



# Commercial Pilot Ground School

Day 13

Maximum Performance Takeoffs and Landings, Power off 180



# Agenda

- Maximum Performance Takeoffs and Landings
- Soft Field Takeoff and Climb
- Soft Field Approach and Landing
- Short Field Takeoff
- Short Field Approach and Landing
- Power off 180 Accuracy Approaches and Landings

# Maximum Performance Takeoffs and Landings

During flight training, you typically learn to fly at airports with relatively long, paved runways. However, not all airports have long runways, many have runways made of dirt, grass, or sod. It is important that you learn how to perform short-field and soft-field take-offs, climbs, approaches, and landings. These maneuvers, also referred to as maximum performance takeoffs and landings, are designed to allow you to operate safely into and out of unimproved airports.



# Soft Field Takeoff and Climb

A soft field may be defined as any runway that measurably retards acceleration during the takeoff roll. The objective of the soft-field takeoff is to transfer the weight of the airplane from the landing gear to the wings as quickly and smoothly as possible to eliminate the drag caused by surfaces such as tall grass, soft dirt, or snow. Takeoffs and climbs from soft fields require special procedures, as well as knowledge of your aircraft's performance characteristics including, best angle-of-climb speed ( $V_x$ ) and best rate-of-climb speed ( $V_y$ ). When using the FAA-approved flight manual or POH performance data, keep in mind that the figures, such as takeoff distance, apply to an airplane in good operating condition, and they are valid only for the listed conditions.



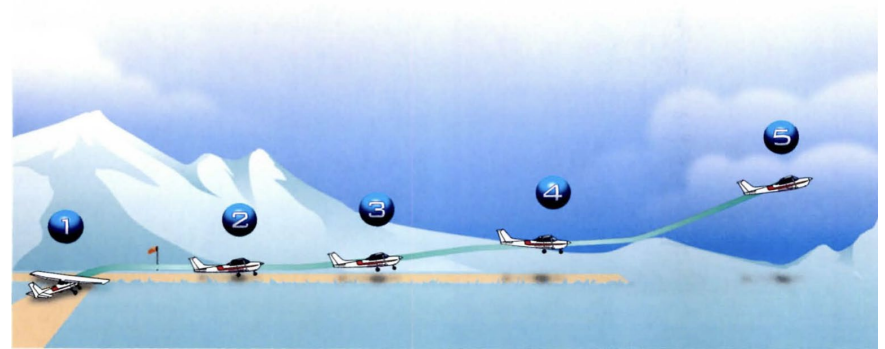
# Soft Field Takeoff and Climb

You actually begin the soft-field procedure during the taxi phase. If the taxi area surface is soft, use full back pressure on the yoke to maintain full-up elevator (or stabilator) deflection with a slight amount of power to keep the airplane moving. This technique transfers some of the airplane's weight from the nose-wheel to the main wheels, resulting in lower power requirements and greater ease in taxiing.



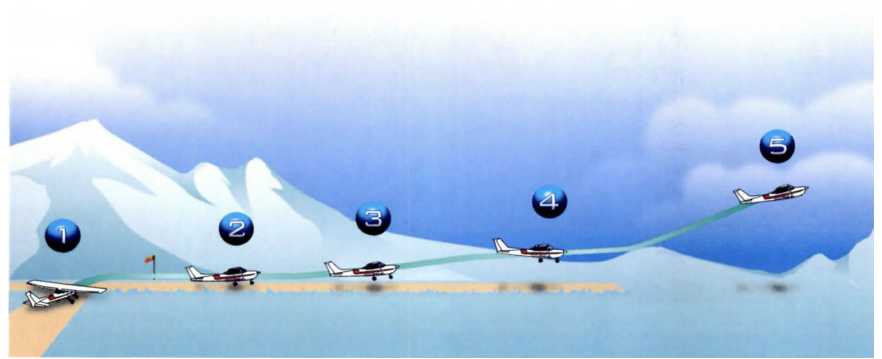
# Soft Field Takeoff and Climb - Procedure

- 1) Complete the before takeoff check on a paved or firm surface area, if practical. This helps to avoid propeller damage and the possibility of the airplane becoming stuck.
  - Set the flap position as recommended by the manufacturer.
  - Clear the approach and departure areas and the traffic pattern prior to taxiing onto the runway. After obtaining a clearance (at a controlled airport) or self announcing your intentions (at an uncontrolled airport), taxi into position for takeoff without stopping.



