CHAPTER 7

Launch and Recovery Procedures and Flight Maneuvers

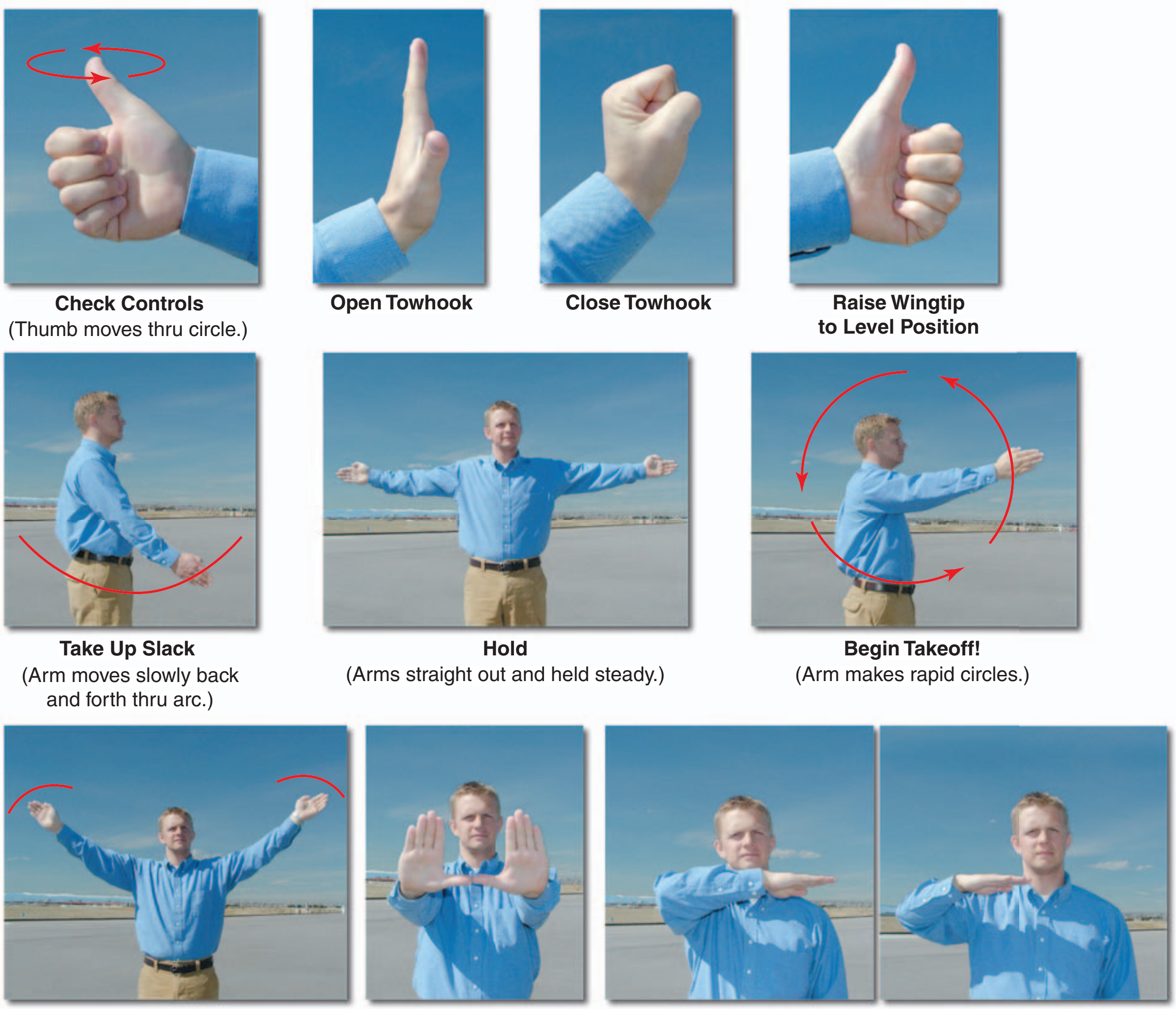
This chapter discusses glider launch and takeoff procedures, traffic patterns, landing and recovery procedures, and flight maneuvers.

AEROTOW LAUNCH SIGNALS

Launching a non-powered glider requires the use of visual signals for communication and coordination between the glider pilot, towpilot, and launch crewmembers. If the aircraft and launch crewmembers are equipped with compatible radios, communication is enhanced over hand signals. Aerotow launch signals consist of pre-launch signals and in-flight signals.

PRE-LAUNCH SIGNALS FOR AEROTOW LAUNCHES

Aerotow pre-launch signals facilitate communication between pilots and launch crewmembers preparing for the launch. These signals are shown in Figure 7-1.



Check Controls
(Thumb moves thru circle.)

Open Towhook

Close Towhook

Raise Wingtip to Level Position

Take Up Slack
(Arm moves slowly back and forth thru arc.)

Hold
(Arms straight out and held steady.)

Begin Takeoff!
(Arm makes rapid circles.)

Stop Operation Immediately!
(Wave arms.)

Stop!

Release Towrope or Stop Engine Now
(Draw arm across throat.)

Figure 7-1. Aerotow pre-launch signals.

IN-FLIGHT AEROTOW VISUAL SIGNALS

Visual signals allow the towpilot and the glider pilot to communicate with each other. The signals are divided into two types: those from the towpilot to the glider pilot, and those from the glider pilot to the towpilot. These signals are shown in Figure 7-2.

TAKEOFF PROCEDURES AND TECHNIQUES

Takeoff procedures for gliders require close coordination between launch crewmembers and pilots. Both the glider and towpilot must be familiar with the appropriate tow procedures.

AEROTOW TAKEOFFS

Normal takeoffs are made into the wind. Prior to takeoff, the towpilot and glider pilot must reach an agreement on the plan for the aerotow. The glider pilot should ensure that the launch crewmember is aware of safety procedures concerning the tow. Some of these items would be proper runway and pattern clearing procedures and glider configuration checks (spoilers closed, tailwheel dolly removed, canopy secured). When the required checklists have been completed

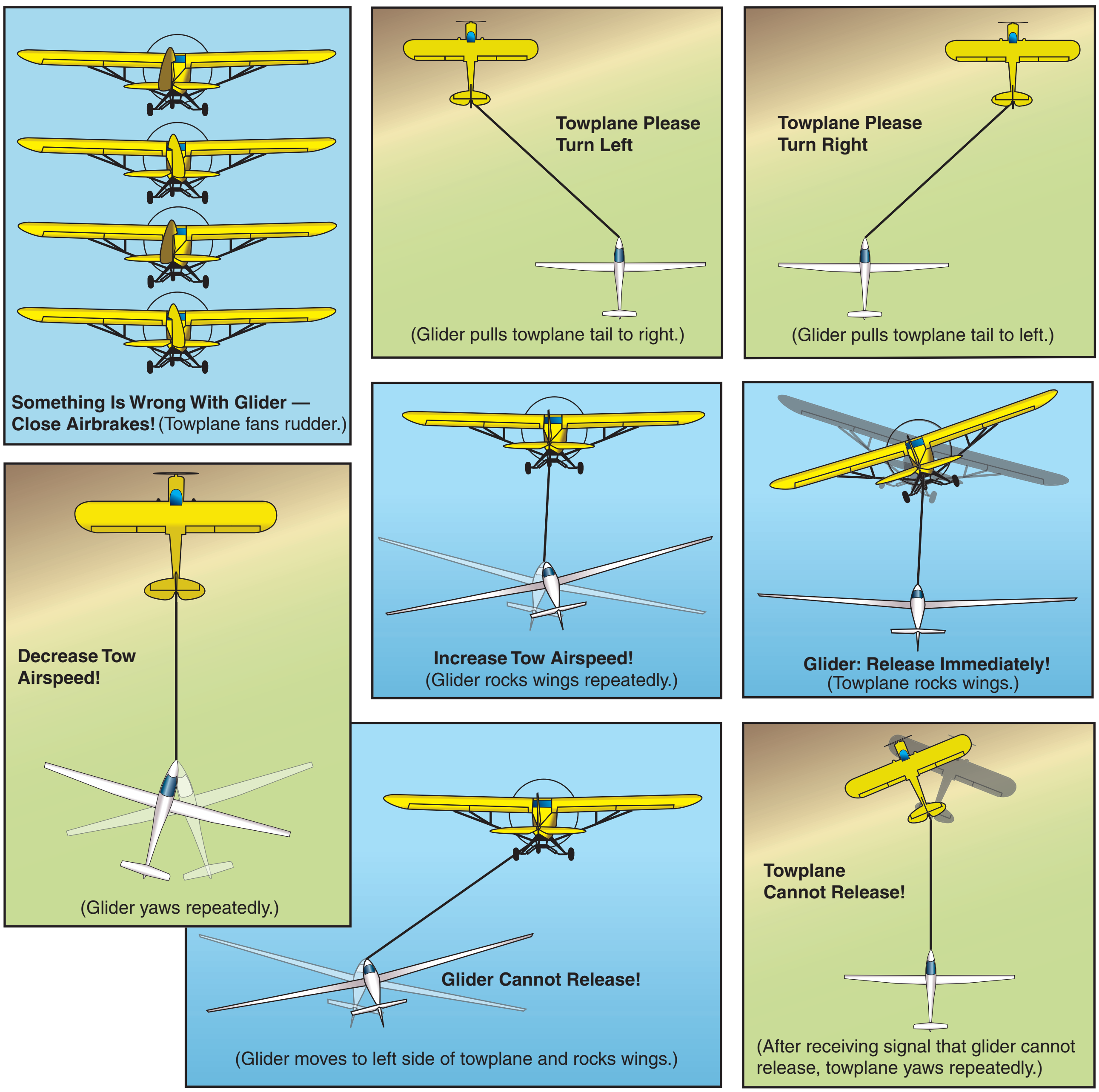


Figure 7-2. In-flight aerotow visual signals.

and both the glider and towplane are ready for takeoff, the glider pilot signals the launch crewmember to hook the towrope to the glider.

NORMAL TAKEOFFS

The hook-up should be done deliberately and correctly, and the release mechanism should be checked for proper operation. The launch crewmember applies tension to the towrope and signals the glider pilot to activate the release. The launch crewmember should verify that the release works properly and signals the glider pilot. When the towline is hooked up to the glider again, the launch crewmember repositions to the wing that is down. When the glider pilot signals "ready for takeoff" the launch crewmember clears both the takeoff and landing area, then signals the towpilot to "take up slack" in the towrope. Once the slack is out of the towrope, the launch crewmember verifies that the glider pilot is ready for takeoff, then raises the wings to a level position. With the wings raised, the launch crewmember does a final traffic pattern check and signals the towpilot to takeoff. At the same time, the glider pilot signals the towpilot by wagging the rudder back and forth, concurring with the launch crewmember's takeoff signal. The procedures may differ somewhat from site to site, so follow local convention.

As the launch begins and the glider accelerates, the launch crewmember runs alongside the glider, holding the wing level. If there is a crosswind, the launch crewmember should hold the wing down into the wind, but not in a way as to steer the glider from the wingtip.

When the glider achieves lift-off airspeed, the glider pilot eases the glider off the ground and climbs to an altitude within three to five feet of the runway surface, while the towplane continues to accelerate to lift-off speed. The glider pilot should maintain this altitude by applying forward stick pressure, as necessary, while the glider is accelerating. Once the towplane lifts off, it accelerates in ground effect to the desired climb airspeed, then the climb begins for both the glider and the towplane.

During the takeoff roll, use the rudder pedals to steer the glider. Control the bank angle of the wings with aileron. Full deflection of the flight controls may be necessary at low airspeeds, but the flight controls become more effective as airspeed increases. [Figure 7-3]

In most takeoffs, the glider achieves flying airspeed before the towplane. However, if the glider is a heavily ballasted glider, the towplane may be able to achieve liftoff airspeed before the glider. In such a situation,

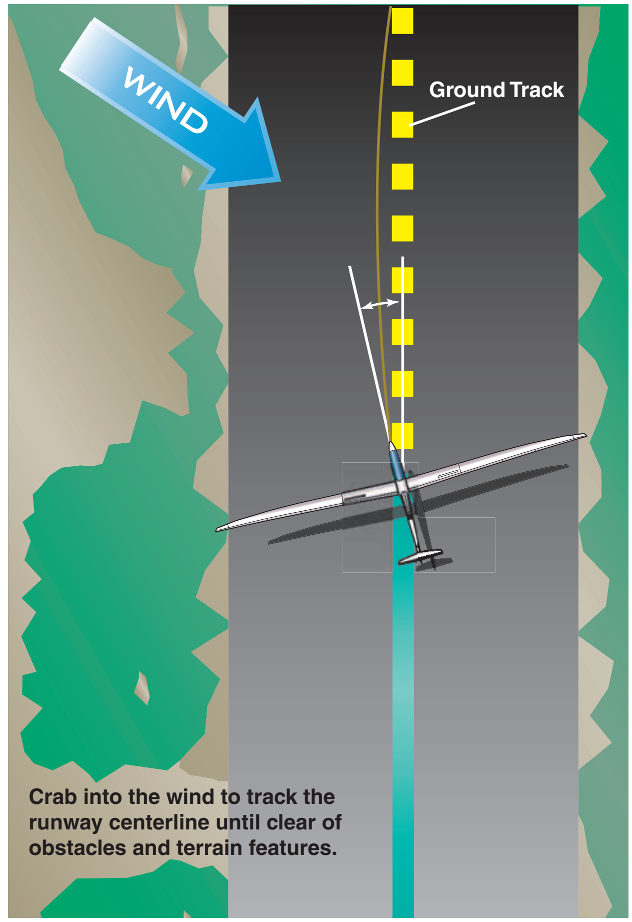


Figure 7-3. Tracking the runway centerline.

the towplane should remain in ground effect until the glider is off the ground. Climb-out must not begin until the previously agreed upon climb airspeed has been achieved.

CROSSWIND AEROTOW TAKEOFFS

Crosswind takeoff procedures are a modification of the normal takeoff procedure. The following are the main differences in crosswind takeoffs.

- The glider tends to yaw, or weathervane, into the wind any time the main wheel is touching the ground. The stronger the crosswind, the greater the tendency of the glider to turn into the wind.
- After liftoff, the glider tends to drift toward the downwind side of the runway. The stronger the crosswind, the greater the glider's tendency to drift downwind.

Prior to takeoff, the glider pilot should coordinate with the launch crewmember to hold the upwind wing slightly low during the initial takeoff roll. 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 glider is accelerating

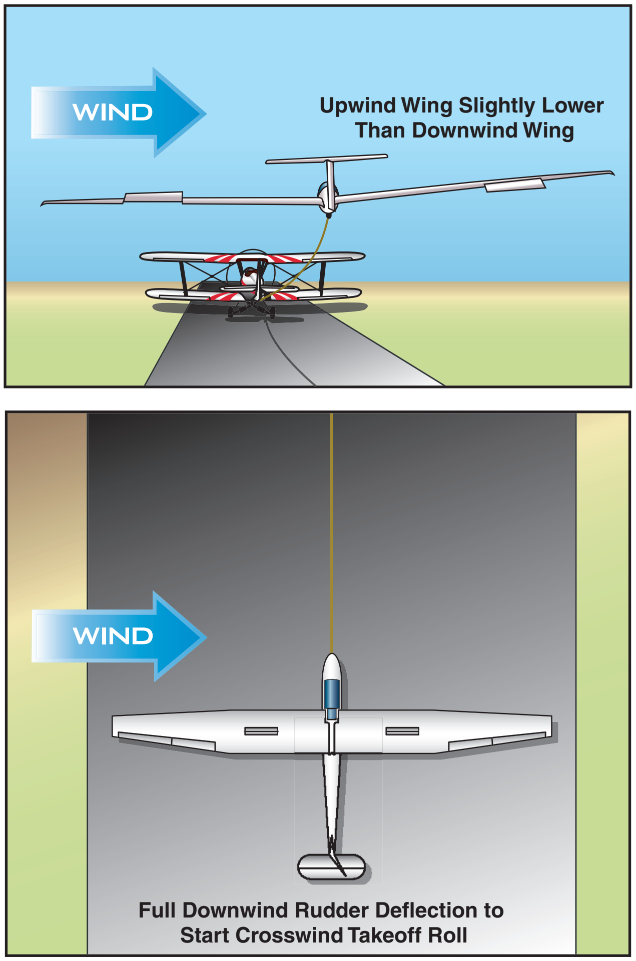


Figure 7-4. Crosswind correction or takeoff.

and until the ailerons start becoming sufficiently effective for maneuvering the glider about its longitudinal (roll) axis. With the aileron held into the wind, the takeoff path must be held straight with the rudder. This requires application of downwind rudder pressure, since the glider tends to weathervane into the wind while on the ground. [Figure 7-4]

As the forward speed of the glider increases and the crosswind becomes more of a relative headwind, the many mechanical application 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. Because the crosswind component effect does not completely dissipate, some aileron pressure must be maintained throughout the takeoff roll to prevent the crosswind from raising the upwind wing. If the upwind wing rises, exposing more surface to the crosswind, a "skipping" action may result, as indicated by a series of small bounces occurring when the glider attempts to fly and then settles back onto the runway. This side skipping imposes side loads on the landing gear. Keeping the upwind wingtip slightly lower than the downwind wingtip prevents the crosswind from getting underneath the upwind wing and lifting it. If the downwind wingtip touches the ground, the resulting friction may cause the glider to yaw in the direction of the dragging wingtip. This could lead to loss of directional control.

While on the runway throughout the takeoff, the glider pilot uses the rudder to maintain directional control and alignment behind the towplane. Yawing back and forth behind the towplane should be avoided, as this effects the ability of the towplane pilot to maintain control. If glider controllability becomes a problem, the glider pilot must release and stop the glider on the remaining runway. Remember, as the glider slows, the crosswind may cause it to weathervane into the wind.

Prior to the towplane becoming airborne and after the glider lifts off, the glider pilot should turn into the wind and establish a wind correction angle to remain behind the towplane. This is accomplished by using coordinated control inputs to turn the glider. Once the towplane becomes airborne and establishes a wind correction angle, the glider pilot repositions to align behind the towplane.

COMMON ERRORS

- Improper glider configuration for takeoff.
- Improper initial positioning of flight controls.
- Improper use of visual launch signals.
- Failure to maintain alignment behind towplane before towplane becomes airborne.
- Improper alignment with the towplane after becoming airborne.
- Climbing too high after liftoff and causing a towplane upset.

TAKEOFF EMERGENCY PROCEDURES

The most common emergency situations on takeoff develop when a towrope breaks, there is an inadvertent towrope release, or towplane loses power. There are five planning situations regarding in-motion towrope breaks, uncommanded release, or power loss of the towplane. While the best course of action depends on many variables, such as runway length, airport environment, and wind, all tow failures have one thing in common: the need to maintain control of the glider. Two possibilities are stalling the glider, or dragging a wingtip on the ground during a low altitude turn and cartwheeling the glider. [Figure 7-5]

Situation 1. If the towrope breaks or is inadvertently released prior to the towplane's liftoff, the standard procedure is for the towplane to continue the takeoff and clear the runway, or abort the takeoff and remain on the left side of the runway. If the towplane loses power during the takeoff, the towpilot should maneuver the towplane to the left side of the runway. If the glider is still on the runway, the glider pilot should pull

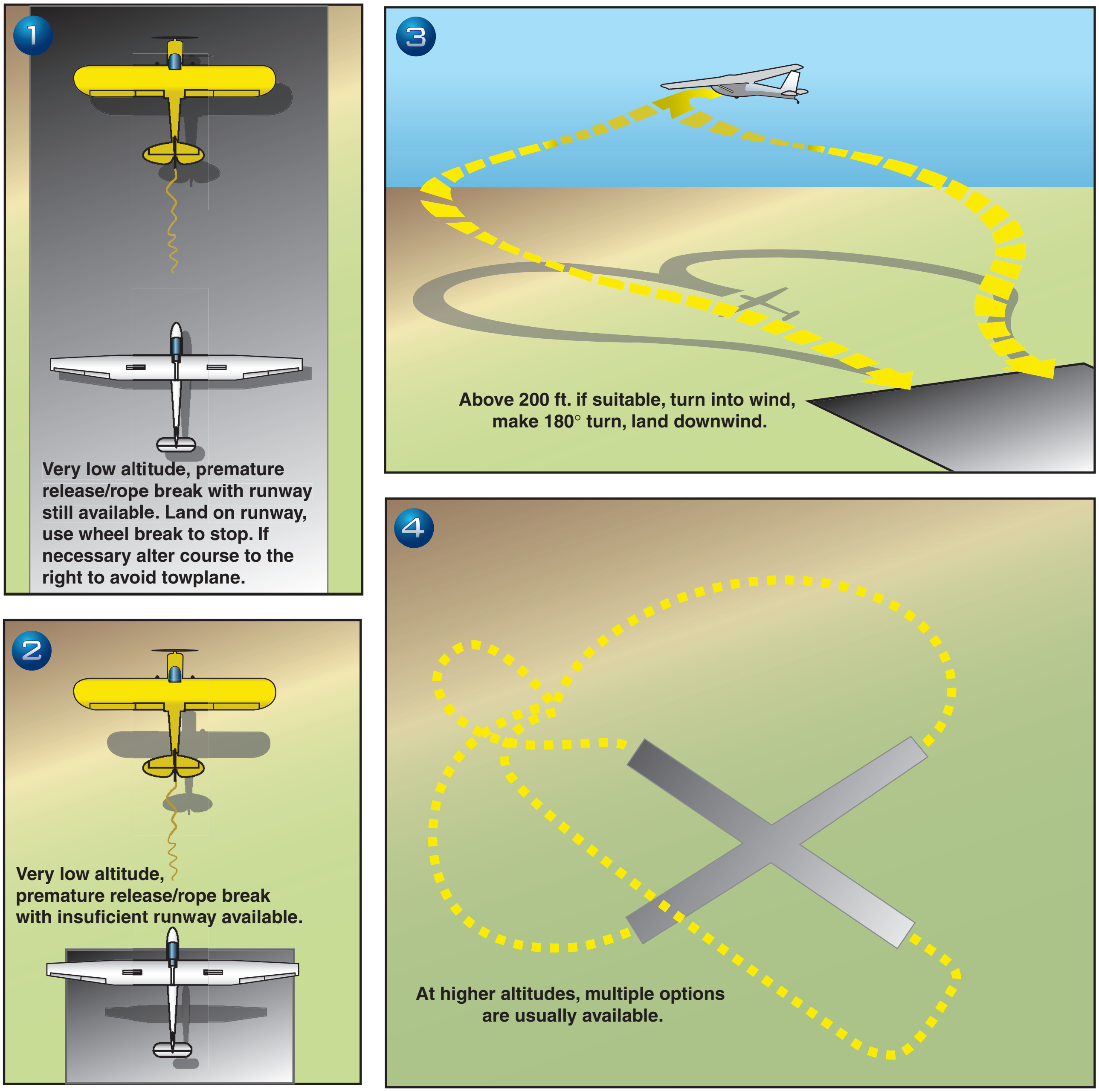


Figure 7-5. Situations for towline break, uncommanded release, or power loss of the towplane.

the release, decelerate using the wheel brake, and be prepared to maneuver to the right side of the runway. If the rope breaks, is inadvertently released, or the towplane loses power after the glider is airborne, the glider pilot should pull the towrope release, land straight ahead, and be prepared to maneuver to the right side of the runway. Pulling the towrope release in either case ensures that the rope is clear of the glider. Since local procedures vary, both the glider and towpilot must be familiar with the specific gliderport/airport procedures.

