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.
- 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.

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 flying sideways. This results in a change in the direction the relative wind strikes the airplane. Slips are characterized by a marked increase in drag and corresponding decrease in airplane climb, cruise, and glide performance. It is the increase in drag, however, that makes it possible for an airplane in a slip to descend rapidly without an increase in airspeed.

Most airplanes exhibit the characteristic of positive static directional stability and, therefore, have a natural tendency to compensate for slipping. An intentional slip, therefore, requires deliberate cross-controlling ailerons and rudder throughout the maneuver.

A "**sideslip**" is entered by lowering a wing and applying just enough opposite rudder to prevent a turn. In a sideslip, the airplane's longitudinal axis remains parallel to the original flightpath, but the airplane no longer flies straight ahead. Instead the horizontal component of wing lift forces the airplane also to move somewhat sideways toward the low wing. [Figure 8-12] The amount of slip, and therefore the rate of sideward movement, is determined by the bank angle. The steeper the bank—the greater the degree of slip. As bank angle is increased, however, additional opposite rudder is required to prevent turning.

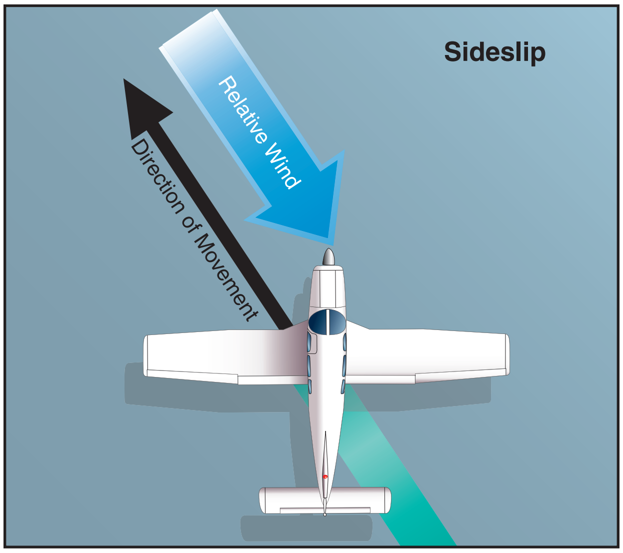

Figure 8-12. Sideslip.

A "**forward slip**" is one in which the airplane's direction of motion continues the same as before the slip was begun. Assuming the airplane is originally in straight flight, the wing on the side toward which the slip is to be made should be lowered by use of the ailerons. Simultaneously, the airplane's nose must be yawed in the opposite direction by applying opposite rudder so that the airplane's longitudinal axis is at an angle to its original flightpath. [Figure 8-13] The degree to which the nose is yawed in the opposite direction from the bank should be such that the original ground track is maintained. In a forward slip, the amount of slip, and therefore the sink rate, is determined by the bank angle. The steeper the bank—the steeper the descent.

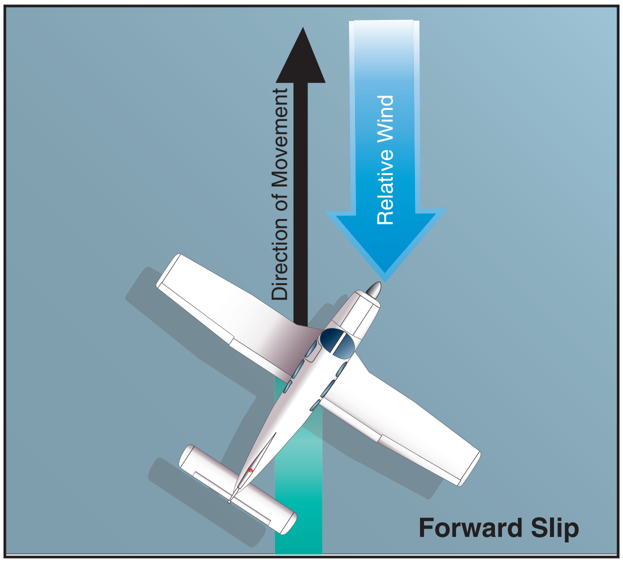

Figure 8-13. Forward slip.

In most light airplanes, the steepness of a slip is limited by the amount of rudder travel available. In both sideslips and forward slips, the point may be reached where full rudder is required to maintain heading even though the ailerons are capable of further steepening the bank angle. This is the **practical slip limit**, because any additional bank would cause the airplane to turn even though full opposite rudder is being applied. If there is a need to descend more rapidly even though the practical slip limit has been reached, lowering the nose will not only increase the sink rate but will also increase airspeed. The increase in airspeed increases rudder effectiveness permitting a steeper slip. Conversely, when the nose is raised, rudder effectiveness decreases and the bank angle must be reduced.