# Soft Field Takeoff and Climb - Procedure

2) Align the airplane with the center of the runway, and while still rolling, smoothly add takeoff power. Make sure you check engine instruments as the engine reaches full power. Maintain full back pressure on the yoke to raise the nosewheel from the soft surface.



# Soft Field Takeoff and Climb - Procedure

As you increase speed and the elevator (or stabilator) becomes more effective, reduce back pressure slightly. Continue to use back pressure on the yoke to hold the nose up and to reduce the amount of weight on the nosewheel

3) As the airplane lifts from the runway surface, reduce back pressure to achieve a level flight attitude.

4) Allow the airplane to accelerate in level flight, within ground effect, to  $V_x$  or  $V_y$  (as required) before starting a climb.

5) Establish the climb attitude maintaining  $V_y$ . Once a positive rate of climb is attained, retract the landing gear and raise the flaps, then trim to relieve control pressures.

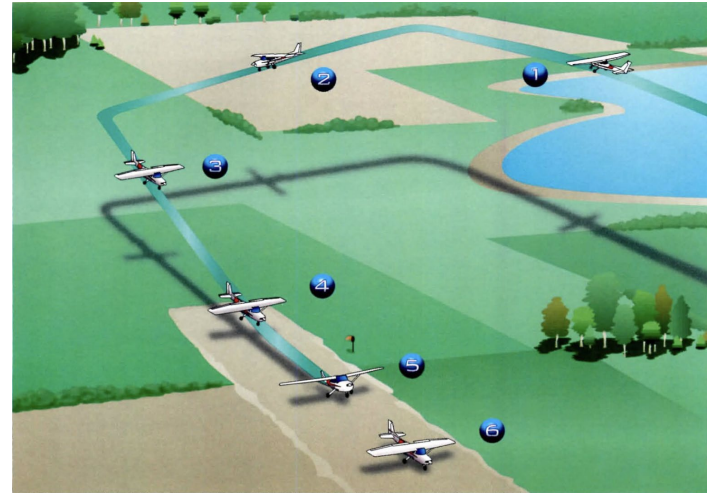


# Soft Field Takeoff and Climb - Video



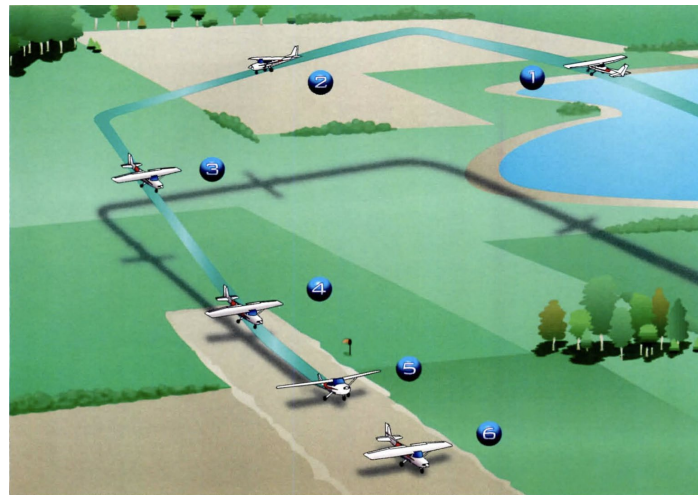
# Soft-Field Approach and Landing

The objective of a soft-field landing is to ease the weight of the airplane from the wings to the main landing gear as gently and slowly as possible, while keeping the nosewheel off the soft surface during most of the landing roll. If executed properly, this technique will prevent the nosewheel from sinking into the soft surface and reduce the possibility of an abrupt stop or possible damage to the airplane during the landing roll.



