CHAPTER 4 – TAKEOFFS

TAKEOFF CONSIDERATIONS

The worst time to be studying about an emergency is during the middle of one. Before beginning a takeoff, consider the following topics. Familiarization makes it easy to cope with adverse conditions or an emergency, should one arise.

AIRSPEED

Airspeed control is important during the takeoff and climb from a mountain strip. With exact airspeed control you are able to extract the maximum performance from the airplane.

Very few operations can associate a rule with the "always" or the "never" monicker without exception...because there are always exceptions to the rule. But, for normal operations, as opposed to special exceptions like adding half the wind-gust factor to the takeoff speed or approach speed, we will, at any airport elevation regardless of density altitude, always use the same indicated airspeed for takeoff as that used at sea level. We will always use the same indicated airspeed for approach to landing that we use for approach to landing at a sea-level airport. Let's see why this is true.

An airplane accelerating for takeoff from a sea-level airport under standard conditions (assuming no instrument error) will register the true airspeed of the airplane on the airspeed indicator. That is, the indicated airspeed and true airspeed are the same. When the airplane operates at a high altitude airport (any airport above sea level) the indicated airspeed is less than the true airspeed.

Assume an airplane is departing from Leadville, Colorado, elevation 9,927 feet msl. At sea level this airplane uses 65 knots true airspeed to rotate. You know the true airspeed must be faster at high altitudes to compensate for the increased true airspeed stalling speed. The thin air affects the power output of the engine, the thrust of the propeller, and the lift of the wings.

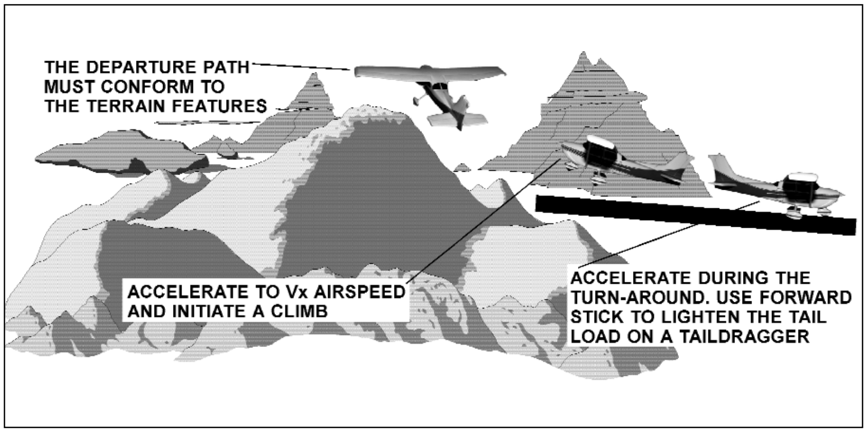
As the airplane accelerates and reaches a true airspeed of 65 knots, the airspeed indicator will only indicate about 56 knots (with standard conditions) because the thin air cannot expand the diaphragm inside the airspeed indicator as much as the thicker air does at sea level. By the time the airspeed indicator shows 65 knots (the speed used to rotate), the airplane is actually going about 75.5 knots true airspeed, automatically compensating for the thin air.

TAKEOFF POWER

Many years ago, the FAA conducted tests to determine the benefits of setting full power before brake release for takeoff. They determined that, aerodynamically, the prop must move forward through the air before becoming efficient; therefore, this static run-up does not increase the takeoff performance by shortening the take-off roll. On a rough field this technique of setting full power before brake release may damage the propeller and horizontal stabilizer.

Although I know, theoretically, that it does no good to make a full-power application before brake release, I prefer to hold the brakes on a short-field takeoff, assuming it can be done without damaging the propeller or horizontal stabilizer. This is especially true if the engine is turbocharged or supercharged. A progressive power application without surging or over-boosting is the reason. This technique reduces the urgency to shove the throttle through the panel as the end of the runway approaches.

On a landing strip where it is unwise to make the full-power application before brake release, with practice, the pilot can begin adding the power during



RULE OF THUMB: WHEN THE RUNWAY LENGTH IS DOUBTFUL, MARK THE MIDPOINT OF THE RUNWAY. IF 71% OF THE TAKEOFF SPEED IS OBTAINED AT THE 50% POINT ON THE RUNWAY, SUFFICIENT RUNWAY IS AVAILABLE FOR THE TAKEOFF. IF NOT, ABORT THE TAKEOFF AND WAIT FOR BETTER CONDITIONS. (COOLER TEMPERATURE, MORE HEADWIND, OR OFF-LOAD SOME PASSENGERS AND BAGGAGE, FERRYING THEM OUT IN SEVERAL TRIPS.

the turn to align with the runway. During the last 30-degrees of turn full power can be set without incurring any damage because of the forward movement of the airplane.

RUNWAY LENGTH REQUIREMENT

There is a simple rule to determine if a particular runway length is sufficient for takeoff.