Discontinuing a slip is accomplished by leveling the wings and simultaneously releasing the rudder pressure while readjusting the pitch attitude to the normal glide attitude. If the pressure on the rudder is released abruptly, the nose will swing too quickly into line and the airplane will tend to acquire excess speed.

Because of the location of the pitot tube and static vents, airspeed indicators in some airplanes may have considerable error when the airplane is in a slip. The pilot must be aware of this possibility and recognize a properly performed slip by the attitude of the airplane, the sound of the airflow, and the feel of the flight controls. Unlike skids, however, if an airplane in a slip is made to stall, it displays very little of the yawing tendency that causes a skidding stall to develop into a spin. The airplane in a slip may do little more than tend to roll into a wings level attitude. In fact, in some airplanes stall characteristics may even be improved.

GO-AROUNDS (REJECTED LANDINGS)

Whenever landing conditions are not satisfactory, a go-around is warranted. There are many factors that can contribute to unsatisfactory landing conditions. Situations such as air traffic control requirements, unexpected appearance of hazards on the runway, overtaking another airplane, wind shear, wake turbulence, mechanical failure and/or an unstabilized approach are all examples of reasons to discontinue a landing approach and make another approach under more favorable conditions. The assumption that an aborted landing is invariably the consequence of a poor approach, which in turn is due to insufficient experience or skill, is a fallacy. The go-around is not strictly an emergency procedure. It is a *normal* maneuver that may at times be used in an emergency situation. Like any other normal maneuver, the go-around must be practiced and perfected. The flight instructor should emphasize early on, and the student pilot should be made to understand, that the go-around maneuver is an alternative to any approach and/or landing.

Although the need to discontinue a landing may arise at any point in the landing process, the most critical go-around will be one started when very close to the ground. Therefore, the earlier a condition that warrants a go-around is recognized, the safer the go-around/rejected landing will be. The go-around maneuver is not inherently dangerous in itself. It becomes dangerous only when delayed unduly or executed improperly. Delay in initiating the go-around normally stems from two sources: (1) landing expectancy, or set—the anticipatory belief that conditions are not as threatening as they are and that the approach will surely be terminated with a safe landing, and (2) pride—the mistaken belief that the act of going around is an admission of failure—failure to execute the approach properly. The improper execution of the go-around maneuver stems from a lack of familiarity with the three cardinal principles of the procedure: **power**, **attitude**, and **configuration**.

POWER

Power is the pilot's first concern. The instant the pilot decides to go around, *full* or *maximum allowable takeoff* power must be applied smoothly and without hesitation, and held until flying speed and controllability are restored. Applying only partial power in a go-around is never appropriate. The pilot must be aware of the degree of inertia that must be overcome, before an airplane that is settling towards the ground can regain sufficient airspeed to become fully controllable and capable of turning safely or climbing. The application of power should be smooth as well as positive. Abrupt movements of the throttle in some airplanes will cause the engine to falter. Carburetor heat should be turned off for maximum power.

ATTITUDE

Attitude is always critical when close to the ground, and when power is added, a deliberate effort on the part of the pilot will be required to keep the nose from pitching up prematurely. The airplane executing a go-around must be maintained in an attitude that permits a buildup of airspeed well beyond the stall point before any effort is made to gain altitude, or to execute a turn. Raising the nose too early may produce a stall from which the airplane could not be recovered if the go-around is performed at a low altitude.

A concern for quickly regaining altitude during a go-around produces a natural tendency to pull the nose up. The pilot executing a go-around must accept the fact that an airplane will not climb until it can fly, and it will not fly below stall speed. In some circumstances, it may be desirable to lower the nose briefly to gain airspeed. As soon as the appropriate climb airspeed and pitch attitude are attained, the pilot should "rough trim" the airplane to relieve any adverse control pressures. Later, more precise trim adjustments can be made when flight conditions have stabilized.

