Chapter 13

Transition to Tailwheel Airplanes

TAILWHEEL AIRPLANES

Tailwheel airplanes are often referred to as conventional gear airplanes. Due to their design and structure, tailwheel airplanes exhibit operational and handling characteristics that are different from those of tricycle gear airplanes. Tailwheel airplanes are not necessarily more difficult to takeoff, land, and/or taxi than tricycle gear airplanes; in fact under certain conditions, they may even handle with less difficulty. This chapter will focus on the operational differences that occur during ground operations, takeoffs, and landings.

LANDING GEAR

The main landing gear forms the principal support of the airplane on the ground. The tailwheel also supports the airplane, but steering and directional control are its primary functions. With the tailwheel-type airplane, the two main struts are attached to the airplane slightly ahead of the airplane's center of gravity (CG).

The rudder pedals are the primary directional controls while taxiing. Steering with the pedals may be accomplished through the forces of airflow or propeller slipstream acting on the rudder surface, or through a mechanical linkage to the steerable tailwheel. Initially, the pilot should taxi with the heels of the feet resting on the cockpit floor and the balls of the feet on the bottom of the rudder pedals. The feet should be slid up onto the brake pedals only when it is necessary to depress the brakes. This permits the simultaneous application of rudder and brake whenever needed. Some models of tailwheel airplanes are equipped with heel brakes rather than toe brakes. In either configuration the brakes are used primarily to stop the airplane at a desired point, to slow the airplane, or as an aid in making a sharp controlled turn. Whenever used, they must be applied smoothly, evenly, and cautiously at all times.

TAXIING

When beginning to taxi, the brakes should be tested immediately for proper operation. This is done by first applying power to start the airplane moving slowly forward, then retarding the throttle and simultaneously applying pressure smoothly to both brakes. If braking action is unsatisfactory, the engine should be shut down immediately.

To turn the airplane on the ground, the pilot should apply rudder in the desired direction of turn and use whatever power or brake that is necessary to control the taxi speed. The rudder should be held in the direction of the turn until just short of the point where the turn is to be stopped, then the rudder pressure released or slight opposite pressure applied as needed. While taxiing, the pilot will have to anticipate the movements of the airplane and adjust rudder pressure accordingly. Since the airplane will continue to turn slightly even as the rudder pressure is being released, the stopping of the turn must be anticipated and the rudder pedals neutralized before the desired heading is reached. In some cases, it may be necessary to apply opposite rudder to stop the turn, depending on the taxi speed.

The presence of moderate to strong headwinds and/or a strong propeller slipstream makes the use of the elevator necessary to maintain control of the pitch attitude while taxiing. This becomes apparent when considering the lifting action that may be created on the horizontal tail surfaces by either of those two factors. The elevator control should be held in the aft position (stick or yoke back) to hold the tail down.

When taxiing in a quartering headwind, the wing on the upwind side will usually tend to be lifted by the wind unless the aileron control is held in that direction (upwind aileron UP). Moving the aileron into the UP position reduces the effect of wind striking that wing, thus reducing the lifting action. This control movement will also cause the opposite aileron to be placed in the DOWN position, thus creating drag and possibly some lift on the downwind wing, further reducing the tendency of the upwind wing to rise.

When taxiing with a quartering tailwind, the elevator should be held in the full DOWN position (stick or yoke full forward), and the upwind aileron down. Since the wind is striking the airplane from behind, these control positions reduce the tendency of the wind to get under the tail and the wing possibly causing the airplane to nose over. The application of these crosswind taxi corrections also helps to minimize the weathervaning tendency and ultimately results in increased controllability.

An airplane with a tailwheel has a tendency to weathervane or turn into the wind while it is being taxied. The tendency of the airplane to weathervane is greatest while taxiing directly crosswind; consequently, directional control is somewhat difficult. Without brakes, it is almost impossible to keep the airplane from turning into any wind of considerable velocity since the airplane's rudder control capability may be inadequate to counteract the crosswind. In taxiing downwind, the tendency to weathervane is increased, due to the tailwind decreasing the effectiveness of the flight controls. This requires a more positive use of the rudder and the brakes, particularly if the wind velocity is above that of a light breeze.

