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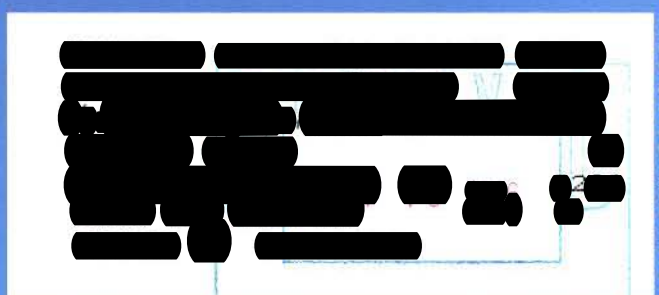
How test pilots measure landing distance



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Left Seat

By J. Mac McClellan
EDITOR-IN-CHIEF

Keeping It on the Runway

The most common type of airplane accident involves departure from the runway on landing. Some pilots lose control and go off the side of the runway with plenty of pavement remaining, but many others simply run out of room and go off the end. The FAA and NTSB are so concerned about landing runway accidents that there is a proposal to add 15 percent to the required runway length for all airplanes that have a runway requirement. In general, small airplanes—those weighing less than 12,500 pounds maximum—do not have certified landing runway length requirements, but all large airplanes and all jets certified so far, no matter what the weight, do have requirements. The proposal is on hold, but I expect some new rule to require jet pilots to use longer runways will appear.

I believe one of the biggest issues in a landing runway accident is that many pilots of all types of airplanes simply don't understand what the information in their pilot operating handbook (POH) or airplane flight manual (AFM) means, and how it was collected.

Once again, airplanes of different weights are treated differently by the FAA. For large airplanes and jets, the landing distances in the manuals are approved by the FAA. And so is the data for most propeller airplanes that have maximum takeoff weights of more than 6,000 pounds. But performance information for piston-powered airplanes weighing less than 6,000 pounds maximum gross weight may or may not be FAA approved. The manual must clearly indicate if the landing runway length data, for example, is or isn't approved.

It probably doesn't matter all that much if your airplane has approved landing runway length information or not, because the manufacturers conduct the tests using the same procedures. Know-

PHOTO: NIGEL MOLL

ing and understanding the flight test procedure is the important thing.

For newer piston airplanes certified under FAR Part 23, and for jets and large airplanes, the landing runway length test is clear. The test pilot must maintain a steady three-degree approach path at VREF airspeed. The runway length required is measured from the point where the airplane is 50 feet above the runway until it stops.

VREF final approach airspeed is typically 1.3 times the stalling speed at the weight of the airplane as it approaches to land. However, some piston singles that trace their certification roots back to the old CAR 3 rules—which includes many airplanes in the fleet—use VREF speeds as low as 1.2 times stall to calculate landing distance. That's a little too slow for my taste. You can find out by comparing the recommended VREF on the landing distance chart to the stalling speed chart and doing the math. Many piston single manuals have a short field landing chart as well as a normal landing distance. Often the short field chart will require an approach speed of 1.2 times stall, and/or a steeper than three-degree approach. There is no such thing as a short field landing distance for larger airplanes, as all landings are treated the same.

The importance of maintaining VREF airspeed is obvious. Every knot above VREF on approach will cause the airplane to float more before touchdown, and will add more energy for the brakes to overcome in the stop. You can be sure that the test pilots who collected the data for landing runway length in your airplane manual were not a single knot over VREF because if they were, they went back and did the test again.

What you probably don't know is that the test pilot almost certainly yanked power back to idle at the 50-foot above the runway point. The rules require the approach to be completely stable at a three-degree approach angle, and that requires power. But at the 50-foot mark, all bets are off and the quickest way to get from 50 feet to the runway is to pull off all of the power.

Most of us, except in the lightest airplane, carry at least a little power into the landing flare because some thrust makes it easier to feel for that smooth touchdown. But that extra power and "feeling" for the runway is using up many, even hundreds, of feet that the test pilot didn't use. The rules don't require test pilots to make a "good" landing, only a safe landing that doesn't overstress the landing gear or airframe. Test pilots talk about "minimum flare" on their landings, and that means just enough to keep from hitting on the nose first.

Depending on the airplane, it can be a challenge to land when you chop the power at 50 feet with no extra airspeed. Turboprops can be the most demanding because their propellers go immediately to flat pitch to maintain turbine speed, and that creates a lot of drag. You can make very short landings in turboprops just like the manual says, but you need to be very quick at getting the nose up as the power comes off. I bet you won't be happy with the results the first time you try it.

Even in piston airplanes you can find a very rapid sinking spell when you come instantly back to idle at 50 feet. Airplanes like the older Cessna singles with their 40-degree flap extension can really come down with all power off, and it takes a deft touch to flare enough to hit on the mains, but not flare too high so that the airplane stalls and pitches down to hit the nosewheel. But you must remember that a test pilot made that kind of landing to deter-

mine runway requirements in the book.

