

# Gear Failure

By George Brown

The Saturday evening was not an unusual one for early August in Central Texas. At over an hour before sunset, the air temperature hovered just below 100 degrees with a light surface wind predominantly out of the east-northeast. Essentially it was a near-perfect VMC evening and since I had done an extensive preflight inspection on our Baron earlier in the day, it was ready to go with full fuel tanks.

Runway 36 at KGTU was the active and traffic was essentially nonexistent, also not unusual at that time of a weekend evening given the state of general aviation during the COVID-19 pandemic. The first 900 feet of the 5,004-foot runway has a significant upgrade, one that I estimate to be more than 2%, which decreases to a total rise of 0.8% to the opposite end. With the takeoff weight of our B55 at 4,600 pounds (500 pounds under gross), ambient temperature,

and wind component that evening, I expected a ground roll of around 1,550 feet, rolling as I advanced the throttles.

As a side note, I don't wear my active noise reduction headset during taxi, run-up, takeoff, approach, and landing. I want to hear mechanical anomalies that otherwise may not be detectable and most of all, the sounds of the wind and engines. In flight the pitch and intensity of "the wind in the wires" is a great backup indicator of what the airplane is doing, even if it doesn't have wires. As a teenager in the 1950s I trained in and flew a J3 and Stearman. Even with constant-speed propellers, a slight change in engine/propeller sound can herald a change in aircraft pitch and even an un-commanded change in power.

## The Event

The engine run-up was normal and we were immediately cleared for takeoff with departure to the northwest. It was all so normal, so familiar, so perfect. Even the engines came up in unison as I pushed the throttles to full power.

After rotating at 85 knots and establishing a positive rate of climb, I retracted the landing gear. But the sound of gear motor operation, although normal in pitch, stopped prematurely. Additionally, the Baron's usual slingshot acceleration and accompanying autonomous pitch increase immediately after gear retraction didn't happen. Acceleration and climb rate were both below normal for the conditions plus the burbling sound of the slipstream by the cabin was all wrong. Takeoff engine power remained normal.

## My Response

A quick glance at the gear indicator lights and then the circuit breakers on the pilot's subpanel foretold what was ahead for us – the orange (red at one time) "gear-in-transit" light was on solid while the gear motor and motor relay circuit breakers were not tripped. Kathryn, in the right-hand seat, motioned toward the yellow light and I responded with, "Yup, gear's hung. It's electrical – I hope." During all of this, my training in addition to my prior experiences in dealing with engine and systems failures, frequent reading about handling emergencies in *ABS Magazine* and other

aviation periodicals and books, and PC-based B55 simulator practice all kicked in – fly the airplane!

While maintaining airspeed, climb rate, and runway heading, I called KGTU tower and requested a return to the airport. The controller, let's call him Ron, cleared us for an immediate turn to enter either a left or right downwind, my choice. During the turn to a left downwind and after responding to Ron's queries of souls and fuel on board and did I require emergency equipment (two souls, 135 gallons, and negative emergency equipment at this time), I requested and was cleared for a low-approach fly-by of the tower for a visual check and report of the gear position. I had no clue as to the gear's position other than it was neither up nor down. A thought also flashed through my mind that this would be a bad time to lose an engine, so I quickly established a rudimentary plan to deal with it if needed and amended the plan in real-time as the flight progressed.

After our fly-by, Ron reported both main gears were angled about 45 degrees and he could not see the nose gear other than its wheel and immediately followed with "say intentions." I responded that we'd climb and turn west and sort out the problem over unpopulated terrain. Because the gear motor circuit breaker had not tripped, I was reasonably confident the gear had not mechanically jammed in its retract cycle, but I wanted to be sure it could be extended for landing, manually if necessary.

For the next order of business, a slow cruise at a comfortable altitude above ground was established. Then after pulling the gear motor breaker and moving the gear switch to down, I engaged the hand crank and gave it a couple of turns counterclockwise. That worked as expected so the problem was definitely an electrical one.

During all gear operations prior to the failure, its motor was consistent in speed and sound with about four seconds to retract the gear and slightly less to extend it. With upright confidence, I stowed the hand crank and reset the gear motor breaker. Some of the best music I'd heard in a while was that short-burst whine from the gear motor. We had three green gear lights!