# Soft-Field Approach and Landing

You should consult your airplane's POH for the appropriate speeds and specific procedures for performing soft-field landings. In the absence of a manufacturer's recommended approach speed, use 1.3 times the stalling speed in the landing configuration. In addition a gust factor adjustment to the approach speed may be applicable.



# Soft-Field Approach

- 1) Ensure that the before landing checklist is completed and that the approach and landing areas are clear. Lower the landing gear and extend approximately one- third of the available flaps .
- 2) Extend the flaps to two-thirds, while progressively reducing the airspeed. Use trim to relieve control pressures.
- 3) Unless obstacles are in the approach path, maintain the same descent angle on final as you would during a normal approach. Maintain the recommended approach speed and extend the remaining flaps.



# Soft-Field Landing

- 1) Hold the airplane one to two feet above the surface as long as possible to dissipate forward speed. Maintain that attitude with power and slowly continue the descent until the airplane touches down at the lowest possible airspeed with the airplane in a nose-high attitude.
- 2) Touch down in a nose-high attitude at the slowest possible airspeed. Maintain back pressure on the yoke to hold the nosewheel off the surface as long as practical. As the airspeed decreases on the roll-out, smoothly and gently lower the nosewheel to the surface.



# Soft-Field Landing

Increase the power slightly, if necessary, to keep the aircraft moving and prevent it from stopping suddenly on the soft surface. Avoid using the brakes since braking action may cause the nosewheel to dig into the soft surface and cause damage to the landing gear. The soft surface should provide sufficient braking action to slow the aircraft.

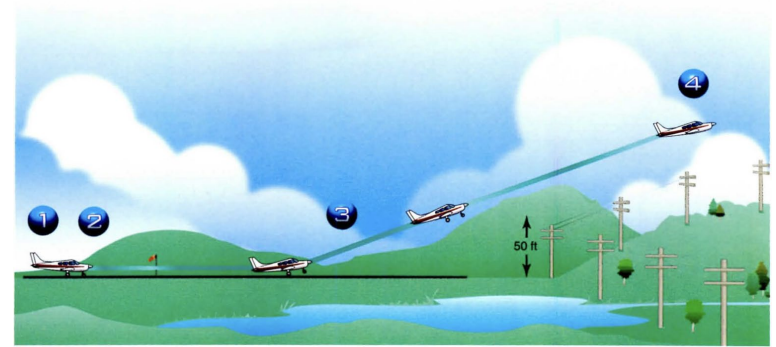


# Soft-Field Approach and Landing - Video



# Short-Field Takeoff

Short-field takeoff and maximum performance climb procedures may be required when the usable runway length is short, or when the runway available for takeoff is restricted by obstructions, such as trees, powerlines, or buildings, at the departure end. During short-field practice sessions, it is usually assumed that you are departing from a short runway and that you must clear an obstacle which is 50 feet in height. To accomplish successful short-field takeoffs and climbs, you must be familiar with the best angle-of-climb speed ( $V_x$ ) and the best rate-of-climb speed ( $V_y$ ) for your airplane. Many manufacturers also specify a best obstacle clearance speed. You should consult your airplane's POH for the appropriate speeds and specific procedures for performing short-field takeoffs.



# Short-Field Takeoff - Procedure

- 1) Complete the before takeoff check. Ensure that the runway, as well as the approach and departure paths are clear of other aircraft. After obtaining a clearance (at a controlled airport) or self announcing your intentions (at an uncontrolled airport), taxi into position at the beginning of the runway so as to allow maximum utilization of the available runway, and align the airplane on the runway centerline.
- 2) Set the flaps as recommended by the manufacturer. The appropriate flap setting varies between airplanes and can range from no flaps to approximately one-half flaps. While holding the brakes, smoothly add takeoff power, then release the brakes to begin the takeoff roll.



# Short-Field Takeoff - Procedure

3) Allow the airplane to accelerate with its full weight on the main wheels by holding the yoke to maintain the elevator (or stabilator) in a neutral position. Smoothly and firmly apply back pressure to the yoke to lift off at the recommended airspeed. Since the airplane accelerates quickly after lift off, you may need to apply additional back pressure to establish and maintain  $V_x$  (or best obstacle clearance speed).

