AIRPLANE MANEUVERS MASTERY

pilotinstitute

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BRIEFINGS

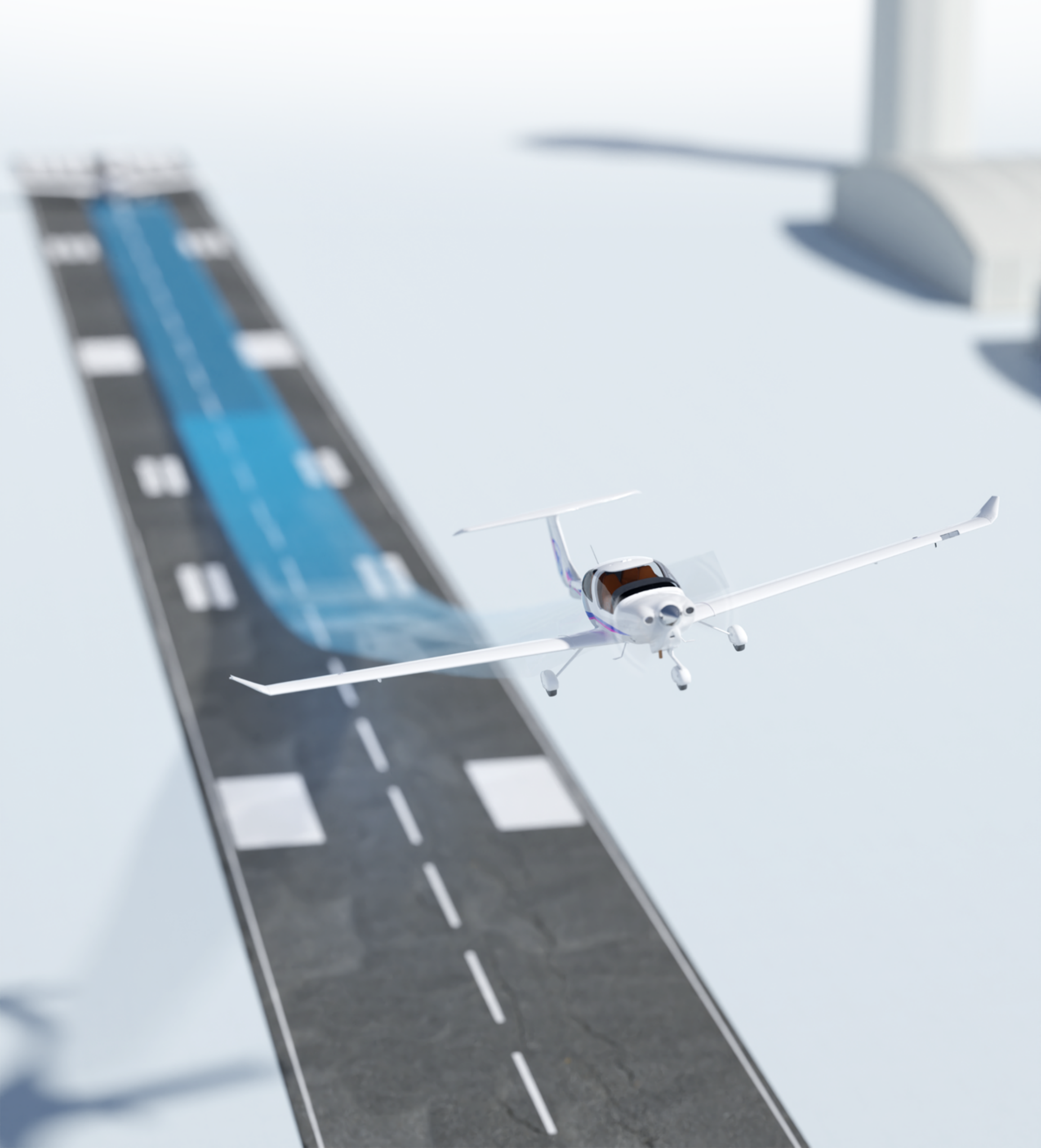
PASSENGER BRIEFING

- This is a nonsmoking flight.
- The emergency exit location is [location].
- To exit the aircraft, [procedure to unlock/open door].
- The fire extinguisher is located [location].
- Seatbelts are to be worn at all times. To release [procedure to release].
- Shoulder harnesses are to be worn for taxi, takeoff, and landing.
- In the pilot and co-pilot seat, we use a positive exchange of controls. I will start with the flight controls. If you want to take control of the aircraft, you should say, "my controls." I will then respond with "your controls," confirming that I have passed control of the aircraft to you. You will then confirm that you are flying the aircraft by saying "my controls."
- Are there any questions?

TAKEOFF BRIEFING

- We are departing on runway [number and designation].
- On a heading of [heading] to [altitude] feet.
- We have [runway length] feet available.
- We need [takeoff over 50' obstacle distance] feet for takeoff.
- If we have an emergency prior to rotation, I will close the throttle and apply brakes heavily, get off the runway if possible, and deal with whatever issue we have.
- If we have rotated and have sufficient runway remaining, we will set back down on the runway, pull power to idle, apply brakes heavily, get off the runway if possible, and deal with whatever issue we have.
- If we have rotated and do not have sufficient runway remaining, we will pitch for the best glide speed of [best glide speed] and land where practical.
- In the event of an off-airport landing, from the surface to 500 feet AGL, we will pick a spot 30 degrees off the nose, 500 to 1,000 feet AGL, we will pick a spot 60 off the nose, and if we are above 1,000 feet AGL we will pick a spot 90 degrees off the nose. We will not try to return to the airport unless we are at least 1,000 feet AGL.

TAKEOFFS



TAXIING

The rudder pedals move the nose-wheel in the direction the pedal is pushed. The rudder pedals are located at the bottom of the left and right pedals. The brake for that wheel is located at the top of each pedal. Keep the balls of the feet on the bottom of the rudder pedals.

Obtain taxi clearances and instructions at towered airports before moving, if possible. Look at the different taxi routes, identify any hot spots, and become familiar with them. A sample radio call is below with runway 7 in use:

"Deer Valley Ground, N647DS Ramp 4, information Sierra, would like a west departure."
"N647DS, Deer Valley Ground, taxi via delta to 7 right."

Write down the clearance. Be sure to read back the clearance to the controller so they know you understand the route. Have a copy of the airport diagram (either paper or electronic), and look at your taxi route before beginning to taxi.

Remember, take the time to be safe. Ask for a progressive taxi if you don't understand the taxi route or instructions. The controller will only give you one specific point; a new one will be given when you reach that point.

At non-towered airports, announce similar information on the CTAF frequency. For example, if Deer Valley Airport is closed, an announcement would sound like this:

"Deer Valley Traffic, N647DS at ramp 4, taxiing to runway 7 right via delta, Deer Valley Traffic."

Just prior to beginning movement, identify the wind direction. This can be done through the ATIS and confirmed by a windsock or any other visual reference, such as flags, bushes, or trees. Enter an appropriate wind correction error.

Remember, for a tailwind: elevator down, aileron away from wind, or "dive away." Any headwind: neutral elevator, aileron into the wind, or "into wind, elevator neutral."

