



FAA Pilot Education Pamphlet Reprints

Planning Your Takeoff

TAKEOFF PERFORMANCE CONSIDERATIONS FOR THE SINGLE ENGINE AIRPLANE--

First . . . be thoroughly familiar with the capabilities and limitations of the airplane you're going to fly . . . then . . . using your Pilot's Operating Handbook and applicable documents . . . plan . . . and be prepared.

MAJOR FACTORS TO CONSIDER . . .

Gross Weight and Center of Gravity

Gross weight is defined as the empty weight of the airplane plus its useful load. Gross weight directly affects stall speed and, consequently, takeoff velocity. The higher the gross weight, the higher the speed required before the airplane can takeoff and, therefore, the longer the takeoff roll. An improperly loaded airplane, with its center of gravity out of limits, may have undesirable handling qualities. When you operate at or near your full gross weight, or are carrying a baggage load that might involve abnormal loading, always refer to your Handbook to determine exactly what your loading limits are before you taxi out.

Density Altitude

Density altitude represents the combined effect of pressure altitude and temperature, and has an effect on performance even at low altitudes and on hot days. High density altitude has a major impact on airplane performance.

Specifically, increased density altitude:

- Decreases available engine power for normally aspirated, that is, non-supercharged engines,
- Decreases propeller efficiency, thereby increasing the required takeoff distance, and
- Increases the required takeoff ground roll.

When operating out of a high density altitude airport, remember that your engine will not develop its maximum rated power for that altitude unless it is leaned to the proper fuel-to-air ratio. Even then, there will be some reduction in available power over comparable performance at sea level. Refer to your Handbook for information on proper leaning procedures for high altitude operation.

Wind

Wind direction and velocity will have a significant effect upon your takeoff roll:



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- **Head Wind:** a head wind will reduce your overall takeoff distance because the airplane will reach its takeoff velocity more quickly and hence will become airborne sooner than in calm air.
 - **Tail Wind:** conversely a tail wind will increase your takeoff distance as the aircraft will take longer to accelerate to its takeoff speed. Remember though your airspeed indicator will in both cases read the same indicated airspeed.
 - **Cross Wind:** the effects of a cross wind on takeoff performance will vary depending upon the wind's direction. A 90 degree cross wind will have a negligible effect on takeoff distance.
 - **Gusting Winds** a gusting wind situation will require that you keep the airplane on the ground for a slightly longer period of time thereby increasing your overall takeoff roll.

Runway

Takeoff and landing distances in Handbooks are predicated on paved dry level runway conditions. A rough dirt or grass landing strip will considerably lengthen your overfill takeoff distance. Likewise standing water snow or slush on a paved runway or an uphill sloping runway will also significantly increase your takeoff roll.

Ground Effect

When flying close to the ground drag is reduced due to the restricted air flow patterns around the wing . . . the so-called "ground effect." This makes it possible to lift off at too high a pitch angle or too soon with a heavy load. However taking off too soon, at possibly too steep an attitude, will cause the airplane's angle of attack to be at or near that of a stall, with drag and thrust nearly equal. If you leave ground effect under these conditions, the airplane may not be able to accelerate to its proper climb speed, without first lowering the nose momentarily. Don't force your airplane to become airborne too soon. Let it lift off when it's ready to fly. Then, hold it in ground effect momentarily before climbing out. This is especially important when departing from a short, soft field with obstacles. What can happen is that you get yourself "behind the power curve." In such cases, the only way to regain your normal climb attitude is to lower the nose, accelerate, and then climb . . . the problem is, will it be too late, or can you sacrifice altitude for speed or . . . are obstacles a problem?

Planning For "What if . . ."

Emergency planning is a must item in preparation for all takeoffs. Most power losses occur at the first application or reduction of power. The best way to check your engine for a possible malfunction is during your engine run-up, before takeoff. And don't rush with your run-up, either. Use your check list. Be alert. Look . . . and listen for any abnormalities that may signal impending power loss or other problem. But, what should you do in the event that you do experience a power loss during takeoff or on climbout?

- If power loss occurs during your takeoff roll--stop straight ahead on the runway, if at all possible. If insufficient runway remains, continue straight ahead, turning only to avoid obstacles.



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- If you experience a power loss after liftoff, don't . . . repeat don't . . . attempt to return to the airport. You should instead, lower the nose to maintain proper airspeed, then land straight ahead with your gear down to lessen impact forces. Make only slight turns to avoid obstacles.
 - Remember, the cardinal rule in the event of any power loss is to maintain airspeed and control at all times.
 - If you experience a power loss after sufficient altitude has been gained, you have the option of either selecting an open field in which to land or, possibly, doing a 180 degree turn and returning to the airport from which you departed. But, don't be trapped because you have a little extra altitude. Maintain your best glide speed until you are sure you can reach the area of intended landing. Then, you can lower the flaps or extend the landing gear. In the meantime, make use of this valuable time to troubleshoot the problem. Maybe, the cause of the power loss is as simple as letting the fuel tank go dry, or placing the fuel selector in an "off" or intermediate position, or moving the mixture control to idle cut-off.

In Summary

- Know your airplane, including all of its subsystems.
- Make sure that when you're transitioning to a new airplane, you get a complete checkout, by a competent flight instructor.
- Use your Pilot's Operating Handbook in determining your airplane's weight and balance limitations, performance and runway length requirements. And don't forget to calculate the effects of density altitude!
- And finally, make consideration of the winds and the condition of the runway part of every preflight planning you do.

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