

N7628L flight ending with gear collapse, 7/25/17

Damian Swift, PIC, 7/26/17

Background to flight

My co-owner left the airplane at the transient parking in Livermore on the morning of 7/25, so he could take public transport to SFO. We prefer to keep the airplane hangared, and a few years ago I experienced minor damage (suspected vandalism) to an airplane based on a tiedown at Livermore (broken antenna, removed nut) and am uncomfortable with the ease of public access to the apron there, so I wanted to return the airplane to our hangar at Byron the same day if possible. I brought along a friend's son who was visiting; this was his first flight in a light airplane. There was no particular urgency about the flight - we have previously left the airplane for several days at a time at Livermore without problems - but it seemed like a nice day to make the short hop.

Background to airplane

In these notes I've paid particular attention to systems associated with the landing gear. In N7628L, the gear is hydraulically operated. The flaps and elevator trim are also hydraulic and operated from the same fluid reservoir and pressure reservoirs though through separate hydraulic lines.

The gear position indicator is a pair of lights operated by a pair of microswitches on the gear struts for each wheel. One light indicates that all the "up" microswitches are closed, the other indicates that all the "down" microswitches are closed. We have previously had issues with microswitches failing to close properly, so the gear could be fully down but the "down" indicator could fail to illuminate. We have adjusted the switches post-flight, but on several occasions we have made landings with the "down" indicator not illuminated. On N7628L, all 3 sets of gear are visible from the cockpit (the nose gear via a mirror on the left sponson), and our normal approach / pre-landing checks include a visual inspection of the position of the gear.

We had some issues with the hydraulics a few years ago, where the pressure would drop unusually fast in operation (symptom: pump heard to repressurize the system unusually often), and some time later there was a severe leak from the brake hydraulics (same fluid reservoir, different lines, not pressurized) which also affected the ability for the system to pressurize. Since maintenance, the hydraulic system has behaved normally.

Flight

The preflight inspection was normal. The hydraulic fluid level was fine. The hydraulic pressure was low, which we normally find after the airplane has sat for a while. The switch for the hydraulic pump was off, which is as we leave it after a flight. During the preflight inspection I ran the pump and it pressurized the system at the usual rate. I didn't observe anything unusual or notable with the hydraulics or any other systems or airframe. I did notice that two screws were loose on the retaining strip for the new canopy seal we had installed recently, and I tightened them partially (as best I could with the tools in the airplane). (I only mention this as it's an indication of remembering specifics.)

Engine startup (at 12:51 local), taxi out, and the power check were normal. The flaps and trim operated normally during the pre-take-off checks. The hydraulic pressure was normal afterwards. My checks include the switch and breaker positions, and I didn't notice any being out of place. I don't recall whether the gear down indicator was lit, though I do recall the flaps down indicator was lit (its lit area is larger and more obvious).

Takeoff was on 25R. Winds were ~5 kts and variable from 200-240. Takeoff and the retraction of the gear and flaps was normal. I don't recall the hydraulic pressure being low afterward.

Departure was from right downwind past Brushy Peak, and I climbed to 2000' for terrain clearance. N7628L has a single Com radio; I tuned to Byron AWOS and listened to one transmission cycle; the wind report was 210/9, which would favor rwy 23. I switched to Byron Unicom and announced that I was setting up for a left downwind to rwy 23. Another aircraft reported being in the pattern for rwy 30 doing touch-and-goes. 30 is longer and often favored; in summer the winds pick up from the SW during the afternoon, and 23 often becomes more favorable. Given the light wind and the presence of traffic for 30, I decided and announced that I would change runways and set up for a left base entry for 30, which is a steeper approach from Brushy Peak. Because of the presence of traffic, I didn't retune and listen to further AWOS transmissions before landing.

Conditions over Brushy Peak and the approach over the wind turbines were light turbulence: noticeable but not abnormal or concerning.

N7628L has quite a high form drag, and descends very steeply with gear and flaps extended. We use the extensions to control the rate of descent in the approach. I lowered the gear, but not the flap, relatively early, consistent with the base entry to 30. The gear lowered positively with a clunk felt through the airframe, as usual. The approach checks were normal. I recall the gear-down indicator being illuminated, and I don't recall the hydraulic pressure reading low. My approach checks include the positions of the switches and circuit breakers appropriate to the type of landing (ground or water); I don't recall any being out of place though again I don't recall the specific positions of each. I made the turn to final at a normal distance and felt that we were

slightly high, so I went straight to full flap, which is normal. I don't remember checking the flap indicator, but their correct operation was evident from the change in descent rate and trim. Once we were established on the approach, I performed the pre-landing checks, including a visual inspection of the gear, which looked normal. I don't remember the gear or flap indicator lights, but I do remember making specific short-final checks of gear (lever and visual), mixture (rich: manual push), and prop (fully fine: manual push).