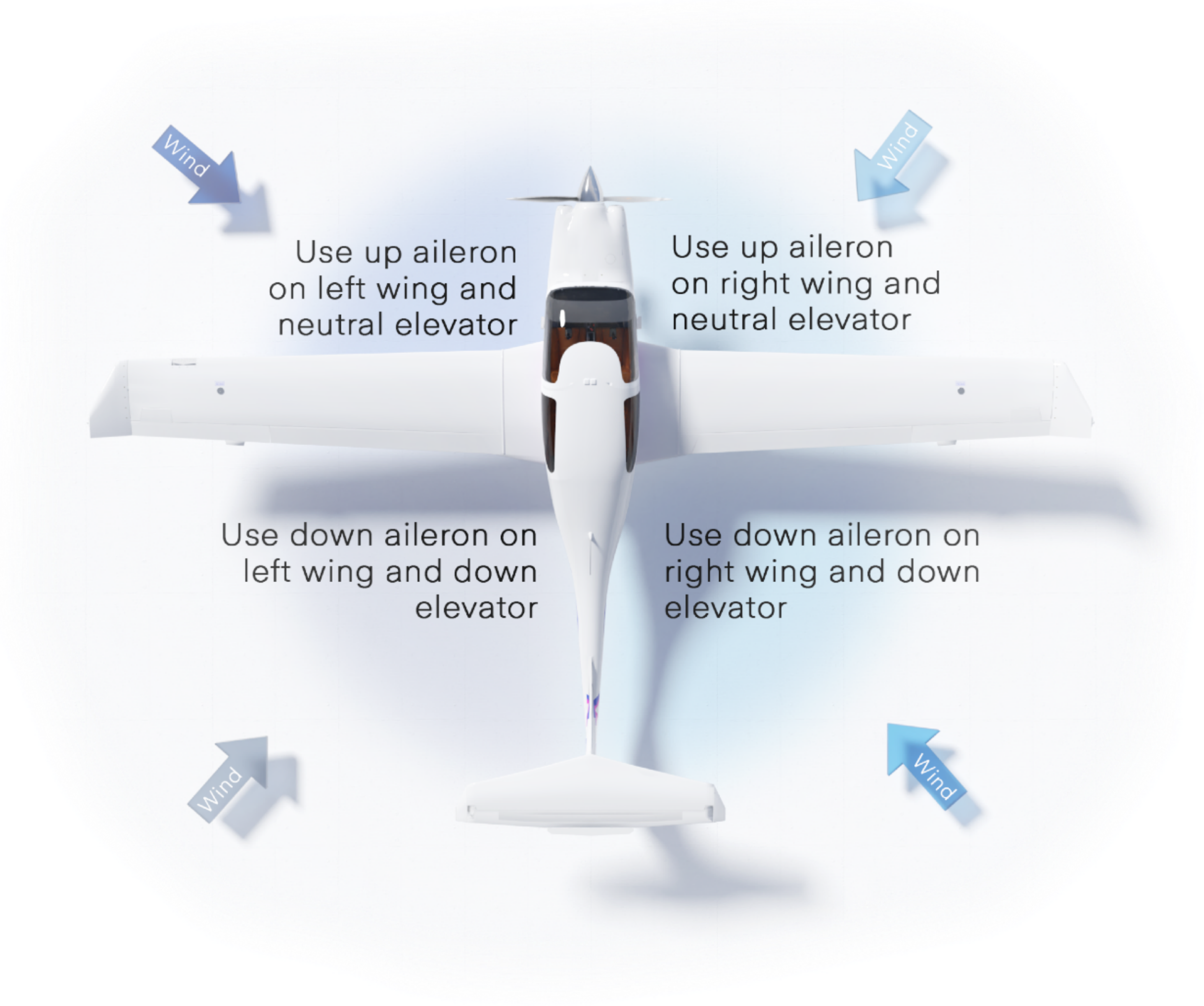
When ready to move, clear the area visually. Also make a radio call, if appropriate. Ensure the parking brake is released. Sometimes, it takes extra power to get the aircraft moving. Once the aircraft is moving, pull power back to idle to establish a taxi speed of a brisk walk.

A good rule of thumb is no more than 5 knots in a non-movement area and 15 knots in a movement area. Too much power is being used if the brakes are constantly being applied to slow down. Keep the centerline of the taxiway aligned with the leg closer to the center of the aircraft.

Once you start moving, smoothly apply the brakes to ensure they are working. After the brakes are checked, resume taxiing. Add just enough power to move at a brisk walk. Push the left rudder pedal to turn the airplane to the left.

To move to the right, push on the right rudder pedal. Try not to "dance" on the pedals. The inputs have a slight delay. Put in a small amount of correction; if more is needed, push more on the pedal. If the input was too much, release some of the pressure. Be aware of the hold-short lines.

Remember, any solid line needs a clearance to cross. If the lines are broken, they can be crossed without a clearance.



NORMAL TAKEOFF

Description

After completing the run-up, taxi to the hold short line and stop behind it so you can see all the lines through the windshield. Call the tower to obtain the proper clearance:

Pilot: "Prescott tower, N647DS holding short runway 3 right, ready for departure."
Controller: *"N647DS, runway 3 right, cleared for takeoff, right downwind departure approved."*

With the proper clearance obtained, look at final approach for any aircraft approaching. Once final is clear, call out "final clear". Then, smoothly apply taxi power to enter the runway. Align the centerlines of the runway with the leg closer to the center of the aircraft.

Once aligned with the centerline, call out "aligned with centerline." Look down the runway and verify no hazards are present. Also, identify a visual reference far off in the distance. Smoothly apply full power, listening for any strange sounds with the engine as its RPMs increase.

Once full power is applied, call out "Power full." The aircraft will begin to accelerate. Remember the left-turning tendencies. Apply right rudder to maintain centerline and alignment with the visual reference outside. Double-check that all the gauges are green and call out "gauges green." Look back outside and ensure the aircraft is tracking straight down the centerline of the runway.

Once the airspeed needle begins moving, call out "airspeed alive." Allow the aircraft to accelerate. Once the aircraft reaches rotation speed (V_R), smoothly pull the yoke aft (towards the pilot).

As the front of the aircraft comes off the ground, maintain the aft pressure on the yoke. When the main wheels come off the ground, the center of gravity will change slightly due to the transition of the weight to the wings from the wheels.

Allow the aircraft to accelerate to V_Y. Just before the aircraft reaches that airspeed (5 kts or so), increase or decrease aft yoke pressure to maintain that speed. Keep looking outside to ensure the aircraft is flying straight to the visual reference point.

Maintain this attitude to 500 feet AGL, then transition to the climb checklist. Remember to always fly the airplane first. Don't prioritize a checklist over the safe operation of the aircraft. It is of utmost importance that all pilots understand the normal takeoff as all other takeoffs build upon it.

