close when the drag link locks over centre. If the rearward force on the nose gear leg was sufficient to force the drag link further over centre, (for example during a heavy landing), the limit switch components would be bent or broken away from the direction of over travel and the mechanical stop would be damaged. No such damage was present on G-AVPS. Consequently, the possibility that the drag link was forced to fold downwards, through the mechanical over centre stop, can be discounted.

Aircraft history

The pilot of G-AVPS had difficulty lowering the landing gear on flights immediately following the previous annual inspection, almost a year before the accident. On one occasion, the landing gear appeared to operate normally, but the green 'down locked' light did not illuminate. On another occasion, after selecting the landing gear DOWN, the nose gear leg only partially extended. The pilot was able to extend and lock the landing gear manually in each instance and the landing gear operated normally on subsequent flights.

Reports available on the AAIB website (www.aaib.gov.uk) and elsewhere, describe numerous occurrences involving mechanical failure of the landing gear on the Twin Comanche and on the PA-24 single engine Comanche, which has an almost identical system. Most are attributed to excessive friction in the system, misalignment of components due to poor maintenance and heavy landings or the presence of foreign matter. A number of operators worldwide have reported symptoms similar to those described in this report.

Conclusion

Damage to the retraction mechanism was consistent with a rearward force on the nose gear leg that was not resisted by the drag link, indicating that the nose gear leg was not locked down prior to touchdown. During the landing roll, the nose gear leg folded rearwards, imposing loads on the landing gear motor attachments in excess of its design limit. As the motor was pulled from its mounting the main gear actuating cables were pulled forwards, resulting in retraction of the main landing gear legs and the total collapse of the landing gear.