4) Once you have cleared the obstacle and reached a safe altitude, lower the nose and accelerate to  $V_y$ . Retract the landing gear and then retract the flaps (if applicable). If no obstacles are present during training, you should maintain  $V_x$  until you are at least 50 feet above the runway surface. Trim to relieve control pressures.

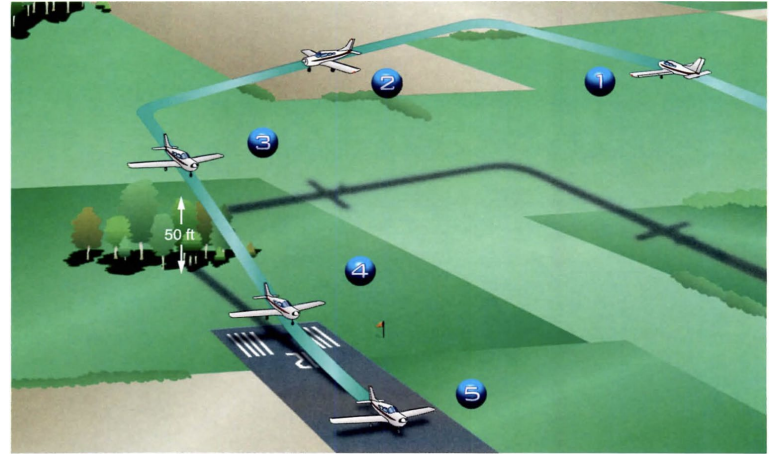


## Short-Field Takeoff - Video



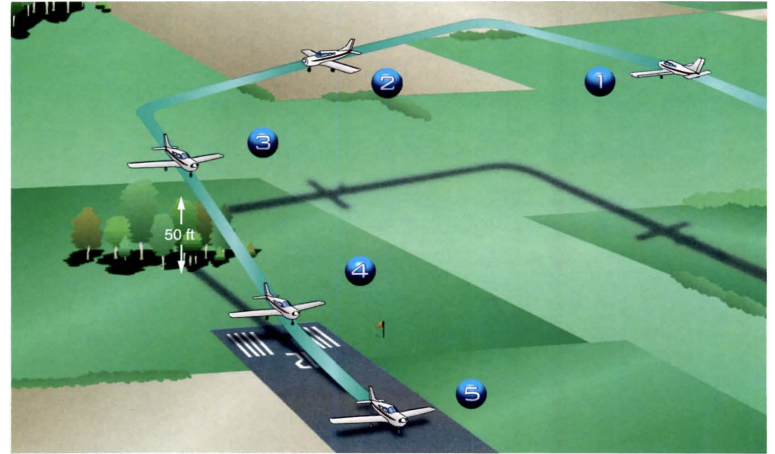
# Short-Field Approach and Landing

A short-field landing is necessary when you have a relatively short landing area or when an approach must be made over obstacles which limit the available landing area. A short-field landing consists of a steep approach over an obstacle, using power and flaps (normally full flaps). A minimum landing speed is desired with a touchdown point as close to the threshold as possible. During short-field landing practice, assume you are making the approach and landing over a 50-foot obstacle.



# Short-Field Approach and Landing

You should consult your airplane's POH for the appropriate speeds and specific procedures for performing short-field takeoffs. In the absence of a manufacturer's recommended speed use 1.3 times the stalling speed in the landing configuration ( $1.3 V_{so}$ ). In gusty conditions, an increase in airspeed of no more than one-half the gust factor should be added.



# Short-Field Approach - Procedure

- 1) Ensure that the before landing checklist is completed and that the approach and landing area is clear. Lower the landing gear and extend approximately one-third of the available flaps.
- 2) Extend the flaps to two-thirds, while progressively reducing the airspeed. Use trim to relieve control pressures.
- 3) Begin the final approach at least 500 feet higher than the touchdown area. Maintain the recommended approach speed and extend the remaining flaps.