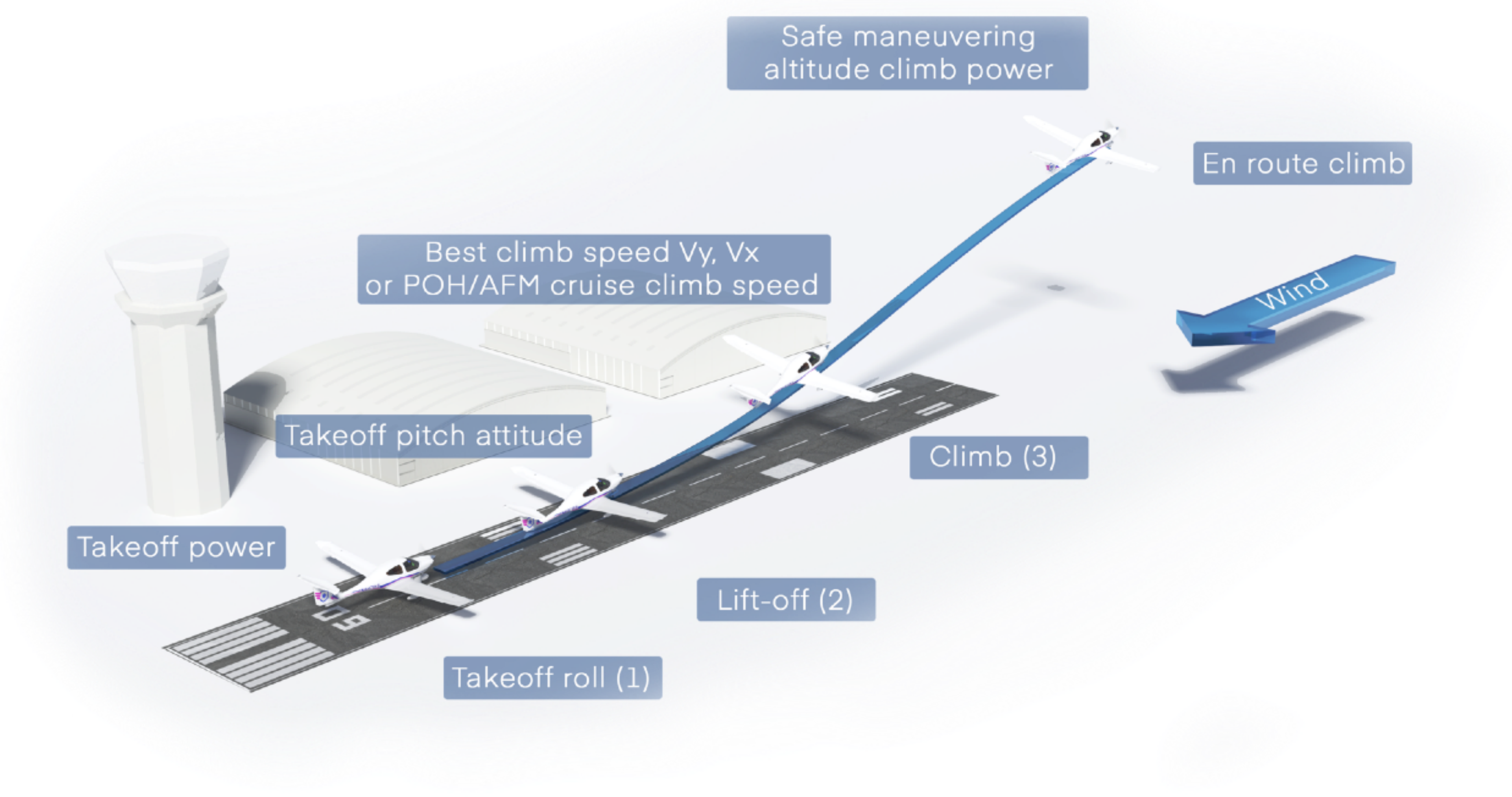
Normal Takeoff Procedure

1. Obtain the proper clearance/make radio call
2. Clear final approach and runway
3. Taxi onto runway
4. Align with centerline
5. Identify visual references off the end of the runway
6. Smoothly add full power
7. Verify gauges in the green
8. Maintain centerline
9. Call out airspeed alive
10. Rotate at VR
11. Climb at VY

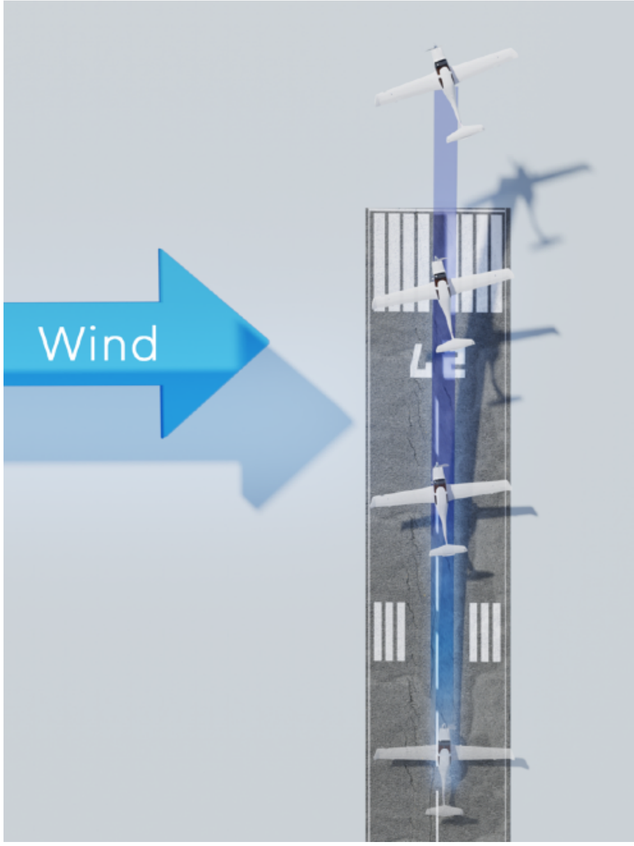
ACS STANDARDS

Private: V_Y +10/-5 kts

Commercial: V_Y ± 5 kts



CROSSWIND TAKEOFF



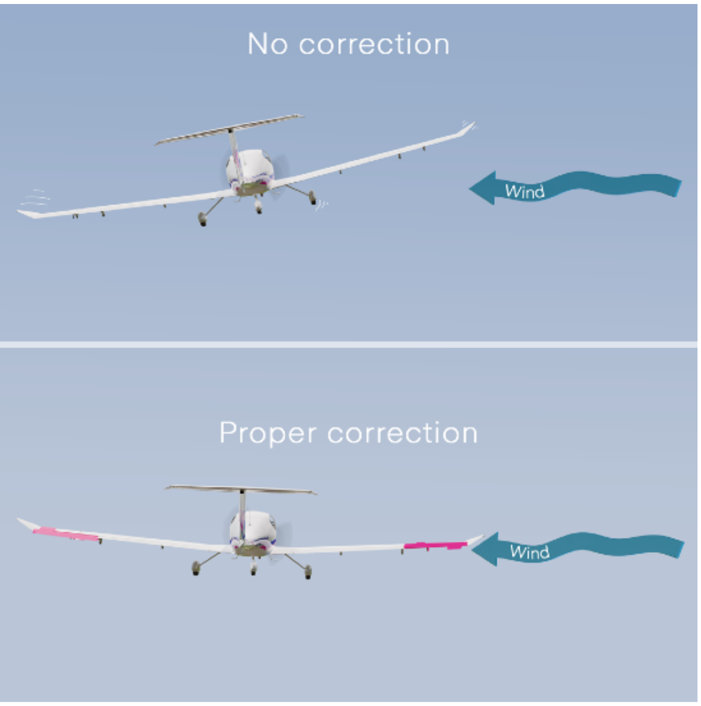
Description

A crosswind takeoff is performed in a very similar fashion to a normal takeoff. Ideally, takeoffs should be performed into a direct headwind. This is not always possible, and taking off with a crosswind has additional factors that must be considered during the takeoff roll.

A wind correction needs to be entered during all phases of flight. Remember when taxiing with a tailwind: elevator down (yoke forward), ailerons away from the wind. With a headwind, elevator neutral, ailerons into the wind. When on the runway, turn the yoke to the direction of the wind, even if there is a slight tailwind.

