

IV. AREA OF OPERATION: TAKEOFFS, LANDINGS, AND GO AROUNDS

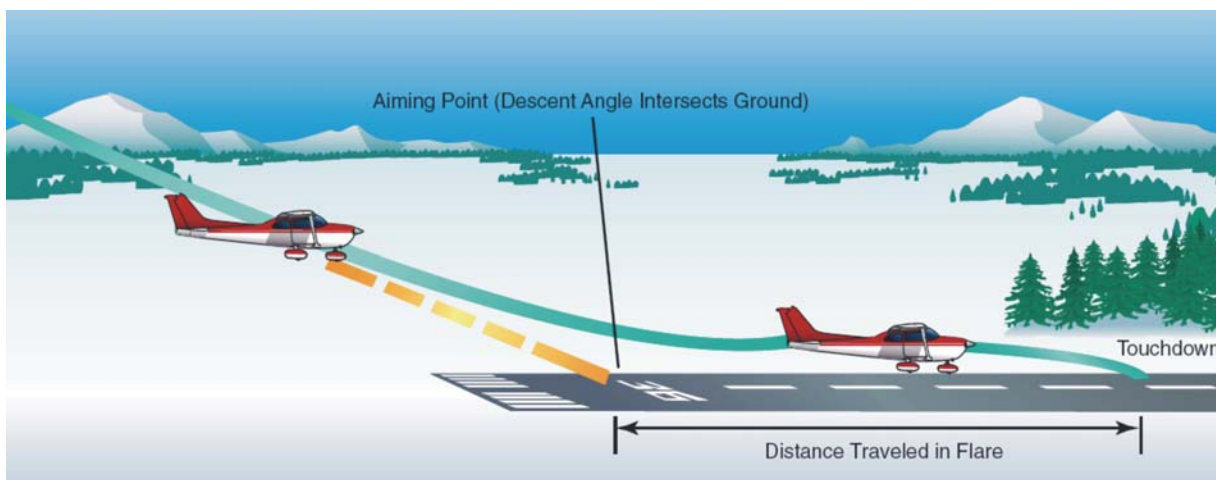
A. TASK: NORMAL AND CROSSWIND TAKEOFF AND CLIMB FAA-H-8083-3; POH/AFM

NOTE: If a crosswind condition does not exist, the applicant's knowledge of crosswind elements shall be evaluated through oral testing..

1. Exhibits knowledge of the elements related to a normal and crosswind takeoff, climb operations, and rejected takeoff procedures.
2. Positions the flight controls for the existing wind conditions.

Crosswind Takeoff

- 1) apply full aileron deflection into the wind.
- 2) Decrease aileron deflection as airspeed increases.
- 3) Takeoff slightly wing low into the wind and then crab airplane into the wind to prevent wind drift and increase performance
3. Clears the area; taxis into the takeoff position and aligns the airplane on the runway center/takeoff path.
4. Advances the throttle smoothly to takeoff power.
5. Establishes and maintains the most efficient lift-off attitude.
6. Lifts off at the recommended airspeed and accelerates to V_Y .
7. Establishes a pitch attitude that will maintain $V_Y + 10/-5$ knots.
8. Retracts the landing gear, if appropriate, and flaps after a positive rate of climb is established.
9. Maintains takeoff power and $V_Y + 10/-5$ knots to a safe maneuvering altitude.
10. Maintains directional control and proper wind-drift correction throughout the takeoff and climb.
11. Complies with noise abatement procedures.
12. Completes the appropriate checklist.



GENERAL

A thorough knowledge of takeoff principles, both in theory and practice, will often prove of extreme value throughout a pilot's career. It will often prevent an attempted takeoff that would result in an accident, or during an emergency, make possible a takeoff under critical conditions when a pilot with a less well rounded knowledge and technique would fail. The takeoff, though relatively simple, often presents the most hazards of any part of a flight. The importance of thorough knowledge and faultless technique and judgment cannot be over emphasized. It must be remembered that the manufacturer's recommended procedures, including airplane configuration and airspeeds, and other information relevant to takeoffs and departure climbs in a specific make and model airplane are contained in the FAA-approved Airplane Flight Manual and/or Pilot's Operating Handbook (AFM/POH) for that airplane. If any of the information in this chapter differs from the airplane manufacturer's recommendations as contained in the AFM/POH, the airplane manufacturer's recommendations take precedence.

TERMS AND DEFINITIONS



Geoffrey Hatcher AGI, MEI, IGI, CFII

1915 Biscayne Little Rock, AR 72227
 (501) 680-7283 www.geoffhatcher.com
 geoff@geoffhatcher.com

Takeoff Roll (ground roll)—the portion of the takeoff procedure during which the airplane is accelerated from a standstill to an airspeed that provides sufficient lift for it to become airborne.

Lift-off (rotation)—the act of becoming airborne as a result of the wings lifting the airplane off the ground or the pilot rotating the nose up, increasing the angle of attack to start a climb.

Initial Climb—begins when the airplane leaves the ground and a pitch attitude has been established to climb away from the takeoff area. Normally, it is considered complete when the airplane has reached a safe maneuvering altitude, or an en route climb has been established.

PRIOR TO TAKEOFF

Before taxiing onto the runway or takeoff area, the pilot should ensure that the engine is operating properly and that all controls, including flaps and trim tabs, are set in accordance with the before takeoff checklist. In addition, the pilot must make certain that the approach and takeoff paths are clear of other aircraft. At uncontrolled airports, pilots should announce their intentions on the common traffic advisory frequency (CTAF) assigned to that airport. When operating from an airport with an operating control tower, pilots must contact the tower operator and receive a takeoff clearance before taxiing onto the active runway. It is not recommended to take off immediately behind another aircraft, particularly large, heavily loaded transport airplanes, because of the wake turbulence that is generated. While taxiing onto the runway, the pilot can select ground reference points that are aligned with the runway direction as aids to maintaining directional control during the takeoff. These may be runway centerline markings, runway lighting, distant trees, towers, buildings, or mountain peaks.

NORMAL TAKEOFF **wind surface length obstructions**

A normal takeoff is one in which the airplane is headed into the wind, or the wind is very light. Also, the takeoff surface is firm and of sufficient length to permit the airplane to gradually accelerate to normal lift-off and climb-out speed, and there are no obstructions along the takeoff path. There are two reasons for making a takeoff as nearly into the wind as possible. First, the airplane's speed while on the ground is much less than if the takeoff were made downwind, thus reducing wear and stress on the landing gear. Second, a shorter ground roll and therefore much less runway length is required to develop the minimum lift necessary for takeoff and climb. Since the airplane depends on airspeed in order to fly, a headwind provides some of that airspeed, even with the airplane motionless, from the wind flowing over the wings.

TAKEOFF ROLL

After taxiing onto the runway, the airplane should be carefully aligned with the intended takeoff direction, and the nosewheel positioned straight, or centered. After releasing the brakes, the throttle should be advanced smoothly and continuously to takeoff power. An abrupt application of power may cause the airplane to yaw sharply to the left because of the torque effects of the engine and propeller. This will be most apparent in high horsepower engines. As the airplane starts to roll forward, the pilot should assure both feet are on the rudder pedals so that the toes or balls of the feet are on the rudder portions, not on the brake portions. Engine instruments should be monitored during the takeoff roll for any malfunctions. In nosewheel-type airplanes, pressures on the elevator control are not necessary beyond those needed to steady it. Applying unnecessary pressure will only aggravate the takeoff and prevent the pilot from recognizing when elevator control pressure is actually needed to establish the takeoff attitude. As speed is gained, the elevator control will tend to assume a neutral position if the airplane is correctly trimmed. At the same time, directional control should be maintained with smooth, prompt, positive rudder corrections throughout the takeoff roll. The effects of engine torque and P-factor at the initial speeds tend to pull the nose to the left. The pilot must use whatever rudder pressure and aileron needed to correct for these effects or for existing wind conditions to keep the nose of the airplane headed straight down the runway. The use of brakes for steering purposes should be avoided, since this will cause slower



Geoffrey Hatcher AGI, MEI, IGI, CFII

1915 Biscayne Little Rock, AR 72227
(501) 680-7283 www.geoffhatcher.com
geoff@geoffhatcher.com

acceleration of the airplane's speed, lengthen the takeoff distance, and possibly result in severe swerving. While the speed of the takeoff roll increases, more and more pressure will be felt on the flight controls, particularly the elevators and rudder. If the tail surfaces are affected by the propeller slipstream, they become effective first. As the speed continues to increase, all of the flight controls will gradually become effective enough to maneuver the airplane about its three axes. It is at this point, in the taxi to flight transition, that the airplane is being flown more than taxied. As this occurs, progressively smaller rudder deflections are needed to maintain direction. The feel of resistance to the movement of the controls and the airplane's reaction to such movements are the only real indicators of the degree of control attained. This feel of resistance is not a measure of the airplane's speed, but rather of its controllability. To determine the degree of controllability, the pilot must be conscious of the reaction of the airplane to the control pressures and immediately adjust the pressures as needed to control the airplane. The pilot must wait for the reaction of the airplane to the applied control pressures and attempt to sense the control resistance to pressure rather than attempt to control the airplane by movement of the controls. Balanced control surfaces increase the importance of this point, because they materially reduce the intensity of the resistance offered to pressures exerted by the pilot. At this stage of training, beginning takeoff practice, a student pilot will normally not have a full appreciation of the variations of control pressures with the speed of the airplane. The student, therefore, may tend to move the controls through wide ranges seeking the pressures that are familiar and expected, and as a consequence over-control the airplane. The situation may be aggravated by the sluggish reaction of the airplane to these movements. The flight instructor should take measures to check these tendencies and stress the importance of the development of feel. The student pilot should be required to feel lightly for resistance and accomplish the desired results by applying pressure against it. This practice will enable the student pilot, as experience is gained, to achieve a sense of the point when sufficient speed has been acquired for the takeoff, instead of merely guessing, fixating on the airspeed indicator, or trying to force performance from the airplane.

LIFT-OFF

Since a good takeoff depends on the proper takeoff attitude, it is important to know how this attitude appears and how it is attained. The ideal takeoff attitude requires only minimum pitch adjustments shortly after the airplane lifts off to attain the speed for the best rate of climb (V_Y). The pitch attitude necessary for the airplane to accelerate to V_Y speed should be demonstrated by the instructor and memorized by the student. Initially, the student pilot may have a tendency to hold excessive back-elevator pressure just after lift-off, resulting in an abrupt pitchup. The flight instructor should be prepared for this. Each type of airplane has a best pitch attitude for normal lift-off; however, varying conditions may make a difference in the required takeoff technique. A rough field, a smooth field, a hard surface runway, or a short or soft, muddy field, all call for a slightly different technique, as will smooth air in contrast to a strong, gusty wind. The different techniques for those other-than-normal conditions are discussed later in this chapter. When all the flight controls become effective during the takeoff roll in a nosewheel-type airplane, back elevator pressure should be gradually applied to raise the nosewheel slightly off the runway, thus establishing the takeoff or lift-off attitude. This is often referred to as "rotating." At this point, the position of the nose in relation to the horizon should be noted, then back-elevator pressure applied as necessary to hold this attitude. The wings must be kept level by applying aileron pressure as necessary. The airplane is allowed to fly off the ground while in the normal takeoff attitude. Forcing it into the air by applying excessive back-elevator pressure would only result in an excessively high pitch attitude and may delay the takeoff. As discussed earlier, excessive and rapid changes in pitch attitude result in proportionate changes in the effects of torque, thus making the airplane more difficult to control. Although the airplane can be forced into the air, this is considered an unsafe practice and should be avoided under normal circumstances. If the airplane is forced to leave the ground by using too much back-elevator pressure before adequate flying speed is attained, the wing's angle of attack may be excessive, causing the airplane to settle back to the runway or even to stall. On the other hand, if sufficient back-elevator pressure is not held to



Geoffrey Hatcher AGI, MEI, IGI, CFII

1915 Biscayne Little Rock, AR 72227
 (501) 680-7283 www.geoffhatcher.com
 geoff@geoffhatcher.com

maintain the correct takeoff attitude after becoming airborne, or the nose is allowed to lower excessively, the airplane may also settle back to the runway. This would occur because the angle of attack is decreased and lift diminished to the degree where it will not support the airplane. It is important, then, to hold the correct attitude constant after rotation or liftoff. As the airplane leaves the ground, the pilot must continue to be concerned with maintaining the wings in a level attitude, as well as holding the proper pitch attitude. Outside visual scan to attain/maintain proper airplane pitch and bank attitude must be intensified at this critical point. The flight controls have not yet become fully effective, and the beginning pilot will often have a tendency to fixate on the airplane's pitch attitude and/or the airspeed indicator and neglect the natural tendency of the airplane to roll just after breaking ground. During takeoffs in a strong, gusty wind, it is advisable that an extra margin of speed be obtained before the airplane is allowed to leave the ground. A takeoff at the normal takeoff speed may result in a lack of positive control, or a stall, when the airplane encounters a sudden lull in strong, gusty wind, or other turbulent air currents. In this case, the pilot should allow the airplane to stay on the ground longer to attain more speed; then make a smooth, positive rotation to leave the ground.