CONFIGURATION

In cleaning up the airplane during the go-around, the pilot should be concerned first with flaps and secondly with the landing gear (if retractable). When the decision is made to perform a go-around, takeoff power should be applied immediately and the pitch attitude changed so as to slow or stop the descent. After the descent has been stopped, the landing flaps may be partially retracted or placed in the takeoff position as recommended by the manufacturer. Caution must be used, however, in retracting the flaps. Depending on the airplane's altitude and airspeed, it may be wise to retract the flaps intermittently in small increments to allow time for the airplane to accelerate progressively as they are being raised. A sudden and complete retraction of the flaps could cause a loss of lift resulting in the airplane settling into the ground. [Figure 8-14]

Unless otherwise specified in the AFM/POH, it is generally recommended that the flaps be retracted (at least partially) *before* retracting the landing gear—for two reasons. First, on most airplanes full flaps produce more drag than the landing gear; and second, in case the airplane should inadvertently touch down as the go-around is initiated, it is most desirable to have the landing gear in the down-and-locked position. After a positive rate of climb is established, the landing gear can be retracted.

When takeoff power is applied, it will usually be necessary to hold considerable pressure on the controls to maintain straight flight and a safe climb attitude. Since the airplane has been trimmed for the approach (a low power and low airspeed condition), application of maximum allowable power will require considerable control pressure to maintain a climb pitch attitude. The addition of power will tend to raise the airplane's nose suddenly and veer to the left. Forward elevator pressure must be anticipated and applied to hold the nose in a safe climb attitude. Right rudder pressure must be increased to counteract torque and P-factor, and to keep the nose straight. The airplane must be held in the proper flight attitude regardless of the amount of control pressure that is required. Trim should be used to relieve adverse control pressures and assist the pilot in maintaining a proper pitch attitude. On airplanes that produce high control pressures when using maximum power on go-arounds, pilots should use caution when reaching for the flap handle. Airplane control may become critical during this high workload phase.

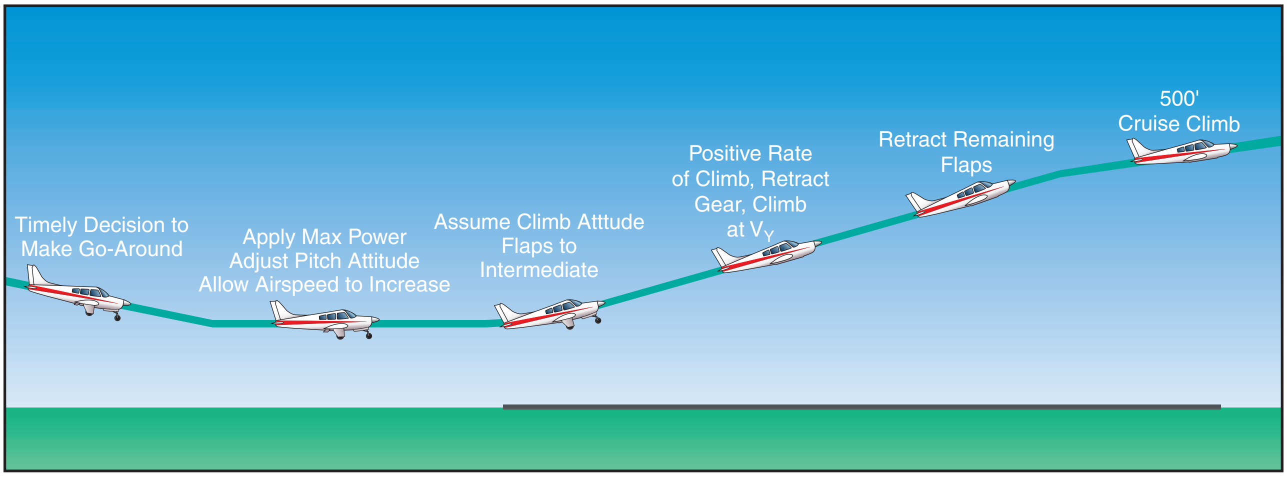

Figure 8-14. Go-around procedure.

The landing gear should be retracted only after the initial or rough trim has been accomplished and when it is certain the airplane will remain airborne. During the initial part of an extremely low go-around, the airplane may settle onto the runway and bounce. This situation is not particularly dangerous if the airplane is kept straight and a constant, safe pitch attitude is maintained. The airplane will be approaching safe flying speed rapidly and the advanced power will cushion any secondary touchdown.

If the pitch attitude is increased excessively in an effort to keep the airplane from contacting the runway, it may cause the airplane to stall. This would be especially likely if no trim correction is made and the flaps remain fully extended. The pilot should not attempt to retract the landing gear until after a rough trim is accomplished and a positive rate of climb is established.

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-round.
- 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 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