After receiving the appropriate clearance and clearing final approach, call out "final clear" and smoothly apply taxi power to enter the runway and align with the centerline. Once aligned with the centerline of the runway, call out "aligned with centerline." Visually look down the runway to verify no hazards are present. Look into the distance for a visual reference.

Enter a wind correction appropriate to the wind direction. If the wind is coming from the right of the aircraft, apply full aileron to the right. Smoothly apply full power and call out "power full." Anticipate the left-turning tendencies and correct with rudder. A crosswind will cause the airplane to want to weathervane(point into the wind). A wind striking the airplane on the left side will push the tail, further aggravating left-turning tendencies. A wind striking the right side of the airplane will counteract left turning tendencies, and pilots may use too much right rudder to keep the airplane on centerline. This can cause the airplane to veer to the right.



As the airplane accelerates, double-check the gauges, and if they are in the normal operating range, call out "gauges green." Ideally, the airplane should take off with a wings-level attitude. Depending on the direction and velocity of the crosswind, the airplane may assume different attitudes. If the airplane is "leaning" into the crosswind, slightly reduce the aileron input to maintain the wings-level attitude. If the airplane is "leaning" away from the direction of the wind, more aileron input is needed. If the control is fully deflected and the aircraft still leans away from the crosswind, the wind may be too strong for the aircraft to handle. In that case, the takeoff should be aborted immediately. To abort the takeoff, pull power to idle and apply brakes heavily.

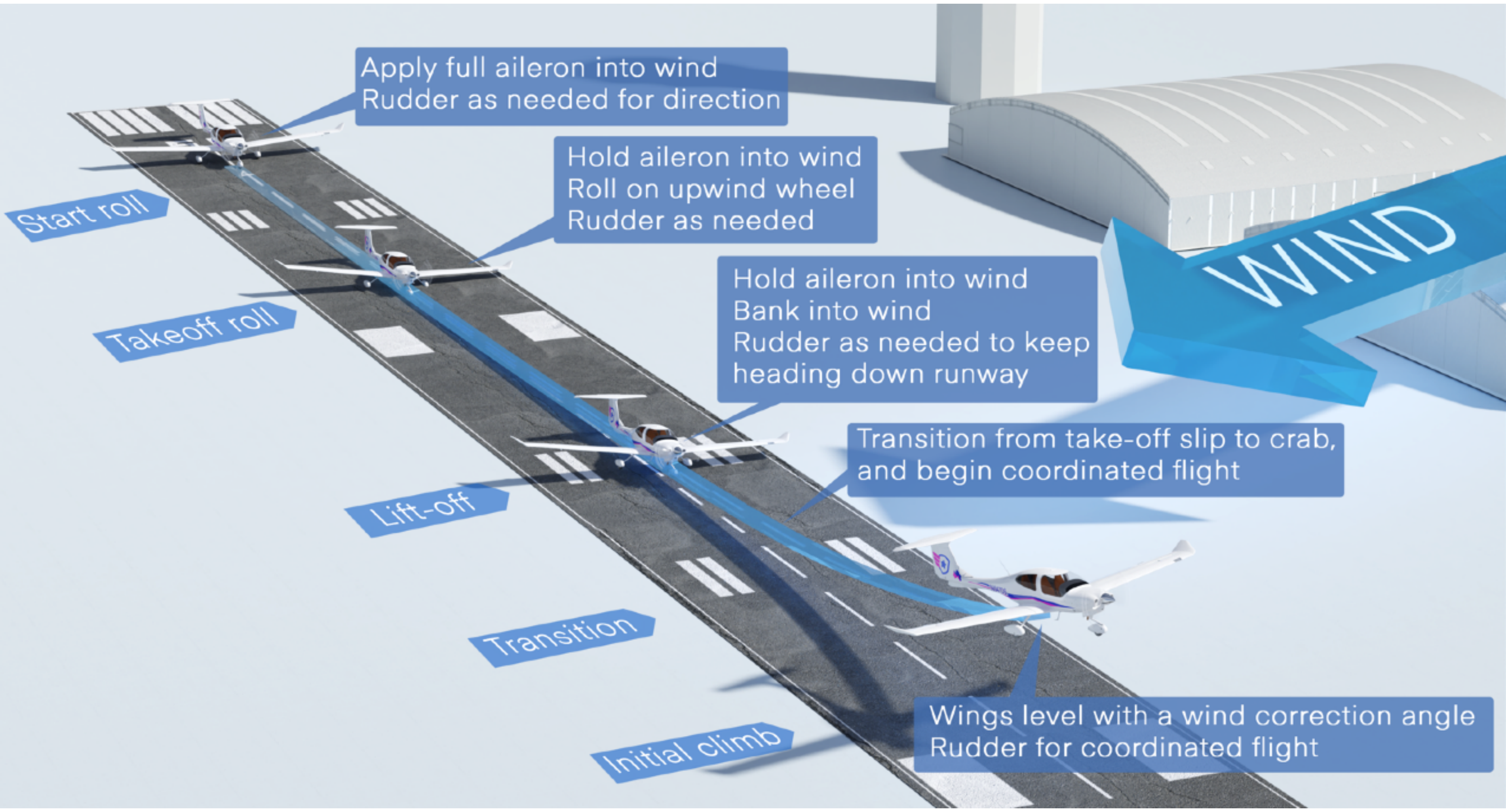
Once the airspeed indicator begins moving, call out "airspeed alive." Maintain the proper aileron control into the wind, with direction controlled with the rudder pedals. As the aircraft reaches rotation speed (VR), smoothly apply pressure to bring the yoke aft (towards the pilot). As the aircraft becomes airborne, the nose wheel will come up first. The downwind wheel (further from the direction of the wind) will come up next, followed by the upwind wheel (closer to the wind).

Release the pressure. Allow the aircraft to come to a wings-level attitude. Point the aircraft in the direction the crosswind is blowing from (called crabbing). Keep checking the visual reference to determine if the airplane is drifting away from it. Adjust the amount of correction to maintain flight towards the visual reference. At 500' AGL, transition to the climb checklist.

Crosswind Takeoff Procedure

ACS STANDARDS
Private: V_Y +10/-5 kts
Commercial: V_Y ± 5 kts

1. Obtain the proper clearance/make radio call
2. Clear final approach and runway
3. Apply wind correction
4. Taxi onto the runway
5. Align with centerline
6. Identify visual references off the end of the runway
7. Smoothly add full power
8. Verify gauges in the green
9. Maintain centerline
10. Call out airspeed alive
11. Reduce wind correction angle to maintain wings level attitude
12. Rotate at V_R
13. Downwind wheel comes up second
14. Upwind wheel comes up last
15. Allow aircraft to crab into the wind
16. Maintain ground track



SHORT FIELD TAKEOFF AND MAXIMUM PERFORMANCE CLIMB

Description

The purpose of this takeoff is to take off in the shortest distance possible. It is also used to gain as much altitude in the shortest distance when the runway is shortened due to obstructions or performance. Short field takeoff rotation speed is usually 5-8 knots slower than normal rotation speed.

To perform the maneuver, follow the procedures in the POH of the aircraft being flown. A generic procedure is below.

Before obtaining takeoff clearance at the hold short line, put flaps to the first notch. Also, apply two turns of nose-up trim. After obtaining the proper clearance, visually verify that no aircraft are on final approach. Call out "final clear." Apply taxi power to enter the runway. Use all available runway. Align the airplane with the centerline of the runway and call out "aligned with centerline." Visually scan the runway for any hazards and look further into the distance for a visual reference aligned with the runway.