INITIAL CLIMB

Upon lift-off, the airplane should be flying at approximately the pitch attitude that will allow it to accelerate to V_Y . This is the speed at which the airplane will gain the most altitude in the shortest period of time. If the airplane has been properly trimmed, some back-elevator pressure may be required to hold this attitude until the proper climb speed is established. On the other hand, relaxation of any back-elevator pressure before this time may result in the airplane settling, even to the extent that it contacts the runway. The airplane will pick up speed rapidly after it becomes airborne. Once a positive rate of climb is established, the flaps and landing gear can be retracted (if equipped). It is recommended that takeoff power be maintained until reaching an altitude of at least 500 feet above the surrounding terrain or obstacles. The combination of V_Y and takeoff power assures the maximum altitude gained in a minimum amount of time. This gives the pilot more altitude from which the airplane can be safely maneuvered in case of an engine failure or other emergency.

Since the power on the initial climb is fixed at the takeoff power setting, the airspeed must be controlled by making slight pitch adjustments using the elevators. However, the pilot should not fixate on the airspeed indicator when making these pitch changes, but should, instead, continue to scan outside to adjust the airplane's attitude in relation to the horizon. In accordance with the principles of attitude flying, the pilot should first make the necessary pitch change with reference to the natural horizon and hold the new attitude momentarily, and then glance at the airspeed indicator as a check to see if the new attitude is correct. Due to inertia, the airplane will not accelerate or decelerate immediately as the pitch is changed. It takes a little time for the airspeed to change. If the pitch attitude has been over or under corrected, the airspeed indicator will show a speed that is more or less than that desired. When this occurs, the cross-checking and appropriate pitch-changing process must be repeated until the desired climbing attitude is established. When the correct pitch attitude has been attained, it should be held constant while cross-checking it against the horizon and other outside visual references. The airspeed indicator should be used only as a check to determine if the attitude is correct. After the recommended climb airspeed has been established, and a safe maneuvering altitude has been reached, the power should be adjusted to the recommended climb setting and the airplane trimmed to relieve the control pressures. This will make it easier to hold a constant attitude and airspeed. During initial climb, it is important that the takeoff path remain aligned with the runway to avoid drifting into obstructions, or the path of another aircraft that may be taking off from a parallel runway. Proper scanning techniques are essential to a safe takeoff and climb, not only for maintaining attitude and direction, but also for collision avoidance in the airport area. When the student pilot nears the solo stage of flight training, it should be explained that the airplane's takeoff performance will be much different when the instructor is out of the airplane. Due to decreased load, the airplane will become airborne sooner and will climb more rapidly. The pitch attitude that the student has learned to associate with initial



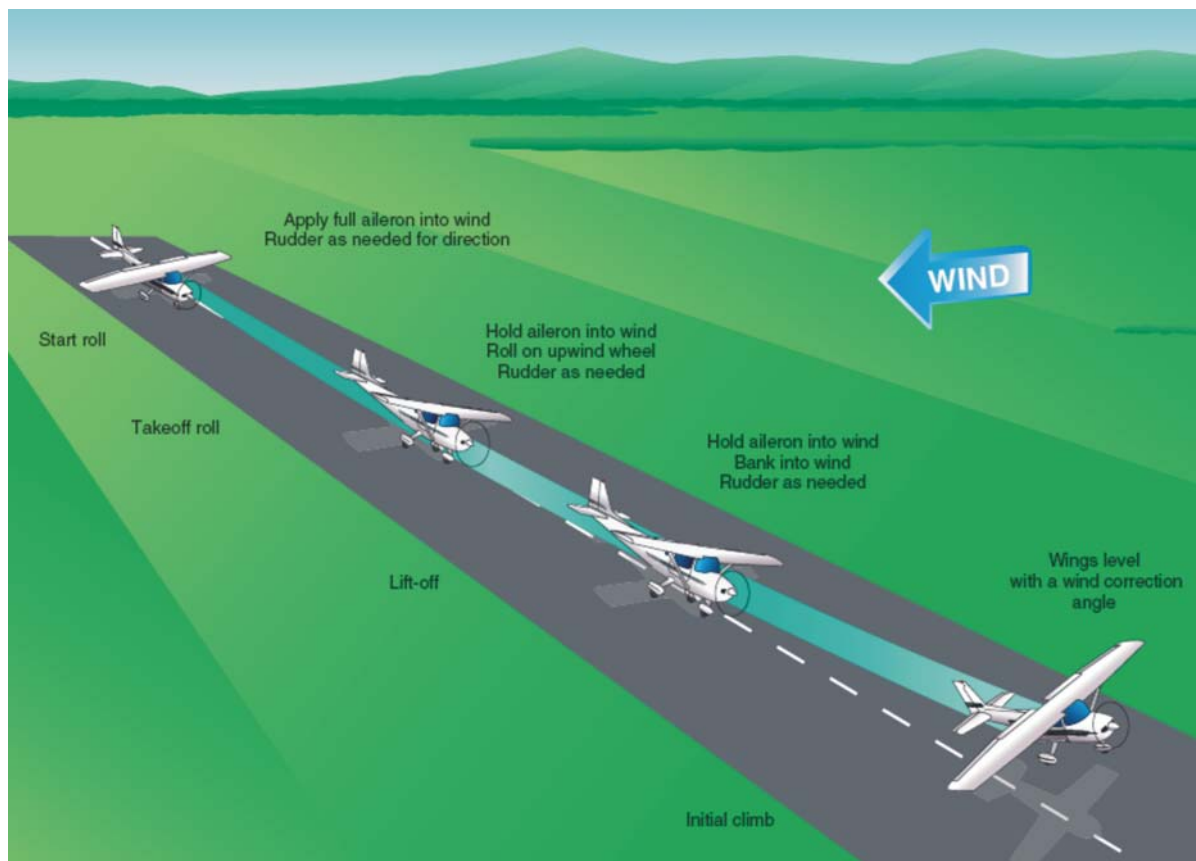
Geoffrey Hatcher AGI, MEI, IGI, CFII

1915 Biscayne Little Rock, AR 72227
 (501) 680-7283 www.geoffhatcher.com
 geoff@geoffhatcher.com

climb may also differ due to decreased weight, and the flight controls may seem more sensitive. If the situation is unexpected, it may result in increased tension that may remain until after the landing. Frequently, the existence of this tension and the uncertainty that develops due to the perception of an "abnormal" takeoff results in poor performance on the subsequent landing.

Common errors in the performance of normal takeoffs and departure climbs are:

- Failure to adequately clear the area prior to taxiing into position on the active runway.
- Abrupt use of the throttle.



- Failure to check engine instruments for signs of malfunction after applying takeoff power.
- Failure to anticipate the airplane's left turning tendency on initial acceleration.
- Overcorrecting for left turning tendency.
- Relying solely on the airspeed indicator rather than developed feel for indications of speed and airplane controllability during acceleration and lift-off.
- Failure to attain proper lift-off attitude.
- Inadequate compensation for torque/P-factor during initial climb resulting in a sideslip.
- Over-control of elevators during initial climbout.
- Limiting scan to areas directly ahead of the airplane (pitch attitude and direction), resulting in allowing a wing (usually the left) to drop immediately after lift-off.
- Failure to attain/maintain best rate-of-climb airspeed (V_Y).
- Failure to employ the principles of attitude flying during climb-out, resulting in "chasing" the airspeed indicator.

CROSSWIND TAKEOFF

While it is usually preferable to take off directly into the wind whenever possible or practical, there will be many instances when circumstances or judgment will indicate otherwise. Therefore, the



Geoffrey Hatcher AGI, MEI, IGI, CFII

1915 Biscayne Little Rock, AR 72227
 (501) 680-7283 www.geoffhatcher.com
 geoff@geoffhatcher.com

pilot must be familiar with the principles and techniques involved in crosswind takeoffs, as well as those for normal takeoffs. A crosswind will affect the airplane during takeoff much as it does in taxiing. With this in mind, it can be seen that the technique for crosswind correction during takeoffs closely parallels the crosswind correction techniques used in taxiing.

TAKEOFF ROLL

The technique used during the initial takeoff roll in a crosswind is generally the same as used in a normal takeoff, except that aileron control must be held INTO the crosswind. This raises the aileron on the upwind wing to impose a downward force on the wing to counteract the lifting force of the crosswind and prevents the wing from rising. As the airplane is taxied into takeoff position, it is essential that the windsock and other wind direction indicators be checked so that the presence of a crosswind may be recognized and anticipated. If a crosswind is indicated, FULL aileron should be held into the wind as the takeoff roll is started. This control position should be maintained while the airplane is accelerating and until the ailerons start becoming sufficiently effective for maneuvering the airplane about its longitudinal axis. With the aileron held into the wind, the takeoff path must be held straight with the rudder. Normally, this will require applying downwind rudder pressure, since on the ground the airplane will tend to **weathervane** into the wind. When takeoff power is applied, torque or P-factor that yaws the airplane to the left may be sufficient to counteract the weathervaning tendency caused by a crosswind from the right. On the other hand, it may also aggravate the tendency to swerve left when the wind is from the left. In any case, whatever rudder pressure is required to keep the airplane rolling straight down the runway should be applied. As the forward speed of the airplane increases and the crosswind becomes more of a relative headwind, the mechanical holding of full aileron into the wind should be reduced. It is when increasing pressure is being felt on the aileron control that the ailerons are becoming more effective. As the aileron's effectiveness increases and the **crosswind component** of the relative wind becomes less effective, it will be necessary to gradually reduce the aileron pressure. The crosswind component effect does not completely vanish, so some aileron pressure will have to be maintained throughout the takeoff roll to keep the crosswind from raising the upwind wing. If the upwind wing rises, thus exposing more surface to the crosswind, a "skipping" action may result. This is usually indicated by a series of very small bounces, caused by the airplane attempting to fly and then settling back onto the runway. During these bounces, the crosswind also tends to move the airplane sideways, and these bounces will develop into side-skipping. This side-skipping imposes severe side stresses on the landing gear and could result in structural failure. It is important, during a crosswind takeoff roll, to hold sufficient aileron into the wind not only to keep the upwind wing from rising but to hold that wing down so that the airplane will, immediately after lift-off, be **sideslipping** into the wind enough to counteract drift.

LIFT-OFF

As the nosewheel is being raised off the runway, the holding of aileron control into the wind may result in the downwind wing rising and the downwind main wheel lifting off the runway first, with the remainder of the takeoff roll being made on that one main wheel. This is acceptable and is referable to side-skipping. If a significant crosswind exists, the main wheels should be held on the ground slightly longer than in a normal takeoff so that a smooth but very definite liftoff can be made. This procedure will allow the airplane to leave the ground under more positive control so that it will definitely remain airborne while the proper amount of wind correction is being established. More importantly, this procedure will avoid imposing excessive side-loads on the landing gear and prevent possible damage that would result from the airplane settling back to the runway while drifting. As both main wheels leave the runway and ground friction no longer resists drifting, the airplane will be slowly carried sideways with the wind unless adequate drift correction is maintained by the pilot. Therefore, it is important to establish and maintain the proper amount of crosswind correction prior to lift-off by applying aileron pressure toward the wind to keep the upwind wing from rising and applying rudder pressure as needed to prevent weathervaning.