Unless the field is soft, or very rough, it is best when taxiing downwind to hold the elevator control in the forward position. Even on soft fields, the elevator should be raised only as much as is absolutely necessary to maintain a safe margin of control in case there is a tendency of the airplane to nose over.

On most tailwheel-type airplanes, directional control while taxiing is facilitated by the use of a steerable tailwheel, which operates along with the rudder. The tailwheel steering mechanism remains engaged when the tailwheel is operated through an arc of about 16 to 18° each side of neutral and then automatically becomes full swiveling when turned to a greater angle. On some models the tailwheel may also be locked in place. The airplane may be pivoted within its own length, if desired, yet is fully steerable for slight turns while taxiing forward. While taxiing, the steerable tailwheel should be used for making normal turns and the pilot's feet kept off the brake pedals to avoid unnecessary wear on the brakes.

Since a tailwheel-type airplane rests on the tailwheel as well as the main landing wheels, it assumes a nose-high attitude when on the ground. In most cases this places the engine cowling high enough to restrict the pilot's vision of the area directly ahead of the airplane. Consequently, objects directly ahead of the airplane are difficult, if not impossible, to see. To observe and avoid colliding with any objects or hazardous surface conditions, the pilot should alternately turn the nose from one side to the other—that is zigzag, or make a series of short S-turns while taxiing forward. This should be done slowly, smoothly, positively, and cautiously.

NORMAL TAKEOFF ROLL

After taxiing onto the runway, the airplane should be carefully aligned with the intended takeoff direction, and the tailwheel positioned straight, or centered. In airplanes equipped with a locking device, the tailwheel should be locked in the centered position. After releasing the brakes, the throttle should be smoothly and continuously advanced to takeoff power. As the airplane starts to roll forward, the pilot should slide both feet down on the rudder pedals so that the toes or balls of the feet are on the rudder portions, not on the brake portions.

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. Also, precession will be particularly noticeable during takeoff in a tailwheel-type airplane if the tail is rapidly raised from a three point to a level flight attitude. The abrupt change of attitude tilts the horizontal axis of the propeller, and the resulting precession produces a forward force on the right side (90° ahead in the direction of rotation), yawing the airplane's nose to the left. The amount of force created by this precession is directly related to the rate the propeller axis is tilted when the tail is raised. With this in mind, the throttle should always be advanced smoothly and continuously to prevent any sudden swerving.

Smooth, gradual advancement of the throttle is very important in tailwheel-type airplanes, since peculiarities in their takeoff characteristics are accentuated in proportion to how rapidly the takeoff power is applied.

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 torque and P-factor at the initial speeds tend to pull the nose to the left. The pilot must use what rudder pressure is 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 they will cause slower acceleration of the airplane's speed, lengthen the takeoff distance, and possibly result in severe swerving.

When the elevator trim is set for takeoff, on application of maximum allowable power, the airplane will (when sufficient speed has been attained) normally assume the correct takeoff pitch attitude on its own—the tail will rise slightly. This attitude can then be maintained by applying slight back-elevator pressure. If the elevator control is pushed forward during the takeoff roll to prematurely raise the tail, its effectiveness will rapidly build up as the speed increases, making it necessary to apply back-elevator pressure to lower the tail to the proper takeoff attitude. This erratic change in attitude will delay the takeoff and lead to directional control problems. Rudder pressure must be used promptly and smoothly to counteract yawing forces so that the airplane continues straight down the runway.

While the speed of the takeoff roll increases, more and more pressure will be felt on the flight controls, particularly the elevators and rudder. Since the tail surfaces receive the full effect of 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.

TAKEOFF

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.

The tail should first be allowed to rise off the ground slightly to permit the airplane to accelerate more rapidly. At this point, the position of the nose in relation to the horizon should be noted, then elevator pressure applied as necessary to hold this attitude. The wings are kept level by applying aileron pressure as necessary.

The airplane may be allowed to fly off the ground while in normal takeoff attitude. Forcing it into the air by applying excessive back-elevator pressure would 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, 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 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 occurs because the angle of attack is decreased and lift is diminished to the degree where it will not support the airplane. It is important to hold the attitude constant after rotation or lift-off.

As the airplane leaves the ground, the pilot must continue to maintain straight flight, as well as holding the proper pitch attitude. During takeoffs in 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 hold the airplane on the ground longer to attain more speed, then make a smooth, positive rotation to leave the ground.