Come to a complete stop. Place the balls of the feet on both brakes and press on them to prevent any forward movement with the aircraft. Input any crosswind correction needed. Smoothly apply full power, calling out "power-full" when full power is applied. Listen for any abnormal sounds while the RPMs rise. Keep pressure on the brakes to prevent any forward movement. When the gauges have all stabilized, call out "gauges green." Release the brakes, and be ready for the left turning tendencies to pull the aircraft to the left. Transition the feet to the rudder pedals, and apply right rudder to keep aligned with centerline. Keep looking outside, checking the gauges, and once the airspeed becomes moving, call out "airspeed alive." Allow the airplane to accelerate, maintaining centerline. Once at the short field rotation speed (V_R), apply smooth aft yoke to begin rotation. Use caution; the aircraft may enter an accelerated stall if rotated too quickly. Allow the airplane to accelerate to V_X and climb at that speed until 50 feet AGL (ACS) or until clear of obstacles. Remember to look outside and verify the aircraft is still tracking toward the visual reference point. Reevaluate any crosswind input required.

Once complete, allow the aircraft to accelerate to V_Y and clean the airplane. Continue climbing at V_Y until 500 feet, then transition to the climb checklist.

Short Field Take-Off Procedure

1. Obtain the proper clearance/make radio call
2. Configure as necessary
3. Clear final approach and runway
4. Use all runway available
5. Align with centerline
6. Come to a stop
7. Apply both brakes
8. Smoothly apply full power
9. Wait for gauges to stabilize
10. Release brakes
11. Maintain centerline
12. Rotate at short-field rotate speed
13. Climb at short-field climb speed or V_X
14. Clear of the obstacle (or approx 50 feet)
15. Clean the aircraft
16. Climb at V_Y

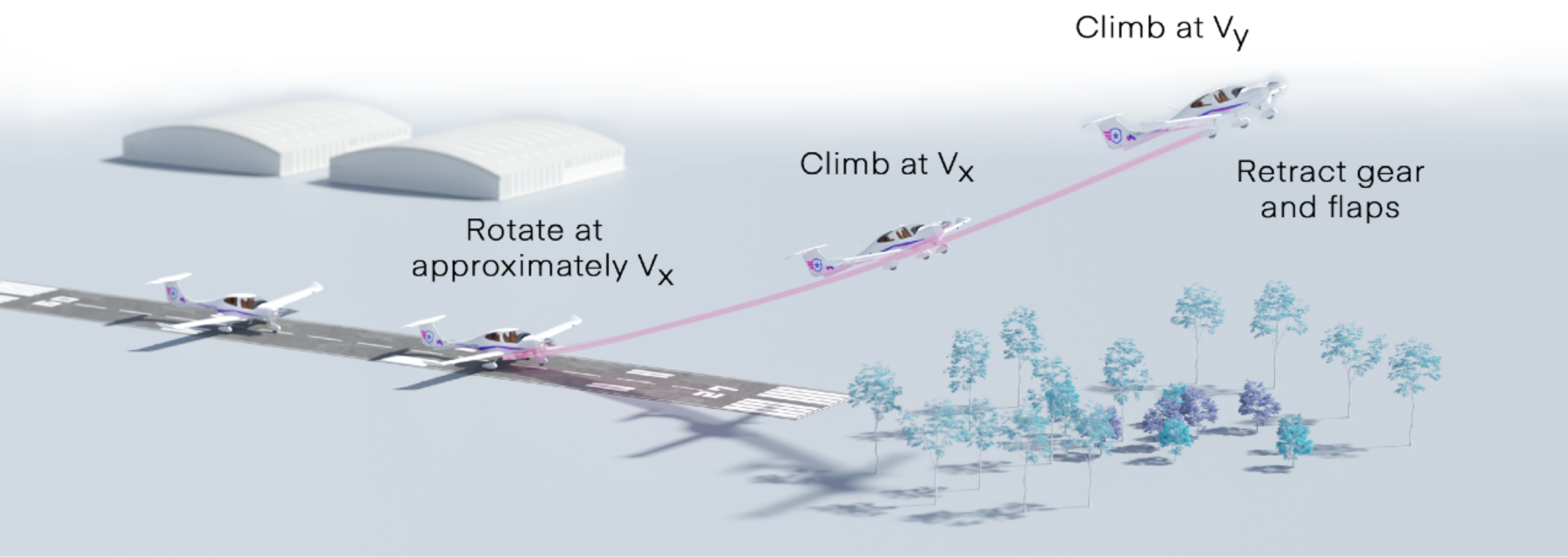
ACS STANDARDS

Private

Rotate at V_X +10/-5 kt
Climb at V_X +10/-5 kt to 50 ft
Pitch for V_Y +10/-5 kt
Maintain V_Y +10/-5 kt

Commercial

Rotate at V_X ± 5 kt
Climb at V_X ± 5 kt to 50 ft
Pitch for V_Y ± 5 kt
Maintain V_Y ± 5 kt



SOFT FIELD TAKEOFF

Description

The purpose of this takeoff is to transition the weight of the aircraft to the wings as soon as possible. This helps the aircraft get up to speed as quickly as possible when taking off on rough ground, mud, or snow.

To perform the maneuver, follow the procedures in the POH of the aircraft being flown. A generic procedure is below.

Flaps should be put to the first notch at the hold short line. The yoke should be full aft to keep the weight off the nose-wheel. Two turns of nose-down trim should be applied. Brakes should not be used, simulating that the weight will move forward and push the nose-wheel into the soft surface if the brakes are used. If the brakes are used during simulation, explain to the instructor or examiner why (e.g., hold short line, in line at the runway). Once the proper clearance is obtained, visually clear the final approach for any aircraft that could be a hazard. Once final is clear, call out "final clear". Slowly taxi onto the runway, maintaining full aft yoke. Align with the centerline of the runway, and apply any wind correction needed. Call out "aligned with centerline". Visually clear the runway and pick a visual reference in the distance aligned with the runway as a reference to fly towards.

Apply full takeoff power. Once applied, call out "power-full." Anticipate the left-turning tendencies and apply right rudder. As the airplane accelerates, release 2-3 inches of back pressure on the yoke. This is more of a "feeling" and comes with practice and experience. Maintain aft yoke pressure. As the airplane accelerates, allow the front wheel to come off the ground. It is acceptable for the front wheel to come up before rotation speed, as the goal is to transition the weight to the wings as soon as possible. The airplane will continue to accelerate, and when the main wheels come off the ground, allow the aircraft to climb approximately 5 feet. Then, smoothly level the airplane.

Allow the airplane to accelerate while still in ground effect, maintaining directional control. Once the airplane reaches V_Y, begin a climb. Remember to check the visual reference to ensure the airplane is traveling in the correct direction. Reevaluate any wind corrections needed. Once past V_Y, clean the airplane by putting the flaps up. Continue climbing at V_Y until 500' AGL, then transition to the climb checklist.

