Between a Rock and a Hard Spot

By Doug Stewart

There is a lot of information and advice out there about how to handle an engine failure. Though I am not minimizing the seriousness of this situation, a complete engine failure, if it occurs during cruise flight, does have the "advantage" of altitude. The requisite skills needed in an emergency approach and landing after a complete engine failure are often learned early in flight training and then hopefully practiced throughout our flying careers. As well, there are well-established checklists and procedures for handling an engine out emergency. 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, things get a lot more complicated when you discover that the engine is only producing partial power immediately after takeoff ... especially when flying from an airport with trees rising at the departure end. And if your initial training was flawed, the rule of primacy could be your worst enemy.

It All Seemed So Perfect

It was the end of August, and one of the most beautiful days of the year. The temperatures were in the mid-seventies, the air was smooth with light and variable winds on the ground, and the high pressure helped to create visibilities that don't 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, and I was thinking that this had been the best day of the summer for me.

Driving back to the airport, we meandered on a dirt road, through rolling hills and thick forest, and then suddenly emerged at the airport. The only real indication that we had transitioned to 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 gentle rolling contour similar to the end of a roller coaster ride.

The airport narrowed towards the departure end, with rising, wooded terrain on both sides, and trees at both ends. I remember thinking that density altitude wouldn't be an issue, given moderate temperatures, high pressure, dry air, and a field elevation of only 510 feet. We were also 300 pounds short of maximum certified gross weight. The windsock indicated light winds at about three knots, favoring a departure to the southwest. The winds wouldn't be of much help, especially in clearing the trees, but it was better than having no wind at all.

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 very end of the runway. Holding the brakes, I applied full power and confirmed that we had the proper manifold pressure, RPM and oil pressure indications before releasing the brakes. With maximum power still applied, I released the brakes and started the take off roll.

Watching to confirm that the airspeed indicator was alive, I saw the airspeed come up to 55 IAS. But then I noticed it drop back down to about 52 IAS. I momentarily considered aborting the take off, but we were already more than half way down the runway, and the possibility of not being able to stop before the end of the runway ran through my mind.

As quickly as that thought appeared, I saw the airspeed reach our

rotation speed of 65 IAS, and I elected to continue the takeoff. After rotation, I positioned the pitch attitude to achieve a best angle speed (Vx) of 72 IAS (slightly lower than the max gross Vx of 75 IAS). My best efforts and best techniques weren't enough to overcome the fact

that we didn't have the power – or the airspeed – to climb fast enough to comfortably clear the pine trees whose tops we were rapidly approaching.

I didn't have many options, or much time to consider even the few I had. Knowing that lowering flaps can have a momentary "balloon" effect, I extended them another 10 degrees to help us over the tree tops.

Back Side of the Power Curve

The "balloon" maneuver got us over the initial stand of trees, but it was costly in terms of energy and airspeed. With more trees looming just ahead, I quickly needed to increase both. But, with the throttle already pushed all the way in and no way to repeat the "balloon" maneuver with flaps, there were even fewer options than before. Though recognizing that retracting flaps would produce a "settling" effect, I had to eliminate some of the drag. So 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 in most Cessnas produces the worst climb rate, but I had no hope of achieving best climb with it extended. Accordingly, I opted to raise the gear.

Here we were, on the back side of the power curve, with trees fast approaching. Continuing to increase pitch would result in the airplane sinking, rather than climbing, and could lead to a stall. It was very clear that 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 the tops of even the lowest of the

trees. I was truly between a rock and a hard place: I could not increase pitch without stalling, and losing control of the airplane. I knew that lowering pitch was the only way to gain the airspeed I needed, but anything lower than my current pitch attitude would surely put us below the treetops.

Hoping I could buy just a few more feet and just 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 was sounding intermittently. I thought we just might make it – but then the propeller hit the top branch of a tree.

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 that I had been thrown left, to the limits of my seat and shoulder belts. My side of the cockpit (the right side) was crushed in and offered no exit. My friend in the left seat was unconscious, so I released my seat belt and managed to crawl across her to get to the door. Once outside the airplane, I was trying to determine how to get her out when a fireman appeared on the scene. He and a second fireman quickly took charge.

Unanswered Questions

Both of us were fortunate to make a full recovery from the serious injuries we suffered in the accident. For me, though, the physical recovery was the least of it. The bruises were not only physical, but mental and emotional as well. 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, this way I continually strive to learn and improve as a pilot.