Situation 2. This situation occurs when both the towplane and glider are airborne and at a low altitude. If an inadvertent release, towrope break, or a signal to release from the towplane occurs at a point in which the glider has insufficient runway directly ahead and has insufficient altitude to make a safe turn, the best course of action is to land the glider straight ahead. After touchdown, use wheel brake, as necessary, to slow and stop as conditions permit. At low altitude, attempting to turn prior to landing is very risky because of the likelihood of dragging a wingtip on the ground and cartwheeling the glider. Slowing the glider as much as possible prior to touching down and rolling onto unknown terrain generally is the safest course of action. Low speed means low impact forces, which reduce the likelihood of injury and reduce the risk of significant damage to the glider.

Situation 3. If an inadvertent release, towrope break, or a signal to release from the towplane occurs after the towplane and glider are airborne, and the glider possesses sufficient altitude to make a 180° turn, then a downwind landing on the departure runway may be attempted.

The 180° turn and downwind landing option should be used only if the glider is within gliding distance of the airport or landing area. In ideal conditions, a minimum altitude of 200 feet above ground level is required to complete this maneuver safely. Such things as a hot day, weak towplane, strong wind, or other traffic may require a greater altitude to make a return to the airport a viable option.

The responsibility of the glider pilot is to avoid the towplane or other aircraft. If the tow was terminated because the towplane was in distress, the towpilot is also dealing with an emergency situation and may maneuver the aircraft abruptly.

After releasing from the towplane at low altitude, if the glider pilot chooses to make a 180° turn and a downwind landing, the first responsibility is to maintain flying speed. The pilot must immediately lower the nose to achieve the proper pitch attitude necessary to maintain the appropriate approach airspeed.

Make the initial turn into the wind. Use a medium bank angle to align the glider with the landing area. Using too shallow a bank angle may not allow enough time for the glider to align with the landing area. Too steep a bank angle may result in an accelerated stall. If the turn is made into the wind, only minor course corrections should be necessary to align the glider with the intended landing area. Throughout the maneuver the pilot must maintain the appropriate approach speed and proper coordination.

Downwind landings result in higher groundspeed due to the effect of tailwind. The glider pilot must maintain the appropriate approach airspeed. During the straight-in portion of the approach, spoilers/dive breaks should be used as necessary to control the descent path. Landing downwind requires a shallower than normal approach. Groundspeed will be higher during a downwind landing and especially noticeable during the flare. After touchdown, spoilers/dive breaks, and wheel brakes should be used as necessary to slow and stop the glider as quickly as possible. During the later part of the roll-out, the glider will feel unresponsive to the controls despite the fact that it is rolling along the runway at a higher than normal groundspeed. It is important to stop the glider before any loss of directional control.

Situation 4. When the emergency occurs at or above 800 feet above the ground, the glider pilot may have more time to assess the situation. Depending on gliderport/airport environment, the pilot may choose to land on a cross runway, land into the wind on the departure runway, or land on a taxiway. In some situations an off gliderport/airport landing may be safer than attempting to land on the gliderport/airport.

Situation 5. If an emergency occurs above the traffic pattern altitude, the glider pilot should maneuver away from the towplane, release the towrope if still attached, and turn toward the gliderport/airport. The glider pilot should evaluate the situation to determine if there is sufficient altitude to search for lift or if it is necessary to return to the gliderport/airport for a landing.

AEROTOW CLIMB-OUT AND RELEASE PROCEDURES

Once airborne and climbing, the glider can fly one of two tow positions. High tow is aerotow flight with the glider positioned above the wake of the towplane. Low tow is aerotow flight with the glider positioned below the wake of the towplane. [Figure 7-6] Climbing turns are made with shallow bank angles and the glider in the high tow position.

High tow is the preferred position for climbing out because the glider is above the turbulence of the towplane wake. High tow affords the glider pilot an ample view of the towplane and provides a measure of protection against fouling if the towrope breaks or is released by the towplane because the towrope falls below the glider in this position.

Low tow offers the glider pilot a better view of the towplane, but puts the glider at risk from towrope fouling if the towrope breaks or is released by the towplane. Low tow is used for cross-country and level flight aerotows.

During level flight aerotows, positioning the glider above the wake of the towplane has several disadvantages. One is that the towplane wake is nearly level rather than trailing down and back as it does during climbing aerotow operations. Because the towplane wake is nearly level, the glider must take a higher position relative to the towplane to ensure the glider stays above the wake. This higher position makes it difficult to see the towplane over the nose of the glider. Easing the stick forward to get a better view of the towplane accelerates the glider toward the towplane, causing the towrope slack. Positioning the glider beneath the wake of the towplane in level flight offers an excellent view of the towplane, but the danger of fouling from a

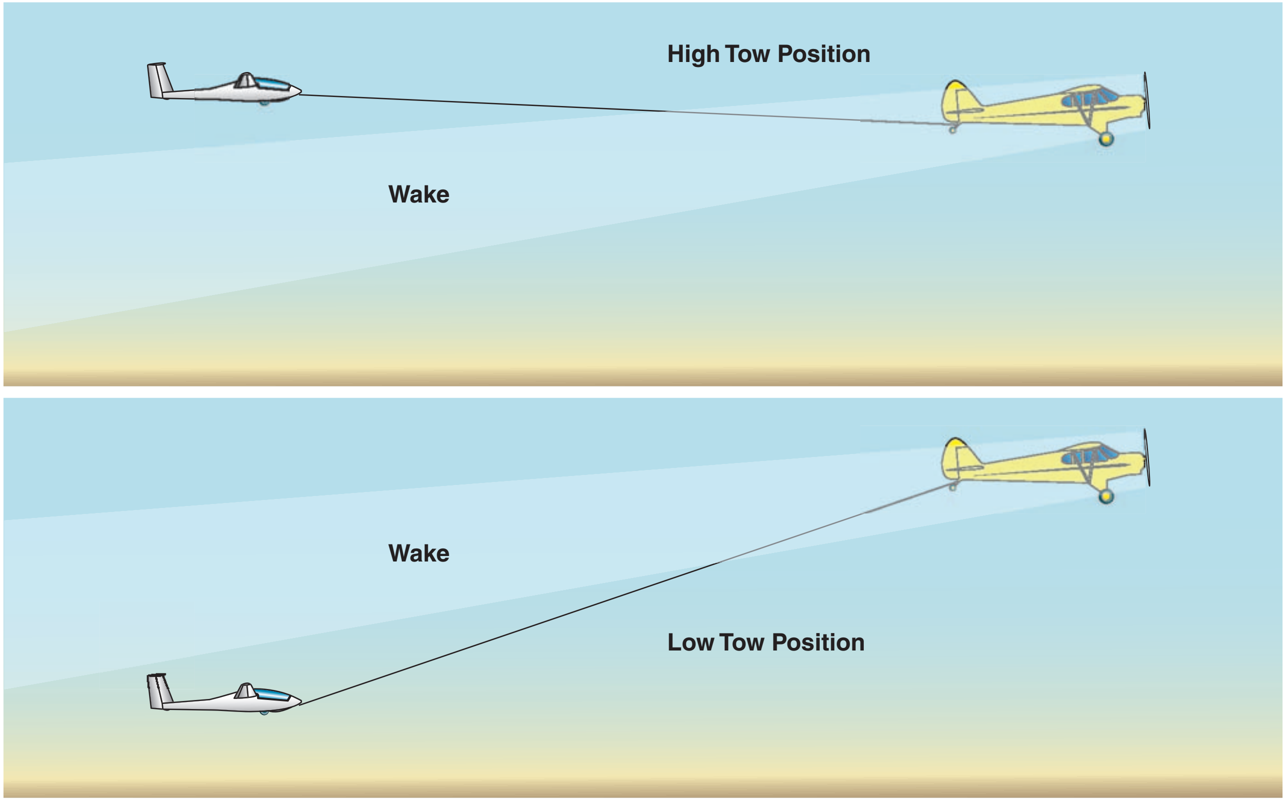


Figure 7-6. Aerotow climb-out.

towrope failure or inadvertent release is greater when flying in the low tow position. Gliders using a center of gravity (CG) tow hook during low tow position on level flight aerotows may encounter the towrope sliding up and to the side of the glider nose, causing possible damage.

Straight ahead climbs are made with the glider in the high tow position. The towpilot should maintain a steady pitch attitude and a constant power setting to maintain the desired climb airspeed. The glider pilot uses visual references on the towplane to maintain lateral and vertical position.

Climbing turns are made with shallow bank angles in the high tow position. During turns, the glider pilot observes and matches the bank angle of the towplane's wings. In order to stay in the same flight path of the towplane, the glider pilot must aim the nose of the glider at the outside wingtip of the towplane. This allows the glider's flight path to coincide with the towplane's flight path. [Figure 7-7]

If the glider's bank is steeper than the towplane's bank, the glider's turn radius is smaller than the towplane's turn radius. [Figure 7-8 on page 7-8] If this occurs, the reduced tension on the towrope causes it to bow and slack, allowing the glider's airspeed to slow. As a

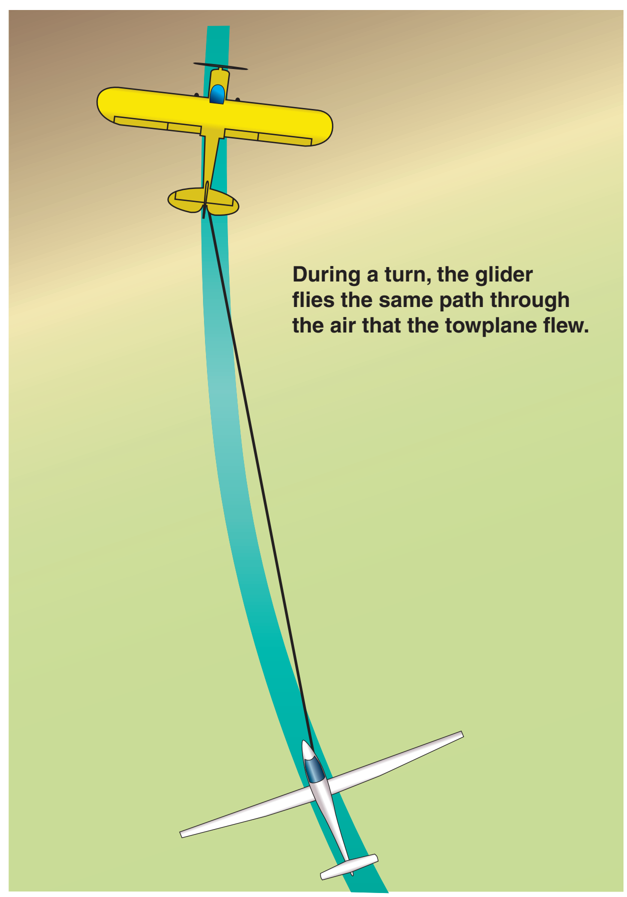


Figure 7-7. Aerotow climbing turns.

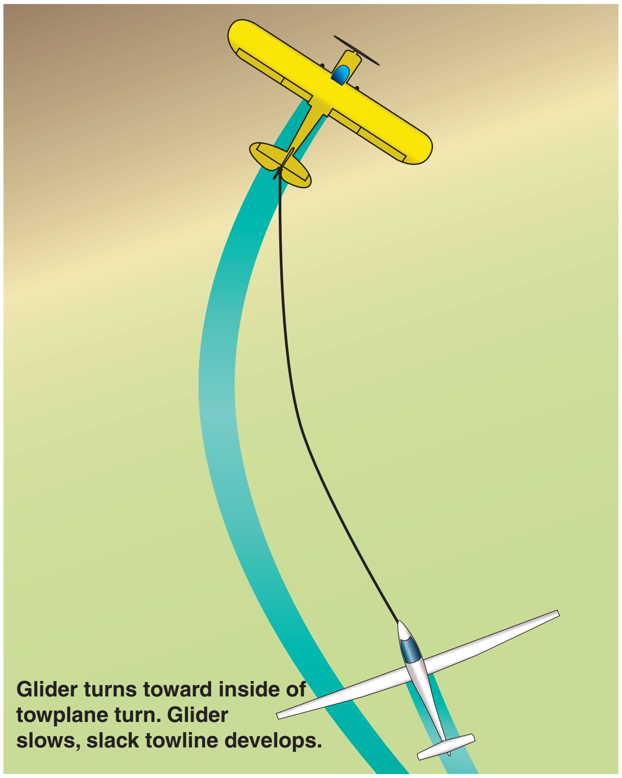


Figure 7-8. Aerotow induced slack towline by turning inside towplane.

result, the glider begins to sink, relative to the towplane. The correct course of action is to reduce the glider's bank angle so the glider flies the same radius of turn as the towplane. If timely corrective action is not taken, and if the glider slows and sinks below the towplane, the towplane may rapidly pull the towrope taut and possibly cause it to fail and/or cause structural damage to both aircraft.

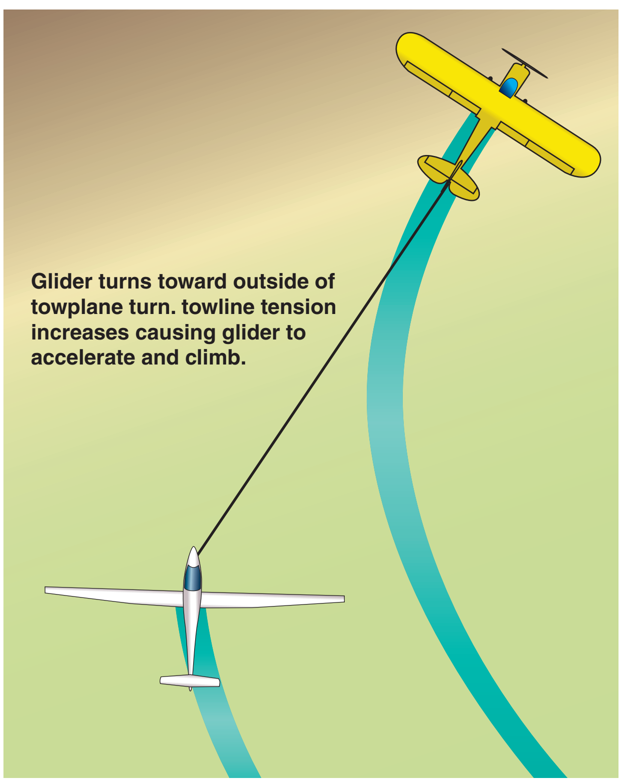


Figure 7-9. Glider bank too shallow, causing turn outside towplane turn.

If the glider's bank is shallower than the towplane, the glider's turn radius is larger than the towplane's turn radius. [Figure 7-9] If this occurs, the increased tension on the towrope causes the glider to accelerate and climb. The correct course of action to take when the glider is turning outside the towplane radius of turn is to increase the glider's bank angle, so the glider eases back into position behind the towplane and flies the same radius of turn as the towplane. If timely corrective action is not taken, and if the glider accelerates and climbs above the towplane, the towplane may lose rudder and elevator control. In this situation, the glider pilot should release the towrope and turn to avoid the towplane.

COMMON ERRORS

- Faulty procedures maintaining vertical and lateral positions during high and/or low tow.
- Inadvertent entry into towplane wake.
- Failure to maintain glider alignment during turns on aerotow.

AEROTOW RELEASE

Standard aerotow release procedures provide safety benefits for both the glider pilot and the towpilot. When the aerotow has reached a predetermined altitude, the glider pilot should clear the area for other aircraft in all directions, especially to the right. When ready to release, the glider pilot should pull the release handle, and visually confirm that towrope has released from the glider as shown in Figure 7-10, item 1. Next, bank to the right, accomplishing 90° of heading change, then level the wings and fly straight, away from the release point. [Item 2] This 90° change of heading achieves maximum separation between towplane and glider in minimum time. After confirming that the glider has released and has turned away from the towplane, the towpilot should turn left away from the release point. [Item 3] Once clear of the glider and other aircraft, the towpilot then begins a descent.

COMMON ERRORS

- Lack of proper tension on towrope.
- Failure to clear the area prior to release.
- Failure to make turn in proper direction after release.
- Release in close proximity of other aircraft.

AEROTOW ABNORMAL PROCEDURES

Mechanical equipment failure, environmental factors, and pilot errors can cause abnormal aerotow occurrences during climb-out.

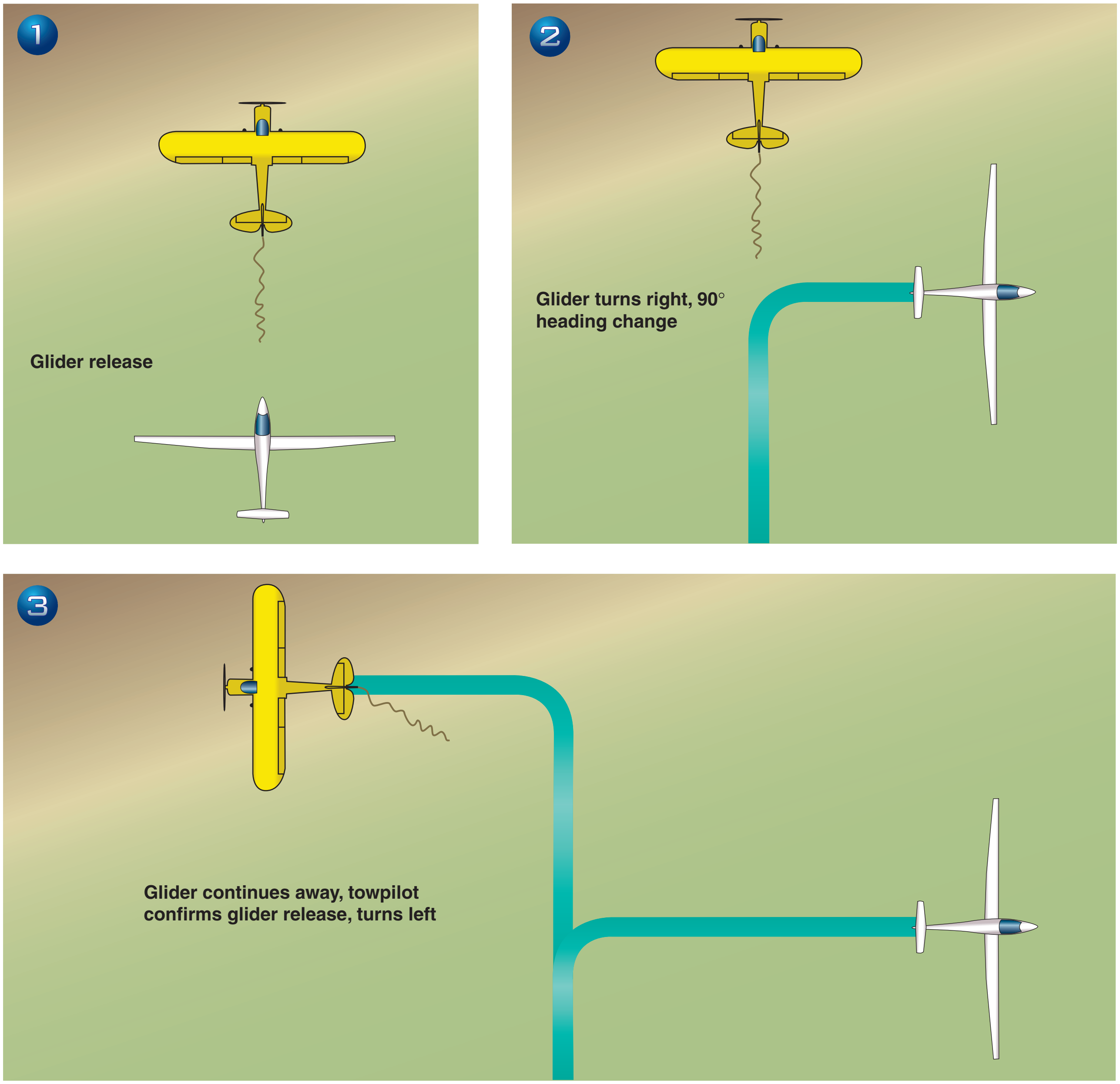


Figure 7-10. Aerotow release.