Soft Field Takeoff Procedure

1. Obtain the proper clearance/make radio call
2. Configure as necessary
3. Clear final approach and runway
4. Stay off the brakes
5. Apply full aft yoke
6. Taxi onto the runway
7. Align with centerline
8. Smoothly apply full power
9. Reduce 1-3" of yoke
10. Rotate at soft field rotate speed
11. Level off in ground effect
12. Accelerate to V_Y
13. Climb at V_Y
14. Clean aircraft

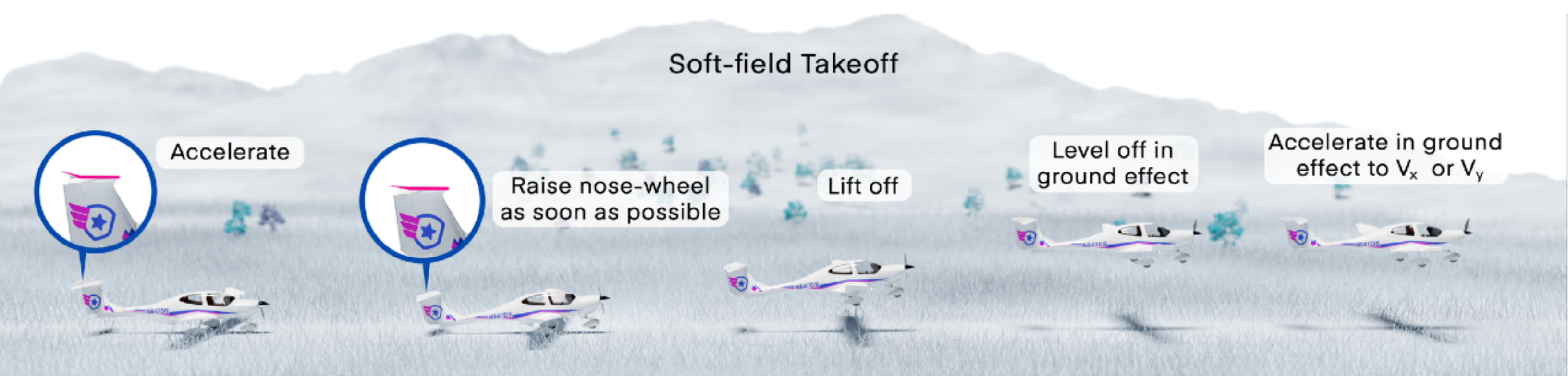
ACS STANDARDS

Private

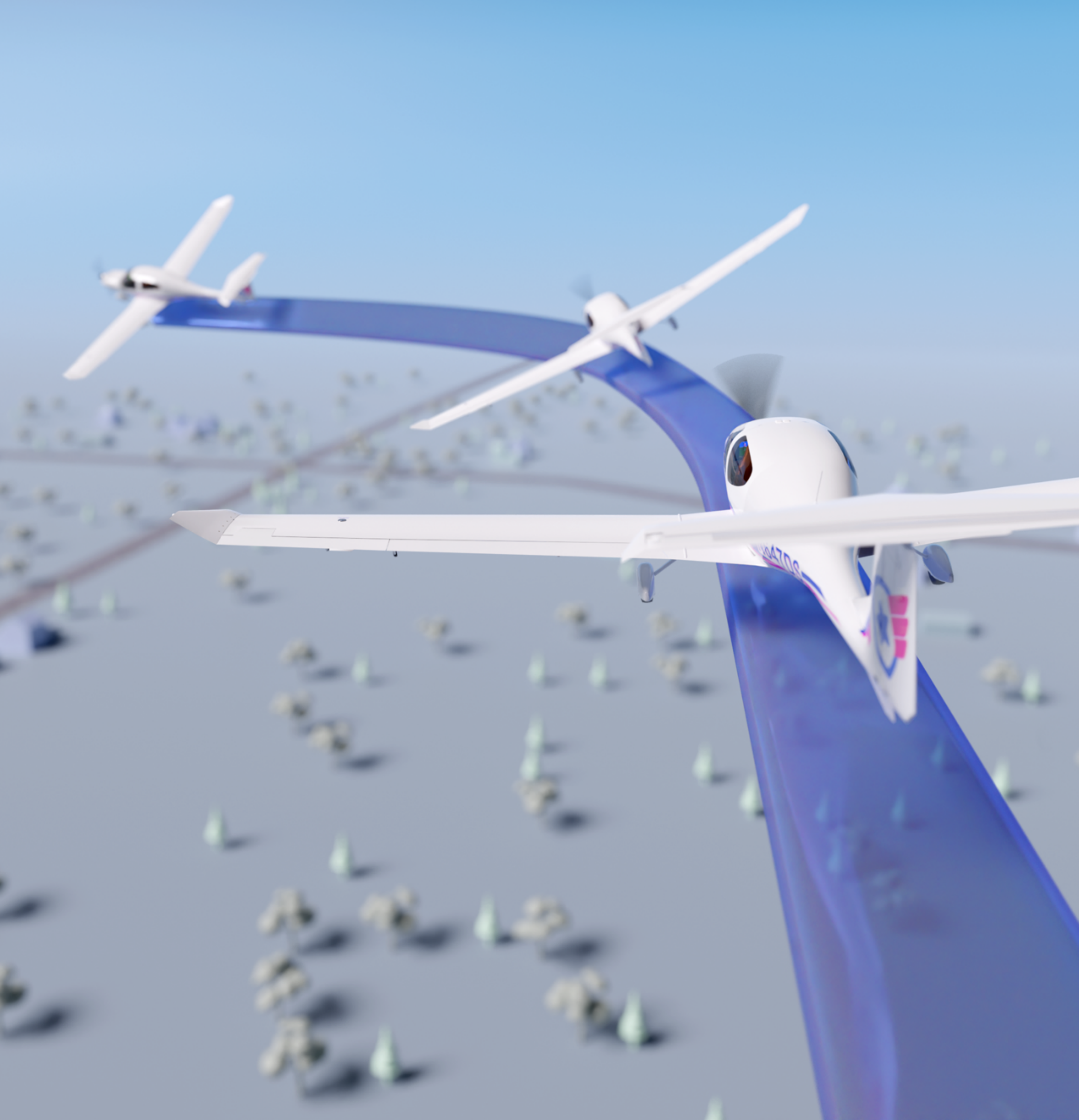
Climb at V_X or V_Y +10/-5
Maintain V_X or V_Y +10/-5 to altitude

Commercial

Climb at V_X or V_Y ± 5
Maintain V_X or V_Y ± 5 to altitude



BASIC MANEUVERS



REJECTED TAKEOFF/ENGINE FAILURE

Pilots must understand the procedures for aborting a takeoff in an emergency or unusual situation. Always review the emergency procedures section of the POH of the respective aircraft being used for the flight.

If a pilot makes an error in performance calculations, the takeoff must be aborted. If the pilot has an engine failure during the takeoff roll or after rotation, several different factors must be considered.

After pilots calculate performance data, they need to establish the point on the runway the airplane should be airborne. If the airplane is not airborne by that point, the takeoff must be aborted immediately. If, during the takeoff roll, a pilot identifies a hazard or potential hazard, abort the takeoff immediately.

Once the decision is made to abort the takeoff during the takeoff roll, pull power to idle. Apply brakes heavily to stop the aircraft as soon as possible. If too much pressure is applied, the brakes may lock up and begin to slide. If this happens, release the brake and begin applying pressure again to slow the aircraft. If a tire is locked, it is not braking; it is sliding and increasing stopping distance.

If the pilot has rotated and has sufficient runway remaining, setting back down on the runway is an option. Reduce power and allow the aircraft to settle back down onto the runway. Once on the runway, apply brakes heavily and full aft yoke to assist with aerodynamic braking. Just be careful not to apply brakes too heavily to lock them up or pull back too quickly on the yoke to cause the aircraft to lift off again.