Round-out and hold-off were normal. I perceived a slight right drift consistent with a light left crosswind of a few kts per the AWOS, and rolled slightly left to counteract it. Just as the left main wheel contacted the runway, I perceived a slight left drift, and I rolled slightly right. It's possible that the left main rose off the ground again, but I'm not sure. The right main contacted the runway. Both contacts were gentle. In responding to the shifting wind, we were in a slight yaw to the right, but I felt it was well within normal bounds. Shortly after that I could feel all 3 wheels on the ground. After a short time (maybe 2-3 seconds), I perceived that we were sinking to the right and yawing slightly right, the latter which I tried to correct with the rudder. Shortly after, I felt a vibration and heard a scraping sound which I believed to be from the right sponson in contact with the runway. The deceleration of the airplane seemed otherwise quite gentle, and I didn't feel that we were in danger. After a while (a few seconds), I felt a slightly stronger vibration, which I believed to be from the keel in contact with the runway. Around this time, I felt that we were traveling reasonably slowly, and that if I could direct the airplane off the runway we might come to a rest out of the area and without blocking the runway. I eased the rudder pressure and allowed the airplane to veer off the runway to the right. When we reached the softer soil and dried grass beside the runway, we decelerated more rapidly and came to a halt, though again it felt quite gentle, notably more gentle than a water landing in anything other than smooth water.

I don't recall feeling alarmed at any point, but after we came to a halt I remember struggling to think what to do next, and it took me several seconds to think to shut down the engine, which I did as a normal shutdown (mixture to idle-cut-off) rather than an emergency (fuel selector off). I may have checked that my passenger was ok before doing even that. I don't remember doing it, but I shut off all or most of the switches and circuit breakers. I remember hearing the airport manager radioing that rwy 12/30 was closed. I didn't feel at risk of fire: there was no smell of gas or smoke, the fuselage and hull seemed to have integrity, the gas tank is between the wings and I could see no sign of distortion or damage to the airframe. I opened the canopy and climbed out, then went around the nose to open the canopy on the starboard side so my passenger could climb out. I observed that the nose gear had collapsed. At the time I thought this must have happened as we came to a rest off the runway, when the nose attitude did seem low. It wasn't until the airport manager pointed out the marks from the nose gear doors in contact with the tarmac that it was evident that the nose gear had collapsed earlier during the landing roll. I didn't perceive a nose-low attitude during our passage along the runway, and I was surprised to learn that the nose gear must have collapsed then.

Inspection and recovery

With the help of the airport manager, we moved a few personal items from the airplane to the hangar. We inspected the airplane and the marks on the runway, clearly identifying scrape marks from the sponson, nose gear doors, and keel, and marks from the collapsed right main wheel. The scrape marks merged with the general landing skid marks, and it was not clear how far back they extended. We found no detached components along the runway. I could not see anything wrong with the landing gear, but I noticed that the right main gear-down microswitch was different than I remembered and than the left-main switch: the external moving part of the switch was a metal stud, rather than being (or covered by) a plastic stud. However, I had not inspected it so closely for a while, so I couldn't say whether it had been like that for some time. The gear down indicator was not lit.

After the FAA inspection, when we were given permission to recover the airplane, we raised the right wing with a short jack on a wooden stack, by alternately jacking and resting on the sponson, as we increased the height of the stacks under the jack and under the sponson. The jacking point was under the main spar just outboard of the main gear well, with some care taken to distribute the load in both places. When the wing was high enough, I was able to push the right main gear by hand to its fully down position, and locked the gear by manually pushing the locking catch until it engaged. With the airplane now resting on both main wheels, we raised the nose by having two people push down on the fuselage just forward of the tail. I was not able to lower the nose gear to the locking position by pushing on it manually. The hydraulic pressure was quite low at this point (several hours after the landing) so I operated the manual emergency gear extension pump a few strokes, which made the nose gear extend and lock.

When there was weight on the right sponson, before we raised the airplane, there was a row of wrinkles in the skin of the right wing. The wing routinely shows wrinkles of similar amplitude during flight, but I had not seen a row exactly like these. The wrinkles vanished when the weight was off the sponson.

We pushed the airplane onto the tarmac and decided it was safe to attempt to taxi it to the hangar under its own power. I turned on the master switch and operated the hydraulic pump, which pressurized the system at the usual rate. The engine started normally. I taxied cautiously back to the hangar, and didn't notice anything unusual in the handling.

I'd like to express my thanks to Steve the airport manager, FAA inspector David Jensen, and owner Randy Howell and staff from the Patriots Jet Team for their help in recovering the airplane.

Possible causes

Immediately after the flight, when I thought that only the right main gear had collapsed on landing, I assumed the fault must have been in the locking mechanism and possibly the gear-down microswitch indicating incorrectly. It didn't occur to me that the problem might have been hydraulic pressure, because all the hydraulic operations and indications had seemed so normal, so unfortunately I didn't pay particular attention to the gauge and switch position.

Given the evident collapse of the nose gear at more or less the same time, it seems hard to explain both as coincident, random locking faults, and low hydraulic pressure seems more likely. An alternative explanation might be locking faults caused by the yawing during touchdown, possibly twisting or shaking gear components sideways, but the yawing was quite slight and if the hydraulic pressure were high it seems unlikely that the gear would have collapsed even if not locked.

The most likely explanation seems to me that I somehow switched the hydraulic pump off during the flight, and didn't notice the incorrect position or the falling pressure. I certainly recollect both being correct on the ground in Livermore, and I don't recollect either being incorrect in the air despite both being on my checklists, but neither do I recollect either being positively correct in the air. I may have been subconsciously distracted by taking a passenger on their first light airplane flight and so concentrated more than usual on a comfortable and controlled flight. There was some potential for distraction in dealing with a change in runway and approach profile into Byron, in light turbulence. But overall I'm very puzzled that I could have failed to observe a problem with the hydraulics over several checks, as I regard myself as a careful pilot who takes safety, procedures, and checklists seriously.