Geoffrey Hatcher AGI, MEI, IGI, CFII

1915 Biscayne Little Rock, AR 72227
(501) 680-7283 www.geoffhatcher.com
geoff@geoffhatcher.com

INITIAL CLIMB

If proper crosswind correction is being applied, as soon as the airplane is airborne, it will be sideslipping into the wind sufficiently to counteract the drifting effect of the wind. This side-slipping should be continued until the airplane has a positive rate of climb. At that time, the airplane should be turned into the wind to establish just enough wind correction angle to counteract the wind and then the wings rolled level. Firm and aggressive use of the rudders will be required to keep the airplane headed straight down the runway. The climb with a wind correction angle should be continued to follow a ground track aligned with the runway direction. However, because the force of a crosswind may vary markedly within a few hundred feet of the ground, frequent checks of actual ground track should be made, and the wind correction adjusted as necessary. The remainder of the climb technique is the same used for normal takeoffs and climbs.

Common errors in the performance of crosswind takeoffs are:

- Failure to adequately clear the area prior to taxiing onto the active runway.
- Using less than full aileron pressure into the wind initially on the takeoff roll.
- Mechanical use of aileron control rather than sensing the need for varying aileron control input through feel for the airplane.
- Premature lift-off resulting in side-skipping.
- Excessive aileron input in the latter stage of the takeoff roll resulting in a steep bank into the wind
- at lift-off.
- Inadequate drift correction after lift-off.

Normal Takeoff

- 1) Align aircraft on centerline of runway and straighten the nose wheel
- 2) Apply power smoothly until Full throttle is attained
- 3) Apply right rudder pressure to counteract torque affects
- 4) Monitor engine instruments for proper operation of engine
- 5) Callout "AIRSPEED ALIVE" when 40 knots is obtained
- 6) Apply back elevator pressure at rotation speed.
- 7) Set pitch to obtain Normal climb speed or V_y (Best Rate of Climb).
- 8) Trim aircraft to hold desired airspeed

B. TASK: NORMAL AND CROSSWIND APPROACH AND LANDING REFERENCES: FAA-H-8083-3; POH/AFM.

NOTE: If a crosswind condition does not exist, the applicant's knowledge of crosswind elements shall be evaluated through oral testing.

1. Exhibits knowledge of the elements related to a normal and crosswind approach and landing.
2. Adequately surveys the intended landing area (ASES).
3. Considers the wind conditions, landing surface, obstructions, and selects a suitable touchdown point.
4. Establishes the recommended approach and landing configuration and airspeed, and adjusts pitch attitude and power as required.
5. Maintains a stabilized approach and recommended airspeed, or in its absence, not more than $1.3 V_{so}$, $\pm 10/-5$ knots, with wind gust factor applied.

Cessna recommended airspeed 152II 55 kts

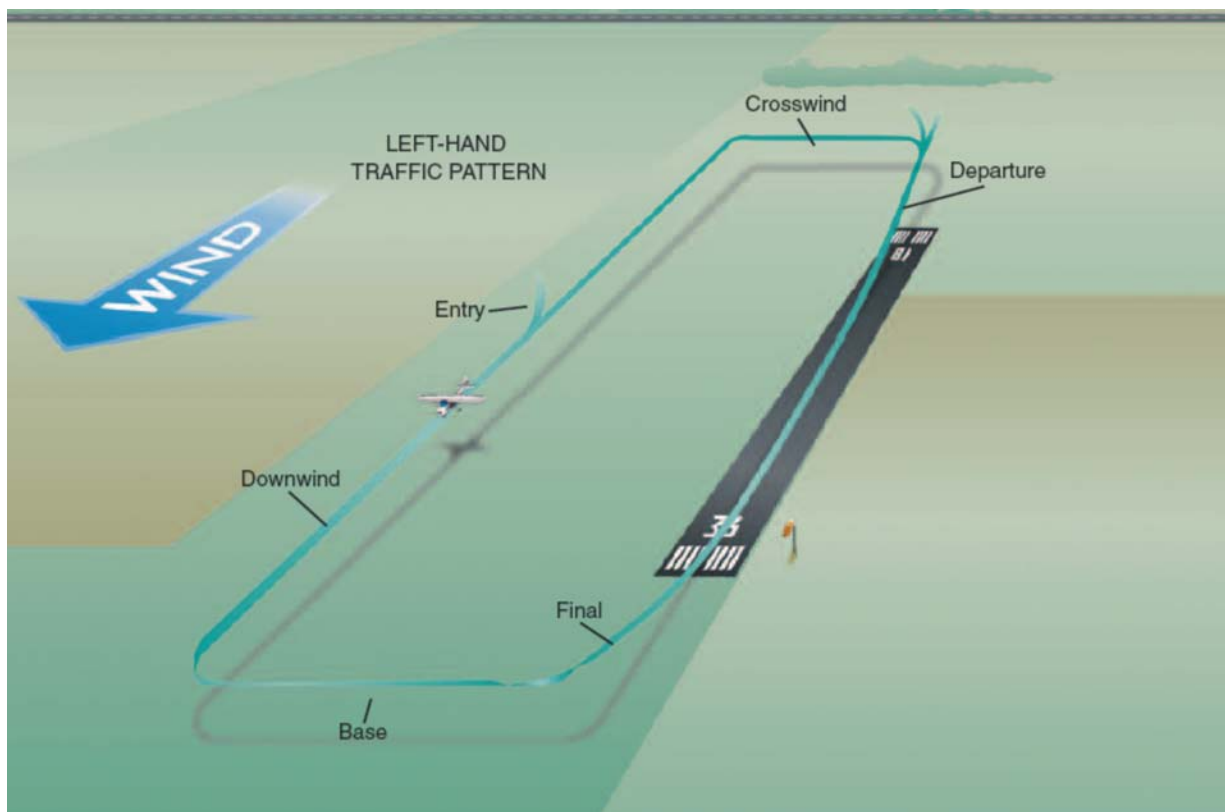
6. Makes smooth, timely, and correct control application during the roundout and touchdown.
- 7.
8. Touches down smoothly at approximate stalling speed.
9. Touches down at or within 400 feet (120 meters) beyond a specified point, with no drift, and with the airplane's longitudinal axis aligned with and over the runway center/landing path.
10. Maintains crosswind correction and directional control throughout the approach and landing sequence.



Geoffrey Hatcher AGI, MEI, IGI, CFII

1915 Biscayne Little Rock, AR 72227
 (501) 680-7283 www.geoffhatcher.com
 geoff@geoffhatcher.com

11. Completes the appropriate checklist.



NORMAL APPROACH AND LANDING

A normal approach and landing involves the use of procedures for what is considered a normal situation; that is, when engine power is available, the wind is light or the final approach is made directly into the wind, the final approach path has no obstacles, and the landing surface is firm and of ample length to gradually bring the airplane to a stop. The selected landing point should be beyond the runway's approach threshold but within the first one-third portion of the runway. The factors involved and the procedures described for the normal approach and landing also have applications to the other-than-normal approaches and landings which are discussed later in this chapter. This being the case, the principles of normal operations are explained first and must be understood before proceeding to the more complex operations. So that the pilot may better understand the factors that will influence judgment and procedures, that last part of the approach pattern and the actual landing will be divided into five phases: **the base leg, the final approach, the roundout, the touchdown, and the after-landing roll.**

It must be remembered that the manufacturer's recommended procedures, including airplane configuration and airspeeds, and other information relevant to approaches and landings in a specific make and model airplane are contained in the FAA-approved Airplane Flight Manual and/or Pilot's Operating Handbook (AFM/POH) for that airplane. If any of the information in this chapter differs from the airplane manufacturer's recommendations as contained in the AFM/POH, the airplane manufacturer's recommendations take precedence.

BASE LEG

- Placement of the base leg is a very important judgment in any landing approach.
- Accurately judge the descent course and distance to the desired aiming point.



Geoffrey Hatcher AGI, MEI, IGI, CFII

1915 Biscayne Little Rock, AR 72227
 (501) 680-7283 www.geoffhatcher.com
 geoff@geoffhatcher.com

The distance and angle will depend on the altitude of the base leg, wind, and wing flaps used
Descent Power used.

When there is a strong wind on final approach or the flaps will be used to produce a steep angle of descent, the base leg must be positioned closer to the approach end of the runway than would be required with a light wind or no flaps. Normally, the landing gear should be extended and the before landing check completed prior to reaching the base leg.

After turning onto the base leg, the pilot should start the descent with reduced power and airspeed of approximately 65

Landing flaps to 20°

Full flaps are not recommended until the final approach

Wind drift correction should be established and maintained to follow descent course

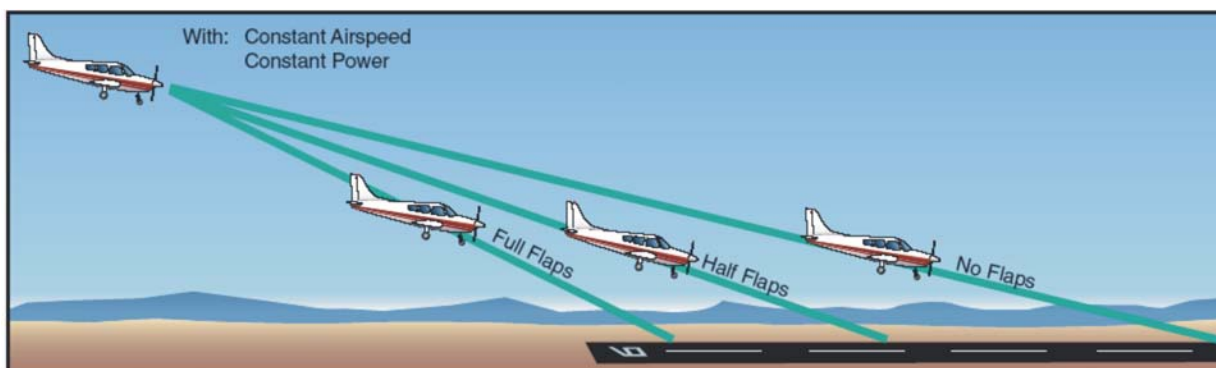
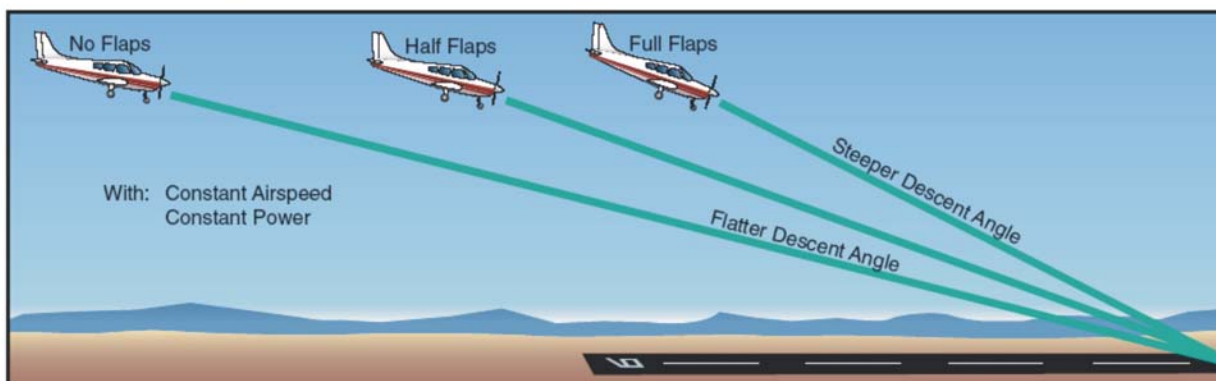


Figure 8-3. Effect of flaps on the landing point.



The base leg should be continued to the point where a medium to shallow-banked turn will align the airplane's path directly with the centerline of the landing runway.

This descending turn should be long enough for the pilot to accurately estimate the resultant point of touchdown, while maintaining the proper approach airspeed.

This will require careful planning as to the starting point and the radius of the turn.

- Angle of bank cannot not exceed a medium bank because of the higher the airspeed at which the airplane stalls.
- base-to final turn at a relatively low altitude important that a stall not occur at this point.

- If an extremely steep bank is needed to prevent overshooting the proper final approach path, it is advisable to discontinue the approach, go around, and plan to start the turn earlier on the next approach rather than risk a hazardous situation.

FINAL APPROACH

After the base-to-final turn, align with the centerline of the runway and recognize drift immediately.

Longitudinal axis aligned with centerline - normal approach, no wind drift.

After aligning the airplane with the runway centerline, the final flap setting should be completed and the pitch attitude adjusted as required for the desired rate of descent. Slight adjustments in pitch and power will be necessary to maintain the descent attitude and the desired approach airspeed.