If the pilot has rotated and does not have sufficient runway remaining, the pilot should pitch for best glide speed and land where practical. Generally, a good rule of thumb is: ground level to 500' AGL, pick a spot within 30 degrees off the nose. 500' AGL to 1000' AGL, pick a landing spot 60 degrees off the nose. Do not try to come back to the runway unless the aircraft is over 1,000' AGL. When over 1,000' AGL, pick a spot 90 degrees off the nose and execute an emergency landing. Commit to memory in an emergency: ABCDE. A- Airspeed (best glide). B-Best place to land. C-Checklist. D-Declare an emergency. E-Execute an emergency landing.

Remember, always fly the airplane first. An aircraft in distress has the right of way over all other aircraft. If a pilot only gets to A and B due to the proximity to the ground, that is acceptable.

Rejected Takeoff/Engine Failure Procedure

1. Pull power to idle
2. Apply brakes heavily
3. Exit the runway if possible
4. Exit aircraft with fire extinguisher

STRAIGHT AND LEVEL FLIGHT

Pilots often perform straight and level flight while traveling to a practice area or on cross-country flights. It is one of the most basic and common maneuvers. Establishing a proper sight picture for VFR operations is vital. It keeps the pilot focused outside instead of inside the cockpit.

To perform straight and level flight, establish a comfortable seating position behind the cowling. This position should allow adequate forward vision. Next, establish where the horizon is in reference to the cowling or some reference point on the windshield. This could be a magnetic compass or rivets, for example. Another method involves using your hand. Place your hand in a "karate chop" position on the cowling and check how many fingers are between the cowling and the horizon. Cross-check the distance of the cowling to the horizon. Once this distance is fixed and the vertical speed indicator and altimeter no longer indicate a climb, the pitch is in the proper position.

Next, check the aircraft's wingtips. They should be an equal distance from the horizon. Equally above or below, depending on if the aircraft is a high or low wing. Check the wings against the turn coordinator and directional gyro to ensure the aircraft is turning. With each wing equal to the horizon and the pitch equalized, this is straight and level flight. Memorize this sight picture.

While looking outside, pilots can determine what attitude the aircraft is in. If the gap between the cowling and the horizon gets smaller, the aircraft is climbing. The smaller the gap, the more of a nose-up attitude the aircraft has entered. Apply forward yoke (push away from the pilot) to bring the nose back to straight and level flight. If the gap between the horizon and the cowling gets bigger, the aircraft is in a nose-down attitude. The bigger the gap, the more nose-down of an attitude the aircraft has entered. Apply aft yoke (pull towards the pilot) to get the nose back to straight and level flight.

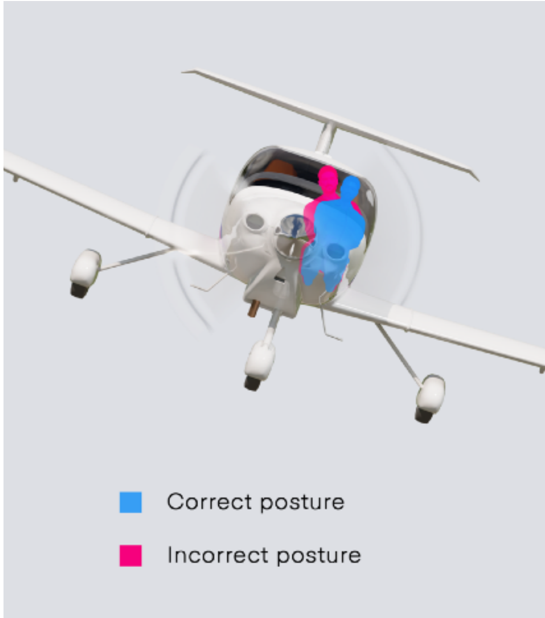
On a high-wing aircraft, if the distance of one wing above the horizon is smaller than the other, the aircraft is in a turn. When one of the wings descends towards the horizon, the other wing will rise. Therefore, one wing will have a large gap, and the other wing will have a small gap. The airplane will turn towards the wing with the smaller gap. Roll the yoke away from the wing with the smaller gap to ensure both gaps between the wing and horizon are equal to return to straight and level flight.

Just the opposite is true in a low-wing aircraft. When straight and level, both wings are below the horizon. As one wing increases the gap between the horizon, the other wing decreases the gap between the wingtip and horizon. A low-wing aircraft will be turning in the direction of the wingtip further away from the horizon. To correct, roll the yoke towards the wing with less gap to the horizon to return to straight and level flight.

LEVEL TURNS

Description

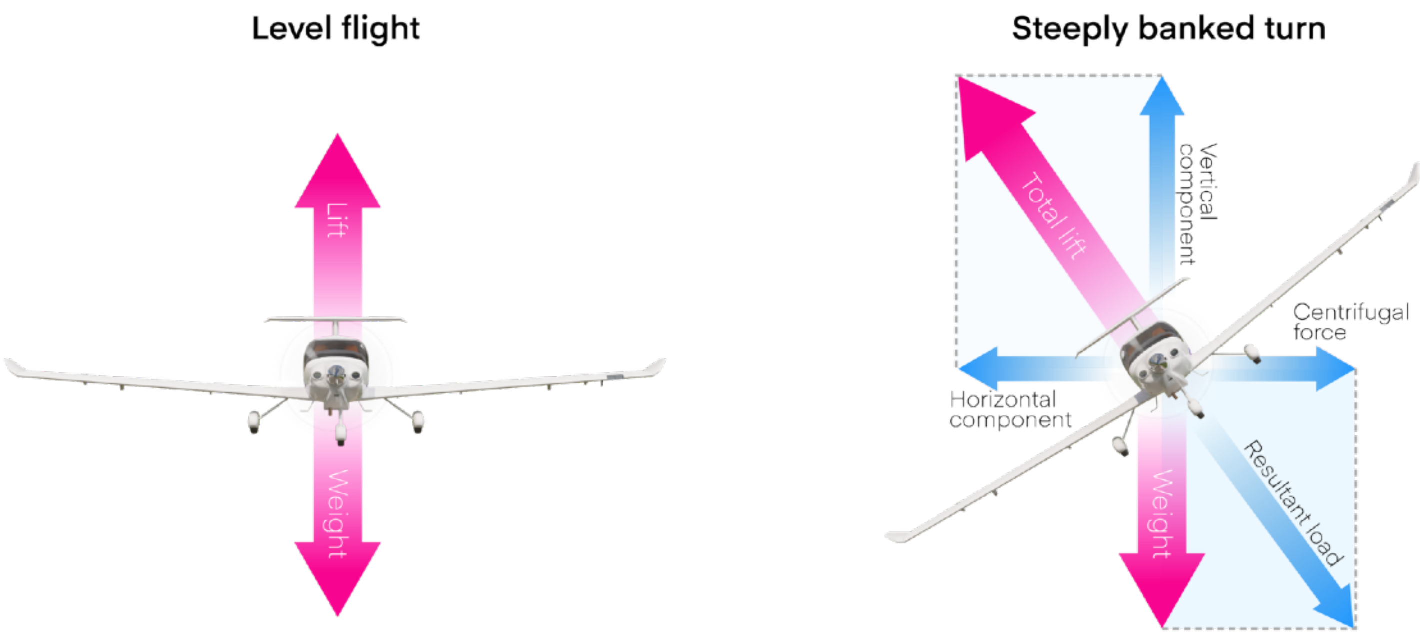
The purpose of level turns is to change the aircraft's direction without gaining or losing altitude. Practicing turns is important. You need to learn the proper time to begin a rollout (depending on the bank angle) to end on the desired heading or visual reference. This takes practice. Remember, when flying VFR, pilots should be outside 90% of the time and checking instruments 10% of the time. All other turning maneuvers build upon this basic maneuver.



