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Last Resort — Downwind Takeoffs and Landings

Considerations and Calculations when there is no alternative

BY STEVE KROG

HAVE THERE BEEN SITUATIONS when you are faced with having to make a downwind takeoff or landing? Where does this situation occur? You might be landing at an airport with a relatively short runway with obstacles at one end. Or, at a fly-in with a lot of activity and the traffic pattern was initially established but then the wind changed, and the traffic flow was such that everyone continued to land with a tailwind. This sometimes happens at EAA AirVenture Oshkosh.

Are downwind takeoffs and landings safe? Legal? Practical? The answer is yes, provided certain calculations are made, precautions are taken prior to attempting, and your own pilot limitations are known and accepted. Are they recommended? No, there are times that they may not be safe depending on the conditions. If you do a reasonable amount of flying to and from both public and private use airports, you will occasionally encounter the challenge of either landing or taking off with a tailwind.

Some airport layouts are such that one must land in one direction and depart in the opposite direction requiring either a downwind landing or takeoff. For example, some airports have a runway grade where one end has a higher elevation than the opposite end. Or, one end may be obstructed by very tall trees, power lines, and other obstructions.

If faced with having or wanting to make either a downwind takeoff or landing, numerous factors need to be considered before executing the maneuver. Aircraft performance numbers and pilot experience must first be reviewed, followed by weather conditions, including temperature, density altitude, wind direction, and velocity. Next, consider the destination airport configuration. What is the layout of the runway: length, width, surface, obstructions, and grade? All need to be known before attempting to take off or land.

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What does all of this mean? Let's look at a potential real-time situation. You own and fly a 1978 Cessna 172. It has been maintained, and the engine is mid-time. Your family owns a remote summer cabin about 100 miles away. A nasty summer storm passed through that area the night before causing some cabin damage according to a phone call from a cabin neighbor. You make the decision to make a quick flight to the cabin to inspect the damage. Two friends are invited to join you. A privately owned public use airport is located about half a mile from your family cabin.

The destination airport has one 3,000-foot turf runway, 09/27. It has a 2-degree upslope running from west to east, and the field elevation is a published 2,400 feet. A line of 80- to 100-foot tall trees is located at the east end, and a three-strand barbed wire fence runs across the west end.

You have flown into this airport in the past, so you're familiar with the layout and challenges. However, the previous flights were solo. Today's flight includes two passengers assisting with the cabin damage inspection.

As a good, safe pilot, the next item on your checklist in preparation for the flight is getting a weather briefing. The airport doesn't have weather reporting capabilities, but airports within 8-10 miles do. It's good VFR along your entire route. The surface winds are reported at 070 degrees and 10 knots, and the temperature is approximately 85 degrees Fahrenheit. Density altitude is an estimated 3,000 feet for the area.

Next, you dig out the pilot's operating handbook (POH) for your 172 and begin calculating the necessary information for making a safe landing followed by a safe takeoff a couple of hours later.

According to the landing data chart, at 2,500 feet and 50 degrees Fahrenheit, it should take approximately 1,310 feet of runway to land (using the 50-foot obstacle data for a safety margin) on Runway 09. The 10-knot headwind should reduce the landing distance by 20 percent (10 percent for every 5 knots of headwind). Allowing for the turf surface, the POH recommends adding 20 percent to the total landing distance. Finally, factoring in the 2 percent upslope from west to east, you should be able to reduce the landing distance by an estimated 20 percent. Then add your personal margin for safety of 500 feet, and you have the expected landing distance.

INITIAL LANDING DISTANCE	1,310 feet
LESS 20% FOR HEADWIND	– 262 feet
PLUS 20% FOR TURF	– 262 feet
LESS 20% FOR UPSLOPE	– 262 feet
PLUS PERSONAL SAFETY MARGIN	+ 500 feet
TOTAL	1,548 feet

Based on the calculations you've made, the landing should be no problem with an estimated length of 1,548 feet — half of the published length of the runway.

With a deep sigh of relief, you turn to the takeoff performance charts to determine today's takeoff distance given the wind, weather, and runway conditions. Using good judgment, you have already decided that a takeoff to the east is out of the question due to the runway end obstacles, upslope, and the surface being turf.