Manufacturer's recommended airspeed, 55-65

When the pitch attitude and airspeed have been stabilized, the airplane should be retrimmed to relieve the pressures being held on the controls.

land in the center of the first third of the runway. The descent angle four fundamental forces adjusting the airspeed, attitude, power, and drag (flaps or forward slip).

The wind also plays a prominent part in the gliding distance over the ground; naturally, the pilot does not have control over the wind but may correct for its effect on the airplane's descent by appropriate pitch and power adjustments.

Considering the factors that affect the descent angle on the final approach, for all practical purposes at a given pitch attitude there is only one power setting for one airspeed, one flap setting, and one wind condition. A change in any one of these variables will require an appropriate coordinated change in the other controllable variables. For example, if the pitch attitude is raised too high without an increase of power, the airplane will settle very rapidly and touch down short of the desired spot. For this reason, the pilot should never try to stretch a glide by applying back elevator pressure alone to reach the desired landing spot. This will shorten the gliding distance if power is not added simultaneously. The proper angle of descent and airspeed should be maintained by coordinating pitch attitude changes and power changes.

The objective of a good final approach is to descend at an angle and airspeed that will permit the airplane to reach the desired touchdown point at an airspeed which will result in minimum floating just before touchdown; in essence, a semi-stalled condition.

Descent course angle and the airspeed critically controlled with the power and pitch attitude as necessary.

Approaches with partial power allow for correcting for being too high in the approach.

Approach is too high, merely lower the nose and reduce the power.

Approach is too low, add power and raise the nose.

USE OF FLAPS

Adjust lift/drag factors by adjusting the descent through the use of landing flaps:

Producing greater lift and permitting lower landing speed.

Producing greater drag, permitting a steep descent angle without airspeed increase.



Reducing the length of the landing roll.

Airplane's pitch behavior.

Design features of the particular airplane. C-152s **balloon** up and pitch up with flap deflection.

The increased camber from flap deflection produces lift primarily on the rear portion of the wing pitching nose down.(COP)

Flap Downwash increases AOA of the horizontal tail. Change in tail load pitches nose up.

First 15° primarily produces lift with minimal drag.

- Flap deflection beyond 15°
Large increase in drag
Large nose up pitching moment in high-wing airplanes

Incremental deflection of flaps on **downwind, base leg, and final** approach allow smaller adjustment of pitch and power. Large flap deflections at one single point require significant pitch and power changes.

When the flaps are lowered, the airspeed will decrease unless the power is increased or the pitch attitude lowered.

On final approach, therefore, the pilot must estimate where the airplane will land through discerning judgment of the descent angle.

If it appears that the airplane is going to overshoot the desired landing spot, more flaps may be used if not fully extended or the power reduced further, and the pitch attitude lowered.

This will result in a steeper approach.

If the desired landing spot is being undershot and a shallower approach is needed, both power and pitch attitude should be increased to readjust the descent angle.

Never retract the flaps to correct for undershooting since that will suddenly decrease the lift and cause the airplane to sink even more rapidly. The airplane must be retrimmed on the final approach to compensate for the change in aerodynamic forces. With the reduced power and with a slower airspeed, the airflow produces less lift on the wings and less downward force on the horizontal stabilizer, resulting in a significant nosedown tendency. The elevator must then be trimmed more noseup. It will be found that the roundout, touchdown, and landing roll are much easier to accomplish when they are preceded by a proper final approach with precise control of airspeed, attitude, power, and drag resulting in a stabilized descent angle.

ESTIMATING HEIGHT AND MOVEMENT

During the approach, roundout, and touchdown, vision is of prime importance. To provide a wide scope of vision and to foster good judgment of height and movement, the pilot's head should assume a natural, straight-ahead position. The pilot's visual focus should not be fixed on any one side or any one spot ahead of the airplane, but should be changing slowly from a point just over the airplane's nose to the desired touchdown zone and back again, while maintaining a deliberate awareness of distance from either side of the runway within the pilot's peripheral field of vision. Accurate estimation of distance is, besides being a matter of practice, dependent upon how clearly objects are seen; it requires that the vision be focused properly in order that the important objects stand out as clearly as possible. Speed blurs objects at close range. For example, most everyone has noted this in an automobile moving at high speed. Nearby objects seem to merge together in a blur, while objects farther away stand out clearly. The driver subconsciously focuses the eyes

sufficiently far ahead of the automobile to see objects distinctly. The distance at which the pilot's vision is focused should be proportionate to the speed at which the airplane is traveling over the ground. Thus, as speed is reduced during the roundout, the distance ahead of the airplane at which it is possible to focus should be brought closer accordingly. If the pilot attempts to focus on a reference that is too close or looks directly down, the reference will become blurred, and the reaction will be either too abrupt or too late. In this case, the pilot's tendency will be to overcontrol, round out high, and make full-stall, drop-in landings. When the pilot focuses too far ahead, accuracy in judging the closeness of the ground is lost and the consequent reaction will be too slow since there will not appear to be a necessity for action. This will result in the airplane flying into the ground nose first. The change of visual focus from a long distance to a short distance requires a definite time interval and even though the time is brief, the airplane's speed during this interval is such that the airplane travels an appreciable distance, both forward and downward toward the ground. If the focus is changed gradually, being brought progressively closer as speed is reduced, the time interval and the pilot's reaction will be reduced, and the whole landing process smoothed out.

ROUNDOUT (FLARE)

The roundout is a slow, smooth transition from a normal approach attitude to a landing attitude, gradually rounding out the flightpath to one that is parallel with, and within a very few inches above, the runway. When the airplane, in a normal descent, approaches within what appears to be 10 to 20 feet above the ground, the roundout or flare should be started, and once started should be a continuous process until the airplane touches down on the ground. As the airplane reaches a height above the ground where a timely change can be made into the proper landing attitude, back-elevator pressure should be gradually applied to slowly increase the pitch attitude and angle of attack. [Figure 8-6] This will cause the airplane's nose to gradually rise toward the desired landing attitude. The angle of attack should be increased at a rate that will allow the airplane to continue settling slowly as forward speed decreases. When the angle of attack is increased, the lift is momentarily increased, which decreases the rate of descent. Since power normally is reduced to idle during the roundout, the airspeed will also gradually decrease. This will cause lift to decrease again, and it must be controlled by raising the nose and further increasing the angle of attack. During the roundout, the airspeed is being decreased to touchdown speed while the lift is being controlled so the airplane will settle gently onto the landing surface. The roundout should be executed at a rate that the proper landing attitude and the proper touchdown airspeed are attained simultaneously just as the wheels contact the landing surface. The rate at which the roundout is executed depends on the airplane's height above the ground, the rate of descent, and the pitch attitude. A roundout started excessively high must be executed more slowly than one from a lower height to allow the airplane to descend to the ground while the proper landing attitude is being established. The rate of rounding out must also be proportionate to the rate of closure with the ground. When the airplane appears to be descending very slowly, the increase in pitch attitude must be made at a correspondingly slow rate. Visual cues are important in flaring at the proper altitude and maintaining the wheels a few inches above the runway until eventual touchdown. Flare cues are primarily dependent on the angle at which the pilot's central vision intersects the ground (or runway) ahead and slightly to the side. Proper depth perception is a factor in a successful flare, but the visual cues used most are those related to changes in runway or terrain perspective and to changes in the size of familiar objects near the landing area such as fences, bushes, trees, hangars, and even sod or runway texture. The pilot should direct central vision at a shallow downward angle of from 10 to 15 toward the runway as the roundout/flare is initiated. Maintaining the same viewing angle causes the point of visual interception with the runway to move progressively rearward toward the pilot as the airplane loses altitude. This is an important visual cue in assessing the *rate* of altitude loss. Conversely, forward movement of the visual interception point will indicate an increase in altitude, and would mean that the pitch angle was increased too rapidly, resulting in an over flare. Location of the visual interception point in conjunction with assessment of flow velocity of nearby off-runway terrain, as well as the similarity of appearance of



Geoffrey Hatcher AGI, MEI, IGI, CFII

1915 Biscayne Little Rock, AR 72227
 (501) 680-7283 www.geoffhatcher.com
 geoff@geoffhatcher.com

height above the runway ahead of the airplane (in comparison to the way it looked when the airplane was taxied prior to takeoff) is also used to judge when the wheels are just a few inches above the runway. The pitch attitude of the airplane in a full-flap approach is considerably lower than in a no-flap approach. To attain the proper landing attitude before touching down, the nose must travel through a greater pitch change when flaps are fully extended. Since the roundout is usually started at approximately the same height above the ground regardless of the degree of flaps used, the pitch attitude must be increased at a faster rate when full flaps are used; however, the roundout should still be executed at a rate proportionate to the airplane's downward motion. Once the actual process of rounding out is started, the elevator control should not be pushed forward. If too much back-elevator pressure has been exerted, this pressure should be either slightly relaxed or held constant, depending on the degree of the error. In some cases, it may be necessary to advance the throttle slightly to prevent an excessive rate of sink, or a stall, all of which would result in a hard, drop-in type landing. It is recommended that the student pilot form the habit of keeping one hand on the throttle throughout the approach and landing, should a sudden and unexpected hazardous situation require an immediate application of power.

TOUCHDOWN

The touchdown is the gentle settling of the airplane onto the landing surface. The roundout and touchdown should be made with the engine idling, and the airplane at minimum controllable airspeed, so that the airplane will touch down on the main gear at approximately stalling speed. As the airplane settles, the proper landing attitude is attained by application of whatever back-elevator pressure is necessary. Some pilots may try to force or fly the airplane onto the ground without establishing the proper landing attitude. The airplane should never be flown on the runway with excessive speed. It is paradoxical that the way to make an ideal landing is to try to hold the airplane's wheels a few inches off the ground as long as possible with the elevators. In most cases, when the wheels are within 2 or 3 feet off the ground, the airplane will still be settling too fast for a gentle touchdown; therefore, this descent must be retarded by further back-elevator pressure. Since the airplane is already close to its stalling speed and is settling, this added back-elevator pressure will only slow up the settling instead of stopping it. At the same time, it will result in the airplane touching the ground in the proper landing attitude, and the main wheels touching down first so that little or no weight is on the nosewheel. After the main wheels make initial contact with the ground, back-elevator pressure should be held to maintain a positive angle of attack for aerodynamic braking, and to hold the nosewheel off the ground until the airplane decelerates. As the airplane's momentum decreases, back-elevator pressure may be gradually relaxed to allow the nosewheel to gently settle onto the runway. This will permit steering with the nosewheel. At the same time, it will cause a low angle of attack and negative lift on the wings to prevent floating or skipping, and will allow the full weight of the airplane to rest on the wheels for better braking action. It is extremely important that the touchdown occur with the airplane's longitudinal axis exactly parallel to the direction in which the airplane is moving along the runway. Failure to accomplish this imposes severe side loads on the landing gear. To avoid these side stresses, the pilot should not allow the airplane to touch down while turned into the wind or drifting.