# Short-Field Landing - Procedure

- 1) As you begin the flare, reduce power smoothly to idle and allow the airplane to touch down in a full-stall condition. Since the short-field approach is made at a steep descent angle and close to the airplane's stalling speed, you must judge the initiation of the flare accurately to avoid flying into the ground or stalling prematurely and sinking rapidly.
- 2) When the airplane is firmly on the runway, lower the nose, retract the flaps (if recommended) and apply the brakes, as necessary to further shorten the roll-out.



## Short-Field Landing - Video



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# Power Off 180 Accuracy Approaches and Landings

Power-off accuracy approaches are approaches and landings made by gliding, with the engine idling, through a specific pattern to a touchdown beyond and within 200 feet of a designated line or mark on the runway. The objective is to impart the judgment and procedures necessary for accurately flying the airplane, without power, to a safe landing.



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# Power Off 180 Accuracy Approaches and Landings

The ability to estimate the distance an airplane will glide to a landing is the real basis of all power-off accuracy approaches and landings. This largely determines the amount of maneuvering that may be done from a given altitude. In addition to the ability to estimate distance, it requires the ability to maintain the proper glide while maneuvering the airplane.



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# Power Off 180 Accuracy Approaches and Landings

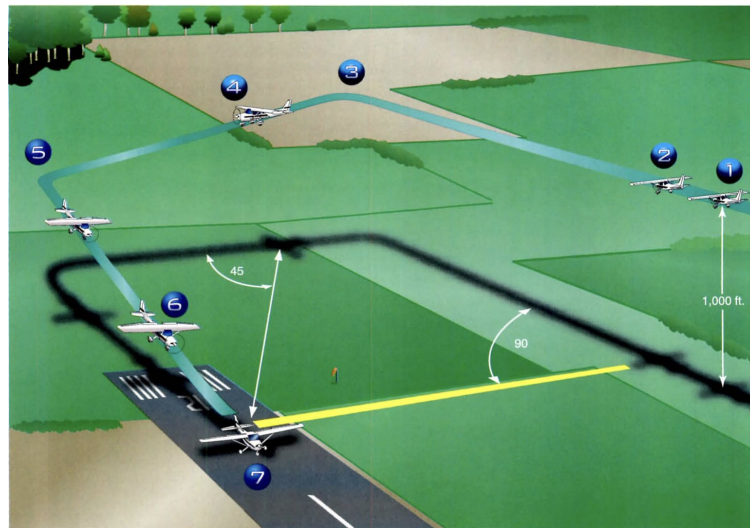
The objective of a good approach is to descend at an angle that will permit the airplane to reach the desired landing area, and at an airspeed that will result in minimum float- ing just before touchdown. To accomplish this, it is essential that both the descent angle and the airspeed be accurately controlled.

Your instructor may introduce you to the 90 power-off accuracy approach before moving to the more challenging 180 approach. The 360 power-off accuracy approach is an advanced maneuver and will develop your power-off approach skills to a higher level.



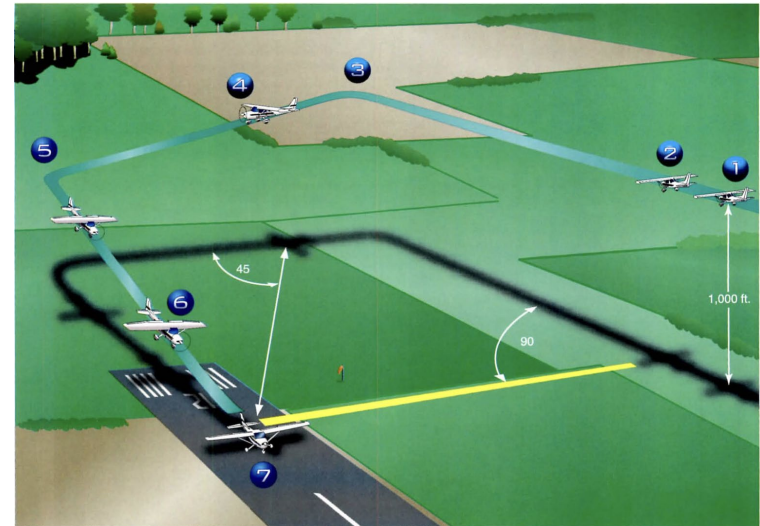
# Power Off 180 Accuracy Approaches and Landings