Using the POH and factoring in the stated conditions, the numbers break out like this:

	TO CLEAR 50-FOOT OBSTACLE	NO OBSTACLE
TAKEOFF DISTANCE	1,910 feet	1,040 feet
DENSITY ALTITUDE FACTOR	+ 114 feet	+ 114 feet
TEMP. FACTOR +10 PERCENT	+ 203 feet	+ 115 feet
TURF SURFACE +7 PERCENT	+ 149 feet	+ 89 feet
TAILWIND +50 PERCENT	+ 1,188 feet	+ 679 feet
DOWN SLOPE -20 PERCENT	- 713 feet	408 feet
TOTAL	2,851 feet	1,629 feet

Note: Not all POHs agree on the effect of downslopes on takeoff distances, and not all airplanes fly the same.

Clarifying some of the above numbers, according to the Cessna POH, you add 10 percent to the takeoff distance for every 25 degrees Fahrenheit above the temperature used in the chart. In this case, the chart temperature was shown as 50 degrees and the outside temperature was 85 degrees, so, for simplification, 10 percent was added.

The turf surface is also a factor affecting the takeoff distance. The POH states that 7 percent should be added for turf. This factor can be quite variable depending on the length of the grass, surface wetness, and roughness.

The tailwind factor significantly increases the takeoff distance. The general rule of thumb states that 10 percent should be added for every 2 knots of tailwind. In this example, we had a 10-knot tailwind meaning we need to add 50 percent to our takeoff distance.

The downslope factor also influences the takeoff roll. Again, the rule of thumb states that one should subtract 10 percent for each degree of downslope. In this example, the downslope was 2 degrees so we subtracted 20 percent from the total takeoff distance. However, there is a certain amount of industry disagreement when factoring in a takeoff roll with a downslope.

The runway length is 3,000 feet, so using the 50-foot obstacle clearance numbers is technically doable, but it doesn't leave much margin for error. If you add your personal 500-foot minimums, it's out of the question as it requires 350 feet more than the runway length. But could you use the published short-field obstacle airspeed and control inputs to aid in shortening the takeoff roll?

Adding all the numbers, we arrive at a ground roll distance of 1,629 feet, which is doable and well within the safety margin. Even if you add in your personal pilot minimums of 500 feet, for a total distance of 2,129 feet, you still have a safety margin of nearly 900 feet.

But there are still some factors to consider before closing the POH and heading to the airplane. How old and in what condition is your aircraft? Are the wing leading edges clean and smooth, or do they have a thick layer of green and brown bug slime? What is the time on the aircraft engine? Is it fairly new and low time, or is it nearing the time before overhaul? A high-time engine is not going to perform like a new low-time engine.

What is the prop's condition? Is it also covered in bug slime? Are the blade leading edges free of nicks and rough edges? Is it full length, or has it been overhauled at some point and shortened by an inch? It's still legal, but will it perform like a new full-length propeller?

Are the tires properly inflated? If tire pressure is only 2-3 pounds low, it will take significantly more power to get the airplane to move, especially on turf.

Many airplanes have wheelpants installed. They make the airplane lines look nice and clean and add 3-5 knots to the airspeed. But they can be a hindrance if taking off on turf as they create a lot of drag while plowing through the tall grass. If the runway hasn't been mowed and the grass is 8-10 inches tall, one may need to factor in another 10-20 percent to compensate for the drag created.

Remember that once the aircraft is in the air it doesn't care what direction the wind is blowing because it all becomes relative wind. However, before reaching this attitude the surface tailwind significantly affects the aircraft. A 10-knot tailwind equates to a groundspeed of 10 knots plus the indicated airspeed. If your planned rotation speed is 60 knots, your groundspeed will be 70 knots until transitioning to flight and relative wind.

And finally, have you picked a visual reference point for a go or no-go decision point? If not, do so. It's a lot easier to make an abort decision if you have a visual reference rather than guessing at it.

If you've never had to perform a downwind takeoff or landing, you might want to chat with your local instructor or an experienced safety pilot and practice a few downwind takeoffs and landings. They have a completely different feel than what you are used to.

Fly safe and have fun. See you at AirVenture. EAA

Steve Krog, EAA 173799, has been flying for more than four decades and giving tailwheel instruction for nearly as long. In 2006 he launched Cub Air Flight, a flight training school using tailwheel aircraft for all primary training.