AFTER-LANDING ROLL

The landing process must never be considered complete until the airplane decelerates to the normal taxi speed during the landing roll or has been brought to a complete stop when clear of the landing area. Many accidents have occurred as a result of pilots abandoning their vigilance and positive control after getting the airplane on the ground. The pilot must be alert for directional control difficulties immediately upon and after touchdown due to the ground friction on the wheels. The friction creates a pivot point on which a moment arm can act. Loss of directional control may lead to an aggravated, uncontrolled, tight turn on the ground, or a **ground loop**. The combination of centrifugal force acting on the center of gravity (CG) and ground friction of the main wheels resisting it during the ground loop may cause the airplane to tip or lean enough for the outside wingtip to contact the ground. This may even impose a sideward force, which could collapse the landing gear. The rudder serves the same purpose on the ground as it does in the air—it controls the yawing of the airplane. The effectiveness of the rudder is dependent on the airflow, which



Geoffrey Hatcher AGI, MEI, IGI, CFII

1915 Biscayne Little Rock, AR 72227
 (501) 680-7283 www.geoffhatcher.com
 geoff@geoffhatcher.com

depends on the speed of the airplane. As the speed decreases and the nosewheel has been lowered to the ground, the steerable nose provides more positive directional control. The brakes of an airplane serve the same primary purpose as the brakes of an automobile—to reduce speed on the ground. In airplanes, they may also be used as an aid in directional control when more positive control is required than could be obtained with rudder or nosewheel steering alone. To use brakes, on an airplane equipped with toe brakes, the pilot should slide the toes or feet up from the rudder pedals to the brake pedals. If rudder pressure is being held at the time braking action is needed, that pressure should not be released as the feet or toes are being slid up to the brake pedals, because control may be lost before brakes can be applied. Putting maximum weight on the wheels after touchdown is an important factor in obtaining optimum braking performance. During the early part of rollout, some lift may continue to be generated by the wing. After touchdown, the nosewheel should be lowered to the runway to maintain directional control. During deceleration, the nose may be pitched down by braking and the weight transferred to the nosewheel from the main wheels. This does not aid in braking action, so back pressure should be applied to the controls without lifting the nosewheel off the runway. This will enable the pilot to maintain directional control while keeping weight on the main wheels. Careful application of the brakes can be initiated after the nosewheel is on the ground and directional control is established. Maximum brake effectiveness is just short of the point where skidding occurs. If the brakes are applied so hard that skidding takes place, braking becomes ineffective. Skidding can be stopped by releasing the brake pressure. Also, braking effectiveness is not enhanced by alternately applying and reapplying brake pressure. The brakes should be applied firmly and smoothly as necessary. During the ground roll, the airplane's direction of movement can be changed by carefully applying pressure on one brake or uneven pressures on each brake in the desired direction. Caution must be exercised when applying brakes to avoid overcontrolling. The ailerons serve the same purpose on the ground as they do in the air—they change the lift and drag components of the wings. During the after-landing roll, they should be used to keep the wings level in much the same way they were used in flight. If a wing starts to rise, aileron control should be applied toward that wing to lower it. The amount required will depend on speed because as the forward speed of the airplane decreases, the ailerons will become less effective. Procedures for using ailerons in crosswind conditions are explained further in this chapter, in the Crosswind Approach and Landing section. After the airplane is on the ground, back-elevator pressure may be gradually relaxed to place normal weight on the nosewheel to aid in better steering. If available runway permits, the speed of the airplane should be allowed to dissipate in a normal manner. Once the airplane has slowed sufficiently and has turned on to the taxiway and stopped, the pilot should retract the flaps and clean up the airplane. Many accidents have occurred as a result of the pilot unintentionally operating the landing gear control and retracting the gear instead of the flap control when the airplane was still rolling. The habit of positively identifying both of these controls, before actuating them, should be formed from the very beginning of flight training and continued in all future flying activities.

STABILIZED APPROACH CONCEPT

A *stabilized approach* is one in which the pilot establishes and maintains a constant angle glidepath towards a predetermined point on the landing runway. It is based on the pilot's judgment of certain visual clues, and depends on the maintenance of a constant final descent airspeed and configuration. An airplane descending on final approach at a constant rate and airspeed will be traveling in a straight line toward a spot on the ground ahead. This spot will not be the spot on which the airplane will touch down, because some float will inevitably occur during the roundout (flare). [Figure 8-9] Neither will it be the spot toward which the airplane's nose is pointed, because the airplane is flying at a fairly high angle of attack, and the component of lift exerted parallel to the Earth's surface by the wings tends to carry the airplane forward horizontally. The point toward which the airplane is progressing is termed the "aiming point." It is the point on the ground at which, if the airplane maintains a constant glidepath, and was *not* flared for landing, it would strike the ground. To a pilot moving straight ahead toward an object, it appears to be stationary. It does not "move." This is how the aiming point can be distinguished—*it does not move*. However, objects



Geoffrey Hatcher AGI, MEI, IGI, CFII

1915 Biscayne Little Rock, AR 72227
 (501) 680-7283 www.geoffhatcher.com
 geoff@geoffhatcher.com

in front of and beyond the aiming point do appear to move as the distance is closed, and they appear to move in opposite directions. During instruction in landings, one of the most important skills a student pilot must acquire is how to use visual cues to accurately determine the true aiming point from any distance out on final approach. From this, the pilot will not only be able to determine if the glidepath will result in an undershoot or overshoot, but, taking into account float during roundout, the pilot will be able to predict the touchdown point to within a very few feet. For a constant angle glidepath, the distance between the horizon and the aiming point will remain constant. If a final approach descent has been established but the distance between the perceived aiming point and the horizon appears to increase (aiming point moving down away from the horizon), then the true aiming point, and subsequent touchdown point, is farther down the runway. If the distance between the perceived aiming point and the horizon decreases (aiming point moving up toward the horizon), the true aiming point is closer than perceived. When the airplane is established on final approach, the shape of the runway image also presents clues as to what must be done to maintain a stabilized approach to a safe landing. A runway, obviously, is normally shaped in the form of an elongated rectangle. When viewed from the air during the approach, the phenomenon known as perspective causes the runway to assume the shape of a trapezoid with the far end looking narrower than the approach end, and the edge lines converging ahead. If the airplane continues down the glidepath *at a constant angle* (stabilized), the image the pilot sees will still be trapezoidal but of proportionately larger dimensions. In other words, *during a stabilized approach the runway shape does not change*. If the approach becomes shallower, however, the runway will appear to shorten and become wider. Conversely, if the approach is steepened, the runway will appear to become longer and narrower. The objective of a stabilized approach is to select an appropriate touchdown point on the runway, and adjust the glidepath so that the true aiming point and the desired touchdown point basically coincide. Immediately after rolling out on final approach, the pilot should adjust the pitch attitude and power so that the airplane is descending directly toward the aiming point at the appropriate airspeed. The airplane should be in the landing configuration, and trimmed for "hands off" flight. With the approach set up in this manner, the pilot will be free to devote full attention toward outside references. The pilot should not stare at any one place, but rather scan from one point to another, such as from the aiming point to the horizon, to the trees and bushes along the runway, to an area well short of the runway, and back to the aiming point. In this way, the pilot will be more apt to perceive a deviation from the desired glidepath, and whether or not the airplane is proceeding directly toward the aiming point. If the pilot perceives any indication that the aiming point on the runway is not where desired, an adjustment must be made to the glidepath. This in turn will move the aiming point. For instance, if the pilot perceives that the aiming point is short of the desired touchdown point and will result in an undershoot, an increase in pitch attitude and engine power is warranted. A constant airspeed must be maintained. The pitch and power change, therefore, must be made smoothly and simultaneously. This will result in a shallowing of the glidepath with the resultant aiming point moving towards the desired touchdown point. Conversely, if the pilot perceives that the aiming point is farther down the runway than the desired touchdown point and will result in an overshoot, the glidepath should be steepened by a simultaneous decrease in pitch attitude and power. Once again, the airspeed must be held constant. **It is essential that deviations from the desired glidepath be detected early, so that only slight and infrequent adjustments to glidepath are required.** The closer the airplane gets to the runway, the larger (and possibly more frequent) the required corrections become, resulting in an *unstabilized* approach.

Common errors in the performance of normal approaches and landings are:

- Inadequate wind drift correction on the base leg.
- Overshooting or undershooting the turn onto final approach resulting in too steep or too shallow a turn onto final approach.
- Flat or skidding turns from base leg to final approach as a result of overshooting/inadequate wind drift correction.
- Poor coordination during turn from base to final approach.



Geoffrey Hatcher AGI, MEI, IGI, CFII

1915 Biscayne Little Rock, AR 72227
 (501) 680-7283 www.geoffhatcher.com
 geoff@geoffhatcher.com

- Failure to complete the landing checklist in a timely manner.
- Unstabilized approach.
- Failure to adequately compensate for flap extension.
- Poor trim technique on final approach.
- Attempting to maintain altitude or reach the runway using elevator alone.
- Focusing too close to the airplane resulting in a too high roundout.
- Focusing too far from the airplane resulting in a too low roundout.
- Touching down prior to attaining proper landing attitude.
- Failure to hold sufficient back-elevator pressure after touchdown.
- Excessive braking after touchdown.

Normal Landing

1. Recommended entry for the traffic pattern is 45 degrees on the downwind leg 80 knots
2. When abeam your touchdown point, perform the following in order:
 - power 1500 rpm
 - Flaps to t/o
 - Hold altitude until 70 kts is attained
 - Trim to 70kts
3. Turn Base when 45 degrees from the touchdown point After you roll out:
 - Flaps landing
 - trim
4. Turn onto the Final leg so the aircraft rolls out wings level aligned with the center line of the runway at 70 kts
 - GUMPS check
 - Slow to 60kts on short final, and then slow the airplane to short approach speed
 - Roundout 15 ft above the runway
 - Fly as long as you can a foot off the runway and allow the aircraft to settle in.

GROUND EFFECT

Ground effect is a factor in every landing and every takeoff in fixed-wing airplanes. Ground effect can also be an important factor in go-arounds. If the go-around is made close to the ground, the airplane may be in the ground effect area. Pilots are often lulled into a sense of false security by the apparent "cushion of air" under the wings that initially assists in the transition from an approach descent to a climb. This "cushion of air," however, is imaginary. The apparent increase in airplane performance is, in fact, due to a reduction in induced drag in the ground effect area. It is "borrowed" performance that must be repaid when the airplane climbs out of the ground effect area. The pilot must factor in ground effect when initiating a go-around close to the ground. An attempt to climb prematurely may result in the airplane not being able to climb, or even maintain altitude at full power. Common errors in the performance of go-arounds (rejected landings) are:

Failure to recognize a condition that warrants a rejected landing.

Indecision.

Delay in initiating a go-around.

Failure to apply maximum allowable power in a timely manner.

Abrupt power application.

Improper pitch attitude.

Failure to configure the airplane appropriately.

Attempting to climb out of ground effect prematurely.

Failure to adequately compensate for torque/P factor.

CROSSWIND

APPROACH AND LANDING

Many runways or landing areas are such that landings must be made while the wind is blowing



Geoffrey Hatcher AGI, MEI, IGI, CFII

1915 Biscayne Little Rock, AR 72227
 (501) 680-7283 www.geoffhatcher.com
 geoff@geoffhatcher.com

across rather than parallel to the landing direction. All pilots should be prepared to cope with these situations when they arise. The same basic principles and factors involved in a normal approach and landing apply to a crosswind approach and landing; therefore, only the additional procedures required for correcting for wind drift are discussed here. Crosswind landings are a little more difficult to perform than crosswind takeoffs, mainly due to different problems involved in maintaining accurate control of the airplane while its speed is decreasing rather than increasing as on takeoff.

There are two usual methods of accomplishing a crosswind approach and landing—the crab method and the wing-low (sideslip) method. Although the crab method may be easier for the pilot to maintain during final approach, it requires a high degree of judgment and timing in removing the crab immediately prior to touchdown. The wing-low method is recommended in most cases, although a combination of both methods may be used.

CROSSWIND FINAL APPROACH

The crab method is executed by establishing a heading (crab) toward the wind with the wings level so that the airplane's ground track remains aligned with the centerline of the runway. [Figure 8-15] This crab angle is maintained until just prior to touchdown, when the longitudinal axis of the airplane must be aligned with the runway to avoid sideward contact of the wheels with the runway. If a long final approach is being flown, the pilot may use the crab method until just before the roundout is started and then smoothly change to the wing-low method for the remainder of the landing.

Figure 8-15. Crabbed approach.

The wing-low (sideslip) method will compensate for a crosswind from any angle, but more important, it enables the pilot to simultaneously keep the airplane's ground track and longitudinal axis aligned with the runway centerline throughout the final approach, roundout, touchdown, and after-landing roll. This prevents the airplane from touching down in a sideward motion and imposing damaging side loads on the landing gear. To use the wing-low method, the pilot aligns the airplane's heading with the centerline of the runway, notes the rate and direction of drift, and then promptly applies drift correction by lowering the upwind wing. [Figure 8-16] The amount the wing must be lowered depends on the rate of drift. When the wing is lowered, the airplane will tend to turn in that direction. It is then necessary to simultaneously apply sufficient opposite rudder pressure to prevent the turn and keep the airplane's longitudinal axis aligned with the runway. In other words, the drift is controlled with aileron, and the heading with rudder. The airplane will now be sideslipping into the wind just enough that both the resultant flight path and the ground track are aligned with the runway. If the crosswind diminishes, this crosswind correction is reduced accordingly, or the airplane will begin slipping away from the desired approach path. [Figure 8-17] To correct for strong crosswind, the slip into the wind is increased by lowering the upwind wing a considerable amount. As a consequence, this will result in a greater tendency of the airplane to turn. Since turning is not desired, considerable opposite rudder must be applied to keep the airplane's longitudinal axis aligned with the runway. In some airplanes, there may not be sufficient rudder travel available to compensate for the strong turning tendency caused by the steep bank. If the required bank is such that full opposite rudder will not prevent a turn, the wind is too strong to safely land the airplane on that particular runway with those wind conditions. Since the airplane's capability will be exceeded, it is imperative that the landing be made on a more favorable runway either at that airport or at an alternate airport. Flaps can and should be used during most approaches since they tend to have a stabilizing effect on the airplane. The degree to which flaps should be extended will vary with the airplane's handling characteristics, as well as the wind velocity.

