DOUG STEWART

Between a ROCK and a HARD SPOT

Handling a Partial-Power Takeoff

There is a lot of information and advice available about how to handle an engine failure. Though I am not minimizing its seriousness, a complete engine failure (especially if it occurs during cruise flight) does have some advantages. First, emergency approach and landing after a complete engine failure is a skill we learn early in flight training and then practice throughout our flying careers. Second, there are well-established checklists for handling an engine-out emergency. Third, and I learned this from the experience I am about to describe, a complete engine failure has the advantage of simplifying decision-making. Assuming that the restart checklist has not produced the desired effect, your priorities are to fly the airplane, choose the best available landing spot you can reach, and land under control at the slowest possible airspeed.

As I discovered a few summers ago, it can get a lot more complicated when you discover that the engine is producing partial power after takeoff, especially when flying from an airport with trees rising at the departure end.

It All Seemed So Perfect

It was late August, one of the most beautiful days of the year. The temperatures were in the mid-70s, the air was smooth with light and variable winds on the ground, and the high pressure helped to create visibilities that do not get much better, especially in New England. My best friend and I flew up to visit a retired FAA safety program manager and his wife. We had a wonderful visit; I was thinking this had been my best day of the summer.

Driving back to the airport, we meandered on a dirt road through gentle hills and thick forest and suddenly emerged at the airport. The only real indication that we were at an airport was a windsock, a couple of hangars, and my parked Cessna *Cardinal* RG. Although the runway had been dirt for many years, it was now asphalt. It was not flat, but had a rolling contour similar to the end of a roller coaster ride.

The airport narrowed toward the departure end, with rising, wooded terrain on both sides and trees at both ends. I remember thinking that density altitude would not be an issue, given moderate

Photo by James Williams

temperatures, high pressure, dry air, and a field elevation of only 510 feet. The windsock indicated light winds at about 3 knots, favoring a departure to the southwest. The winds would not be much help, especially in clearing the trees, but it was better than having no wind.

Something's Not Right Here

After a thorough pre-flight inspection, we fired up the *Cardinal*. We completed an uneventful run-up and ran the before-takeoff checklists, then taxied to the end of the runway. I was flying from the right seat, which after so many years of flight instructing, is a natural and comfortable position. Holding the brakes, I applied full power and confirmed that we had the proper manifold pressure, RPM, and oil-pressure indications before I released the brakes. With maximum power still applied, I released the brakes and started the takeoff roll.

My best techniques were not enough to overcome the fact that we did not have the power—or the airspeed—to climb fast enough to clear the pine trees.

Watching to confirm that the airspeed indicator was alive, I saw the airspeed come up to 55 mph indicated airspeed. Then I noticed it drop back down to about 52 mph. I momentarily considered aborting the takeoff, but we were already about two-thirds down the runway and the possibility of not being able to stop before the end of the runway ran through my mind.

Why didn't I abort the takeoff at the first instant I had that thought?

As quickly as I had that thought, I saw the airspeed reach our rotation speed of 65 mph; I elected to continue the takeoff. After we rotated, I positioned the pitch attitude to achieve a best-angle speed (Vx) of 72 mph (slightly lower than the max gross Vx of 75 mph). My best efforts and techniques were not enough to overcome the fact that we did not have the power—or the airspeed—to climb fast enough to comfortably clear the pine trees whose tops we were rapidly approaching.

I did not have many options or much time to consider even the few I had. Remembering that lowering flaps can have a momentary balloon effect, I extended them another 10 degrees to help us over the tops.

Back Side of the Power Curve

The balloon maneuver got us over the initial stand of trees, but it was costly in energy and airspeed. With more trees just ahead, I quickly needed to increase both. But, with power already set at maximum and no way to repeat the balloon maneuver with flaps, there were even fewer options. Recognizing that retracting flaps would produce a settling effect, I had to eliminate some of the drag. I retracted the flaps back to the 10-degree setting, turned toward the lowest of the trees, and considered what to do about the still-extended landing gear. Gear in transition produces the worst climb rate, but I had no hope of achieving best climb with it extended. I opted to raise the gear.

Now, returning to airspeed. Here we were on the back side of the power curve with trees fast approaching. In case you've forgotten that concept, the back side of the power curve exists whenever there is insufficient power to overcome the induced drag created by high angles of attack. Continuing to increase pitch would result in the airplane sinking, rather than climbing, and could lead to a stall.

It was very clear the engine was not making enough power for us to climb. I would have to lower the pitch attitude to accelerate back to Vx, but we were still below even the lowest of the trees. I was truly between a rock and a hard spot: I could not increase pitch without stalling and losing control of the airplane. Although I knew that lowering pitch was the only way to gain the airspeed I needed, anything lower than my current pitch attitude would surely put us into the treetops.

Photo by Ken Peppard

Hoping I could buy a few more feet and a little more time, I worked the pitch in an effort to keep us above both stall speed and the trees. The stall warning horn sounded intermittently. I thought we just might make it, but then the propeller hit a branch. The airplane yawed and banked to the right and then pitched down as we descended through branches and leaves.

When the airplane came to a stop, I found I had been thrown left to the limits of my seat and shoulder belts. My side of the cockpit was crushed in and offered no exit. My friend in the left seat was unconscious, so I released my seatbelt and managed to crawl across her to get to the door. Once outside the airplane, I was determining how to get her out when a firefighter appeared. He and a second firefighter quickly took charge.