Mechanical equipment failures can be caused by towrope and towhook failures, towplane mechanical failures, and/or glider mechanical failures. Towrope failure (one that breaks unexpectedly) can result from using an under-strength or worn towrope. Towrope failures can be avoided by using appropriately rated towrope material, weak links when necessary, proper towrings, and proper towrope maintenance.

Towhook system failures include uncommanded towrope releases or the inability to release. These failures can occur in either the towplane or the glider towhook system. Proper preflight and maintenance of these systems should help to avoid these types of failures. Towplane mechanical failures can involve the powerplant and/or flight control. When the towpilot encounters a mechanical failure, he or she should signal the glider pilot to release immediately. This is one of many situations that make it vitally important that both the towpilot and glider pilot have a thorough knowledge of aerotow visual signals.

Glider mechanical failure can include towhook system malfunctions, flight control problems, and/or improper assembly or rigging. If a mechanical failure occurs, the glider pilot must assess the situation to determine the best course of action. In some situations, it may be beneficial to remain on the aerotow, while other situations may require immediate release.

If the glider release mechanism fails, the towpilot should be notified either by radio or tow signal and the glider should maintain the high tow position. The towpilot should tow the glider over the gliderport/airport and release the glider from the towplane. The towrope should fall back and below the glider. The design of the towhook mechanism is such that the rope pulls free from the glider by it's own weight. Since some gliders do not "back release," the glider pilot should pull the release to ensure the towrope is in fact released.

Failure of both the towplane and glider release mechanisms is extremely rare. If it occurs, however, radio or tow signals between the glider and towpilot should verify this situation. The glider pilot should move down to the low tow position once the descent has started to the gliderport/airport. The glider pilot needs to use spoilers/dive breaks to maintain the low tow position and to avoid over taking the towplane. The towpilot should plan the approach to avoid obstacles. The approach should be shallow enough so that the glider touches down first. The glider pilot should use the spoilers/dive breaks to stay on the runway, and use the wheel brake as necessary to avoid overtaking the towplane. Excessive use of the glider wheel break may result in the towplane landing hard.

Environmental factors include encountering clouds, mountain rotors, or restricted visibility. Any of these factors also may require the glider pilot to release from the aerotow. During the aerotow, each pilot is responsible for avoiding situations that would place the other pilot at risk. For the towplane pilot, examples of pilot error include deliberately starting the takeoff before the glider pilot has signaled the glider is ready for launch, using steep banks during the aerotow without prior consent of the glider pilot, or frivolous use of aerotow signals, such as "release immediately!" For the glider pilot, examples of pilot error include rising high above the towplane during takeoff and climb, or leaving airbrakes open during takeoff and climb.

One of the most dangerous occurrences during the aerotow is allowing the glider to rise high above and losing sight of the towplane. The tension on the towrope by the glider pulls the towplane tail up, lowering its nose. If the glider continues to rise pulling the towplane tail higher, the towpilot may not be able to raise the nose. Ultimately, the towpilot may run out of up elevator authority. Additionally, the towpilot may not be able to release the towrope from the towplane. This situation can be critical if it occurs at altitudes below 500 feet AGL. Upon losing sight of the towplane, the glider pilot must release immediately.

SLACK LINE

Slack line is a reduction of tension in the towrope. If the slack is severe enough it might entangle the glider, or cause damage to the glider or towplane. The following situations may result in a slack line.

- Abrupt power reduction by the towplane.

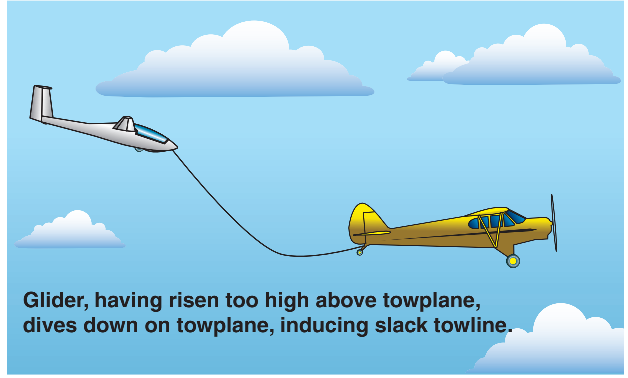


Figure 7-11. Diving on towplane.

- Aerotow descents.
- Turning the glider inside the towplane turn radius. [Figure 7-8]
- Turbulence.
- Abrupt recovery from a high tow position. [Figure 7-11]

Slack line recovery procedures should be initiated as soon as the glider pilot becomes aware of the situation. The pilot's initial action should be to yaw away from the bow in the line. In the event the yawing motion fails to reduce the slack sufficiently, careful use of spoilers/dive brakes can be used to decelerate the glider and take up the slack. When the towline tightens, stabilize the tow, then gradually resume the desired aerotow position. When the slack in the line is excessive, or beyond the pilot's capability to safely recover, the pilot should immediately release from the aerotow.

COMMON ERRORS

- Failure to take corrective action at the first indication of a slack line.
- Use of improper procedure to correct slack line, causing excessive stress on tow rope, towplane, and glider.

BOXING THE WAKE

Boxing the wake is a performance maneuver designed to demonstrate a pilot's ability to accurately maneuver the glider around the towplane's wake during aerotow. [Figure 7-12]

Boxing the wake requires flying a rectangular pattern around the towplane's wake. Before starting the maneuver, the glider should descend through the wake to the center low tow position as a signal to the towpilot that the maneuver is about to begin. The pilot uses coordinated control inputs to move the glider out to one side of the wake and holds that lower corner of the rectangle momentarily with rudder pressure. Applying back pressure to the control stick starts a vertical ascent, then rudder pressure is used to maintain equal

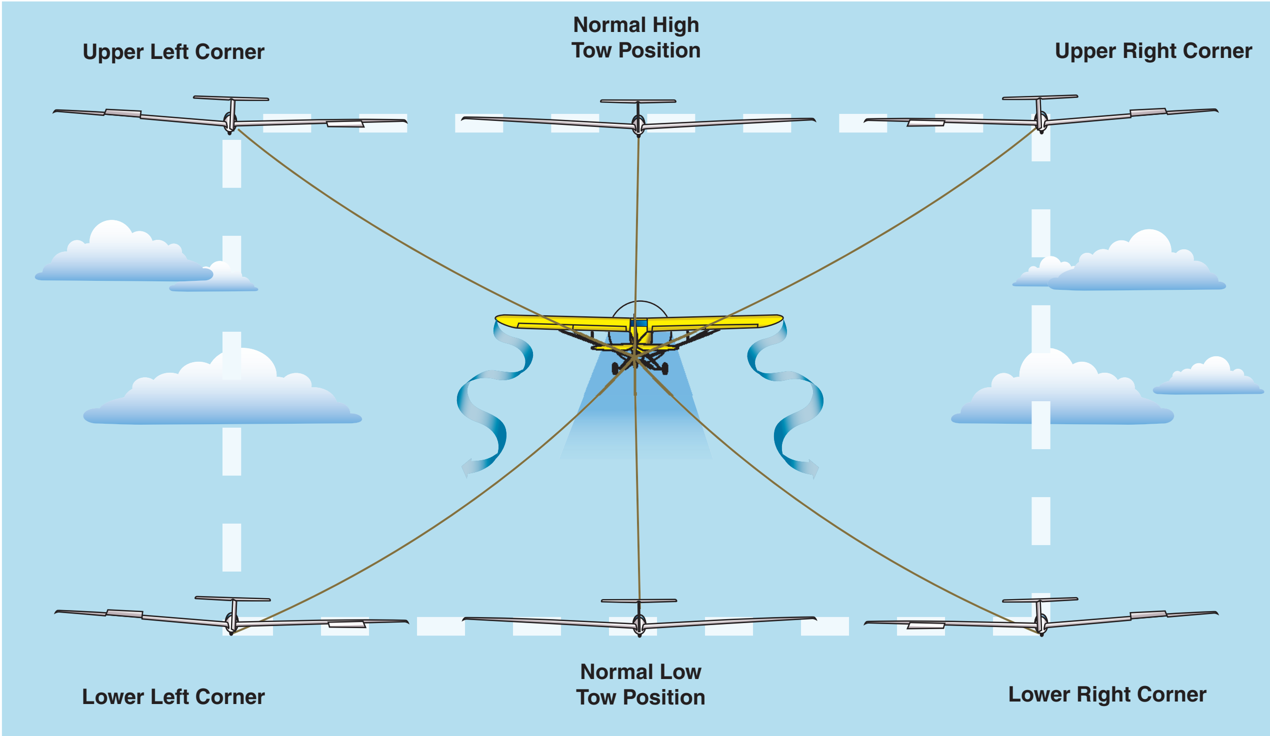


Figure 7-12. Boxing the wake.

distance from the wake. The pilot holds the wings level with the ailerons to parallel the towplane's wings. When the glider has attained high corner position, the pilot momentarily maintains this position.

As the maneuver continues, the pilot reduces the rudder pressure and uses coordinated flight controls to bank the glider to fly along the top side of the box. The glider should proceed to the opposite corner using aileron and rudder pressure, as appropriate. The pilot maintains this position momentarily with rudder pressure, then begins a vertical descent by applying forward pressure to the control stick. Rudder pressure is used to maintain glider position at an equal distance from the wake. The pilot holds the wings level with the ailerons to parallel the towplane's wings. When the glider has attained low corner position, the pilot momentarily maintains this position. The pilot releases the rudder pressure and, using coordinated flight controls, banks the glider to fly along the bottom side of the box until reaching the original center low tow position. From center low tow position, the pilot maneuvers the glider through the wake to the center high tow position, completing the maneuver.

COMMON ERRORS

- Performing an excessively large rectangle around the wake.
- Improper control coordination and procedure
- Abrupt or rapid changes of position.

If pulling the towline release handle fails to release the towline, cycle release handle and try again several times. If handle still fails to release, fly over winch/auto and allow the back release to function.

Figure 7-13. Testing the towhook.

GROUND LAUNCH TAKEOFF

When ground launching, it is essential to use a tow hook that has an automatic back-release feature. This protects the glider if the pilot is unable to release the towline during the launch. The failure of the tow release could cause the glider to be pulled to the ground as it flies over the launching vehicle or winch. Since the back-release feature of the tow hook is so important, it should be tested prior to every flight. [Figure 7-13]

GROUND LAUNCH SIGNALS

PRE-LAUNCH SIGNALS FOR GROUND LAUNCHES (WINCH/AUTOMOBILE)

Pre-launch visual signals for a ground launch operation allow the glider pilot, the glider wing runner, the safety officer, and the launch crew to communicate over considerable distances. When ground launching with an automobile, the glider and launch automobile may be 1,000 or more feet apart. When launching with a winch, at the beginning of the launch the glider may be 4,000 feet or more from the winch. Because of the great distances involved, members of the ground launch crew use colored flags or large paddles to enhance visibility as shown in Figure 7-14.

When complex information must be relayed over great distances, visual pre-launch signals can be augmented with direct voice communications between crewmember stations. Hard-wired ground telephones, two-way radios, or wireless telephones can be used to communicate between stations, adding protection against premature launch and facilitating an aborted launch if an unsafe condition arises.

IN-FLIGHT SIGNALS FOR GROUND LAUNCHES

Since ground launches are of short duration, in-flight signals for ground launches are limited to signals to the winch operator or ground vehicle driver to increase or decrease speed. [Figure 7-15]

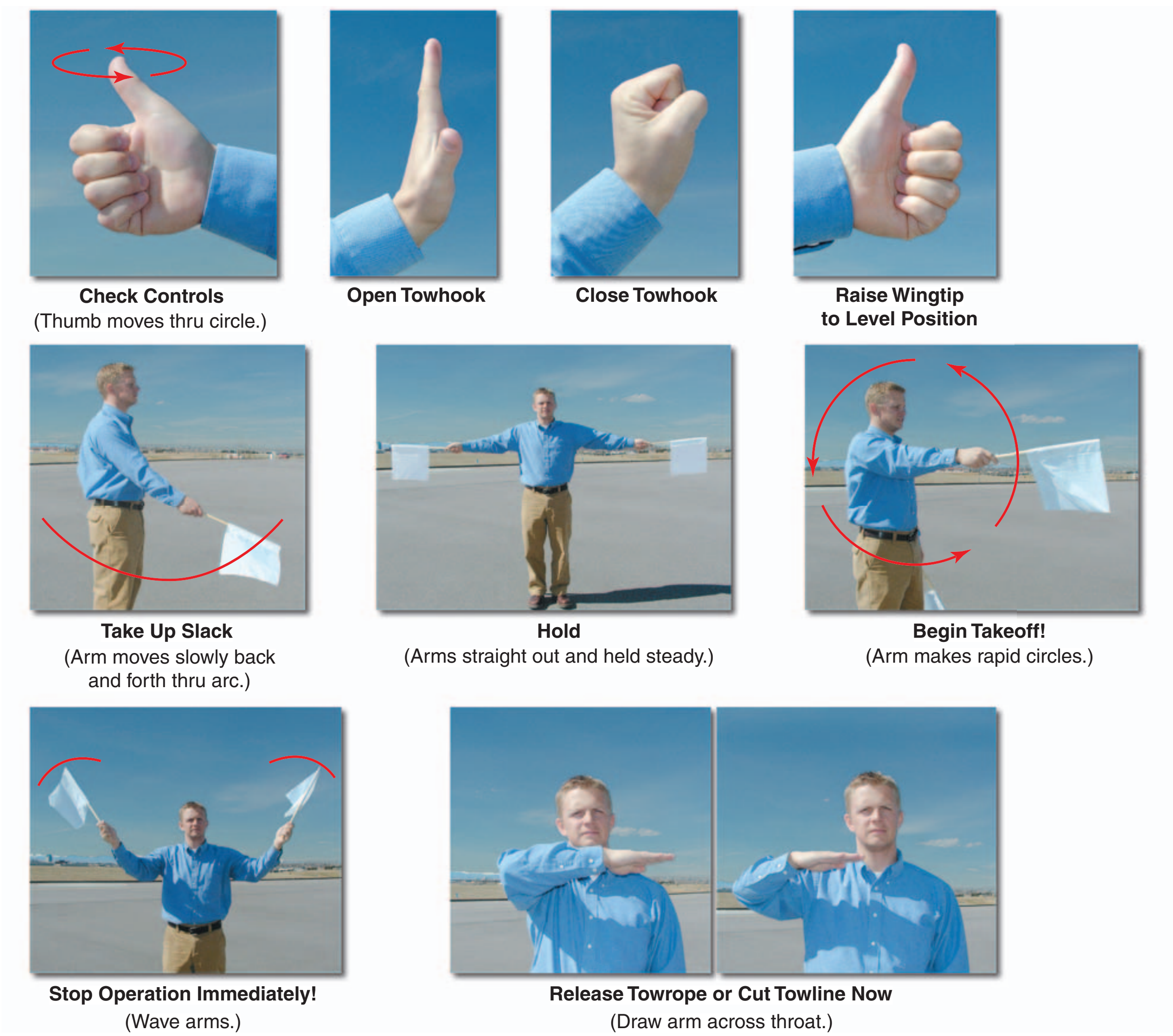


Figure 7-14. Winch and aerotow pre-launch signals.

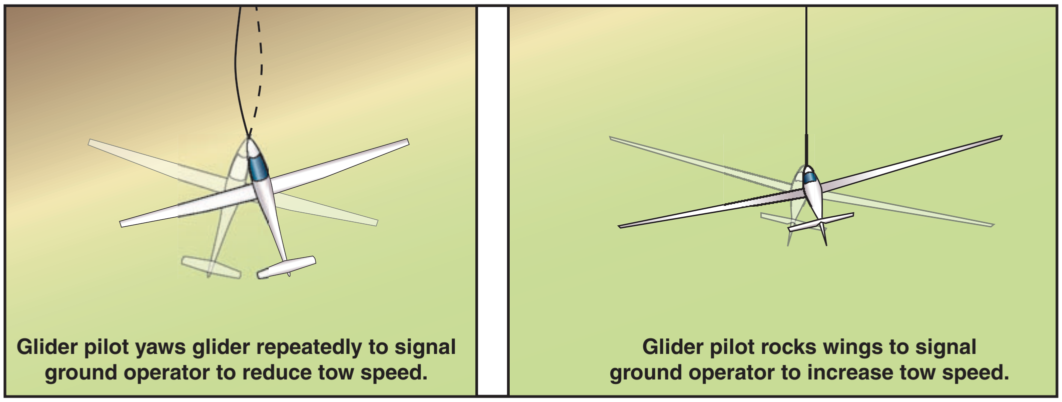


Figure 7-15. In-flight signals for ground launch.

TOW SPEEDS

Proper ground launch tow speed is critical for a safe launch. Figure 7-16 compares various takeoff profiles that result when tow speeds vary above or below the correct speed.

Each glider certified for ground launch operations has a placarded maximum ground launch tow speed. This speed is normally the same for automobile or winch launches. The glider pilot should fly the launch staying at or below this speed to prevent structural damage to the glider during the ground tow.

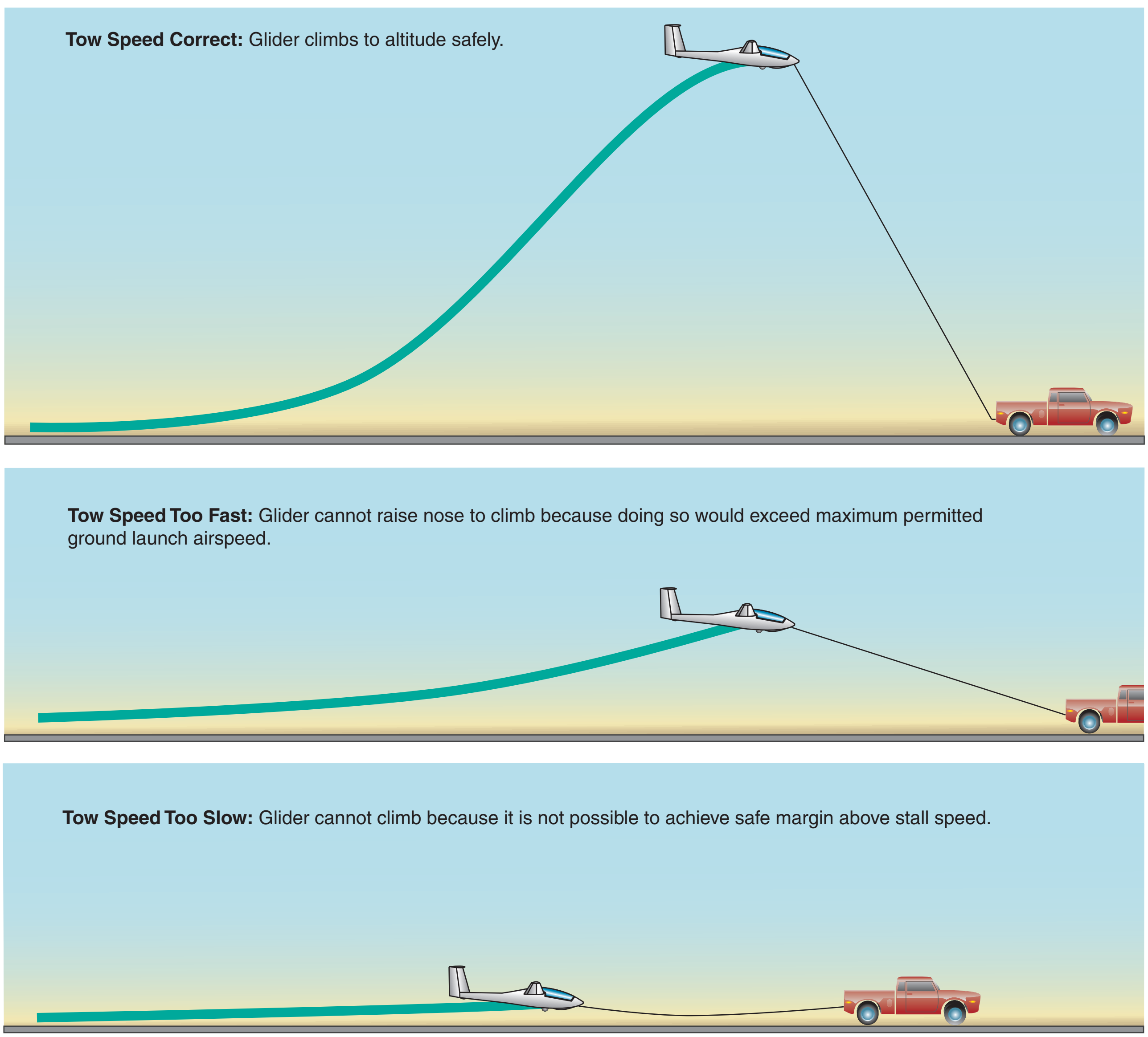


Figure 7-16. Ground launch tow speed.

AUTOMOBILE LAUNCH

During automobile ground launches, the glider pilot and driver should have a thorough understanding of what ground speeds are to be used prior to any launch. Before the first launch, the pilot and vehicle driver should determine the appropriate vehicle ground tow speeds considering the surface wind velocity, the glider speed increase during launch, and the wind gradient encountered during the climb. They should include a safety factor so as not to exceed this maximum vehicle ground tow speed.