There were many unanswered questions, but the most important one to me was: what should I have done differently to avert this disaster? 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 some pilots, though, I was more concerned about running off the end of the runway and causing damage to my airplane. But it was almost game over because, in those few seconds I had to consider the situation, I simply did not game 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 intimately, and the engine had been running well. There were no issues with density altitude, and weight and balance was not an issue. 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. So confident was I that I saw no need to make the actual performance calculations.

Still, I had sensed something amiss. It reminded me of a moment in Ernie 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 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. There is still room for choice.

Mr. Gann made the same choice I did: He decided to commit to flying. Like me, he broke ground and lumbered out of ground effect with the realization that he would not clear the Taj Mahal just ahead 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 over the Taj and allowed him to avoid hitting

workers who were restoring the building.Unlike me, however, Mr. Gann had no other obstacles in his path, and thus had the luxury of losing some altitude as he cleaned up the airplane to get a climb going. I, however, had more trees still in my path.

A Do-Over

In case you're wondering, Ernie Gann arrived at his destination to learn that, contrary to his fuel order, the tanks had been topped off. He had not personally checked, and was thus operating with three tons more than he had planned for. In my case the

NTSB determined: "The pilot's failure to clear the trees during takeoff due to a partial loss of engine power for undetermined reasons." in its probable cause report. So I guess I will never know why the engine let me down, although I do have strong suspicions.

The NTSB was able to determine, through the non-volatile memory of my engine monitor, that there was a 6 GPH drop in fuel flow six seconds after the application of full power which continued through another 4 GPH drop before the final recording one minute after the start of the takeoff roll. Although I will never be able to document this conclusively I am convinced that a baffle broke off in one of the mufflers, thus blocking the exhaust system, which led to the loss of power. (The NTSB never did examine the exhaust system.)

Regardless of the engine's role, I do know that I played one as well. 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 take off with maximum performance climb." In preparing for the oral portion of this exercise, I pored over the performance tables for my airplane 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 fifty-foot obstacle.

Lessons Learned

As I made these computations, though, I realized one of the major mistakes I had made. Specifically, I focused on clearing the obstacle. Just as I taught (until this accident), I followed the drill I had learned so many years ago for short field takeoff and maximum performance climb: Use all available runway; hold the brakes as you apply full power; lift off at the proper rotation speed; accelerate to Vx (best angle climb speed), and maintain it until clear of the obstacle. The rule of primacy almost killed me and my best friend.

As a student pilot, I learned to fly at an airport with a 2,600' runway that had tall trees at the departure end of the preferred runway. In virtually all of the training I received, the consideration on takeoff was to clear the trees. And sad to say, there never really was a discussion of how much ground roll would be required before rotation. There was also no mention of assuring proper fuel flow before roatation since the airplane I trained in did not have fuel flow instrumentation. So the things that I learned early on, which are the hardest things to un-learn, prevailed in this takeoff. I never really considered my abort point nor did I confirm fuel flow.

Everything I had learned and practiced in the short field take off was predicated upon clearing the obstacle, but therein lays the mistake. The first number you obtain from the performance charts is for the ground roll. I learned the hard way how important that number is.

Had I done the planning on the day of the accident, with all the correct information relative to density altitude, wind, weight and balance, and runway surface and gradient, I would have determined that I needed 960 feet for the ground roll. Then, when I

reached that point and found myself not yet airborne I would have had no indecision about aborting the takeoff. Even if I had continued on, when my airspeed faltered at a point 200 feet beyond the 960 feet I needed, I would have known that my only choice was to abort the take off and accept the consequences. And, I would have kept an abnormal airspeed indication from developing into a life-threatening emergency.

There are several lesson that I learned from this accident. From the perspective of a pilot it is the importance of establishing an abort point on **every** takeoff regarless of runway length. It also includes confirmation of full power, oil pressure, proper fuel flow (or pressure) and airspeed alive prior to rotation.

But from the perspective of an instructor the lesson learned is the critical importance of understanding the rule of primacy. The things that we teach our clients in their early hours of training are the things that will stick with them for the rest of their flying years. We have a responsibility to ensure that what we teach is correct, complete and understood by the pilot-in-training.

To this day I have to constantly and consciously overcome some of the things that I was either not taught at all, or taught incorrectly. I've got over 14,000 hours of flight hours logged but my learning never ends. Thankfully, I am alive to keep learning... not only how to be a better pilot, but also to be a better instructor

Doug Stewart is the 2004 National CFI of the Year, an eight time Master CFI and a DPE. He has provided more than 11,000 hours of dual instruction.