CROSSWIND TAKEOFF

It is important to establish and maintain the proper amount of crosswind correction prior to lift-off; that is, apply aileron pressure toward the wind to keep the upwind wing from rising and apply rudder pressure as needed to prevent weathervaning.

As the tailwheel is 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 one main wheel. This is acceptable and is preferable 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 definite lift-off 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 drift correction is being established. More importantly, it 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 until adequate drift correction is maintained.

SHORT-FIELD TAKEOFF

Wing flaps should be lowered prior to takeoff if recommended by the manufacturer. Takeoff power should be applied smoothly and continuously, (there should be no hesitation) to accelerate the airplane as rapidly as possible. 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. The tail should be allowed to rise off the ground slightly, then held in this tail-low flight attitude until the proper lift-off or rotation airspeed is attained. For the steepest climb-out and best obstacle clearance, the airplane should be allowed to roll with its full weight on the main wheels and accelerated to the lift-off speed.

SOFT-FIELD TAKEOFF

Wing flaps may be lowered prior to starting the takeoff (if recommended by the manufacturer) to provide additional lift and transfer the airplane's weight from the wheels to the wings as early as possible. The airplane should be taxied onto the takeoff surface without stopping on a soft surface. Stopping on a soft surface, such as mud or snow, might bog the airplane down. The airplane should be kept in continuous motion with sufficient power while lining up for the takeoff roll.

As the airplane is aligned with the proposed takeoff path, takeoff power is applied smoothly and as rapidly as the powerplant will accept it without faltering. The tail should be kept low to maintain the inherent positive angle of attack and to avoid any tendency of the airplane to nose over as a result of soft spots, tall grass, or deep snow.

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. The airplane should be allowed to accelerate to climb speed in ground effect.

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 at approximately stalling speed. As the airplane settles, the proper landing attitude must be attained by applying whatever back-elevator pressure is necessary. The roundout and touchdown should be timed so that the wheels of the main landing gear and tailwheel touch down simultaneously (three-point landing). This requires proper timing, technique, and judgment of distance and altitude. [Figure 13-1]

When the wheels make contact with the ground, the elevator control should be carefully eased fully back to hold the tail down and to keep the tailwheel on the ground. This provides more positive directional control of the airplane equipped with a steerable tailwheel, and prevents any tendency for the airplane to nose over. If the tailwheel is not on the ground, easing back on the elevator control may cause the airplane to become airborne again because the change in attitude will increase the angle of attack and produce enough lift for the airplane to fly.

It is extremely important that the touchdown occur with the airplane's longitudinal axis exactly parallel to the direction the airplane is moving along the runway. Failure to accomplish this not only imposes severe side loads on the landing gear, but imparts groundlooping (swerving) tendencies. To avoid these side stresses or a ground loop, the pilot must never allow the airplane to touch down while in a crab or while 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. 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. This is because the CG is behind the main wheels. [Figure 13-2]

Any difference between the direction the airplane is traveling and the direction it is headed will produce a moment about the pivot point of the wheels, and the airplane will tend to swerve. Loss of directional control may lead to an aggravated, uncontrolled, tight turn on the ground, or a ground loop. The combination of inertia acting on the 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