The tow speed can be determined by using the following calculations.

1. Subtract the surface winds from the maximum placarded ground launch tow speed for the particular glider.
2. Subtract an additional five miles per hour for the airspeed increase during the climb.
3. Subtract the estimated wind gradient increase encountered during the climb.
4. Subtract a 5 MPH safety factor.

Maximum ground launch speed	**75 MPH**
1. Surface winds 10 MPH	**65 MPH**
2. Airspeed increase during climb 5 MPH	**60 MPH**
3. Estimated climb wind gradient 5 MPH	**55 MPH**
4. Safety factor of 5 MPH	**50 MPH**
Automobile tow speed	**50 MPH**

During winch launches, the winch operator applies full power smoothly and rapidly until the glider reaches an angle of 30° above the horizon. At this point, the operator should start to reduce the power until the glider is about 60° above the horizon where only about 20 percent of the power is needed. As the glider reaches the 70° point above the horizon, the power is reduced to idle. The winch operator monitors the glider continuously during the climb for any signals to increase or decrease speed from the glider pilot. [Figure 7-17]

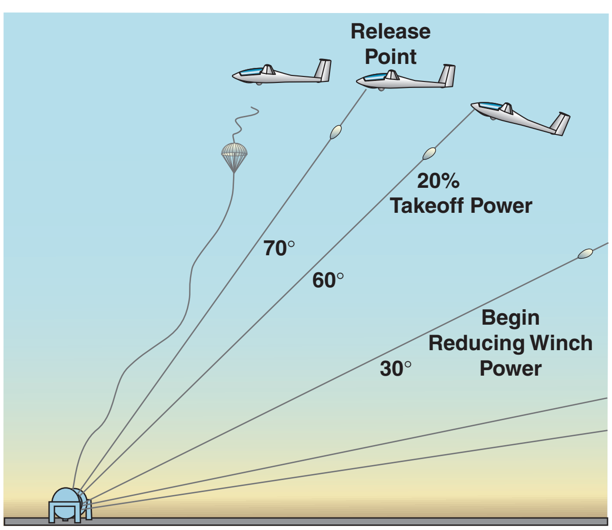


Figure 7-17. Winch procedures.

NORMAL INTO-THE-WIND GROUND LAUNCH

Normal takeoffs are made into the wind. Prior to launch, the glider pilot, ground crew, and launch equipment operator must be familiar with the launch signals and procedures. When the required checklists for the glider and ground launch equipment have been completed and the glider pilot, ground crew, and launch equipment operator are ready for takeoff, the glider pilot should signal the ground crewmember to hook the towline to the glider. The hook-up must be done deliberately and correctly. The release mechanism should be checked for proper operation. To accomplish this, the ground crewmember should apply tension to the towrope and signal the glider pilot to activate the release. The ground crewmember should verify that the release has worked properly and signal the glider pilot. When the towline is hooked up to the glider again, the ground crewmember takes a position at the wingtip of the down wing. When the glider pilot signals "ready for takeoff," the ground crewmember clears both the takeoff and landing area. When the ground crewmember has assured the traffic pattern is clear, the ground crewmember then signals the launch equipment operator to "take up slack" in the towline. Once the slack is out of the towline, the ground crewmember again verifies that the glider pilot is ready for takeoff. Then ground crewmember raises the wings to a level position, does a final traffic pattern check, and signals to the launch equipment operator to begin the takeoff.

***NOTE**: The glider pilot should be prepared for a takeoff anytime the towline is attached to the glider.*

The length, elasticity, and mass of the towline used for ground launching has several effects on the glider being launched. First, it is difficult or impossible to prevent the glider from moving forward as the long towline is tautened. Elasticity in the towline causes the glider to creep forward as the towline is tightened. For this reason, the towline is left with a small amount of slack prior to beginning the launch. It is important for the pilot to be prepared for the launch prior to giving the launch signal. If the launch is begun before the pilot gives the launch signal, the glider pilot should pull the towline release handle promptly. In the first several seconds of the launch, the glider pilot should hold the stick forward to avoid kiting.

During the launch, the glider pilot tracks down the runway centerline and monitors the airspeed. (Figure 7-18, item 1) When the glider accelerates and attains liftoff

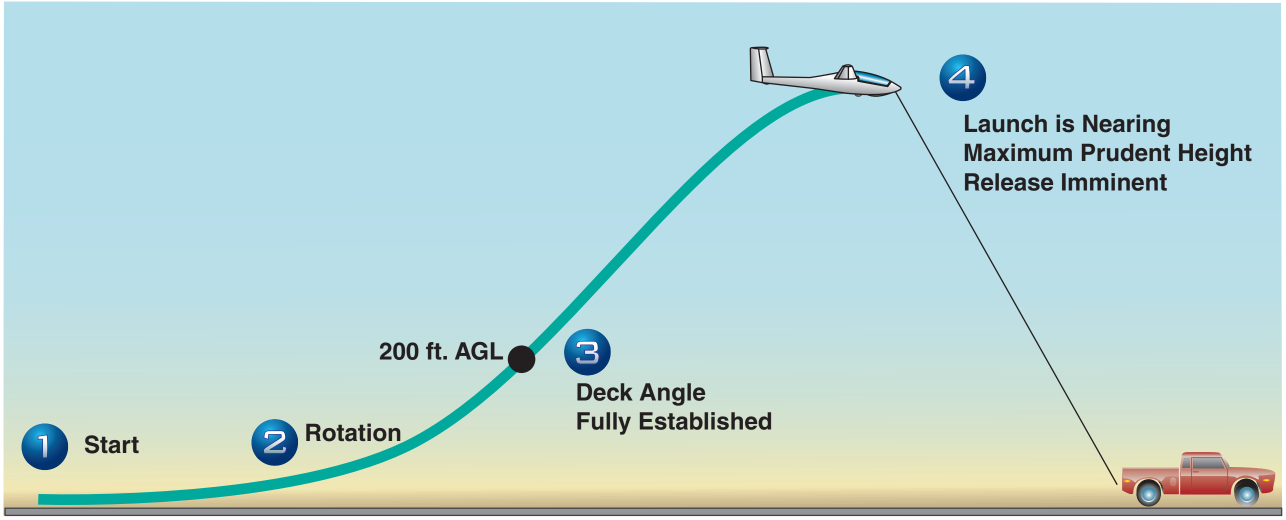


Figure 7-18. Ground launch takeoff profile.

speed the glider pilot eases the glider off the ground. The time interval from standing start to liftoff may be as short as three to five seconds. After the initial liftoff, the pilot should smoothly raise the nose to the proper pitch attitude, watching for an increase in airpseed. If the nose is raised too soon, or too steeply, the pitch attitude will be excessive while the glider is still at low altitude. If the towline breaks or the launching mechanism loses power, recovery from such a high pitch attitude may be difficult or impossible. Conversely, if the nose is raised too slowly, the glider may gain excessive airspeed, and may exceed the maximum ground launch tow speed. The shallow climb may result in the glider not attaining planned release altitude. If this situation occurs, the pilot should pull the release, and land straight ahead, avoiding obstacles and equipment.

As the launch progresses, the pilot should ease the nose up gradually (item 2), while monitoring the airspeed to ensure that it is adequate for launch but does not exceed the maximum permitted ground launch tow airspeed. When optimum pitch attitude for climb is attained (item 3), the glider should be approximately 200 feet above ground level. The pilot must monitor the airspeed during this phase of the climb-out to ensure the airspeed is adequate to provide a safe margin above stall speed but below the maximum ground launch airspeed. If the towline breaks or if the launching mechanism loses power at or above this altitude, the pilot will have sufficient altitude to release the towline and lower the nose from the climb attitude to the approach attitude that provides an appropriate airspeed for landing straight ahead.

As the glider nears its maximum altitude (item 4), it begins to level off above the launch winch or tow vehicle, and the rate of climb decreases. In this final phase of the ground launch, the towline is pulling steeply down on the glider. The pilot should gently lower the nose of the glider to reduce tension on the towline, and then pull the towline release two or three times to ensure the towline has released. The pilot will feel the release of the towline as it departs the glider. The pilot should enter a turn to visually confirm the fall of the towline. If only a portion of the towline is seen falling to the ground, it is possible that the towline is broken and a portion of the towline is still attached to the glider.

If pulling the tow release handle fails to release the towline, the back-release mechanism of the towhook automatically releases the towline as the glider overtakes and passes the launch vehicle or winch.

CROSSWIND TAKEOFF AND CLIMB—GROUND LAUNCH

The following are the main differences between crosswind takeoffs and climb procedures and normal takeoff and climb procedures.

- During the takeoff roll, the weathervaning tendency, although present, is much less due to the rapid acceleration to liftoff airspeed.
- After liftoff, the glider tends to drift toward the downwind side of the runway. The stronger the crosswind, the greater the glider's tendency to drift downwind.

After liftoff, the glider pilot should establish a wind correction angle toward the upwind side of the runway to prevent drifting downwind. This prevents downwind drift and allows the glider to work upwind of the runway during the climb-out. When the towline is released at the top of the climb, it will tend to drift back toward the centerline of the launch runway, as shown in Figure 7-19 on the next page. This helps keep the towline from fouling nearby wires, poles, fences, aircraft,

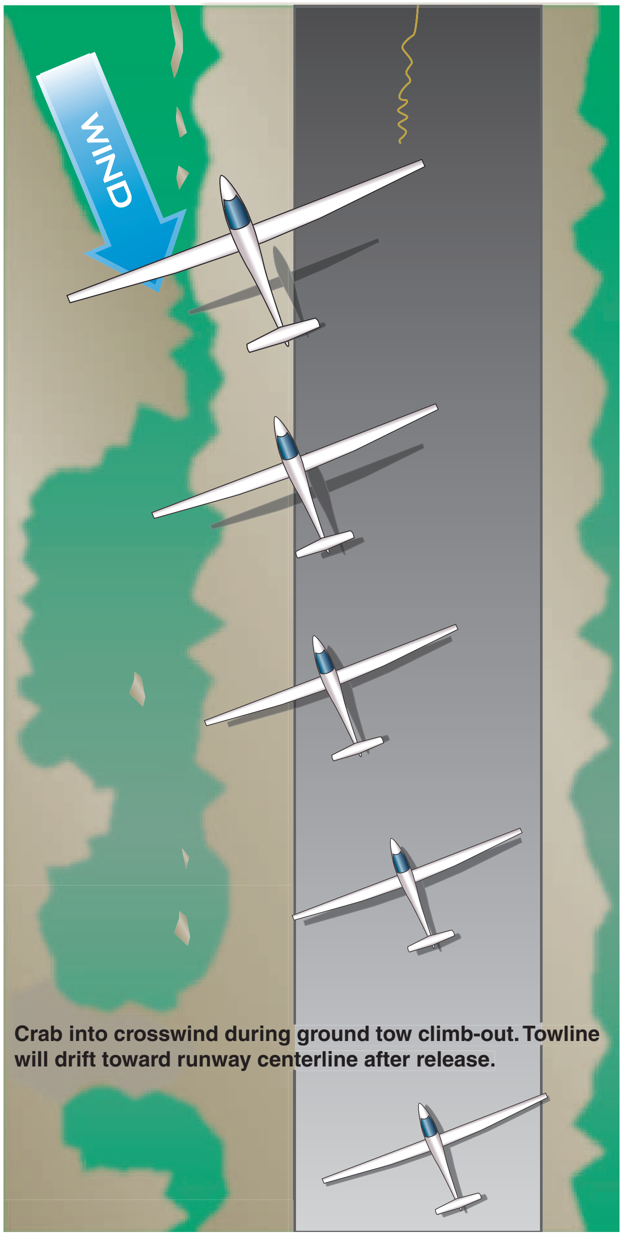


Figure 7-19. Ground launch crosswind drift correction.

and other obstacles on the side of the launching runway. Should the glider drift to the downwind side of the runway, the towline may damage items, such as other aircraft, runway lights, nearby fences, structures, and obstacles.

GROUND TOW LAUNCH— CLIMB-OUT AND RELEASE PROCEDURES

The pitch attitude/airspeed relationship during ground launch is unique. During the launch, pulling back on the stick tends to increase airspeed, and pushing forward tends to reduce airspeed. This is opposite of the normal pitch/airspeed relationship. The wings of the glider divert the towing force of the launch vehicle in an upward direction, enabling rapid climb. The greater the diversion from horizontal pulling power to vertical lifting power, the faster the airspeed. This is true, provided the tow vehicle is powerful enough to meet the energy demands the glider is making on the launch system.

COMMON ERRORS

- Improper glider configuration for takeoff.
- Improper initial positioning of flight controls.
- Improper use of visual launch signals.
- Improper crosswind procedure.
- Improper climb profile.
- Faulty corrective action for adjustment of air speed and porpoising.
- Exceeding maximum launch airspeed.
- Improper towline release procedure.

ABNORMAL PROCEDURES, GROUND LAUNCH

The launch equipment operator manages ground launch towline speed. Because the launch equipment operator is remote from the glider, it is not uncommon for initial tow speed to be too fast or too slow. If the towline speed is too fast, the glider will not be able to climb very high because of excessive airspeed. If the towline speed is too slow, the glider may be incapable of liftoff, possibly stall after becoming airborne or once airborne be incapable of further climb. The pilot should use appropriate signals to direct the launch operator to increase or decrease speed. The pilot must anticipate and be prepared to deal with these situations. In the event these abnormal situations develop, the pilot's only alternative may be to release the towline and land straight ahead.

Wind gradient (a sudden increase in wind speed with height) can have a noticeable effect on ground launches. If the wind gradient is significant or sudden, or both, and the pilot maintains the same pitch attitude the indicated airspeed will increase, possibly exceeding the maximum ground launch tow speed. The pilot must adjust the airspeed to deal with the effect of the gradient. When encountering a wind gradient the pilot should push forward on the stick to reduce the indicated airspeed. [Figure 7-20] The only way for the glider to resume climb without exceeding the maximum ground launch airspeed is for the pilot to signal the launch operator to reduce tow speed. After the reduction of the towing speed, the pilot can resume normal climb. If the tow speed is not reduced, the glider may be incapable of climbing to safe altitude.

Ground launch may be interrupted by a ground launch mechanism malfunction. A gradual deceleration in rate of climb and/or airspeed may be an indication of such a malfunction. If you suspect a launch mechanism malfunction, release and land straight ahead.

EMERGENCY PROCEDURES— GROUND LAUNCH

The most common type of problem is a broken towline. [Figure 7-21] When there is a towline failure, the

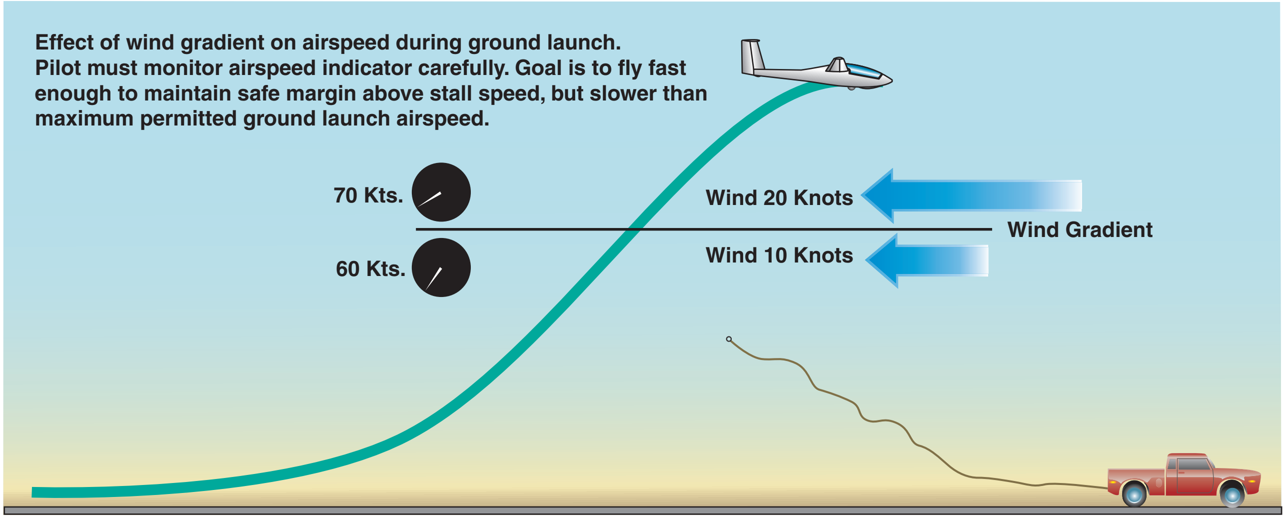


Figure 7-20. Ground launch wind gradient.

glider pilot must pull the release handle and immediately lower the nose of the glider to achieve and maintain a safe airspeed. The distinguishing features of the ground launch are nose-high pitch attitude and a relatively low altitude for a significant portion of the launch and climb. If a towline break occurs and the glider pilot fails to respond promptly, the nose-high attitude of the glider may result in a stall. Altitude may be insufficient for recovery unless the pilot recognizes and responds to the towline break by lowering the nose.

If the glider tow release mechanism fails, the pilot should fly at an airspeed no slower than best lift/drag (L/D) airspeed over and away from the ground launch

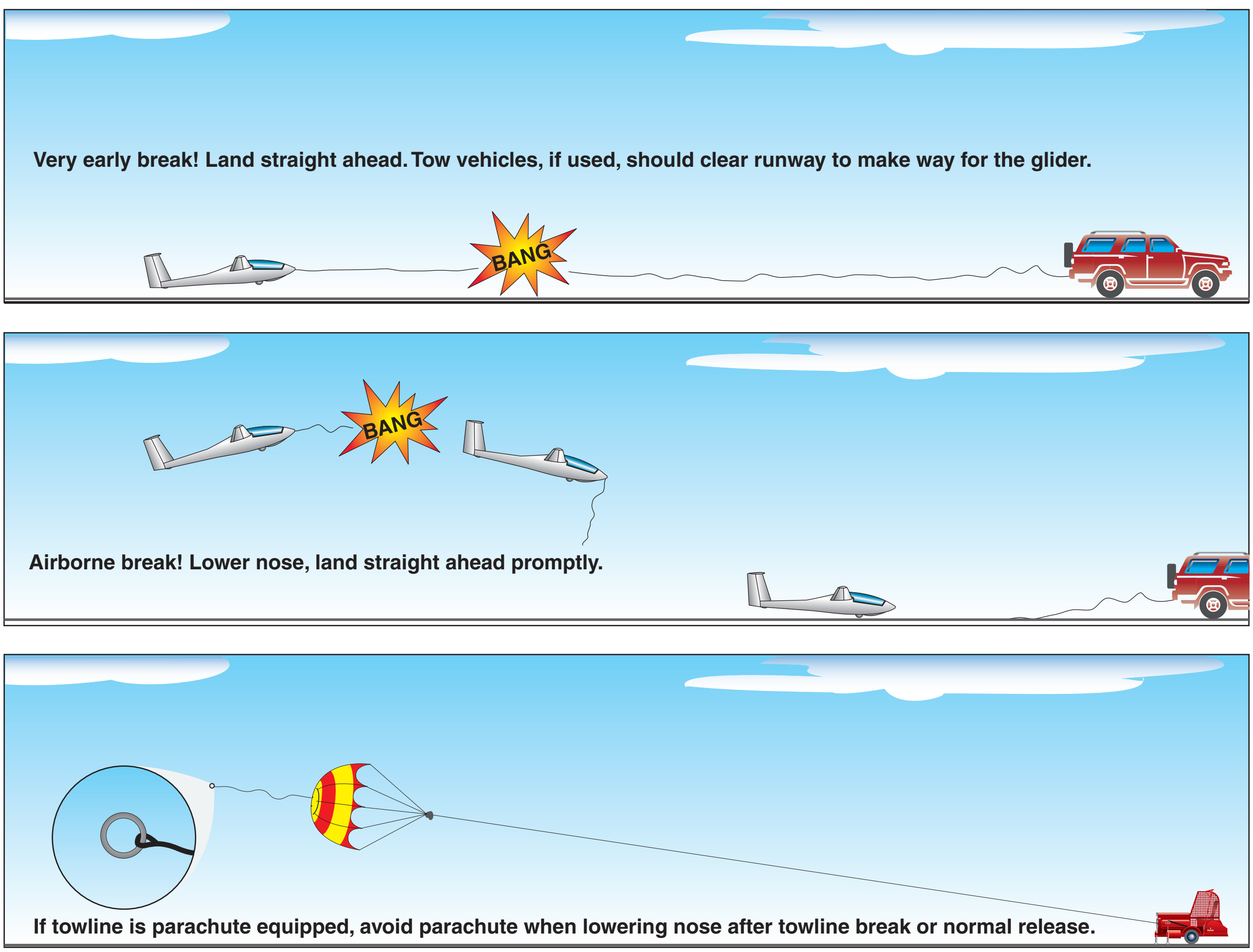


Figure 7-21. Ground launch towline break.

equipment, allowing the back release to activate or the weak link to fail. The ground launch equipment is also equipped with an emergency release mechanism in the event the glider tow release fails. If a winch is used, it will be equipped with a guillotine to cut the towline. An automobile used for ground launch is normally equipped with some form of backup release mechanism.

SELF-LAUNCH TAKEOFF PROCEDURES

PREPARATION AND ENGINE START

The self-launching glider has many more systems than a non-motorized glider, so the preflight inspection is more complex. A positive control check is just as critical as it is in any other glider. Ailerons, elevator, rudder, elevator trim tab, flaps, and spoiler/dive breaks must all be checked. In addition, numerous other systems must be inspected and readied for flight. These include the fuel system, the electrical system, the engine, the propeller, the cooling system, and any mechanisms and controls associated with extending or retracting the engine or propulsion system. Instruments, gauges, and all engine and propulsion system controls must be inspected for proper operation.