Lessons Learned

We were both fortunate to make a full recovery from our injuries. For me, the physical recovery was the least of it; the bruises were also mental and emotional. I spent many a sleepless night going over and over the accident and the events that led up to it. I tend to be harsh on myself, but being harsh is how I continually strive to learn and improve as a pilot.

There were many unanswered questions. The most important one was: What could I, or should I, have done differently to avert this disaster? That question led to more: Why didn't I abort the takeoff at the first instant I had that thought? Why had I continued and lifted off as soon as we reached rotation speed? What was I thinking?

I knew there was an airspeed abnormality, which led to my early thoughts of aborting the takeoff. Like many pilots, I was more concerned about running off the end of the runway and damaging my airplane. But, it was almost game over. In the few seconds I had to consider the situation, I simply did not figure out the consequences of trying to climb out over trees with less than maximum power.

There was also a sense of complacency at work. I knew my airplane and the engine had been running well. There were no issues with density altitude. Weight and balance was not a concern. I was confident that my *Cardinal* would have no problems in clearing trees that stood more than 2,500 feet from the start of our takeoff roll. I was so confident, I saw no need to make the actual performance calculations.

As Easy As A-B-C

Emergency approaches were one of the hardest areas to master when I was learning to fly. I struggled to remember what to do first, fumbled around the sky looking for the best field, and constantly lost my place on the emergency checklist.

I eventually came across a simple ABC checklist for emergencies, which calls for an immediate focus on the most important tasks. Over the years, I added a few letters and developed the concept into a detailed outline for ground and flight training. It works. Even the most flustered flier can instantly recall the alphabet. The checklist is structured to stimulate recall of the right tasks in the right sequence.

Airspeed. Memorize best glide speed and try not to lose any altitude until reaching that speed. Once there, trim the aircraft for hands-off glide.

Best field. Note wind direction and strength, then current position. Are you directly over a suitable field now? Is there a suitable field at downwind position? Is there a suitable field at base or final position? Also, note present altitude relative to traffic pattern altitude, or 800 to 1,000 feet above ground level (AGL). Are you too high or too low? How can you fix it—flaps, extend, slips, S-turns?

Checklist. Start with a flow pattern across the panel. If altitude and circumstances permit, review the written restart checklist. Under all circumstances, it's more important to fly the airplane than to check the list.

Declare an emergency. Note current position and then tune the radio to 121.5 MHz, which should already be in the standby position. When making the mayday call, state who (tail number), what, where, and how many aboard. Set the transponder to 7700.

Exit preparation. Prepare the passengers for the landing. Ensure seatbelts are tightened, then brief passengers on exit procedures and assignments. Make sure the first aid/survival equipment is in a convenient place and prepare the aircraft, for example, cracking open doors, if the Pilot's Operating Handbook/Aircraft Flight Manual so directs.

Fire prevention. Shut the fuel off, along with the three Ms: mixture, mags, and master. Ensure the fire extinguisher is close at hand.

Ground plan. Touch down at the slowest possible airspeed, and then evacuate the aircraft. Account for everyone and use the first aid/survival equipment as needed.

— Susan Parson

Nevertheless, I had sensed something was amiss. It reminded me of Ernest Gann's *Fate is the Hunter* when the author notes:

> *… I already sense something is wrong. We are halfway down the runway and have only achieved sixty miles an hour … Appreciation through habit is nearly instantaneous, but understanding is not. What the [expletive deleted] is wrong now? … Yet all is apparently in order. These are the moments of truth in a pilot's life when he must decide within seconds whether he should abandon take-off and jump the brakes, or fully commit his airplane to flight.*

Gann made the same choice I did. He fully committed. He broke ground and lumbered out of ground effect only to realize that he would not clear a bigger obstruction than trees—the Taj Mahal—without non-standard action. And, just as I did in order to clear the first set of trees in my path, he deployed more flaps, which ballooned him to barely clear the spike of the first minaret and then the second.

Regardless of how many hours in your logbook, the learning never ends.

A Do-Over

In case you're wondering, check out chapter 13. Gann arrived at his destination to learn that, contrary to his fuel order, the tanks had been topped off. He was operating with 3 tons more weight than he had planned to carry. In my case, the NTSB determined that "the engine failed to produce sufficient power to climb for an undetermined reason."

Regardless of the engine's role, I know I played one. As is often the case after an accident, the FAA required me to take a re-certification check ride to the Commercial Pilot Practical Test Standards with emphasis on "performance and limitations; and short-field takeoff with maximum performance climb." In preparing for the oral portion of this exercise, I pored over my airplane's performance tables to calculate the performance I should have had on the day of the crash. Even with a fudge factor for a 30-year-old airframe, the book said I needed only 1,560 feet (including a 960-foot ground roll) to clear a 50-foot obstacle.

As I made these computations, I realized my major mistake. The first number you obtain from the performance charts is for the ground roll. How often, however, do we move on to consider whether there will be sufficient distance from the obstacle to clear it? Had I done the planning—with all the correct information relative to density altitude, wind, weight and balance, and runway surface and gradient—I would have known I needed 960 feet for the ground roll, with the rest needed to clear the obstacle.

In my case, the airspeed faltered at a point 200 feet beyond the 960 feet of ground-roll distance. Had I done the calculations, I would have known my only choice was to abort. That choice might have led to some damage to the airplane, but it would have kept an abnormal airspeed indication from developing into a life-threatening emergency.

Regardless of how many hours in your logbook, the learning never ends. Thankfully, I am alive to keep learning.

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Photo by James Williams