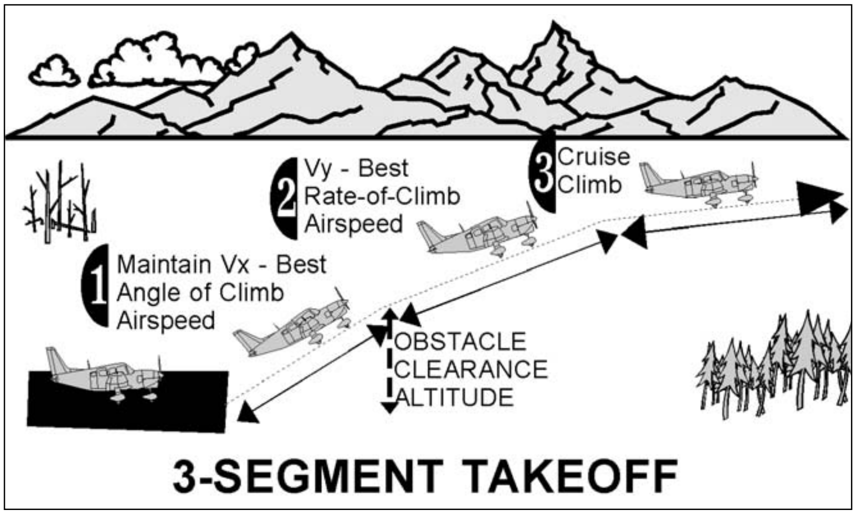
RULE OF THUMB for sufficient runway length for takeoff

Multiply 10 times the square root of the percentage of liftoff distance required. This equals the percentage of liftoff speed that should be attained in that distance.

A fellow experiencing mechanical difficulties (lack of fuel) landed in a small hay field and was hesitant to try to fly the airplane from this short field. He contacted me to see if it could be flown from the field.

The performance charts for this airplane turned out to be worthless under the existing condition of density altitude and the 12-inch high hay.

When you fly from a short runway and you have doubts that the performance of the airplane is adequate to takeoff in the distance available under existing con-



ditions of density altitude and aircraft loading, use the "runway length sufficient" rule of thumb.

Mark the mid-point of the runway. The reason for this is because the airplane stops better than it accelerates. If you accelerate to the halfway point and determine you have insufficient speed for takeoff, you can easily stop in the remaining distance.

Take the square root of 50 (percentage of liftoff distance required equals half or 50 percent of the runway). This value is 7.07. Multiply this by 10 (10 times the square root), for a total of 70.7. If 71 percent of the liftoff speed is attained by the halfway point of the runway, the airplane will take off in the space remaining.

This does not guarantee the rate of climb will be sufficient to clear any obstacles that may be present after takeoff, but it does guarantee that you can takeoff in the space available.

GUSTY WIND TAKEOFF

For takeoff operations during gusty wind conditions, keep the airplane on the ground until obtaining a speed of V_R plus one half the gust factor.

TAILWIND TAKEOFF

Due to terrain considerations, backcountry airstrips are generally located beside creeks and rivers where more or less flat terrain exists. It is desirable to land upstream and takeoff downstream at backcountry strips to let the sloping terrain work with you. But, you must be mindful of the wind.

When wind is created by solar effect, the air rises and begins moving upslope. The sun heats the canyon creating convection currents and these morning winds—called a *Valley Breeze*—blow up the canyons. The valley breeze is generally 4-6 knots. This means, when landing upslope (upstream), the airplane will experience a tailwind.

In the evening, as the air cools and becomes heavier, it slides down the mountains creating evening winds—called a *Mountain Breeze.* The mountain breeze is stronger than the valley breeze, usually around 10-12 knots. This means a flight departing during the late afternoon or evening, flying downslope, will be exposed to a tailwind.

RULE OF THUMB for the effect of a tailwind on takeoff distance

The tailwind takeoff distance is equal to 110 percent of the computed takeoff distance for the existing density altitude plus the value of the tailwind component divided by the rotation speed.

How does a tailwind affect the takeoff distance? For an airplane with a takeoff distance of 1,000 feet, a rotation speed of 50 knots and a 10-knot tailwind, the takeoff distance would be:

1,000 x 1.10 = 1,100 feet (takeoff distance x 110 percent) plus

1,000 x 10/50 = 200 feet (tailwind/rotation speed)

Total 1,100 feet plus 200 feet = 1,300 feet

UPSLOPE OR DOWNSLOPE RUNWAY

RULE OF THUMB Upslope or Downslope Runway Takeoff Distance

For takeoff on an upslope runway, from one degree up to two degrees, add 10 percent per degree.

For downslope runways, decrease the takeoff distance five percent per degree.

BREAKEVEN HEADWIND

Often when I am speaking before a group of pilots someone asks, “How can I determine whether to takeoff upslope into the wind or down slope with a tailwind?”

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