After preflighting the self-launching glider and clearing the area, start the engine in accordance with the manufacturer's instructions. Typical items on a self-launching glider engine-start checklist include fuel mixture control, fuel tank selection, fuel pump switch, engine priming, propeller pitch setting, cowl flap setting (if cowl flaps are fitted), throttle setting, magneto or ignition switch setting, and electric starter activation. After starting the oil pressure, oil temp, alternator/generator charging, and suction instruments should be checked. If the engine and propulsion systems are operating within normal limits, taxi operations can begin.

COMMON ERRORS

- Failure to use or improper use of checklist.
- Improper or unsafe starting procedures.
- Excessively high RPM after starting.
- Failure to ensure proper clearance of propeller.

TAXIING THE SELF-LAUNCHING GLIDER

Self-launching gliders are designed with a variety of landing gear configurations. These include tricycle-landing gear and tailwheel-landing gear. Other types of self-launch gliders rest primarily on the main landing gear wheel in the center of the fuselage and depend on outrigger wheels or skids to prevent the wingtips from contacting the ground. These types of gliders often feature a retractable powerplant for drag reduction. After the launch, the powerplant is retracted into the fuselage and stowed.

Due to the long wingspan and low wingtip ground clearance, many airport taxiways, and some runways, may not be wide enough to accommodate a self-launch glider. Additionally, limited crosswind capability may lead to directional control difficulties during taxi operations.

Taxiing on soft ground requires additional power. Self-launch gliders with outrigger wingtip wheels may lose directional control if a wingtip wheel bogs down. Well-briefed wing walkers should hold the wings level during low-speed taxi operations on soft ground.

COMMON ERRORS

- Improper use of brakes.
- Failure to comply with airport markings, signals, and clearances.
- Taxiing too fast for conditions.
- Improper control positioning for wind. conditions.
- Failure to consider wingspan and space required to maneuver during taxiing.

BEFORE TAKEOFF CHECK— SELF-LAUNCHING GLIDER

The manufacturer provides a takeoff checklist. As shown in Figure 7-22, the complexity of many self-launching gliders makes a written takeoff checklist an essential safety item. Before takeoff items on a self-launch glider may include fuel quantity check, fuel pressure check, oil temperature check, oil pressure check, engine run-up, throttle/RPM check, propeller pitch setting, cowl flap setting, and vacuum check. In addition, other items also must be completed. These include making sure seat belts and shoulder harnesses are latched or secured, doors and windows are closed and locked, canopies are closed and locked, airbrakes are closed and locked, altimeter is set, VHF radio transceiver is set, and the directional gyros is set.

COMMON ERRORS

- Improper positioning of the self-launch glider for run-up.
- Failure to use or improper use of checklist.
- Improper check of flight controls.
- Failure to review takeoff emergency procedures.

NORMAL TAKEOFF— SELF-LAUNCHING GLIDER

When the before takeoff checklist is complete, the pilot should check for traffic and prepare for takeoff. If operating from an airport with an operating control tower, request and receive an ATC clearance prior to

Figure 7-22. Self-launch glider instrument panels.

taxi. The pilot should make a final check for conflicting traffic, then taxi out on to the active runway and align the glider with the centerline.

The pilot should smoothly apply full throttle and begin the takeoff roll, tracking down the centerline of the runway, easing the self-launch glider off the runway at the recommended lift-off airspeed, and allowing the glider to accelerate in ground effect until reaching the appropriate climb airspeed. If the runway has an obstacle ahead, this will be best angle of climb airspeed (Vx) until the obstacle is cleared. If no obstacle is present, the preferred airspeed will be either best rate of climb airspeed (Vy), or the airspeed for best engine cooling during climb. The pilot should monitor the engine and instrument systems during climb out. If the self-launch glider has a time limitation on full throttle operation, the throttle should be adjusted as necessary during the climb.

CROSSWIND TAKEOFF—SELF-LAUNCHING GLIDER

The long wingspan and low wingtip clearance of the typical self-launch glider makes it vulnerable to wing tip strikes on runway border markers, light stanchions, and other obstacles along the edge of the runway. The takeoff roll should be started with upwind aileron and downwind rudder. In a right crosswind, for example, the control stick should be held to the right and the rudder held to the left. The aileron input keeps the crosswind from lifting the upwind wing, and the downwind rudder minimizes the weathervaning tendency of the self-launch glider in a crosswind. As airspeed increases, control effectiveness will improve, and the pilot can gradually decrease some of the control. The self-launch glider should be lifted off at the appropriate lift-off airspeed, and accelerate to climb airspeed. During the climb, a wind correction angle should be established so that the self-launch glider will track the extended centerline of the takeoff runway. [Figure 7-23]

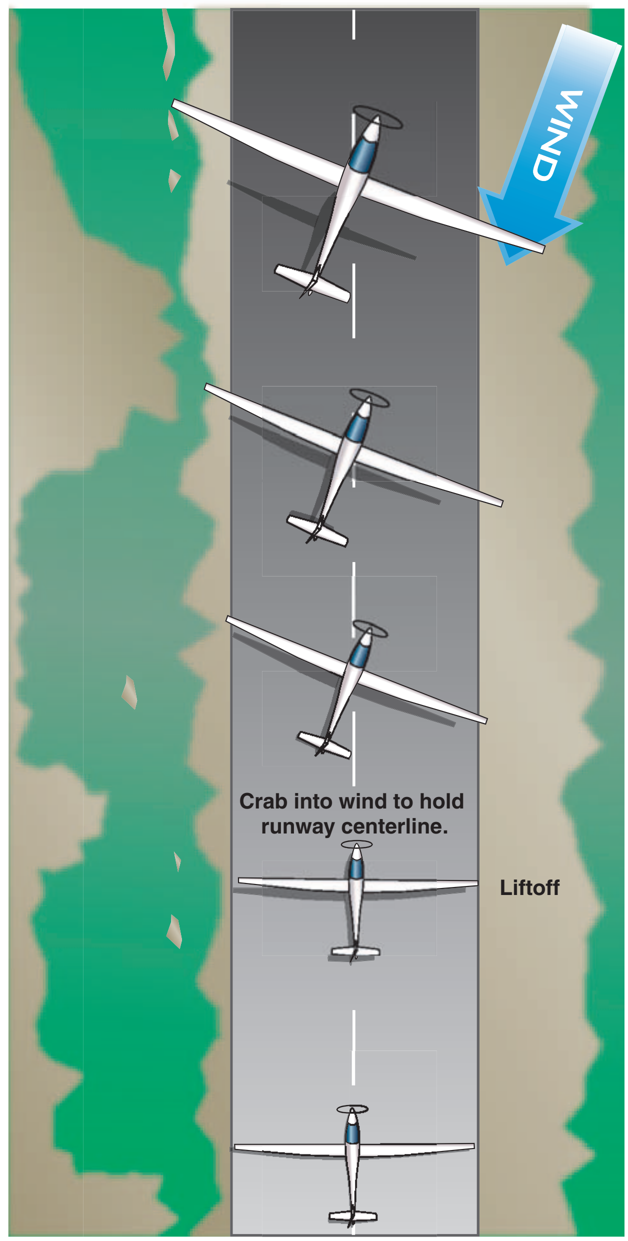


Figure 7-23. Self-launch glider—crosswind takeoff.

COMMON ERRORS

- Improper initial positioning of flight controls.
- Improper power application.
- Inappropriate removal of hand from throttle.
- Poor directional control.
- Improper use of flight controls.
- Improper pitch attitude during takeoff.
- Failure to establish and maintain proper climb attitude and airspeed.
- Improper crosswind control technique.

SELF-LAUNCH—CLIMB-OUT AND SHUTDOWN PROCEDURES

Self-launch gliders have powerplant limitations, as well as aircraft performance and handling limitations. Powerplant limits include temperature limits, maximum RPM limit, maximum manifold pressure limit, useable fuel limit, and similar items. The Glider Flight Manual (GFM) or Pilot's Operating Handbook (POH) provides useful information about recommended power settings and target airspeed for best angle of climb, best rate-of-climb, best cooling performance climb, and level flight cruise operation while under power. If full-throttle operation is time limited to reduce engine wear, the GFM/POH describes the recommended operating procedures. Aircraft performance limits include weight and balance limits, minimum and maximum front seat weight restrictions, maximum permitted airspeed with engine extended, maximum airspeed to extend or retract the engine, flap operating airspeed range, airbrake operating airspeed range, maneuvering speed, rough air speed limitations, and never exceed speed.

The engine heats up considerably during takeoff and climb, so cooling system mismanagement or failure can lead to dangerously high temperatures in a short time. An overheated engine cannot supply full power, meaning climb performance will be reduced. Extended overheating can cause an in-flight fire. To minimize the chances of engine damage or fire, monitor engine temperatures carefully during high power operations, and observe the engine operating limits described in the GFM/POH.

Many self-launch gliders have a time limitation on full throttle operation to prevent overheating and premature engine wear. If the self-launch glider is equipped with cowl flaps for cooling, make certain the cowl flaps are set properly for high-power operations. In some self-launch gliders, operating at full power with cowl flaps closed can result in an overheated, ruined engine in as little as 2 minutes. If abnormally high engine system temperatures are encountered, follow the procedures described in the GFM/POH. Typically, these require reduced power along with higher airspeed to enhance engine cooling. Cowl flap instructions may be provided as well. If these measures are ineffective in reducing high temperatures, the safest course of action may be to shut down the engine and make a precautionary landing. A safe landing, whether on or off the airport, is always preferable to an in-flight fire.

Handling limitations for a given self-launch glider may be quite subtle and may include minimum controllable airspeed with power on, minimum controllable airspeed with power off, and other limitations described in the GFM/POH. Self-launch gliders come in many configurations. Those with a top-mounted retractable engine and/or propeller have a thrust line that is quite distant from the longitudinal axis of the glider. The result is that significant changes of power settings tend to cause substantial pitch attitude changes. For instance, full power setting in these self-launch gliders introduces a nose-down pitching moment because the thrust line is high above the longitudinal axis of the glider. To counteract this pitching moment, the pilot should hold the control stick back. If power is quickly reduced from full power to idle power while the control stick is held steady, these gliders tend to pitch up considerably. The nose-up pitching moment may be vigorous enough to induce a stall!

During climb-out, the pilot should hold a pitch attitude that results in climbing out at the desired airspeed, adjusting elevator trim as necessary. Climbs in self-launch gliders are best managed with smooth control inputs and, when power changes are necessary, smooth and gradual throttle adjustments.

When climbing under power, most self-launch gliders exhibit a left- or right-turning tendency (depending on whether the propeller is turning clockwise or counterclockwise) due to P-factor. P-factor is caused by the uneven distribution of thrust caused by the difference in the angle of attack of the ascending propeller blade and the descending propeller blade. Use the rudder to counteract P-factor during climbs with power.

Turns are accomplished with a shallow bank angle because steep banks result in a much-reduced rate of climb. As with all turns in a glider, properly coordinating aileron and rudder results in more efficient flight and a faster climb rate. The pilot should clear for other air traffic before making any turn.

Detailed engine shutdown procedures are described in the GFM/POH. A guide to shutdown procedures is described below, but the GFM/POH is the authoritative source for any self-launch glider.

Engines reach high operating temperatures during extended high-power operations. To reduce or eliminate shock cooling, and to reduce the possibility of in-flight fire, the manufacturer provides engine cool-down procedures to reduce engine system temperatures prior to shutdown. Reducing throttle setting allows the engine to begin a gradual cool down. The GFM/POH may also instruct the pilot to adjust propeller pitch at this time. Lowering the nose to increase airspeed provides faster flow of cooling air to the engine cooling system. Several minutes of reduced throttle and increased cooling airflow are enough to allow the engine to be shut down. If the engine is retractable, additional time after engine shutdown may be necessary to reduce engine temperature to acceptable limits prior to retracting and stowing the engine in the fuselage. Consult the GFM/POH for details. [Figure 7-24]

Retractable-engine self-launch gliders are aerodynamically efficient when the engine is stowed, but produce high-drag when the engine is extended and not providing thrust. Stowing the engine is critical to efficient soaring flight. Prior to stowing, the propeller must be aligned with the longitudinal axis of the glider, so the propeller blades do not interfere with the engine bay doors. Since the engine/propeller installation in these gliders is aft of the pilot's head, these gliders usually have a mirror, enabling the pilot to perform a visual propeller alignment check prior to stowing the engine/propeller pod. Detailed instructions for stowing the engine and propeller are found in the GFM/POH

Figure 7-24. Types of self-launch gliders.

for the particular glider. If a malfunction occurs during engine shutdown and stowage, the pilot cannot count on being able to get the engine restarted. The pilot should have a landing area within power-off gliding distance in anticipation of this eventuality.

Some self-launch gliders use a nose-mounted engine/propeller installation that resembles the typical installation found on single-engine airplanes. In these self-launch gliders, the shutdown procedure usually consists of operating the engine for a short time at reduced power to cool the engine down to acceptable shutdown temperature. After shutdown, the cowl flaps, if installed, should be closed to reduce drag and increase gliding efficiency. The manufacturer may recommend a time interval between engine shutdown and cowl flap closure, to prevent excess temperatures from developing in the confined, tightly cowled engine compartment. These temperatures may not be harmful to the engine itself, but may degrade the structures around the engine, such as composite engine mounts or installed electrical components. Excess engine heat may result in fuel vapor lock.

If the propeller blade pitch can be controlled by the pilot while in flight, the propeller is usually set to coarse pitch, or if possible, feathered, to reduce propeller drag during non-powered flight. Some self-launch gliders require the pilot to set the propeller to coarse pitch prior to engine shutdown. Other self-launch gliders require the pilot to shut down the engine first, then adjust propeller blade pitch to coarse pitch or to feathered position. As always, follow the shutdown procedures described in the GFM/POH.

COMMON ERRORS

- Failure to follow manufacturer's recommended procedure for engine shutdown, feathering, and stowing procedure (if applicable).
- Failure to maintain positive aircraft control while performing engine shutdown procedures.

LANDINGS

If the self-launch glider is to land under power, the pilot should perform the engine restart procedures at a safe altitude to allow time to reconfigure. The pilot should follow the manufacturer's recommended pre-starting checklist. Once the engine is started, the pilot should allow time for it to warm up. After the engine is started the pilot should ensure that all systems necessary for landing are operational, such as the electrical system and landing gear.

The pilot should fly the traffic pattern so as to land into the wind and plan the approach path to avoid all obstacles. The landing area should be of sufficient length to allow for touchdown and roll-out within the performance limitations of the particular self-launch glider. The pilot should also take into consideration any crosswind conditions and the landing surface. After touchdown, the pilot should maintain direction control, and slow the self-launch glider so as to clear the landing area. The after landing checklist should be completed when appropriate.

COMMON ERRORS

- Poor judgment of approach path.
- Improper use of flaps, spoilers, and/or dive brakes.
- Improper approach and landing speed.
- Improper crosswind correction.
- Improper technique during roundout and touchdown.
- Poor directional control after landing.
- Improper use of brakes.
- Failure to use the appropriate checklist.

EMERGENCY PROCEDURES

SELF-LAUNCHING GLIDER

The pilot of a self-launching glider should formulate emergency plans for any type of failure that might occur. Thorough knowledge of aircraft performance data, normal takeoff/landing procedures, and emergency procedures, as outlined in the GFM/POH, is essential to the successful management of any emergency situation. Mismanagement of the aircraft systems through lack of knowledge may cause serious difficulty. For instance, if the spoilers/dive brakes are allowed to open during takeoff and climbout, the self-launch glider may be incapable of generating sufficient power to continue climbing. Other emergency situations may include in-flight fire, structural failure, encounters with severe turbulence/wind shear, canopy failure, and inadvertent encounter with instrument meteorological conditions.

Possible options for handling emergencies are influenced by the altitude above the terrain, wind, weather conditions, density altitude, glider performance, takeoff runway length, landing areas near the gliderport, and other air traffic. Emergency options may include landing straight ahead on the remaining runway, landing off-field, or returning to the gliderport to land on an available runway. The appropriate emergency procedures may be found in the GFM/POH for the specific self-launch glider.

PERFORMANCE MANEUVERS

STRAIGHT GLIDES

To perform a straight glide the glider pilot must hold a constant heading and airspeed. The heading reference should be some prominent point in front of the glider on the Earth's surface. The pilot will also note that during a straight glide each wingtip should be an equal distance above the earth surface. With the wings level, the pitch attitude is established with reference to a point on or below the horizon to establish a specified airspeed. Any change in pitch attitude will result in a change in airspeed. There will be a pitch attitude reference for best glide speed, another for the minimum sink speed, and another for slow flight. The pitch attitude is adjusted with the elevator to hold the specific airspeed. The glider elevator trim control allows the pilot to trim the glider to hold a constant pitch attitude, therefore a constant airspeed. Straight glides should be coordinated as indicated by a centered yaw string or slip-skid ball.

The glider pilot should also stay alert to airflow noise changes. At a constant airspeed in coordinated flight, wind noise should be constant. Any changes in airspeed or coordination cause a change in the wind noise. Gusts that cause the airspeed to change momentarily can be ignored. Holding a constant pitch attitude results in maintaining the desired airspeed.

The glider pilot should learn to fly throughout a wide range of airspeeds; from minimum controllable airspeed to maximum allowable airspeed. This enables the pilot to learn the feel of the controls of the glider throughout its speed range. If the glider is equipped with spoilers/dive brakes and/or flaps, the glider pilot should become familiar with the changes that occur in pitch attitude and airspeed when these controls are used.

COMMON ERRORS

1. Rough or erratic pitch attitude and airspeed control.
2. Rough, uncoordinated, or inappropriate control applications.
3. Failure to use the trim or improper use of trim.
4. Improper use of controls when using spoilers, dive breaks and/or flaps.

TURNS

The performance of turns involves coordination of all three flight controls: ailerons, rudder, and elevator. For purposes of this discussion, turns are divided into the following three classes as shown in Figure 7-25.

- Shallow turns are those in which the bank (less than approximately 20°) is so shallow that the inherent lateral stability of the glider is acting to level the wings unless some aileron is applied to maintain the bank.

- Medium turns are those resulting from a degree of bank (approximately 20° to 45°) at which the lateral stability is overcome by the

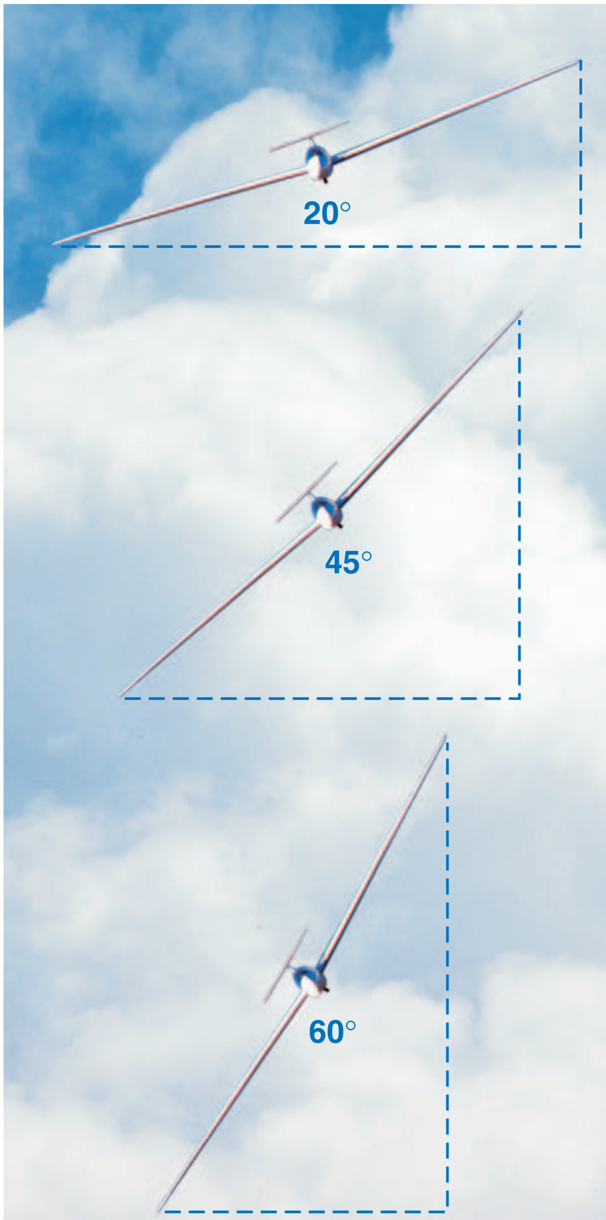


Figure 7-25. Shallow, medium, and steep turns.

overbanking tendency, resulting in no control inputs (other than elevator) being required to maintain the angle.

- Steep turns are those resulting from a degree of bank (45° or more) at which the "overbank ing tendency" of a glider overcomes stability, and the bank increases unless aileron is applied to prevent it.

Before starting any turn, the pilot must clear the airspace in the direction of the turn. A glider is turned by banking (lowering the wing in the direction of the desired turn, thus raising the other). When the glider is flying straight, the total lift is acting perpendicular to the wings and to the earth. As the glider is banked into a turn, total lift becomes the resultant of two components. One, the vertical lift component, continues to act perpendicular to the earth and opposes gravity. Second, the horizontal lift component (centripetal) acts parallel to the earth's surface and opposes inertia (apparent centrifugal force). These two lift components act at right angles to each other, causing the resultant total lifting force to act perpendicular to the banked wing of the glider. It is the horizontal lift component that actually turns the glider, not the rudder.