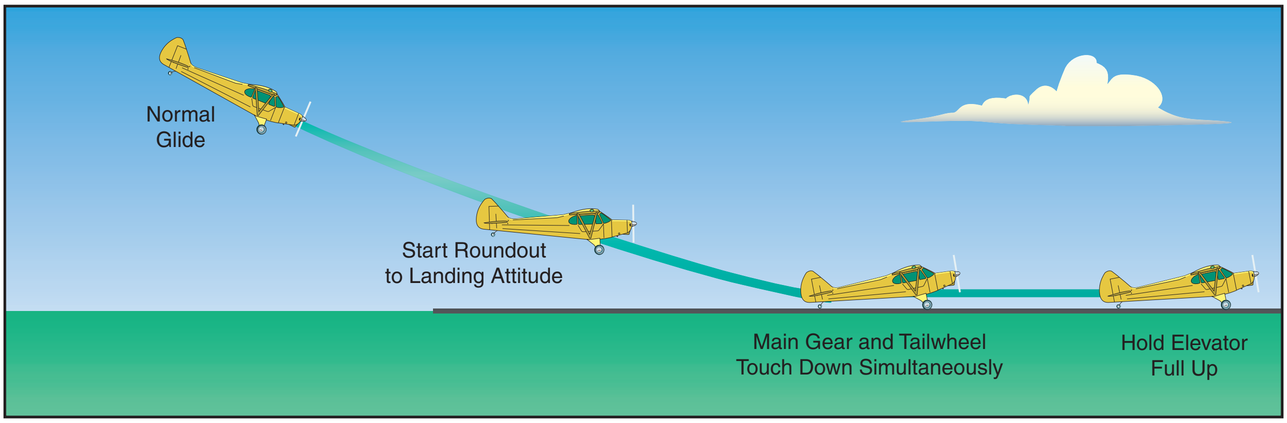

Figure 13-1. Tailwheel touchdown.

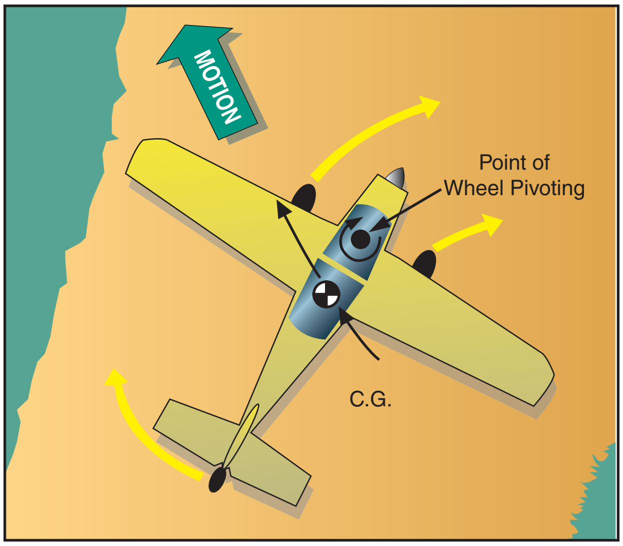

Figure 13-2. Effect of CG on directional control.

wingtip to contact the ground, and may even impose a sideward force that could collapse the landing gear. The airplane can ground loop late in the after-landing roll because rudder effectiveness decreases with the decreasing flow of air along the rudder surface as the airplane slows. As the airplane speed decreases and the tailwheel has been lowered to the ground, the steerable tailwheel provides more positive directional control.

To use the brakes, the pilot should slide the toes or feet up from the rudder pedals to the brake pedals (or apply heel pressure in airplanes equipped with heel brakes). 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. During the ground roll, the airplane's direction of movement may 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.

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.

The elevator control should be held back as far as possible and as firmly as possible, until the airplane stops. This provides more positive control with tailwheel steering, tends to shorten the after-landing roll, and prevents bouncing and skipping.

If available runway permits, the speed of the airplane should be allowed to dissipate in a normal manner by the friction and drag of the wheels on the ground. Brakes may be used if needed to help slow the airplane. After the airplane has been slowed sufficiently and has been turned onto a taxiway or clear of the landing area, it should be brought to a complete stop. Only after this is done should the pilot retract the flaps and perform other checklist items.

CROSSWIND LANDING

If the crab method of drift correction has been used throughout the final approach and roundout, the crab must be removed 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 results in severe side loads being imposed on the landing gear and imparts ground looping tendencies.

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 it touches down.

As the forward speed decreases after initial contact, the weight of the airplane will cause the downwind main wheel to gradually settle onto the runway.

An adequate amount of power should be used to maintain the proper airspeed throughout the approach, and the throttle should be retarded to idling position after the main wheels contact the landing surface. Care must be exercised in closing the throttle before the pilot is ready for touchdown, because the sudden or premature closing of the throttle may cause a sudden increase in the descent rate that could result in a hard landing.

CROSSWIND AFTER-LANDING ROLL

Particularly during the after-landing roll, special attention must be given to maintaining directional control by the use of rudder and tailwheel steering, while keeping the upwind wing from rising by the use of aileron. Characteristically, an airplane has a greater profile, or side area, behind the main landing gear than forward of it. [Figure 13-3] 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. This weathervaning tendency is more prevalent in the tailwheel-type because the airplane's surface area behind the main landing gear is greater than in nosewheel-type airplanes.