CROSSWIND ROUNDOUT (FLARE)

Generally, the roundout can be made like a normal landing approach, but the application of a crosswind correction is continued as necessary to prevent drifting. Since the airspeed decreases as the roundout progresses, the flight controls gradually become less effective. As a result, the crosswind correction being held will become inadequate. When using the wing-low method, it is necessary to gradually increase the deflection of the rudder and ailerons to maintain the proper amount of drift correction. Do not level the wings; keep the upwind wing down throughout the roundout. If the wings are leveled, the airplane will begin drifting and the touchdown will occur while drifting. Remember, the primary objective is to land the airplane without subjecting it



Geoffrey Hatcher AGI, MEI, IGI, CFII

1915 Biscayne Little Rock, AR 72227
(501) 680-7283 www.geoffhatcher.com
geoff@geoffhatcher.com

to any sideloads that result from touching down while drifting.

CROSSWIND TOUCHDOWN

If the crab method of drift correction has been used throughout the final approach and roundout, the crab must be removed the instant before touchdown by applying rudder to align the airplane's longitudinal axis with its direction of movement. This requires timely and accurate action. Failure to accomplish this will result in severe side loads being imposed on the landing gear.

If the wing-low method is used, the crosswind correction (aileron into the wind and opposite rudder) should be maintained throughout the roundout, and the touchdown made on the upwind main wheel. During gusty or high wind conditions, prompt adjustments must be made in the crosswind correction to assure that the airplane does not drift as the airplane touches down.

As the forward momentum decreases after initial contact, the weight of the airplane will cause the downwind main wheel to gradually settle onto the runway. In those airplanes having nosewheel steering interconnected with the rudder, the nosewheel may not be aligned with the runway as the wheels touch down because opposite rudder is being held in the crosswind correction. To prevent swerving in the direction the nosewheel is offset, the corrective rudder pressure must be promptly relaxed just as the nosewheel touches down.

CROSSWIND AFTER-LANDING ROLL

Particularly during the after-landing roll, special attention must be given to maintaining directional control by the use of rudder or nosewheel steering, while keeping the upwind wing from rising by the use of aileron. When an airplane is airborne, it moves with the air mass in which it is flying regardless of the airplane's heading and speed. When an airplane is on the ground, it is unable to move with the air mass (crosswind) because of the resistance created by ground friction on the wheels.

Characteristically, an airplane has a greater profile or side area, behind the main landing gear than forward of it does. With the main wheels acting as a pivot point and the greater surface area exposed to the crosswind behind that pivot point, the airplane will tend to turn or weathervane into the wind. Wind acting on an airplane during crosswind landings is the result of two factors. One is the natural wind, which acts in the direction the air mass is traveling, while the other is induced by the movement of the airplane and acts parallel to the direction of movement. Consequently, a crosswind has a headwind component acting along the airplane's ground track and a crosswind component acting 90° to its track. The resultant or relative wind is somewhere between the two components. As the airplane's forward speed decreases during the after-landing roll, the headwind component decreases and the relative wind has more of a crosswind component. The greater the crosswind component, the more difficult it is to prevent weathervaning. Retaining control on the ground is a critical part of the after-landing roll, because of the weathervaning effect of the wind on the airplane. Additionally, tire side load from runway contact while drifting frequently generates roll-overs in tricycle geared airplanes. The basic factors involved are cornering angle and side load. Cornering angle is the angular difference between the heading of a tire and its path. Whenever a load bearing tire's path and heading diverge, a side load is created. It is accompanied by tire distortion. Although side load differs in varying tires and air pressures, it is completely independent of speed, and through a considerable range, is directional proportional to the cornering angle and the weight supported by the tire. As little as 10° of cornering angle will create a side load equal to

half the Ch 08.qxd 5/7/04 8:08 AM Page 8-15

supported weight; after 20° the side load does not increase with increasing cornering angle. For each high-wing, tricycle geared airplane, there is a cornering angle at which roll-over is inevitable. The roll-over axis being the line linking the nose and main wheels. At lesser angles, the roll-over may be avoided by use of ailerons, rudder, or steerable nosewheel *but not brakes*.

While the airplane is decelerating during the after-landing roll, more and more aileron is applied to keep the upwind wing from rising. Since the airplane is slowing down, there is less airflow around the ailerons and they become less effective. At the same time, the relative wind is becoming more of a crosswind and exerting a greater lifting force on the upwind wing. When the airplane is coming to a stop, the aileron control must be held fully toward the wind.

MAXIMUM SAFE CROSSWIND VELOCITIES

Takeoffs and landings in certain crosswind conditions are inadvisable or even dangerous. [Figure 8-



Geoffrey Hatcher AGI, MEI, IGI, CFII

1915 Biscayne Little Rock, AR 72227
(501) 680-7283 www.geoffhatcher.com
geoff@geoffhatcher.com

18] If the crosswind is great enough to warrant an extreme drift correction, a hazardous landing condition may result. Therefore, the takeoff and landing capabilities with respect to the reported surface wind conditions and the available landing directions must be considered. **Figure 8-18. Crosswind chart.**

Before an airplane is type certificated by the Federal Aviation Administration (FAA), it must be flight tested to meet certain requirements. Among these is the demonstration of being satisfactorily controllable with no exceptional degree of skill or alertness on the part of the pilot in 90° crosswinds up to a velocity equal to $0.2 V_{SO}$. This means a windspeed of two-tenths of the airplane's stalling speed with power off and landing gear/flaps down. Regulations require that the demonstrated crosswind velocity be included on a placard in airplanes certificated after May 3, 1962. The headwind component and the crosswind component for a given situation can be determined by reference to a crosswind component chart. [Figure 8-19] It is imperative that pilots determine the maximum crosswind component of each airplane they fly, and avoid operations in wind conditions that exceed the capability of the airplane.

Common errors in the performance of crosswind approaches and landings are:

Attempting to land in crosswinds that exceed the airplane's maximum demonstrated crosswind component.

Inadequate compensation for wind drift on the turn from base leg to final approach, resulting in undershooting or overshooting.

Inadequate compensation for wind drift on final approach.

Unstabilized approach.

Failure to compensate for increased drag during sideslip resulting in excessive sink rate and/or too low an airspeed.

Touchdown while drifting.

Excessive airspeed on touchdown.

Failure to apply appropriate flight control inputs during rollout.

Failure to maintain direction control on rollout.

Excessive braking.

TURBULENT AIR APPROACH AND LANDING

Power-on approaches at an airspeed slightly above the normal approach speed should be used for landing in turbulent air. This provides for more positive control of the airplane when strong horizontal wind gusts, up and down drafts, are experienced. Like other power-on approaches (when the pilot can vary the amount of power), a coordinated combination of both pitch and power adjustments is usually required. As in most other landing approaches, the proper approach attitude and airspeed require a minimum roundout and should result in little or no floating during the landing. To maintain good control, the approach in turbulent air with gusty crosswind may require the use of partial wing flaps. With less than full flaps, the airplane will be in a higher pitch attitude. Thus, it will require less of a pitch change to establish the landing attitude, and the touchdown will be at a higher airspeed to ensure more positive control. The speed should not be so excessive that the airplane will float past the desired landing area. One procedure is to use the normal approach speed plus one-half of the wind gust factors. If the normal speed is 70 knots, and the wind gusts increase 15 knots, airspeed of 77 knots is appropriate. In any case, the airspeed and the amount of flaps should be as the airplane manufacturer recommends. An adequate amount of power should be used to maintain the proper airspeed and descent path throughout the approach, and the throttle retarded to idling position only after the main wheels contact the landing surface. Care must be exercised in closing the throttle before the pilot is ready for touchdown. In this situation, the sudden or premature closing of the throttle may cause a sudden increase in the descent rate that could result in a hard landing. Landings from power approaches in turbulence should be such that the touchdown is made with the airplane in approximately level flight attitude. The pitch attitude at touchdown should be only enough to prevent the nose wheel from contacting the surface before



Geoffrey Hatcher AGI, MEI, IGI, CFII

1915 Biscayne Little Rock, AR 72227
(501) 680-7283 www.geoffhatcher.com
geoff@geoffhatcher.com

the mainwheels have touched the surface. After touchdown, the pilot should avoid the tendency to apply forward pressure on the yoke as this may result in **wheelbarrowing** and possible loss of control. The airplane should be allowed to decelerate normally, assisted by careful use of wheel brakes. Heavy braking should be avoided until the wings are devoid of lift and the airplane's full weight is resting on the landing gear.

Crosswind Landing

- Pattern is the same as normal with only a few differences as listed below:
- You will generally use less flaps with the crosswind landing (from 0 to 10 degrees) This will give you a shallower descent angle and also a higher airspeed
- On Final, use the side slip technique to keep the aircraft aligned with the runway centerline. Touchdown should happen on the upwind main wheel first followed by the downwind main wheel and then the nose wheel.
- As the airspeed decreases on the landing and rollout, increase aileron input into the wind to counteract the forces of the wind on the airplane.

C. TASK: SOFT-FIELD TAKEOFF AND CLIMB REFERENCES: FAA-H-8083-3; POH/AFM.

Objective. To determine that the applicant:

1. Exhibits knowledge of the elements related to a soft-field takeoff and climb.
2. Positions the flight controls for existing wind conditions and to maximize lift as quickly as possible.
3. Clears the area; taxis onto the takeoff surface at a speed consistent with safety without stopping while advancing the throttle smoothly to takeoff power.
4. Establishes and maintains a pitch attitude that will transfer the weight of the airplane from the wheels to the wings as rapidly as possible.
5. Lifts off at the lowest possible airspeed and remains in ground effect while accelerating to V_x or V_y , as appropriate.
6. Establishes a pitch attitude for V_x or V_y , as appropriate, and maintains selected airspeed $+10/-5$ knots, during the climb.
7. Retracts the landing gear, if appropriate, and flaps after clear of any obstacles or as recommended by the manufacturer.
8. Maintains takeoff power and V_x or $V_y + 10/-5$ knots to a safe maneuvering altitude.
9. Maintains directional control and proper wind-drift correction throughout the takeoff and climb.
10. Completes the appropriate checklist.

SOFT/ROUGH-FIELD TAKEOFF AND CLIMB

Takeoffs and climbs from soft fields require the use of operational techniques for getting the airplane airborne as quickly as possible to eliminate the drag caused by tall grass, soft sand, mud, and snow, and may or may not require climbing over an obstacle. The technique makes judicious use of ground effect and requires a feel for the airplane and fine control touch. These same techniques are also useful on a rough field where it is advisable to get the airplane off the ground as soon as possible to avoid damaging the landing gear. Soft surfaces or long, wet grass usually reduces the airplane's acceleration during the takeoff roll so much that adequate takeoff speed might not be attained if normal takeoff techniques were employed. It should be emphasized that the correct takeoff procedure for soft fields is quite different from that appropriate for short fields with firm, smooth surfaces. To minimize the hazards associated with takeoffs from soft or rough fields, support of the airplane's weight must be transferred as rapidly as possible from the wheels to the wings as the takeoff roll proceeds. Establishing and maintaining a relatively high angle of attack or nose-high pitch attitude as early as possible does this. Wing flaps may be lowered prior to starting the takeoff (if recommended by the manufacturer) to provide additional lift and to transfer the airplane's weight from the wheels to the wings as early as possible. Stopping on a soft surface, such as mud or snow, might bog the airplane down; therefore, it should be kept in continuous motion with sufficient power while lining up for the takeoff roll.