When applying aileron to bank the glider, the aileron on the rising wing is lowered produces a greater drag than the raised aileron on the lowering wing. This increased drag causes the glider to yaw toward the rising wing, or opposite to the direction of turn. To counteract this adverse yawing moment, rudder pressure must be applied in the desired direction of turn simultaneously with aileron pressure. This action is required to produce a coordinated turn.

After the bank has been established in a medium banked turn, all pressure applied to the aileron may be relaxed. The glider will remain at the selected bank with no further tendency to yaw since there is no longer a deflection of the ailerons. As a result, pressure may also be relaxed on the rudder pedals, and the rudder allowed to streamline itself with the direction of the slipstream. Rudder pressure maintained after establishing the turn will cause the glider to skid to the outside of the turn. If a definite effort is made to center the rudder rather than let it streamline itself to the turn, it is probable that some opposite rudder pressure will be exerted inadvertently. This will force the glider to yaw opposite its turning path, causing the glider to slip to the inside of the turn. The yaw string or ball in the slip indicator will be displaced off-center whenever the glider is skidding or slipping sideways. In proper coordinated flight, there is no skidding or slipping.

In all gliding, constant airspeed turns, it is necessary to increase the angle of attack of the wing as the bank progresses by adding nose-up elevator pressure. This is required because the total lift must be equal to the vertical component of lift plus the horizontal lift component. To stop the turn, coordinated use of the aileron and rudder pressure are added to bring the wings back to level flight, and elevator pressure is relaxed.

There is a direct relationship between, airspeed, bank angle, and rate and radius of turn. The rate of turn at any given true airspeed depends on the horizontal lift component. The horizontal lift component varies in proportion to the amount of bank. Therefore, the rate of turn at a given true airspeed increases as the angle of bank is increased. On the other hand, when a turn is made at a higher true airspeed at a given bank angle, the inertia is greater and the horizontal lift component required for the turn is greater, causing the turning rate to become slower. Therefore, at a given angle of bank, a higher true airspeed will make the radius of turn larger because the glider will be turning at a slower rate.

As the angle of bank is increased from a shallow bank to a medium bank, the airspeed of the wing on the outside of the turn increases in relation to the inside wing. The additional lift so developed balances the lateral stability of the glider. No aileron pressure is required to maintain the bank. At any given airspeed, aileron pressure is not required to maintain the bank.

If the bank is increased from a medium bank to a steep bank, the radius of turn decreases even further. The greater lift of the outside wing then causes the bank to steepen and opposite aileron is necessary to keep the bank constant.

As the radius of the turn becomes smaller, a significant difference develops between the speed of the inside wing and the speed of the outside wing. The wing on the outside of the turn travels a longer circuit than the inside wing, yet both complete their respective circuits in the same length of time. Therefore, the outside wing travels faster than the inside wing, and as a result, it develops more lift. This creates an overbanking tendency that must be controlled by the use of the ailerons. Because the outboard wing is developing more lift, it also has more induced drag. This causes a slip during steep turns that must be corrected by rudder usage.

To establish the desired angle of bank, the pilot should use visual reference points on the glider, the Earth's surface, and the natural horizon. The pilot's posture while seated in the glider is very important, particularly during turns. It will affect the interpretation of outside visual references. The beginning pilot may lean away from or into the turn rather than ride with the glider. This should be corrected immediately if the pilot is to properly learn to use visual references.

Applications of large aileron and rudder produces rapid roll rates and allow little time for corrections before the desired bank is reached. Slower (small control displacement) roll rates provide more time to make necessary pitch and bank corrections. As soon as the glider rolls from the wings-level attitude, the nose will start to move along the horizon, increasing its rate of travel proportionately as the bank is increased.

COMMON ERRORS

- Failure to clear turn.
- Nose starts to move before the bank starts—rudder is being applied too soon.
- Bank starts before the nose starts turning, or the nose moves in the opposite direction—the rudder is being applied too late.
- Nose moves up or down when entering a bank—excessive or insufficient elevator is being applied.

As the desired angle of bank is established, aileron and rudder pressures should be relaxed. This stops the bank from increasing because the aileron and rudder control surfaces will be neutral in their streamlined position. The up-elevator pressure should not be relaxed, but should be held constant to maintain the desired airspeed. Throughout the turn, the pilot should crosscheck the airspeed indicator to verify the proper pitch is being maintained. The crosscheck should also include outside visual references. If gaining or losing airspeed, the pitch attitude should be adjusted in relation to the horizon.

During all turns, the ailerons, rudder, and elevator are used to correct minor variations in pitch and bank just as they are in straight glides.

The roll-out from a turn is similar to the roll-in except the flight controls are applied in the opposite direction. Aileron and rudder are applied in the direction of the roll-out or toward the high wing. As the angle of bank decreases, the elevator pressure should be relaxed, as necessary, to maintain airspeed.

Since the glider will continue turning as long as there is any bank, the roll-out must be started before reaching the desired heading. The amount of lead required to roll-out on the desired heading depends on the degree of bank used in the turn. Normally, the lead is one half the degrees of bank. For example, if the bank is 30°, lead the roll-out by 15°. As the wings become level, the control pressures should be smoothly relaxed so the controls are neutralized as the glider returns to straight flight. As the roll-out is being completed, attention should be given to outside visual references, as well as the airspeed and heading indicators to determine that the wings are being leveled and the turn stopped.

COMMON ERRORS

- Rough or uncoordinated use of controls during the roll-in and roll-out.
- Failure to establish and maintain the desired angle of bank.
- Overshooting/undershooting the desired heading.

In a slipping turn, the glider is not turning at the rate appropriate to the bank being used, since the glider is yawed toward the outside of the turning flight path. The glider is banked too much for the rate of turn, so the horizontal lift component is greater than the centrifugal force. Equilibrium between the horizontal lift component and centrifugal force is reestablished either by decreasing the bank (ailerons), increasing yaw (rudder), or a combination of the two. [Figure 7-26]

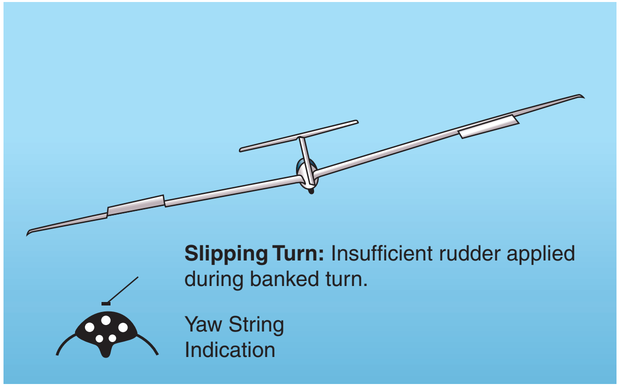


Figure 7-26. Slipping turn.

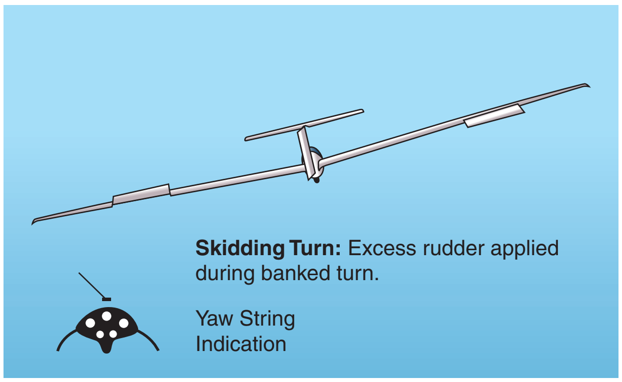


Figure 7-27. Skidding turn.

A skidding turn results from an excess of centrifugal force over the horizontal lift component, pulling the glider toward the outside of the turn. The rate of turn is too great for the angle of bank. Correction of a skidding turn thus involves a decrease in yaw (rudder), an increase in bank (aileron), or a combination of the two changes. [Figure 7-27]

The yaw string identifies slips and skids. In flight, the rule to remember is simple: step away from the tail of the yaw string. If the tail of the yaw string is to the left of center, press the right rudder pedal to coordinate the glider and center the yaw string. If the tail of the yaw string is right of center, pressure the left rudder pedal to coordinate the glider and center the yaw string. [Figure 7-28]

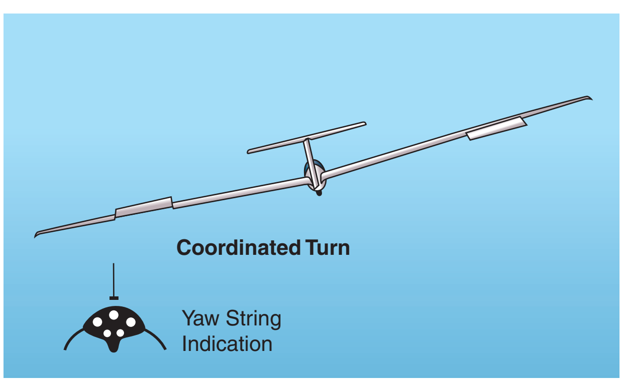


Figure 7-28. Coordinated turn.

The ball in the slip/skid indicator also indicates slips and skids. When using this instrument for coordination, you should apply rudder pressure on the side that the ball is offset (step on the ball).

Correction for uncoordinated condition should be accomplished by using appropriate rudder and aileron control pressures simultaneously to coordinate the glider.

STEEP TURNS

Soaring flight requires competence in steep turns. In thermalling flight, small-radius turns are often necessary to keep the glider in or near the core of the thermal updraft, where lift is usually strongest and rapid climbs are possible. At any given airspeed, increasing the angle of bank will decrease the radius of the turn and increase the rate of turn. The radius of a turn at any given bank angle varies directly with the square of the airspeed at which the turn is made, therefore the slower the airspeed the smaller the turn radius. To keep the radius of turn small, it is necessary to bank steeply, while maintaining an appropriate airspeed, such as minimum sink or best glide speed. The pilot must be aware that as the bank angle increases, the stall speed increases.

Before starting the steep turn, the pilot should ensure that the area is clear of other traffic since the rate of turn will be quite rapid. After establishing the appropriate airspeed, the glider should be smoothly rolled into a coordinated steep turn with at least 45° of bank. The pilot should use outside visual reference to establish and maintain the desired bank angle. If the pilot does not add back pressure to maintain the desired airspeed after the bank is established, the glider will have a tendency to enter a spiral. To counteract the overbanking tendency caused by the steep turn, the pilot should apply top aileron pressure. Because the top aileron pressure pulls the nose away from the direction of the turn, the pilot also has to apply bottom rudder pressure. A coordinated (no slip or skid) steep turn requires back pressure on the elevator for airspeed control, top aileron pressure for bank control, and bottom rudder pressure to stream line the fuselage with the flight path.

COMMON ERRORS

- Failure to clear turn.
- Uncoordinated use of controls.
- Loss of orientation.
- Failure to maintain airspeed within tolerance.
- Unintentional stall or spin.
- Excessive deviation from desired heading during roll-out.

SPIRAL DIVE

Allowing the nose of the glider to get excessively low during a steep turn may result in a significant increase in airspeed and loss in altitude. This is known as a spiral dive. If the pilot attempts to recover from this situation by only applying back elevator pressure, the limiting load factor may be exceeded, causing structural failure. To properly recover from a spiral dive, the pilot should first reduce the angle of bank with coordinated use of the rudder and aileron, then smoothly increase pitch to the proper attitude.

COMMON ERRORS

- Failure to recognize when a spiral dive is developing.
- Rough, abrupt, and/or uncoordinated control application during recovery.
- Improper sequence of control applications.

MANEUVERING AT MINIMUM CONTROL AIRSPEED, STALLS, AND SPINS

All pilots must be proficient in maneuvering at minimum controllable airspeed and stall recognition and recovery. In addition, all flight instructor applicants must be proficient in spins entries, spins, and spin recovery.

MANEUVERING AT MINIMUM CONTROLLABLE AIRSPEED

Maneuvering during slow flight demonstrates the flight characteristics and degree of controllability of a glider at minimum speeds. By definition, the term "flight at minimum controllable airspeed" means a speed at which any further increase in angle of attack or load factor causes an immediate stall. Pilots must develop an awareness of the particular glider flight characteristics in order to recognize and avoid stalls, which may inadvertently occur during the slow airspeeds used in takeoffs, climbs, thermalling, and approaches to landing.

The objective of maneuvering at minimum controllable airspeed is to develop the pilot's sense of feel and ability to use the controls correctly, and to improve proficiency in performing maneuvers that require slow airspeeds. Maneuvering at minimum controllable airspeed should be performed using outside visual reference. It is important that pilots form the habit of frequently referencing the pitch attitude of the glider for airspeed control while flying at slow speeds.

The maneuver is started from either best glide or minimum sink speed. The pitch attitude is smoothly and gradually increased. While the glider is losing airspeed, the position of the nose in relation to the horizon should be noted and should be adjusted as necessary until the minimum controllable airspeed is established. During these changing flight conditions, it is important to re-trim the glider, as necessary, to compensate for changes in control pressures. Excessive or too aggressive back pressure on the elevator control may result in an abrupt increase in pitch attitude and a rapid decrease in airspeed, which leads to a higher angle of attack and a possible stall. When the desired pitch attitude and airspeed have been established, it is important to continually crosscheck the pitch attitude on the horizon and the airspeed indicator to ensure accurate control is being maintained.

When minimum controllable airspeed is established in straight flight, turns should be practiced to determine the glider's controllability characteristics at this selected airspeed. During the turns the pitch attitude may need to be decreased in order to maintain the airspeed. If a steep turn is encountered, and the pitch attitude is not decreased, the increase in load factor may result in a stall. A stall may also occur as a result of abrupt or rough control movements resulting in momentary increases in load factor. Abruptly raising the flaps during minimum controllable airspeed will result in sudden loss of lift, possibly causing a stall.

Minimum controllable airspeed should also be practiced with extended spoilers/dive breaks. This will provide additional understanding of the changes in pitch attitude caused by the increase in drag from the spoilers/dive breaks.

Actual minimum controllable airspeed depends upon various conditions, such as the gross weight and CG location of the glider and the maneuvering load imposed by turns and pull-ups. Flight at minimum controllable airspeed requires positive use of rudder and ailerons. The diminished effectiveness of the flight controls during flight at minimum controllable airspeed will help pilots develop the ability to estimate the margin of safety above the stalling speed.

COMMON ERRORS

- Failure to establish or to maintain minimum controllable airspeed.
- Improper use of trim.
- Rough or uncoordinated use of controls.
- Failure to recognize indications of a stall.

STALL RECOGNITION AND RECOVERY

A stall can occur at any airspeed and in any attitude. In the case of the self-launch glider under power, a stall can also occur with any power setting. A stall occurs when the smooth airflow over the glider's wing is disrupted and the lift decreases rapidly. This occurs when the wing exceeds its critical angle of attack.

The practice of stall recovery and the development of awareness of stalls are of primary importance in pilot training. The objectives in performing intentional stalls are to familiarize the pilot with the conditions that produce stalls, to assist in recognizing an approaching stall, and to develop the habit of taking prompt preventive or corrective action.

Intentional stalls should be performed so the maneuver is completed by 1,500 feet above the ground for recovery and return to normal, wings-level flight. Though it depends on the degree to which a stall has progressed, most stalls require some loss of altitude during recovery. The longer it takes to recognize the approaching stall, the more complete the stall is likely to become, and the greater the loss of altitude to be expected.

Pilots must recognize the flight conditions that are conducive to stalls and know how to apply the necessary corrective action since most gliders do not have an electrical or mechanical stall warning device. Pilots should learn to recognize an approaching stall by sight, sound, and feel. The following cues may be useful in recognizing the approaching stall.

Vision is useful in detecting a stall condition by noting the attitude of the glider. This sense can only be relied on when the stall is the result of an unusual attitude of the glider. Since the glider can also be stalled from a normal attitude, vision in this instance would be of little help in detecting the approaching stall.

Hearing is also helpful in sensing a stall condition. In the case of a glider, a change in sound due to loss of airspeed is particularly noticeable. The lessening of the noise made by the air flowing along the glider structure as airspeed decreases is also quite noticeable, and when the stall is almost complete, aerodynamic vibration and incident noises often increase greatly.

Kinesthesia, or the sensing of changes in direction or speed of motion, is probably the most important and the best indicator to the trained and experienced pilot. If this sensitivity is properly developed, it will warn of a decrease in speed or the beginning of a settling or mushing of the glider.

The feeling of control pressures is also very important. As speed is reduced, the resistance to pressures on the controls become progressively less. Pressures exerted on the controls tend to become movements of the control surfaces. The lag between these movements and the response of the glider becomes greater, until in a complete stall all controls can be moved with almost no resistance, and with little immediate effect on the glider.

Signs of an impending stall include the following.

- High nose attitude.
- Low airspeed indication.
- Low airflow noise.
- Back pressure on sticks.
- Mushy controls, especially ailerons.
- Buffet.

Always make clearing turns before performing stalls. During the practice of intentional stalls, the real objective is not to learn how to stall a glider, but to learn how to recognize an approaching stall and take prompt corrective action. The recovery actions must be taken in a coordinated manner.

First, at the indication of a stall, the pitch attitude and angle of attack must be decreased positively and immediately. Since the basic cause of a stall is always an excessive angle of attack, the cause must first be eliminated by releasing the back-elevator pressure that was necessary to attain that angle of attack or by moving the elevator control forward. This lowers the nose and returns the wing to an effective angle of attack. The amount of elevator control pressure or movement to use depends on the design of the glider, the severity of the stall, and the proximity of the ground. In some gliders, a moderate movement of the elevator control—perhaps slightly forward of neutral—is enough, while in others a forcible push to the full forward position may be required. An excessive negative load on the wings caused by excessive forward movement of the elevator may impede, rather than hasten, the stall recovery. The object is to reduce the angle of attack, but only enough to allow the wing to regain lift. [Figure 7-29]

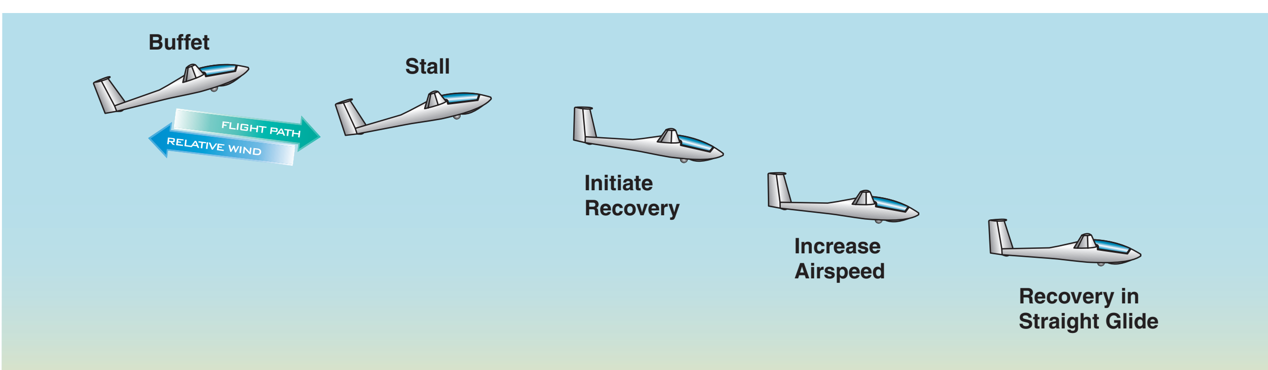


Figure 7-29. Stall recovery.

If stalls are practiced or encountered in a self-launch glider, the maximum allowable power should be applied during the stall recovery to increase the self-launch glider's speed and assist in reducing the wing's angle of attack. Generally, the throttle should be promptly, but smoothly, advanced to the maximum allowable power. Although stall recoveries should be practiced without, as well as with the use of power, in self-launch gliders during actual stalls the application of power is an integral part of the stall recovery. Usually, the greater the power applied, the less the loss of altitude. Maximum allowable power applied at the instant of a stall usually does not cause overspeeding of an engine equipped with a fixed-pitch propeller, due to the heavy air load imposed on the propeller at slow airspeeds. However, it will be necessary to reduce the power as airspeed is gained after the stall recovery so the airspeed does not become excessive. When performing intentional stalls, the tachometer indication should never be allowed to exceed the red radial line (maximum allowable RPM) as marked on the instrument.

Whether in a glider or self-launched glider, wings level, straight flight should be regained with coordinated use of all controls. The first few practices should consist of approaches to stalls, with recovery initiated as soon as the first buffeting or partial loss of control is noted. In this way, the pilot can become familiar with the indications of an approaching stall without fully stalling the glider.

Stall accidents usually result from an inadvertent stall at a low altitude in which a recovery was not accomplished prior to contact with the surface. As a preventive measure, stalls should be practiced at an altitude that allows recovery at no lower than 1,500 feet AGL.

Different types of gliders have different stall characteristics. Most gliders are designed so the wings stall progressively outward from the wing roots (where the wing attaches to the fuselage) to the wingtips. This is the result of designing the wings so the wingtips have a smaller angle of incidence than the wing roots. Such a design feature causes the wingtips to have a smaller angle of attack than the wing roots during flight.

Exceeding the critical angle of attack causes a stall. Since the wing roots will exceed the critical angle before the wingtips, they will stall first. The wings are designed in this manner so aileron control will be available at high angles of attack (slow airspeed) and give the glider more stable stalling characteristics. When the glider is in a stalled condition, the wingtips continue to provide some degree of lift, and the ailerons still have some control effect. During recovery from a stall, the return of lift begins at the tips and progresses toward the roots. Thus, the ailerons can be used to level the wings.