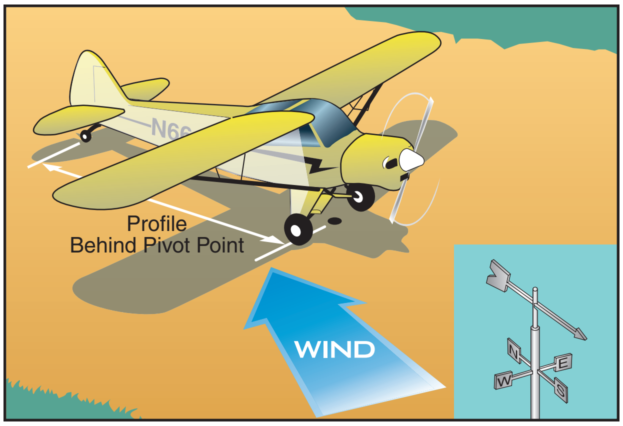

Figure 13-3. Weathervaning tendency.

Pilots should be familiar with the crosswind component of each airplane they fly, and avoid operations in wind conditions that exceed the capability of the airplane, as well as their own limitations.

While the airplane is decelerating during the after-landing roll, more aileron must be 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. Consequently, when the airplane is coming to a stop, the aileron control must be held fully toward the wind.

WHEEL LANDING

Landings from power approaches in turbulence or in crosswinds should be such that the touchdown is made with the airplane in approximately level flight attitude. The touchdown should be made smoothly on the main wheels, with the tailwheel held clear of the runway. This is called a "wheel landing" and requires careful timing and control usage to prevent bouncing. These wheel landings can be best accomplished by holding the airplane in level flight attitude until the main wheels touch, then immediately but smoothly retarding the throttle, and holding sufficient forward elevator pressure to hold the main wheels on the ground. The airplane should never be forced onto the ground by excessive forward pressure.

If the touchdown is made at too high a rate of descent as the main wheels strike the landing surface, the tail is forced down by its own weight. In turn, when the tail is forced down, the wing's angle of attack increases resulting in a sudden increase in lift and the airplane may become airborne again. Then as the airplane's speed continues to decrease, the tail may again lower onto the runway. If the tail is allowed to settle too quickly, the airplane may again become airborne. This process, often called "porpoising," usually intensifies even though the pilot tries to stop it. The best corrective action is to execute a go-around procedure.

SHORT-FIELD LANDING

Upon touchdown, the airplane should be firmly held in a three-point attitude. This will provide aerodynamic braking by the wings. Immediately upon touchdown, and closing the throttle, the brakes should be applied evenly and firmly to minimize the after-landing roll. The airplane should be stopped within the shortest possible distance consistent with safety.

SOFT-FIELD LANDING

The tailwheel should touch down simultaneously with or just before the main wheels, and should then be held down by maintaining firm back-elevator pressure throughout the landing roll. This will minimize any tendency for the airplane to nose over and will provide aerodynamic braking. The use of brakes on a soft field is not needed because 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.

GROUND LOOP

A ground loop is an uncontrolled turn during ground operation that may occur while taxiing or taking off, but especially during the after-landing roll. It is not always caused by drift or weathervaning, although these things may cause the initial swerve. Careless use of the rudder, an uneven ground surface, or a soft spot that retards one main wheel of the airplane may also cause a swerve. In any case, the initial swerve tends to cause the airplane to ground loop.

Due to the characteristics of an airplane equipped with a tailwheel, the forces that cause a ground loop increase as the swerve increases. The initial swerve develops inertia and this, acting at the CG (which is located behind the main wheels), swerves the airplane even more. If allowed to develop, the force produced may become great enough to tip the airplane until one wing strikes the ground.

If the airplane touches down while drifting or in a crab, the pilot should apply aileron toward the high wing and stop the swerve with the rudder. Brakes should be used to correct for turns or swerves only when the rudder is inadequate. The pilot must exercise caution when applying corrective brake action because it is very easy to overcontrol and aggravate the situation. If brakes are used, sufficient brake should be applied on the low-wing wheel (outside of the turn) to stop the swerve. When the wings are approximately level, the new direction must be maintained until the airplane has slowed to taxi speed or has stopped.