TAKEOFF ROLL



Geoffrey Hatcher AGI, MEI, IGI, CFII

1915 Biscayne Little Rock, AR 72227
(501) 680-7283 www.geoffhatcher.com
geoff@geoffhatcher.com

As the airplane is aligned with the takeoff path, takeoff power is applied smoothly and as rapidly as the powerplant will accept it without faltering. As the airplane accelerates, enough back-elevator pressure should be applied to establish a positive angle of attack and to reduce the weight supported by the nose wheel. When the airplane is held at a nose-high attitude throughout the takeoff run, the wings will, as speed increases and lift develops, progressively relieve the wheels of more and more of the airplane's weight, thereby minimizing the drag caused by surface irregularities or adhesion. If this attitude is accurately maintained, the airplane will virtually fly itself off the ground, becoming airborne at airspeed slower than a safe climb speed because of ground effect.

LIFT-OFF

After becoming airborne, the nose should be lowered very gently with the wheels clear of the surface to allow the airplane to accelerate to V_Y , or V_X if obstacles must be cleared. Extreme care must be exercised immediately after the airplane becomes airborne and while it accelerates, to avoid settling back onto the surface. An attempt to climb prematurely or too steeply may cause the airplane to settle back to the surface as a result of losing the benefit of ground effect. An attempt to climb out of ground effect before sufficient climb airspeed is attained may result in the airplane being unable to climb further as the ground effect area is transited, even with full power. Therefore, it is essential that the airplane remain in ground effect until at least V_X is reached. This requires feel for the airplane, and a very fine control touch, in order to avoid over-controlling the elevator as required control pressures change with airplane acceleration.

INITIAL CLIMB

After a positive rate of climb is established, and the airplane has accelerated to V_Y , retract the landing gear and flaps, if equipped. If departing from an airstrip with wet snow or slush on the takeoff surface, the gear should not be retracted immediately. This allows for any wet snow or slush to be air-dried. In the event an obstacle must be cleared after a soft-field takeoff, the climb-out is performed at V_X until the obstacle has been cleared. After reaching this point, the pitch attitude is adjusted to V_Y and the gear and flaps are retracted. The power may then be reduced to the normal climb setting.

Common errors in the performance of soft/rough field takeoff and climbs are:

- Failure to adequately clear the area.
- Insufficient back-elevator pressure during initial takeoff roll resulting in inadequate angle of attack.
- Failure to cross-check engine instruments for indications of proper operation after applying power.
- Poor directional control.
- Climbing too steeply after lift-off.
- Abrupt and/or excessive elevator control while attempting to level off and accelerate after liftoff.
- Allowing the airplane to "mush" or settle resulting in an inadvertent touchdown after lift-off.
- Attempting to climb out of ground effect area before attaining sufficient climb speed.
- Failure to anticipate an increase in pitch attitude as the airplane climbs out of ground effect.

- 1) Set flaps to manufacturer's recommendation.
- 2) Hold full back elevator pressure to alleviate weight from nose wheel
- 3) Do not use brakes or stop moving once taxiing onto soft surface
- 4) Align aircraft on centerline of runway
- 5) Apply full power
- 6) Apply right rudder pressure to counteract torque effects
- 7) Monitor engine instruments for proper operation
- 8) Callout "AIRSPEED ALIVE" when 40 knts is obtained
- 9) Keep control wheel back until the nose of the airplane lifts off the runway. Then



Geoffrey Hatcher AGI, MEI, IGI, CFII

1915 Biscayne Little Rock, AR 72227
 (501) 680-7283 www.geoffhatcher.com
 geoff@geoffhatcher.com

lower the nose slightly to reduce drag.

10) Aircraft will lift off at lowest possible airspeed.

11) Lower nose and remain just above the runway (within ground effect) until 58kts V_x .

12) Set pitch to obtain V_x (Best Angle of Climb), until clear of obstacle.

13) Lower nose to Normal climb speed of V_y (Best Rate of Climb).

14) Raise flaps at 400 agl

15) Trim aircraft to hold desired airspeed

D. TASK: SOFT-FIELD APPROACH AND LANDING REFERENCES: FAA-H-8083-3; POH/AFM.

1. Exhibits knowledge of the elements related to a soft-field approach and landing.
2. Considers the wind conditions, landing surface and obstructions, and selects the most suitable touchdown area.
3. Establishes the recommended approach and landing configuration, and airspeed; adjusts pitch attitude and power as required.
4. Maintains a stabilized approach and recommended airspeed, or in its absence not more than $1.3 V_{so}$, $+10/-5$ knots, with wind gust factor applied.
5. Makes smooth, timely, and correct control application during the roundout and touchdown.
6. Touches down softly with no drift, and with the airplane's longitudinal axis aligned with the runway/landing path.
7. Maintains crosswind correction and directional control throughout the approach and landing sequence.
8. Maintains proper position of the flight controls and sufficient speed to taxi on the soft surface.
9. Completes the appropriate checklist.

SOFT-FIELD APPROACH AND LANDING

Landing on fields that are rough or have soft surfaces, such as snow, sand, mud, or tall grass requires unique procedures. When landing on such surfaces, the objective is to touch down as smoothly as possible, and at the slowest possible landing speed. The pilot must control the airplane in a manner that the wings support the weight of the airplane as long as practical, to minimize drag and stresses imposed on the landing gear by the rough or soft surface. The approach for the soft-field landing is similar to the normal approach used for operating into long, firm landing areas. The major difference between the two is that, during the soft-field landing, the airplane is held 1 to 2 feet off the surface in ground effect as long as possible. This permits a more gradual dissipation of forward speed to allow the wheels to touch down gently at minimum speed. This technique minimizes the nose-over forces that suddenly affect the airplane at the moment of touchdown. Power can be used throughout the level-off and touchdown to ensure touchdown at the slowest possible airspeed, and the airplane should be *flown* onto the ground with the weight fully supported by the wings. [Figure 8-24] The use of flaps during soft-field landings will aid in touching down at minimum speed and is recommended whenever practical. In low-wing airplanes, the flaps may suffer damage from mud, stones, or slush thrown up by the wheels. If flaps are used, it is generally inadvisable to retract them during the after-landing roll because the need for flap retraction is usually less important than the need for total concentration on maintaining full control of the airplane. The final approach airspeed used for short-field landings is equally appropriate to soft-field landings. The use of higher approach speeds may result in excessive float in ground effect, and floating makes a smooth, controlled touchdown even more difficult. There is, however, no reason for a steep angle of descent unless obstacles are present in the approach path. Touchdown on a soft or rough field should be made at the lowest possible airspeed with the airplane in a nose-high pitch attitude. In nose-wheel-type airplanes, after the main wheels touch the surface, the pilot should hold sufficient back-elevator pressure to keep the nose wheel off the surface. Using back-elevator pressure and engine power, the pilot can control the rate at which the weight of the airplane is transferred from the wings to the wheels. Field conditions may warrant that the pilot maintain a flight condition in which the main wheels are just touching the surface but the weight of the airplane is still being supported by the wings, until a suitable taxi surface is reached. At any time during this transition phase, before



Geoffrey Hatcher AGI, MEI, IGI, CFII

1915 Biscayne Little Rock, AR 72227
 (501) 680-7283 www.geoffhatcher.com
 geoff@geoffhatcher.com

the weight of the airplane is being supported by the wheels, and before the nosewheel is on the surface, the pilot should be able to apply full power and perform a safe takeoff (obstacle clearance and field length permitting) should the pilot elect to abandon the landing. Once committed to a landing, the pilot should gently lower the nosewheel to the surface. A slight addition of power usually will aid in easing the nosewheel down. The use of brakes on a soft field is not needed and should be avoided as this may tend to impose a heavy load on the nose gear due to premature or hard contact with the landing surface, causing the nosewheel to dig in. The soft or rough surface itself will provide sufficient reduction in the airplane's forward speed. Often it will be found that upon landing on a very soft field, the pilot will need to increase power to keep the airplane moving and from becoming stuck in the soft surface.

Common errors in the performance of soft-field approaches and landings are:

Excessive descent rate on final approach.

Excessive airspeed on final approach.

Unstabilized approach.

Roundout too high above the runway surface.

Poor power management during roundout and touchdown.

Hard touchdown.

Inadequate control of the airplane weight transfer from wings to wheels after touchdown.

Allowing the nose-wheel to "fall" to the runway after touchdown rather than controlling its descent.

Estimating landing distance available

Over Fly the runway and time the flight from landing threshold to departure end obstacle

Ground speed nm/hr x 1.7 x seconds traveled = feet of runway

E. TASK: SHORT-FIELD TAKEOFF (CONFINED AREA—ASES) AND MAXIMUM PERFORMANCE CLIMB

1. Exhibits knowledge of the elements related to a short-field (confined area ASES) takeoff and maximum performance climb.
2. Positions the flight controls for the existing wind conditions; sets the flaps as recommended.
3. Clears the area; taxis into takeoff position utilizing maximum available takeoff area and aligns the airplane on the runway center/takeoff path.
4. Selects an appropriate take off path for the existing conditions (ASES).
5. Applies brakes (if appropriate), while advancing the throttles smoothly to takeoff power.
6. Establishes and maintains the most efficient lift-off attitude.
7. Lifts off at the recommended airspeed, and accelerates to the recommended obstacle clearance airspeed or V_x .
8. Establishes a pitch attitude that will maintain the recommended obstacle clearance airspeed, or $V_x + 10/-5$ knots, until the obstacle is cleared, or until the airplane is 50 feet (20 meters) above the surface.
9. After clearing the obstacle, establishes the pitch attitude for V_y , accelerates to V_y , and maintains $V_y + 10/-5$ knots, during the climb.
10. Retracts the landing gear, if appropriate, and flaps after clear of any obstacles or as recommended by manufacturer.
11. Maintains takeoff power and $V_y + 10/-5$ to a safe maneuvering altitude.
12. Maintains directional control and proper wind-drift correction throughout the takeoff and climb.
13. Completes the appropriate checklist.

SHORT-FIELD TAKEOFF AND MAXIMUM PERFORMANCE CLIMB

Takeoffs and climbs from fields where the takeoff area is short or the available takeoff area is restricted by obstructions require that the pilot operate the airplane at the limit of its takeoff performance capabilities. To depart from such an area safely, the pilot must exercise positive and precise control of airplane attitude and airspeed so that takeoff and climb performance results in the shortest ground roll and the steepest angle of climb. [Figure 5-7] The achieved result should be consistent with the performance section of the FAA-approved Airplane Flight Manual and/or Pilot's



Geoffrey Hatcher AGI, MEI, IGI, CFII

1915 Biscayne Little Rock, AR 72227
 (501) 680-7283 www.geoffhatcher.com
 geoff@geoffhatcher.com

Operating Handbook (AFM/POH). In all cases, the power setting, flap setting, airspeed, and procedures prescribed by the airplane's manufacturer should be followed. In order to accomplish a maximum performance takeoff safely, the pilot must have adequate knowledge in the use and effectiveness of the best angle-of-climb speed (V_x) and the best rate-of-climb speed (V_y) for the specific make and model of airplane being flown. The speed for V_x is that which will result in the greatest gain in altitude for a given distance over the ground. It is usually slightly less than V_y which provides the greatest gain in altitude per unit of time. The specific speeds to be used for a given airplane are stated in the FAA-approved AFM/POH. It should be emphasized that in some airplanes, a deviation of 5 knots from the recommended speed will result in a significant reduction in climb performance. Therefore, precise control of airspeed has an important bearing on the successful execution as well as the safety of the maneuver.

TAKEOFF ROLL

Taking off from a short field requires the takeoff to be started from the very beginning of the takeoff area. At this point, the airplane is aligned with the intended takeoff path. If the airplane manufacturer recommends the use of flaps, they should be extended the proper amount before starting the takeoff roll. This permits the pilot to give full attention to the proper technique and the airplane's performance throughout the takeoff. Some authorities prefer to hold the brakes until the maximum obtainable engine r.p.m. is achieved before allowing the airplane to begin its takeoff run. However, it has not been established that this procedure will result in a shorter takeoff run in all light single-engine airplanes. Takeoff power should be applied smoothly and continuously—without hesitation—to accelerate the airplane as rapidly as possible. The airplane should be allowed to roll with its full weight on the main wheels and accelerated to the lift-off speed. As the takeoff roll progresses, the airplane's pitch attitude and angle of attack should be adjusted to that which results in the minimum amount of drag and the quickest acceleration. In nosewheel-type airplanes, this will involve little use of the elevator control, since the airplane is already in a low drag attitude.