Using the ailerons requires finesse to avoid an aggravated stall condition. For example, if the right wing dropped during the stall and excessive aileron control was applied to the left to raise the wing, the aileron that was deflected downward (right wing) would produce a greater angle of attack (and drag). Possibly, a more complete stall would occur at the tip because the critical angle of attack would be exceeded. The increase in drag created by the high angle of attack on that wing might cause the airplane to yaw in that direction. This adverse yaw could result in a spin unless directional control was maintained by rudder, and/or the aileron control was sufficiently reduced.

Even though excessive aileron pressure may have been applied, a spin will not occur if directional (yaw) control is maintained by timely application of coordinated rudder pressure. Therefore, it is important that the rudder be used properly during both the entry and the recovery from a stall. The primary use of the rudder in stall recoveries is to counteract any tendency of the glider to yaw or slip. The correct recovery technique would be to decrease the pitch attitude by applying forward elevator pressure to reduce the angle of attack and while simultaneously maintaining directional control with coordinated use of the aileron and rudder.

Due to engineering design variations, the stall characteristics for all gliders cannot be specifically described; however, the similarities found in gliders are noteworthy enough to be considered. The factors that affect the stalling characteristics of the glider are weight and balance, bank and pitch attitude, coordination, and drag. The pilot should learn the effect of the stall characteristics of the glider being flown and the proper correction. It should be reemphasized that a stall can occur at any airspeed, in any attitude, or at any power setting in the case of a self-launch glider, depending on the total number of factors affecting the particular glider.

Whenever practicing stalls while turning, a constant bank angle should be maintained until the stall occurs. After the stall occurs coordinated control inputs should be made to return the glider to level flight.

ADVANCED STALLS

Advanced stalls include secondary, accelerated, and crossed-control stalls. These stalls are extremely useful for pilots to expand their knowledge of stall/spin awareness.

SECONDARY STALL

This stall is called a secondary stall because it may occur after a recovery from a preceding stall. It is caused by attempting to hasten the completion of a stall recovery before the glider has regained sufficient flying speed and the critical angle of attack is again exceeded. When this stall occurs, the back-elevator pressure should again be released just as in a normal stall recovery. When sufficient airspeed has been regained, the glider can then be returned to wings-level, straight flight. This stall usually occurs when the pilot uses abrupt control input to return to wings-level, straight flight after a stall or spin recovery.

ACCELERATED STALLS

Though the stalls already discussed normally occur at a specific airspeed, the pilot must thoroughly understand that all stalls result solely from attempts to fly at excessively high angles of attack. During flight, the angle of attack of a glider wing is determined by a number of factors, the most important of which are the airspeed, the gross weight of the glider, and the load factors imposed by maneuvering.

At gross weight, the glider will consistently stall at the same indicated airspeed if no acceleration is involved. The glider will, however, stall at a higher indicated airspeed when excessive maneuvering loads are imposed by steep turns, pull-ups, or other abrupt changes in its flight path. Stalls entered from such flight situations are called "accelerated maneuver stalls," a term that has no reference to the airspeeds involved.

Stalls that result from abrupt maneuvers tend to be more rapid or severe than the unaccelerated stalls, and because they occur at higher-than-normal airspeeds, they may be unexpected by pilots. Failure to take immediate steps toward recovery when an accelerated stall occurs may result in a complete loss of flight control, possibly causing a spin.

Accelerated maneuver stalls should not be performed in any glider in which the maneuver is prohibited in the GFM/POH. If they are permitted, they should be performed with a bank of approximately 45°, and in no case at a speed greater than the glider manufacturer's recommended airspeeds or the design maneuvering speed specified for the glider. The design maneuvering speed is the maximum speed at which the glider can be stalled or the application of full aerodynamic control will not exceed the glider's limit load factor. At or below this speed, the glider is designed so that it stalls before the limit load factor can be exceeded.

The objective of demonstrating accelerated stalls is not to develop competency in setting up the stall, but rather to learn how they may occur and to develop the ability to recognize such stalls immediately, and to take prompt, effective recovery action. It is important that recoveries are made at the first indication of a stall, or immediately after the stall has fully developed; a prolonged stall condition should never be allowed.

A glider will stall during a coordinated turn as it does from straight flight except the pitching and rolling actions tend to be more sudden. If the glider is slipping toward the inside of the turn at the time the stall occurs, it tends to roll rapidly toward the outside of the turn as the nose pitches down because the outside wing stalls before the inside wing. If the glider is skidding toward the outside of the turn, it will have a tendency to roll to the inside of the turn because the inside wing stalls first. If the coordination of the turn at the time of the stall is accurate, the glider's nose will pitch away from the pilot just as it does in a straight flight stall, since both wings stall simultaneously.

Glider pilots enter an accelerated stall demonstration by establishing the desired flight attitude, then smoothly, firmly, and progressively increasing the angle of attack until a stall occurs. Because of the rapidly changing flight attitude, sudden stall entry, and possible loss of altitude, it is extremely vital that the area be clear of other aircraft and the entry altitude be adequate for safe recovery.

Actual accelerated stalls most frequently occur during turns in the traffic pattern close to the ground or while maneuvering during soaring flight. The demonstration of accelerated stalls is accomplished by exerting excessive back-elevator pressure. Most frequently, it would occur during improperly executed steep turns, stall and spin recoveries, and pullouts from steep dives. The objectives are to determine the stall characteristics of the glider and develop the ability to instinctively recover at the onset of a stall at other-than-normal stall speed or flight attitudes. An accelerated stall, although usually demonstrated in steep turns, may actually be encountered any time excessive back-elevator pressure is applied and/or the angle of attack is increased too rapidly.

From straight flight at maneuvering speed or less, the glider should be rolled into a steep banked (maximum 45°) turn and back-elevator pressure gradually applied. After the bank is established, back-elevator pressure should be smoothly and steadily increased. The resulting apparent centrifugal force pushes the pilot's body down in the seat, increases the wing loading, and decreases the airspeed. Back-elevator pressure should be firmly increased until a definite stall occurs.

When the glider stalls, recovery should be made promptly by releasing back-elevator pressure. If the turn is uncoordinated, one wing may tend to drop suddenly, causing the glider to roll in that direction. If this occurs, the glider should be returned to wings-level, straight flight with coordinated control pressure.

A glider pilot should recognize when an accelerated stall is imminent and take prompt action to prevent a completely stalled condition. It is imperative that a prolonged stall, excessive airspeed, excessive loss of altitude, or spin be avoided.

CROSSED-CONTROL STALL

The objective of a crossed-control stall demonstration maneuver is to show the effect of improper control technique and to emphasize the importance of using coordinated control pressures whenever making turns. This type of stall occurs with the controls crossed—aileron pressure applied in one direction and rudder pressure in the opposite direction, and the critical angle of attack is exceeded. [Figure 7-30]

This is a stall that is most likely to occur during a poorly planned and executed base-to-final approach turn, and often is the result of overshooting the centerline of the runway during that turn. Normally, the proper action to correct for overshooting the runway is to increase the rate of turn by using coordinated aileron and rudder. At the relatively low altitude of a base-to-final approach turn, improperly trained pilots may be apprehensive of steeping the bank to increase the rate of turn. Rather than steeping the bank, they hold the bank constant and attempt to increase the rate of turn by adding more rudder pressure in an effort to align with the runway.

The addition of rudder pressure on the inside of the turn causes the speed of the outer wing to increase, creating

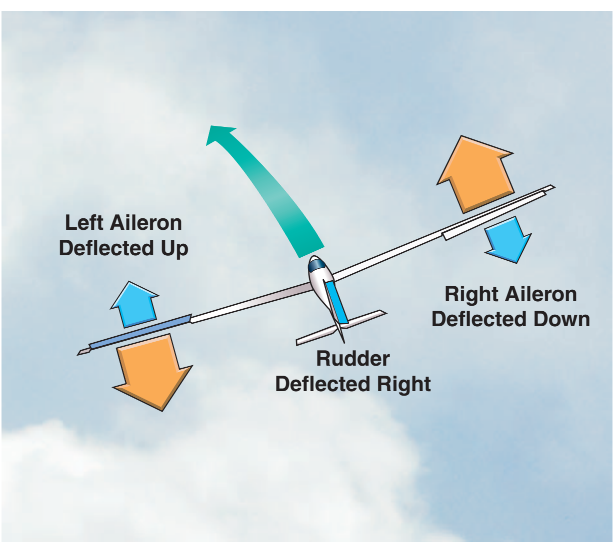


Figure 7-30. Crossed-control approach to a stall.

greater lift on that wing. To keep that wing from rising and to maintain a constant angle of bank, opposite aileron pressure is required. The added inside rudder pressure will also cause the nose to lower in relation to the horizon. Consequently, additional back-elevator pressure would be required to maintain a constant-pitch attitude. The resulting condition is a turn with rudder applied in one direction, aileron in the opposite direction, and excessive back-elevator pressure—a pronounced cross-control condition.

Since the glider is in a skidding turn during the cross-control condition, the wing on the outside of the turn speeds up and produces more lift than the inside wing; thus, the glider starts to increase its bank. The down aileron on the inside of the turn helps drag that wing back, slowing it up and decreasing its lift. This further causes the glider to roll. The roll may be so fast that it is possible the bank will be vertical or past vertical before it can be stopped.

For the demonstration of the maneuver, it is important that it be entered at a safe altitude because of the possible extreme nose down attitude and loss of altitude that may result. Before demonstrating this stall, the pilot should clear the area for other air traffic. While the gliding attitude and airspeed are being established, the glider should be re-trimmed. When the glide is stabilized, the glider should be rolled into a medium-banked turn to simulate a final approach turn that would overshoot the centerline of the runway. During the turn, excessive rudder pressure should be applied in the direction of the turn but the bank held constant by applying opposite aileron pressure. At the same time, increased back-elevator pressure is required to keep the nose from lowering.

All of these control pressures should be increased until the glider stalls. When the stall occurs, releasing the control pressures, simultaneously decreasing the angle of attack initiates the recovery. In a cross-control stall, the glider often stalls with little warning. The nose may pitch down, the inside wing may suddenly drop, and the glider may continue to roll to an inverted position. This is usually the beginning of a spin. It is obvious that close to the ground is no place to allow this to happen.

Recovery must be made before the glider enters an abnormal attitude (vertical spiral or spin); it is a simple matter to return to wings-level, straight flight by coordinated use of the controls. The pilot must be able to recognize when this stall is imminent and must take immediate action to prevent a completely stalled condition. It is imperative that this type of stall not occur during an actual approach to a landing, since recovery may be impossible prior to ground contact due to the low altitude.

COMMON ERRORS

- Improper pitch and bank control during straight-ahead and turning stalls.
- Rough or uncoordinated control procedures.
- Failure to recognize the first indications of a stall.
- Failure to achieve a stall.
- Poor recognition and recovery procedures.
- Excessive altitude loss or airspeed or encountering a secondary stall during recovery.

SPINS

A spin may be defined as an aggravated stall that results in what is termed "autorotation" wherein the glider follows a downward corkscrew path. As the glider rotates around a vertical axis, the rising wing is less stalled than the descending wing, creating a rolling, yawing, and pitching motion. The glider is basically being forced downward by rolling, yawing, and pitching in a spiral path. [Figure 7-31]

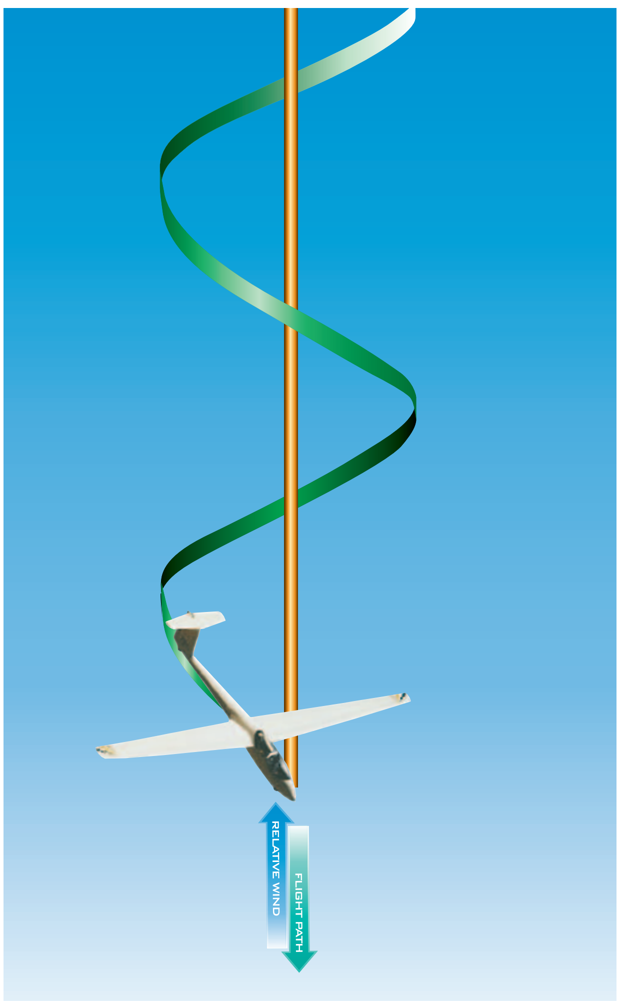


Figure 7-31. Autorotation of spinning glider.

The autorotation results from an unequal angle of attack on the glider's wings. The rising wing has a decreasing angle of attack, in which the relative lift increases and the drag decreases. In effect, this wing is less stalled. Meanwhile, the descending wing has an increasing angle of attack, past the wing's critical angle of attack (stall) where the relative lift decreases and drag increases.

A spin is caused when the glider's wing exceeds its critical angle of attack (stall) with a side slip or yaw acting on the glider at, or beyond, the actual stall. During this uncoordinated maneuver, a pilot may not be aware that a critical angle of attack has been exceeded until the glider yaws out of control toward the lowering wing. If stall recovery is not initiated immediately, the glider may enter a spin.

If this stall occurs while the glider is in a slipping or skidding turn, this can result in a spin entry and rotation in the direction that the rudder is being applied, regardless of which wingtip is raised.

Many gliders have to be forced to spin and require good judgment and technique to get the spin started. These same gliders may be put into a spin accidentally by mishandling the controls in turns, stalls, and flight at minimum controllable airspeeds. This fact is additional evidence of the necessity for the practice of stalls until the ability to recognize and recover from them is developed.

Often a wing drops at the beginning of a stall. When this happens, the nose will attempt to move (yaw) in the direction of the low wing. This is when use of the rudder is important during a stall. The correct amount of opposite rudder must be applied to keep the nose from yawing toward the low wing. By maintaining directional control and not allowing the nose to yaw toward the low wing before stall recovery is initiated, a spin will be averted. If the nose is allowed to yaw during the stall, the glider will begin to skid in the direction of the lowered wing and will enter a spin.

A glider must be stalled in order to enter a spin; therefore, continued practice of stall recognition will help the pilot develop a more instinctive and prompt reaction in recognizing an approaching spin. It is essential to learn to apply immediate corrective action any time it is apparent the glider is approaching spin conditions. If it is impossible to avoid a spin, the pilot should immediately execute spin recovery procedures.

The flight instructor should demonstrate spins and spin recovery techniques with emphasis on any special spin procedures or techniques required for a particular glider. Before beginning any spin operations, the following items should be reviewed.

- GFM/POH limitations section, placards, or type certification data sheet, to determine if the glider is approved for spins.
- Weight and balance limitations.
- Proper recommended entry and recovery procedures.
- The requirements for parachutes. It would be appropriate to review current Title 14 of the Code of Federal Regulations (14 CFR) part 91 for the latest parachute requirements.

A thorough glider preflight should be accomplished with special emphasis on excess or loose items that may affect the weight, CG, and controllability of the glider. Slack or loose control cables (particularly rudder and elevator) could prevent full anti-spin control deflections and delay or preclude recovery in some gliders.

Prior to beginning spin training, the flight area, above and below the glider, must be clear of other air traffic. Clearing the area may be accomplished while slowing the glider for the spin entry. All spin training should be initiated at an altitude high enough for a completed recovery at or above 1,500 feet AGL.

There are four phases of a spin: entry, incipient, developed, and recovery.

ENTRY PHASE

In the entry phase, the pilot provides the necessary elements for the spin, either accidentally or intentionally. The entry procedure for demonstrating a spin is similar to a stall. As the glider approaches a stall, smoothly apply full rudder in the direction of the desired spin rotation while applying full back (up) elevator to the limit of travel. Always maintain the ailerons in the neutral position during the spin procedure unless the GFM/POH specifies otherwise.

INCIPIENT PHASE

The incipient phase takes place between the time the glider stalls and rotation starts until the spin has fully developed. This change may take up to two turns for most gliders. Incipient spins that are not allowed to develop into a steady-state spin are the most commonly used in the introduction to spin training and recovery techniques. In this phase, the aerodynamic and inertial forces have not achieved a balance. As the incipient spin develops, the indicated airspeed should be near or below stall airspeed.

The incipient spin recovery procedure should be commenced prior to the completion of 360° of rotation. The pilot should apply full rudder opposite the direction of rotation.

DEVELOPED PHASE

The developed phase occurs when the glider's angular rotation rate, airspeed, and vertical speed are stabilized while in a flight path that is nearly vertical. This is when glider aerodynamic forces and inertial forces are in balance, and the attitude, angles, and self-sustaining motions about the vertical axis are constant or repetitive. The spin is in equilibrium.

RECOVERY PHASE

The recovery phase occurs when the angle of attack of the wings drops below the critical angle of attack and autorotation slows. Then the nose drops below the spin pitch attitude and rotation stops. This phase may last for a quarter turn to several turns.

To recover, control inputs are initiated to disrupt the spin equilibrium by stopping the rotation and stall. To accomplish spin recovery, the manufacturer's recommended procedures should be followed. In the absence of the manufacturer's recommended spin recovery procedures, the following general spin recovery procedures are recommended.

Step 1—Position the ailerons to neutral. Ailerons may have an adverse effect on spin recovery. Aileron control in the direction of the spin may speed up the rate of rotation and delay the recovery. Aileron control opposite the direction of the spin may cause the down aileron to move the wing deeper into the stall and aggravate the situation. The best procedure is to ensure that the ailerons are neutral. If the flaps are extended prior to the spin, they should be retracted as soon as possible after spin entry.

Step 2—Apply full opposite rudder against the rotation. Make sure that full (against the stop) opposite rudder has been applied.

Step 3—Apply a positive and brisk, straight forward movement of the elevator control past neutral to break the stall. This should be done immediately after full rudder application. The forceful movement of the elevator will decrease the excessive angle of attack and break the stall. The controls should be held firmly in this position. When the stall is "broken," the rotation stops.

Step 4—After spin rotation stops, neutralize the rudder. If the rudder is not neutralized at this time, the ensuing increased airspeed acting upon a deflected rudder will cause a yawing or skidding effect. Slow and overly cautious control movements during spin recovery must be avoided. In certain cases it has been found that such movements result in the glider continuing to spin indefinitely, even with anti-spin inputs. A brisk and positive technique, on the other hand, results in a more positive spin recovery.

Step 5—Begin applying back-elevator pressure to raise the nose to level flight. Caution must be used not to apply excessive back-elevator pressure after the rotation stops. Excessive back-elevator pressure can cause a secondary stall and result in another spin. Care should be taken not to exceed the "G" load limits and airspeed limitations during recovery.

It is important to remember that the above-spin recovery procedures are recommended for use only in the absence of the manufacturer's procedures. Before any pilot attempts to begin spin training, the pilot must be familiar with the procedures provided by the manufacturer for spin recovery.

The most common problems in spin recovery include pilot confusion in determining the direction of spin rotation and whether the maneuver is a spin versus spiral. If the airspeed is increasing, the glider is no longer in a spin but in a spiral. In a spin, the glider is stalled and the airspeed is at or below stalling speed.

COMMON ERRORS

- Failure to clear area before spins.
- Failure to establish proper configuration prior to spin entry.
- Failure to recognize conditions leading to a spin.
- Failure to achieve and maintain stall during spin entry.
- Improper use of controls during spin entry, rotation, and/or recovery.
- Disorientation during spin.
- Failure to distinguish a spiral dive and a spin.
- Excessive speed or secondary stall during spin recovery.
- Failure to recovery with minimum loss of altitude.

MINIMUM SINK AIRSPEED

Minimum sink airspeed is defined as the airspeed at which the glider loses the least amount of altitude in a given period of time. Minimum sink airspeed varies with the weight of the glider. Glider manufacturers publish the altitude loss in feet per minute or meters per second (e.g. 122 ft/min or 0.62 m/sec) at a specified weight. Flying at minimum sink airspeed results in maximum duration in the absence of convection in the atmosphere.

The minimum sink airspeed given in the GFM/POH is based on the following conditions.

- The glider is wings-level and flying a straight flight path; load factor is 1.0 G.
- The glider flight controls are perfectly coordinated.
- Wing flaps are set to zero degrees and air brakes are closed and locked.
- The wing is free of bugs or other contaminants.
- The glider is at a manufacturer-specified weight.

While flying in a thermalling turn, the proper airspeed is the minimum sink airspeed appropriate to the load factor, or G-load, that the glider is undergoing. The glider's stall speed increases with load factor. The minimum sink speed needs to be increased with an increase in load factor. For example, if a glider stall speed is 34 knots and the wings-level minimum sink airspeed is 40 knots, consider the following for thermalling.