To be sure the gear was fully extended, again I pulled the gear motor circuit breaker, engaged the hand crank, and moved it a little over 1/8<sup>th</sup> of a turn where it stopped with the sector gear against the stop pin inside the gearbox. With the gear crank stowed again and the motor circuit breaker reset, we headed back to the airport. Fortunately, traffic into or out of KGTU remained nonexistent.

After my request for a second low approach and fly-by of the tower, Ron approved and then provided visual confirmation that the gear was down. The landing and taxi to our hangar were uneventful.

## Let's Go Again

To not let a perfect VMC evening get by us, we parked the Baron in its hangar and pulled our Hawk XP out of its nest. I had also done a preflight inspection on it earlier in the day, just in case we decided to fly it instead of the Baron. As we had hoped, we were treated to smooth, clear, and cool air at altitude. Best of all, our original reason for the evening's flight was fulfilled. We witnessed a most colorful sunset and simultaneous rise of a full moon from our

6,500-foot vantage point over northwest Lampasas County, away from the surface lighting of the Austin and Killeen (Fort Hood) metropolitan areas.

## Source of the Failure

On our late-model B55, the two landing gear safety (squat) switches, one on each main landing gear strut, are wired in series between the pilot's landing gear switch and the landing gear motor relay and motor. With the weight of the airplane on the main landing gear, the squat switch circuit is open disabling electrical power to the relay and motor. This is to prevent inadvertent retraction of the gear with the airplane on the ground. However, when the airplane is in flight (or on jacks), the circuit is closed to provide electrical power to the motor relay and thereby the motor to retract the gear. For extending the gear, a separate circuit provides the electrical power from the pilot's landing gear switch, through the down limit switch, and to the motor relay and motor. Because of this electrical design, the squat switch circuit was my prime suspect for failure of the gear to fully retract – time for the appropriate Beech wiring diagram and a volt-ohm meter.

Wiring to the squat switches included three wires on the left-side switch and four on the right side. Each time the gear is retracted these factory-installed wires were bent in a moderate radius to about 90 degrees by the action of the gear strut; during extension they were bent back 90 degrees to more or less straight. After 40 years and perhaps 1,500 or more gear cycles, any one of the wires could be broken inside its insulation. Additionally, each of the

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two groups of wires ran inside a protective plastic sleeve, further hiding a damaged wire from view. Of course, other potential causes could have been a defective squat switch, a high-resistance connection in any one of the five connectors in the circuit, or even a defective motor relay.

With the Baron on jacks, a couple of gear test cycles ran without hesitation. But after we freed each of the two wiring harnesses that were held securely in place by cable clamps and ties, removed the sheathing from them, and then lightly tugged on or shifted each wire individually, the gear didn't even move for the next test cycle. The first wire we looked at showed an open circuit. With the airplane static on the jacks, enough of the broken strands remained touching end-to-end to complete the circuit; that is, until the wire was moved by hand in the hangar – or by the slipstream during the gear failure flight.

With one wire broken, we were certain the rest of the wires were equally stressed and likely to break soon, if they hadn't already. So all the wires were replaced with new ones, covered by new protective sleeves, and rerouted to ameliorate much of the bending stress during gear cycles. We also checked the microswitches that make up the two squat switch assemblies and verified they functioned correctly to disable gear retraction with the airplane on the ground. Subsequent gear swing tests were successful on jacks and again during the for-real tests in flight.

### Epilogue

I can attest that "startle factor" is real, seemingly making seconds pass as minutes. Although I was primed for a possible power failure at takeoff, there was that brief moment to accept that the unexpected gear failure was real. Was I out of my comfort zone? Heavens, yes! But at no time did I feel overwhelmed by the airplane and the gear failure, primarily because I knew how the Baron would perform under the circumstances and it did as I expected. To me and from its onset, dealing with the entire event was one of "by the numbers, one step at a time."

As a post script, the next day as I was moving the wing jacks and tail weight into position under the airplane, Ron, the tower controller, came to the hangar. He just wanted to meet me and to see the Baron up close. Here I took advantage of my golden opportunity to thank him in person for his much-appreciated assistance throughout the event.



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