- Begin the maneuver by entering a normal traffic pattern. You can determine the strength and direction of wind by the amount of crab required to maintain the proper ground track on the legs of the traffic pattern. When on the downwind leg of the traffic pattern your altitude should be no higher than 1,000 feet AGL.
- Perform your before landing checklist and visually clear the final approach path and landing runway. Extend the landing gear at this point if your aircraft is so equipped. Select the point on the runway at which you intend to land.



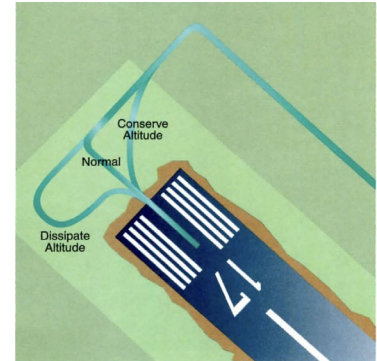
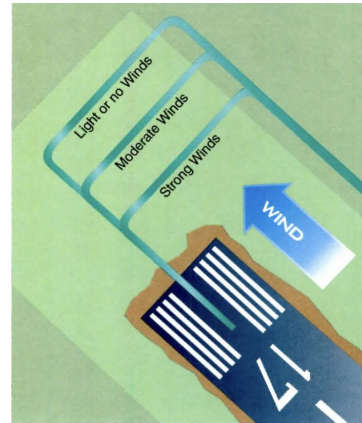
# Power Off 180 Accuracy Approaches and Landings

- Upon reaching the downwind key position, which is directly abeam the point of intended landing, close the throttle to idle. Decrease your airspeed to the manufacturer's recommended glide speed while maintaining altitude. In the absence of a recommended glide speed, use  $1.4 V_{so}$ .
- Your turn to the base leg of the traffic pattern should be made at a point that is appropriate for the existing wind conditions and your glide angle. You should use the base leg to dissipate or conserve altitude as necessary.



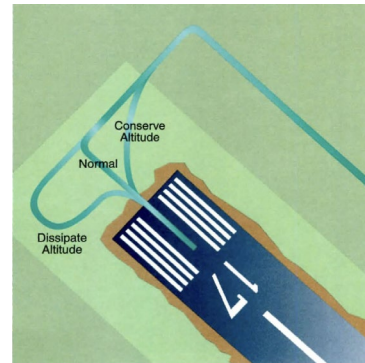
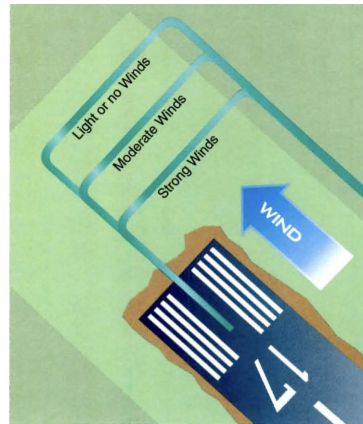
# Power Off 180 Accuracy Approaches and Landings

- At the base leg key position, 45° from the intended point on landing, reassess your altitude, wind speed and direction. Determine if you may need to dissipate or conserve altitude.
- Time your turn to the final approach course so as to roll out on the runway centerline just as you would in a normal traffic pattern. Clear the final approach path for traffic prior to beginning the turn.



# Power Off 180 Accuracy Approaches and Landings

- On the final approach, lower your flaps or enter a slip if necessary to increase your descent angle without increasing your airspeed. Your goal is to descend at an angle that will allow you to reach your intended point of landing at an airspeed that results in little or no float just prior to touchdown.
- Land with little or no float on or past but within 200 feet of the intended landing point. While your goal is to make the intended landing point, do not fixate on making your landing on that particular spot. A good and safe landing is far more important.



# Power Off 180 Accuracy Landings - Video