LIFT-OFF

Approaching best angle-of-climb speed (V_x), the airplane should be smoothly and firmly lifted off, or rotated, by applying back-elevator pressure to an attitude that will result in the best angle-of-climb airspeed (V_x). Since the airplane will accelerate more rapidly after lift-off, additional back-elevator pressure becomes necessary to hold a constant airspeed. After becoming airborne, a wings level climb should be maintained at V_x until obstacles have been cleared or, if no obstacles are involved, until an altitude of at least 50 feet above the takeoff surface is attained. Thereafter, the pitch attitude may be lowered slightly, and the climb continued at best rate-of-climb speed (V_y) until reaching a safe maneuvering altitude. Remember that an attempt to pull the airplane off the ground prematurely, or to climb too steeply, may cause the airplane to settle back to the runway or into the obstacles. Even if the airplane remains airborne, the initial climb will remain flat and climb performance/obstacle clearance ability seriously degraded until best angle-of-climb airspeed (V_x) is achieved. [Figure 5-8] The objective is to rotate to the appropriate pitch attitude at (or near) best angle-of-climb airspeed. It should be remembered, however, that some airplanes will have a natural tendency to lift off well before reaching V_x . In these airplanes, it may be necessary to allow the airplane to lift off in ground effect and then reduce pitch attitude to level until the airplane accelerates to best angle-of-climb airspeed with the wheels just clear of the runway surface. This method is preferable to forcing the airplane to remain on the ground with forward-elevator pressure until best angle-of-climb speed is attained. Holding the airplane on the ground unnecessarily puts excessive pressure on the nosewheel, may result in "wheelbarrowing," and will hinder both acceleration and overall airplane performance.

INITIAL CLIMB

On short-field takeoffs, the landing gear and flaps should remain in takeoff position until clear of obstacles (or as recommended by the manufacturer) and V_y has been established. It is generally unwise for the pilot to be looking in the cockpit or reaching for landing gear and flap controls until obstacle clearance is assured. When the airplane is stabilized at V_y , the gear (if equipped) and then the flaps should be retracted. It is usually advisable to raise the flaps in increments to avoid sudden



Geoffrey Hatcher AGI, MEI, IGI, CFII

1915 Biscayne Little Rock, AR 72227
 (501) 680-7283 www.geoffhatcher.com
 geoff@geoffhatcher.com

loss of lift and settling of the airplane. Next, reduce the power to the normal climb setting or as recommended by the airplane manufacturer.

- Common errors in the performance of short-field takeoffs and maximum performance climbs are: Failure to adequately clear the area.
- Failure to utilize all available runway/takeoff area.
- Failure to have the airplane properly trimmed prior to takeoff.
- Premature lift-off resulting in high drag.
- Holding the airplane on the ground unnecessarily with excessive forward-elevator pressure.
- Inadequate rotation resulting in excessive speed after lift-off.
- Inability to attain/maintain best angle-of-climb airspeed.
- Fixation on the airspeed indicator during initial climb.
- Premature retraction of landing gear and/or wing flaps.

- 1) Set flaps to manufacturer's recommendation. Usually 10 degrees.
- 2) Align aircraft on centerline of runway using all available runway with the nose wheel straight
- 3) **Hold brakes**
- 4) Apply full power
- 5) Release brakes 6) **Apply right rudder pressure** to counteract torque effects
- 7) Monitor engine instruments for proper operation
- 8) Callout "*Oil pressure Airspeed Alive*" when 40 knots is obtained
- 9) Apply back elevator pressure at rotation speed.
- 10) Set pitch to obtain V_x (Best Angle of Climb), until clear of obstacle
- 11) Lower nose to Normal climb speed or V_y (Best Rate of Climb).
- 12) Raise flaps 400 Agl/ 75 kts
- 13) Trim aircraft to hold desired airspeed cruise climb

F. TASK: SHORT-FIELD APPROACH AND LANDING REFERENCES: FAA-H-8083-3; POH/AFM.

1. Exhibits knowledge of the elements related to a short-field (confined area ASES) approach and landing.
2. Adequately surveys the intended landing area (ASES).
3. Considers the wind conditions, landing surface, obstructions, and selects the most suitable touchdown point.
4. Establishes the recommended approach and landing configuration and airspeed; adjusts pitch attitude and power as required.
5. Maintains a stabilized approach and recommended approach airspeed, or in its absence not more than $1.3 V_{SO}$, $+10/-5$ knots, with wind gust factor applied.
6. Makes smooth, timely, and correct control application during the roundout and touchdown.
7. Selects the proper landing path, contacts the surface at the minimum safe airspeed with the proper pitch attitude for the surface conditions (ASES).
8. Touches down smoothly at minimum control airspeed (ASEL).
9. Touches down at or within 200 feet (60 meters) beyond a specified point, with no side drift, minimum float and with the airplane's longitudinal axis aligned with and over the runway center/landing path.
10. Maintains crosswind correction and directional control throughout the approach and landing sequence.
11. Applies brakes, (ASEL) or elevator control (ASES), as necessary, to stop in the shortest distance consistent with safety.
12. Completes the appropriate checklist.

SHORT-FIELD APPROACH AND LANDING

Short-field approaches and landings require the use of procedures for approaches and landings at fields with a relatively short landing area or where an approach is made over obstacles that limit the available landing area. [Figures 8-20 and 8-21] As in short-field takeoffs, it is one of the most critical of the maximum performance operations. It requires that the pilot fly the airplane at one of its crucial performance capabilities while close to the ground in order to safely land within confined areas. This



Geoffrey Hatcher AGI, MEI, IGI, CFII

1915 Biscayne Little Rock, AR 72227
 (501) 680-7283 www.geoffhatcher.com
 geoff@geoffhatcher.com

low-speed type of power-on approach is closely related to the performance of flight at minimum controllable airspeeds. To land within a short-field or a confined area, the pilot must have precise, positive control of the rate of descent and airspeed to produce an approach that will clear any obstacles, result in little or no floating during the roundout, and permit the airplane to be stopped in the shortest possible distance. The procedures for landing in a short-field or for landing approaches over obstacles, as recommended in the AFM/POH, should be used. A stabilized approach is essential. [Figures 8-22 and 8-23] These procedures generally involve the use of full flaps, and the final approach started from an altitude of at least 500 feet higher than the touchdown area. A wider than normal pattern should be used so that the airplane can be properly configured and trimmed. In the absence of the manufacturer's recommended approach speed, a speed of not more than $1.3 V_{SO}$ should be used. For example, in an airplane that stalls at 60 knots with power off, and flaps and landing gear extended, the approach speed should not be higher than 78 knots. In gusty air, no more than one-half the gust factor should be added. An excessive amount of airspeed could result in a touchdown too far from the runway threshold or an after-landing roll that exceeds the available landing area. After the landing gear and full flaps have been extended, the pilot should simultaneously adjust the power and the pitch attitude to establish and maintain the proper descent angle and airspeed. A coordinated combination of both pitch and power adjustments is required. When this is done properly, very little change in the airplane's pitch attitude and power setting is

necessary to make corrections in the angle of descent and airspeed. The short-field approach and landing is in reality an accuracy approach to a spot landing. The procedures previously outlined in the section on the stabilized approach concept should be used. If it appears that the obstacle clearance is excessive and touchdown will occur well beyond the desired spot, leaving insufficient room to stop, power may be reduced while lowering the pitch attitude to steepen the descent path and increase the rate of descent. If it appears that the descent angle will not ensure safe clearance of obstacles, power should be increased while simultaneously raising the pitch attitude to shallow the descent path and decrease the rate of descent. Care must be taken to avoid an excessively low airspeed. If the speed is allowed to become too slow, an increase in pitch and application of full power may only result in a further rate of descent. This occurs when the angle of attack is so great and creating so much drag that the maximum available power is insufficient to overcome it. This is generally referred to as operating in the **region of reversed command** or operating on the **back side of the power curve**. Because the final approach over obstacles is made at a relatively steep approach angle and close to the airplane's stalling speed, the initiation of the roundout or flare must be judged accurately to avoid flying into the ground, or stalling prematurely and sinking rapidly. A lack of floating during the flare, with sufficient control to touch down properly, is one verification that the approach speed was correct. Touchdown should occur at the minimum controllable airspeed with the airplane in approximately the pitch attitude that will result in a power-off stall when the throttle is closed. Care must be exercised to avoid closing the throttle too rapidly before the pilot is ready for touchdown, as closing the throttle may result in an immediate increase in the rate of descent and a hard landing. Upon touchdown, the airplane should be held in this positive pitch attitude as long as the elevators remain effective. This will provide aerodynamic braking to assist in deceleration. Immediately upon touchdown, and closing the throttle, appropriate braking should be applied to minimize the after-landing roll. The airplane should be stopped within the shortest possible distance consistent with safety and controllability. If the proper approach speed has been maintained, resulting in minimum float during the roundout, and the touchdown made at minimum control speed, minimum braking will be required.

Common errors in the performance of short-field approaches and landings are:

- Failure to allow enough room on final to set up the approach, necessitating an overly steep approach and high sink rate.
- Unstabilized approach.
- Undue delay in initiating glidepath corrections.
- Too low an airspeed on final resulting in inability to flare properly and landing hard.



Geoffrey Hatcher AGI, MEI, IGI, CFII

1915 Biscayne Little Rock, AR 72227
 (501) 680-7283 www.geoffhatcher.com
 geoff@geoffhatcher.com

Too high an airspeed resulting in floating on roundout.
 Prematurely reducing power to idle on roundout resulting in hard landing.
 Touchdown with excessive airspeed.
 Excessive and/or unnecessary braking after touchdown.
 Failure to maintain directional control.

Short-Field Landing

Recommended entry for the traffic pattern is 45 degrees on the downwind leg

When abeam your touchdown point, perform the following in order:

- 1) Reduce power 1500 rpm
- 2) Flaps to t/o
- 3) Hold altitude until 70kts is attained
- 4) Trim to hold 70 kts

Turn onto the Base leg when you are 1 to 1½ times farther out than normal. After you roll wings level on the Base leg perform the following in order:

- 1) Flaps to landing
- 2) Re-trim to hold 70 knots airspeed

Turn onto the Final leg so the aircraft rolls out wings level aligned with the center line of the runway; slow the airplane to the short-field approach speed

Maintain 500ft AGL until able to see your touchdown point beyond your obstacle (see diagram below), then add full flaps and reduce power.

Reduce power to idle and land firmer than normal with little or no flare. Apply brakes without locking them and bring the airplane to a stop.

K. TASK: FORWARD SLIP TO A LANDING (ASEL and ASES) REFERENCES: FAA-H-8083-3; POH/AFM.

1. Exhibits knowledge of the elements related to forward slip to a landing.
2. Considers the wind conditions, landing surface and obstructions, and selects the most suitable touchdown point.
3. Establishes the slipping attitude at the point from which a landing can be made using the recommended approach and landing configuration and airspeed; adjusts pitch attitude and power as required.
4. Maintains a ground track aligned with the runway center/landing path and an airspeed, which results in minimum float during the roundout.
5. Makes smooth, timely, and correct control application during the recovery from the slip, the roundout, and the touchdown.
6. Touches down smoothly at the approximate stalling speed, at or within 400 feet (120 meters) beyond a specified point, with no side drift, and with the airplane's longitudinal axis aligned with and over the runway center/landing path.
7. Maintains crosswind correction and directional control throughout the approach and landing sequence.
8. Completes the appropriate checklist.

INTENTIONAL SLIPS

A slip occurs when the bank angle of an airplane is too steep for the existing rate of turn.

Unintentional slips are most often the result of uncoordinated rudder/aileron application. Intentional slips, however, are used to dissipate altitude without increasing airspeed, and/or to adjust airplane ground track during a crosswind. Intentional slips are especially useful in forced landings, and in situations where obstacles must be cleared during approaches to confined areas. A slip can also be used as an emergency means of rapidly reducing airspeed in situations where wing flaps are inoperative or not installed. A slip is a combination of forward movement and sideward (with respect to the longitudinal axis of the airplane) movement, the lateral axis being inclined and the sideward movement being toward the low end of this axis (low wing). An airplane in a slip is in fact



Geoffrey Hatcher AGI, MEI, IGI, CFII

1915 Biscayne Little Rock, AR 72227
 (501) 680-7283 www.geoffhatcher.com
 geoff@geoffhatcher.com