Test pilots behave differently than normal pilots after touchdown in the way they use the brakes. Most of us wait a few seconds to let the airplane settle down before we get on the brakes, and usually our first application of pressure is light to feel for the traction and effectiveness of the brakes. Not the test pilots. As soon as the nosewheel is down, which is only an instant after the mains, they are on the brakes with maximum effort.

In a jet with powered antiskid brakes test pilots simply mash down on the pedals as hard as they can, and the antiskid system makes sure the wheels don't lock and destroy the tires. As they say, if your butt is touching the seat, you're not pressing hard enough on the pedals. The experience can only be described as violent. Anything not tied down flies forward. You feel the antiskid cycling pressure on and off the brakes to keep the wheels turning while maintaining maximum traction with the pavement. No passenger would willingly endure such a stop except in an emergency.

To try to imagine a test pilot landing for certification consider that a Gulfstream 550 can be flying at 110 knots at 50 feet above the runway. Measuring from that point the pilot can touchdown and stop in a total distance of less than 2,300 feet. And that would be at a landing weight of about 50,000 pounds. The Gulfstream is an amazing airplane with exceptionally good brakes and large spoilers that automatically deploy on touchdown, but that is an incredibly short landing. Gulfstream pilots are good, but I don't think many would find a 3,000-foot runway satisfactory, even though the book says it offers a 30 percent cushion over what the book says it required.

Adding 15 percent to the required runway of a Gulfstream, in this example, is no big deal. But, if the airplane is being flown for hire, the required runway length in the manual must be no longer than 60 percent of the available runway. Now, add another 15 percent to that, and land at a higher weight, and the number of runways available can become restrictive.

But the very fact that airplanes operated for hire get a 40 percent cushion over what test pilots demonstrated in certification clearly shows the difference between test pilot flying and real world flying. Test pilots don't run off the runway, but real world pilots do.

My point is that when you compare the landing distance in your manual to the runway available, be sure to think about how the landing distances in the manual were obtained. If the runway available is close to the book, I think you should consider your approach and landing to be an abnormal procedure, because that's what it will take to match the numbers. The manuals don't lie, but you do need to use a very specific technique, not normal everyday procedures, to achieve the published results.

It Was My Fault

The accident record is full of pilots who ignored warnings of trouble because they were overly confident that everything was well. I did the same thing not long ago. It wasn't a dangerous situation, but it sure was inconvenient, and it was my fault.

I was at an airport that had a gas pump instead of fuel trucks. I taxied to the pump and asked for both wings of my Baron 58 to be topped off and walked away.

When I went to pay the fuel bill the guy who had done the fueling apologized for "over filling" one wing, but said he got the other just right. Barons have a tab in the tank with the word "full" and a line about three or four inches below the filler port. Beech put the mark there so that there would be room for fuel to expand without venting overboard if the airplane sat out in the sun. Line guys regularly fill the tanks to the brim to avoid the risk, I assume, of being yelled at for not really topping off the tanks. It was filling past the line that I assumed this fellow meant when he said he had overfilled one side.

But clue number one to a potential problem was the fuel bill. The fuel bill was for 25 gallons less than I expected. I never miss my estimate of fuel burned on the last leg by more than five gallons, and usually can come within a couple gallons of knowing what the top off total will be. The airplane is that predictable. I noticed this big difference, but blamed myself for making a mistake in calculating the fuel I had burned.

When I walked around the airplane I looked in the left tank and it was filled to the brim. And that was just fine because I was planning an immediate departure with no opportunity for the fuel to expand. When I looked in the right wing fuel port I couldn't see fuel. That was clue number two that there may be a problem. But there is enough dihedral in the Baron's wing, and the fuel tanks extend for almost the entire length of the leading edge, so that fuel is not visible when it is down only a gallon or two. The mechanical "sight" gauges read only up to 60 gallons and it showed more than that was in the tank, but I had no way of knowing if the other 26 gallons it holds were there or not. I guessed that the fueler had believed he overfilled the left tank and stopped just a little short on the right.

Clue number three of a problem came inside the cockpit when I checked the fuel gauges. The right side showed about three-quarters full. Because there are three individual tanks in each wing of my Baron there are multiple sensors that need to be electronically massaged to get an accurate reading with more than half-full tanks. The gauges work pretty well, but their real accuracy is from about one-third down, and their calibration point is empty, not full. Though my fuel gauges have worked well, I chose not to believe it.

Shortly after liftoff the clues added up to the unavoidable conclusion that the right tank wasn't even close to full. The left wing was very heavy and even full aileron trim to the right couldn't hold it up without some pressure on the control wheel. My choice was to make a VFR return and land for the missing fuel, or fly partway home and stop for gas. I chose to keep going for a couple hours to avoid thunderstorms that were approaching the departure airport.

Nothing about this situation was really unsafe because even with the missing avgas the right side had more than three hours of fuel. But the fact that I ignored at least three very positive indications of a problem was a jolt. We have all asked ourselves after reading about an accident how it could have happened when the pilot had so many warnings. Now I can understand, at least a little. I am taking this benign, but very real, mistake to heart and will try to use the experience to fight the complacency that is the enemy of safety in all flight operations.