- In a 30° banked turn, load factor is 1.2 Gs. The approximate square root of 1.2 is 1.1. Thirty-four knots times 1.1 yields a 37 knots stall speed. The minimum sink speed is still above the stall speed but by only approximately 3 knots. The margin of safety is decreasing and the pilot should consider increasing the minimum sink speed by a factor proportionate to the stall speed increase, in this case 44 knots.

- In a 45° banked turn, load factor is 1.4 Gs. The approximate square root of 1.4 is 1.2. Thirty-four knots times 1.2 yields a 41 knots stall speed. The minimum sink speed is now below the stall speed. If the pilot increases the mini mum sink speed proportionately to the stall airspeed, the new speed would be 48 knots, a 7 knot safety factor.

- In a 60° banked turn, load factor is 2.0 Gs. The approximate square root of 2.0 is 1.4. Thirty-four knots times 1.4 yields a 48 knots stall speed. The minimum sink speed is now below the stall speed. The pilot should increase the minimum sink speed proportionately to 56 knots, yielding an 8 knot safety factor.

Minimum sink airspeed is always slower than best L/D airspeed at any given operating weight. If the operating weight of the glider is noticeably less than maximum gross weight, then the actual minimum sink airspeed at that operating weight will be slower than that published.

COMMON ERRORS

- Improper determination of minimum sink speed.
- Failure to maintain proper pitch attitude and airspeed control.

BEST GLIDE AIRSPEED

Best glide (Lift/Drag) **airspeed** is defined as the airspeed that results in the least amount of altitude loss over a given distance. This allows the glider to glide the greatest distance in still air. This performance is expressed as glide ratio. The manufacturer publishes the best glide airspeed for specified weights and the resulting glide ratio. For example, a glide ratio of 36:1 means that the glider will loose 1 foot of altitude for every 36 feet of forward movement in still air at this airspeed. The glide ratio will decrease at airspeeds above or below best glide airspeed. The best glide speed can be found from the glider polars in Chapter 5—Performance Limitations.

COMMON ERRORS

- Improper determination of best glide airspeed for given condition.
- Failure to maintain proper pitch attitude and airspeed control.

SPEED-TO-FLY

Speed-to-fly refers to the optimum airspeed for proceeding from one source of lift to another. Speed-to-fly depends on the following.

1. The rate-of-climb the pilot expects to achieve in the next thermal or updraft.
2. The rate of ascent or descent of the air mass through which the glider is flying.
3. The glider's inherent sink rate at all airspeeds between minimum sink airspeed and never exceed airspeed.
4. Headwind or tailwind.

The object of speed-to-fly is to minimize the time and/or altitude required to fly from the current position to the next thermal. Speed-to-fly information is presented to the pilot in one or more of the following ways.

- By placing a speed-to-fly ring (MacCready ring) around the variometer dial.
- By using a table or chart.
- By using an electronic flight computer that displays the current optimum speed-to-fly.

The pilot determines the speed-to-fly during initial planning and than constantly updates this information in flight. The pilot must be aware of changes in the flying conditions in order to be successful in conducting cross-country flights or during competition.

COMMON ERRORS

- Improper determination of speed-to-fly.
- Failure to maintain proper pitch attitude and airspeed control.

TRAFFIC PATTERNS

The pilot must be familiar with the approach and landing traffic pattern at the local gliderport/airport because the approach actually starts some distance away. Most gliderports/airports use an initial point (IP) from which to begin the approach for each landing area. The IP may be located over the center of the gliderport/airport or at a remote location near the traffic pattern. As shown in Figure 7-32, the sequence of a normal approach is from over the IP to the downwind leg, base leg, final approach, flare, touchdown, rollout, and stop. Once the landing roll is completed, it is important to clear the active runway as soon as possible to allow other pilots to land safely.

Once over the IP, the pilot flies along the downwind leg of the planned landing pattern. The pilot should plan to be over the IP at an altitude of 800 to 1,000 feet AGL or as recommended by the local field operating procedures. During this time it is important to look for other aircraft and to listen on the communications radio, if one is installed, for other aircraft in the vicinity of the gliderport/airport. Glider pilots should be aware of other activities located at the gliderport/airport, and it is important that they are familiar with good operating practices established in the FAA *Aeronautical Information Manual* and Advisory Circulars. Glider operations usually establish the patterns for their operation with other activities in mind. Pilots new to a gliderport/airport should obtain a thorough checkout before conducting any flights.

Pilots should complete the landing checklist prior to the downwind leg. A good landing checklist is known as **FUSTALL**.

- Flaps—Set (if applicable).
- Undercarriage—Down and locked (if applicable).
- Speed—Approach speed established.
- Trim—Set.
- Air brakes (spoilers/dive brakes)—Checked for correct operation.
- Landing area—Look for wind, other aircraft, and personnel.
- Land the glider.

This checklist can be modified as necessary for any glider.

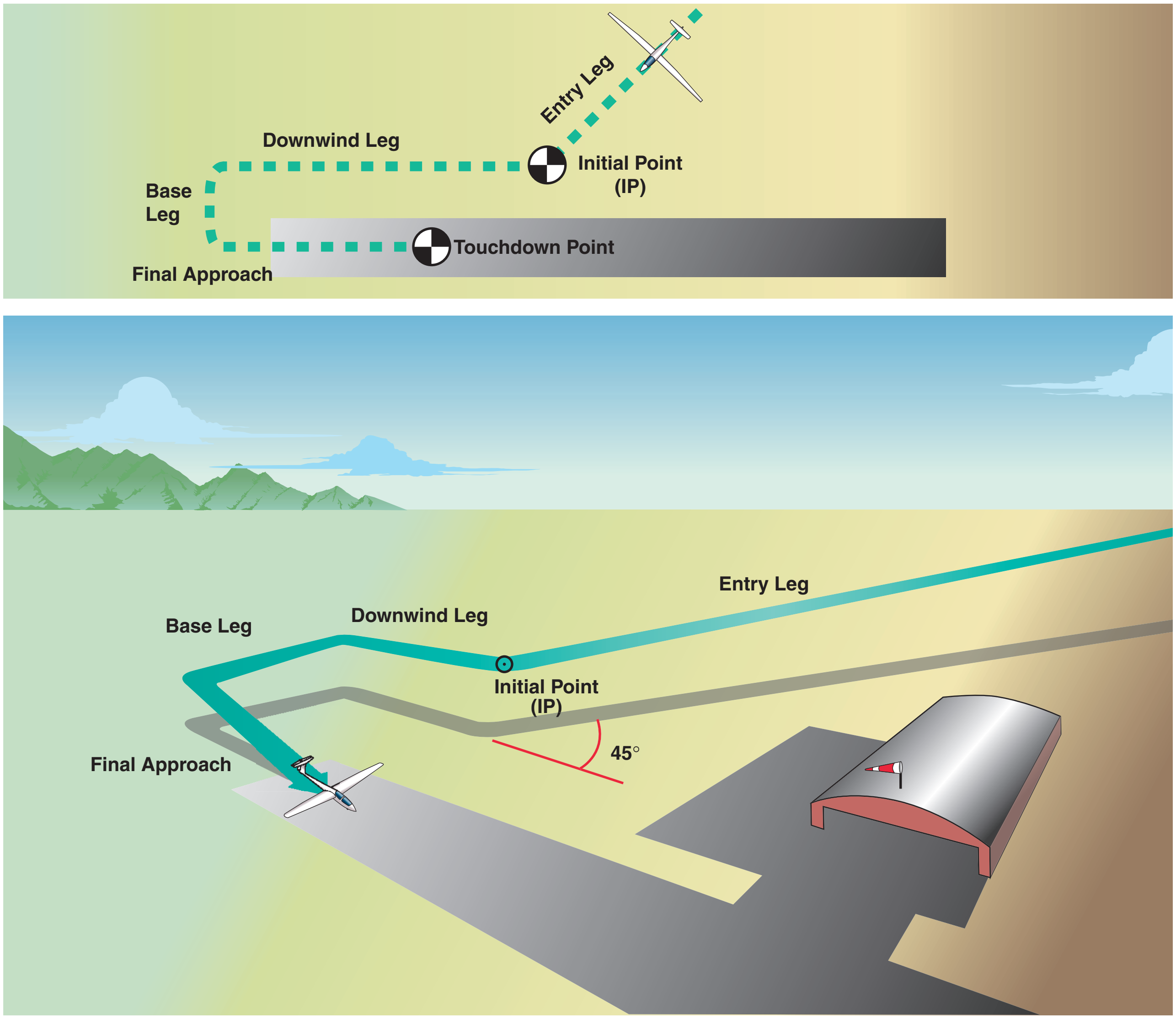


Figure 7-32. Traffic pattern.

After accomplishing the checklist, concentrate on judging your approach angle and staying clear of other aircraft while monitoring your airspeed. Medium turns should be used in the traffic pattern. The approach should be made using spoilers/dive brakes as necessary to dissipate excess altitude. Use the elevator to control the approach speed.

Strong crosswinds, tailwinds, or high sink rates that are encountered in the traffic pattern will require the pilot to modify the individual pattern leg. A strong tailwind or headwind will require a shortening or lengthening of the leg respectively. A sudden encounter with a high sink rate may require the pilot to turn toward the landing area sooner than normal. The pilot should not conduct a 360° turn once established on the downwind leg. Throughout the traffic pattern the pilot should be constantly aware of the approach speed.

When at an appropriate distance from the IP, the pilot should maneuver the glider to enter the downwind leg. The distance from downwind leg to the landing area should be approximately $^1/_4$ to $^1/_2$ mile. This will vary at different locations. On the downwind, leg the glider should be descending to arrive abeam the touchdown point at an altitude between 500 and 600 feet AGL. On downwind leg, the groundspeed will be higher due to the tailwind. The pilot should use the spoilers/dive brakes as necessary to arrive at this altitude. The pilot should also monitor the gliders position with reference to the touchdown area. If the wind is pushing the glider away from or toward the touchdown area, the pilot should stop the drift by establishing a wind correction angle into the wind. Failure to do so will affect the point where the base leg should be started.

The base leg should be started when the touchdown point is approximately 45° over the pilot's shoulder looking back at the touchdown area. Once established on the base leg, the pilot should scan the extended final approach path in order to detect any aircraft that might be on long final approach to the landing area in use. The turn to base leg should be timely in order to keep the point of intended touchdown area within easy gliding range. The pilot should adjust the turn to correct for wind drift encountered on the base leg. On base leg, the pilot should adjust the spoilers/dive brakes, as necessary, to position the glider at the desired glide angle.

The turn onto the final approach is made so as to line up with the centerline of the touchdown area. The pilot should adjust the spoilers/dive brakes as necessary to fly the desired approach angle to the aim point. The selected aim point should be prior to the touchdown point to accommodate the landing flair. The pilot flairs the glider at or about three to five feet AGL and the glider floats some distance until it touches down.

When within three to five feet of the ground, begin the flare with slight back elevator. As the airspeed decreases, the pilot holds the glider in a level or tail low attitude so as to touchdown at the slowest possible speed while the glider still is under aerodynamic control. After touchdown the pilot should concentrate on rolling out straight down the centerline of the touchdown area.

Tracking down the centerline of the touchdown area is an important consideration in gliders. The long, low wingtips of the glider are susceptible to damage from runway border markers, runway light stanchions, or taxiway markers. Turning off the runway should be done only if and when the pilot has the glider under control.

Landing in high, gusty winds or turbulent conditions may require higher approach airspeeds to improve controllability and provide a safer margin above stall airspeed. A rule of thumb is to add $^1/_2$ the gust factor to the normal approach airspeed. This increased approach airspeed affords better penetration into the headwind on final approach. The adjusted final approach airspeed should not be greater than the maneuvering speed (V_A) or maximum turbulence penetration speed (V_B), whichever is lower.

CROSSWIND LANDINGS

Crosswind landings require a crabbing or slipping method to correct for the effects of the wind on the final approach. Additionally, the pilot must land the glider without placing any unnecessary side load on the landing gear.

The crab method requires the pilot to point the nose of the glider into the wind and fly a straight track along the desired ground path. The stronger the wind, the greater the crab angle. Prior to flare, the pilot must be prepared to align the glider with the landing area. The pilot should use the rudder to align the glider prior to touchdown and deflect the ailerons into the wind to control the side drift caused by the crosswind.

In the slip method, the pilot uses rudder and ailerons to slip the glider into the wind to prevent drifting downwind of the touchdown area. The disadvantage of the slip method is that the sink rate of the glider increases, forcing the pilot to adjust the spoilers/dive brakes, as necessary, to compensate for this additional sink rate.

Whether the pilot selects the slip or crab method for crosswind landing is personal preference. The important action is to stabilize the approach early enough on final so as to maintain a constant approach angle and airspeed to arrive at the selected touchdown point.

COMMON ERRORS

- Improper glide path control.
- Improper use of flaps, spoilers/dive brakes.
- Improper airspeed control.
- Improper correction of crosswind.
- Improper procedure for touchdown/landing.
- Poor directional control during/after landing.
- Improper use of wheel brakes.

SLIPS

A slip is a descent with one wing lowered. It may be used for either of two purposes, or both of them combined. A slip may be used to steepen the approach path without increasing the airspeed, as would be the case if the spoilers/dive brakes were inoperative or to clear an obstacle. It can also be used to make the glider move sideways through the air to counteract the drift which results from a crosswind.

Formerly, slips were used as a normal means of controlling landing descents to short or obstructed fields, but they are now primarily used in the performance of crosswind landings and short/off-field landings.

With the installation of effective spoilers/dive brakes on modern gliders, the use of slips to steepen or control the angle of descent is no longer a common procedure. However, the pilot still needs skill in performance of forward slips to correct for possible errors in judgment of the landing approach.

The primary purpose of forward slips is to dissipate altitude without increasing the glider's airspeed, particularly in gliders not equipped with flaps or those with inoperative spoilers/dive brakes. There are many circumstances requiring the use of forward slips, such as in a landing approach over obstacles and in making off-field landings. It is always wise to allow an extra margin of altitude for safety in the original estimate of the approach. In the latter case, if the inaccuracy of the approach is confirmed by excess altitude when nearing the boundary of the selected field, slipping may dissipate the excess altitude.

The use of slips has definite limitations. Some pilots may try to lose altitude by violent slipping rather than by smoothly maneuvering and exercising good judgment and using only a slight or moderate slip. In off-field landings, this erratic practice invariably will lead to trouble since enough excess speed may result in preventing touching down anywhere near the touchdown point, and very often will result in overshooting the entire field.

The forward slip is a slip in which the glider's direction of motion continues the same as before the slip was begun. [Figure 7-33] If there is any crosswind, the slip will be much more effective if made into the wind. Assuming the glider is originally in straight flight, the wing on the side that the slip is to be made should be lowered by using the ailerons. Simultaneously, the glider's nose must be yawed in the opposite direction by applying opposite rudder so the glider's longitudinal axis is at an angle to its original flight path. 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. The nose should also be raised as necessary to prevent the airspeed from increasing.

If a slip is used during the last portion of a final approach, the longitudinal axis of the glider must be aligned with the runway just prior to touchdown so the glider touches down headed in the direction in which it is moving. This requires timely action to discontinue the slip and align the glider's longitudinal axis with its direction of travel over the ground well before the instant of touchdown. Failure to accomplish this imposes severe sideloads on the landing gear and imparts violent ground looping tendencies.

Discontinuing the 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 glider will tend to acquire excess airspeed.

Because of the location of the pitot tube and static vents, airspeed indicators in some gliders may have considerable error when the glider is in a slip. The pilot must be aware of this possibility and recognize a properly performed slip by the attitude of the glider, the sound of the airflow, and the feel of the flight controls.

A sideslip, [Figure 7-34] as distinguished from a forward slip, is one during which the glider's longitudinal axis remains parallel to the original flight path, but in which the flight path changes direction according to the steepness of the bank. The sideslip is important in counteracting wind drift during crosswind landings and is discussed in crosswind landing section of this chapter.

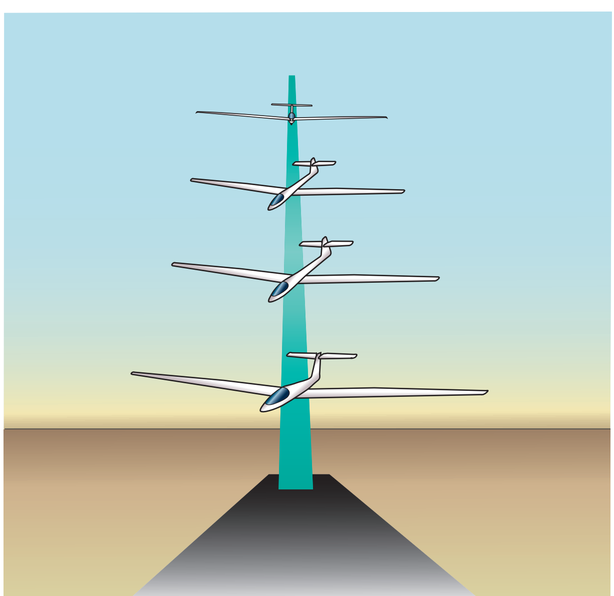


Figure 7-33. Forward slip.

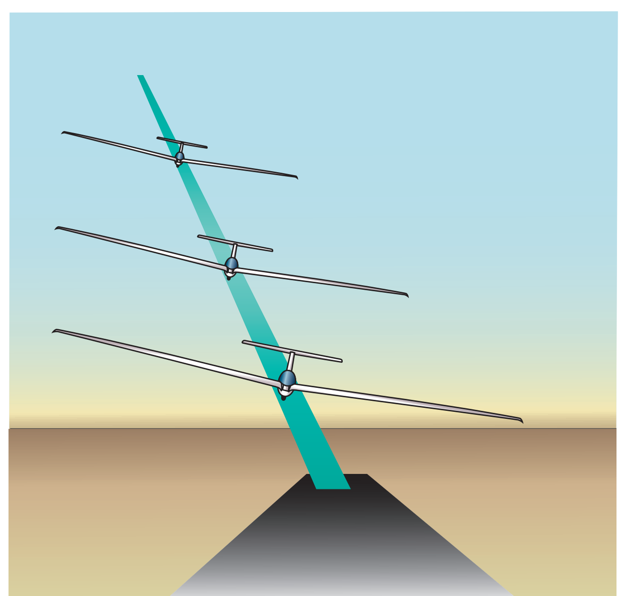


Figure 7-34. Side slip.

COMMON ERRORS

- Improper glide path control.
- Improper use of slips.
- Improper airspeed control.
- Improper correction for crosswind.
- Improper procedure for touchdown/landing.
- Poor directional control during/after landing.
- Improper use of brakes.

DOWNWIND LANDINGS

Downwind landings present special hazards and should be avoided when an into-the-wind landing is available. However, factors such as gliderport/airport layout, presence of insurmountable obstacles, such as high terrain at one end of the runway, runway slope or grade, or a launch failure at low altitude can require you to make a downwind landing. The pilot must use the normal approach airspeed during a downwind landing. Any airspeed in excess only causes the approach area and runway needed for approach and landing to increase.

The tailwind increases the touchdown groundspeed and lengthens the landing roll. The increased distance for landing can be determined by dividing the actual touchdown speed by the normal touchdown speed, and squaring the result. For example, if the tailwind is 10 knots and the normal touchdown speed is 40 knots, the actual touchdown speed is 50 knots. This touchdown speed is 25 percent more than the normal speed, a factor of 1.25. A factor of 1.25 squared equals 1.56. This means the landing distance will increase 56 percent over the normal landing distance.

On downwind approaches, a shallower approach angle should be used, depending on obstacles in the approach path. Use the spoilers/dive brakes and perhaps a forward slip as necessary to achieve the desired glide path.

After touchdown, use the wheel brake to reduce groundspeed as soon as is practical. This is necessary to maintain aerodynamic control of the glider.

COMMON ERRORS

- Improper glide path control.
- Improper use of slips.
- Improper airspeed control.
- Improper correction of crosswind.
- Improper procedure for touchdown/landing.
- Poor directional control during/after landing.
- Improper use of wheel brakes.

AFTER-LANDING AND SECURING

After landing, move or taxi the glider clear of all runways. If the glider is to be parked for a short interval between flights, choose a spot that does not inconvenience other gliderport/airport users. Protect the glider from wind by securing a wingtip with a weight or by tying it down. Consult the manufacturer's handbook for the recommended methods for securing the glider. Remember that even light winds can cause gliders to move about, turn sideways, or cause the higher wing in a parked glider to slam down onto the ground. Because gliders are particularly vulnerable to wind effects, the glider should be secured any time it is unattended.

When the glider is done flying for the day, move it to the tiedown area. Secure the glider in accordance with the recommendation in the GFM/POH. The tiedown anchors should be strong and secure. Apply external control locks to the glider flight control surfaces. Control locks should be large, well marked, and brightly painted. If a cover is used to protect the pitot tube, the cover should be large and brightly colored. If a canopy cover is used, secure it so that the canopy cover does not scuff the canopy in windy conditions.

If the glider is stored in a hangar, be careful while moving the glider to avoid damaging it or other aircraft in the hangar. Chock the main wheel and tailwheel of the glider when it is in position in the hangar. If stored in a wings-level position, put a wing stand under each wingtip. If stored with one wing high, place a weight on the lowered wing to hold it down.

If the glider is to be disassembled and stored in a trailer, tow the glider to the trailer area and align the fuselage with the long axis of the trailer. Collect all tools, dollies, and jigs required to disassemble and stow the glider. Secure the trailer so that loading the glider aboard does not move or upset the trailer or trailer doors. Follow the disassembly checklist in the GFM/POH. Stow the glider components securely in the trailer. When the glider has been stowed and secured, collect all tools and stow them properly. Close trailer doors and hatches. Secure the trailer against wind and weather by tying it down properly.