To perform the maneuver, first perform the pre-maneuver checklist, if applicable. Then, determine where the aircraft will be turning. Visually clear the area and make a radio call if appropriate. For high-wing aircraft especially, pick out a visual reference on the horizon because the wing will cover the horizon when the turn begins.

With the pilot holding the yoke in the palms of the hand, hold the thumbs up. The direction in which the thumbs point is the direction in which the aircraft will turn.

A standard rate turn is 3° per second. To calculate a standard rate turn, divide the airspeed by 10 and add half of the number. For example, while turning at 90 knots, 90/10=9. Half of 9 is 4.5. 9 + 4.5 =13.5. So, for a 90-knot turn, to achieve a standard rate turn of 3° per second, the aircraft would have to be banked 13.5°.



As the pilot rolls into a turn to the left, the left-wing lowers, and the right-wing raises. Both lift and drag increase on the raised wing and decrease on the lowered wing. This will cause the nose to point towards the extended wing. The nose will point towards the right in a turn to the left. Apply left rudder to counteract this turn towards the right wing, called adverse yaw.

The Vertical Component of Lift (VCL) that keeps the aircraft airborne decreases as the Horizontal Component of Lift (HCL) increases. HCL is what turns the aircraft. Since the aircraft is losing the VCL, the nose will drop slightly. Increase the angle of attack (AOA) to compensate for this loss in lift. Drag increases on the outer wing, and power should be increased to compensate for this as well. Small corrections are needed for both AOA and power.

Continue with the aileron input until the desired bank angle has been achieved. Once achieved, roll the yoke level (like in straight and level). The aircraft will continue to turn. Keep looking outside, making small corrections to compensate for climbs or descents.

Plan the rollout at approximately half the bank angle before the visual reference. If the visual reference is at 270 and the aircraft is banked 15 degrees, plan to roll out at 277 or 263, depending on the direction of the turn.

To roll out, smoothly apply yoke in the direction opposite of the turn, raising the lowered wing. As the wing rises, HCL is lost, and VCL is gained. Reduce the AOA, reduce power back to straight and level flight settings, and resume straight and level flight.

Level Turns Procedure

1. Determine the direction of turn and the new direction
2. Visually clear to the new direction
3. Smoothly roll into a standard rate turn
4. Increase AOA to maintain altitude
5. Add power to maintain airspeed
6. Smoothly begin rollout before the desired point
7. Reduce AOA to prevent climbing
8. Reduce power to maintain airspeed

CONSTANT AIRSPEED CLIMBS/CLIMBING TURNS

Climbs are a basic maneuver used to gain altitude, get above terrain, avoid hazards, or avoid other aircraft. For climbs to occur, lift must be greater than weight. Thrust must overcome drag to increase airspeed. There are also several different types of climbs. Review the POH for the aircraft being used to understand the normal, VY, and VX climb. A normal climb is usually a higher airspeed than VY or VX, allowing better visibility and engine cooling. A VY climb is the best rate of climb for altitude gain. This climb attitude will result in the fastest altitude gain. This is usually the recommended airspeed or attitude after rotation on takeoff. A VX climb is the best angle of climb. This climb is used to gain as much altitude as possible in the shortest distance, such as avoiding an obstacle at the end of the runway.

To perform a climb or climbing turn, first perform the pre-maneuver checklist if appropriate. Then, visually clear the area and make a radio call. Then, apply climb power. In small GA aircraft, climb power is usually full power. The aircraft will climb at whatever airspeed it was trimmed at. Once the airplane begins to climb, smoothly apply aft yoke to obtain the desired climb airspeed or pitch attitude. If power is not increased and a climb is entered, airspeed will decrease and could lead to a stall.

Once in the climb, keep scanning for other traffic. Maintain pitch attitude. Remember, performance decreases as altitude increases. During the summer months, a small airplane with two passengers and full fuel may be unable to climb greater than 100 FPM at higher altitudes.

Plan to level off 10% of the climb rate before the altitude. For example, if climbing at 500 FPM, begin the level off at 50 feet before the desired altitude.

After completing the climb, lean the mixture to ensure the best engine operation. This will prevent the fowling of spark plugs. Re-trim the airplane for straight and level flight.

Climbing turns are a combination of a level turn and a climb. Climbing turns are less efficient than constant airspeed climbs because some VCL is lost to the HCL to turn the airplane. The steeper the bank, the higher the loss of the VCL and the longer a climb will take. Therefore, a turn in a climb will take longer to reach the desired altitude. A turning climb can be established by entering a turn first. You can also enter the climb first, or enter the turn and climb simultaneously. In times of poor performance at higher altitudes, it is recommended to turn while remaining level. Then, perform a constant airspeed climb independently.

DESCENTS/DESCENDING TURNS

Descents are used to change altitude, transition to a landing for ground operations, or avoid other aircraft. For a descent to occur, weight must overcome lift. There are also several different types of descents. The most common method to descend is the partial power descent. Another descent method is the minimum safe airspeed descent, also called the short field approach. There is an emergency descent, which is generally performed with the power at idle with a high airspeed to get to the ground as quickly as possible. There is also a descent called a glide, where the airplane descends to land without any engine power, such as in the case of an engine failure. Not always discussed is a descent called minimum sink. The aircraft will stay airborne as long as possible when at this airspeed. It will not glide as far, but will give additional time in the air. As always, review the POH of the aircraft being used to determine the proper descent procedures before flight.

To perform a normal descent, first perform the descent checklist. At higher altitudes, the air is thinner, and the mixture is leaned to ensure a proper air/fuel ratio. When descending, the air thickens, and if the mixture is not increased, it could lead to a lean condition where too little fuel is in the air/fuel mixture. This could lead to the engine stalling due to a lack of fuel, or detonation in the engine. Therefore, the mixture is generally put “full rich” when making large altitude descents. Then, visually clear the area and make a radio call. To begin a partial power descent, reduce the power to around 1,500 RPM. The nose of the aircraft will begin to drop, and the airplane will descend at the airspeed it was trimmed for. To increase the rate of descent, either push the yoke forward to increase airspeed or reduce power to decrease lift. A normal descent rate is around 500 FPM. Plan to level off at 10% of the descent rate above the desired altitude. If descending at 500 FPM, begin to level off at 50 feet above the desired altitude.

Turning descents are performed in the same way as normal partial power descents. In a turn, the aircraft gives up the VCL for the HCL. If a turn is entered in a descent, the nose of the airplane will drop even more, increasing the rate of descent. This must be compensated for when planning the level-off. When entering a turning descent, the turn or descent can be entered first, or both can be entered simultaneously.

Emergency descents and glides will be covered in emergency operations, page 33.

TRIM

Trim is used to relieve control pressures. Trim can be located on the elevator, rudder, or ailerons. Elevator trim is the most common in general aviation aircraft, which helps with pitch. Rudder and Aileron trim can be found in GA aircraft. The more complex the aircraft, the more likely the aircraft is to have additional trim surfaces.

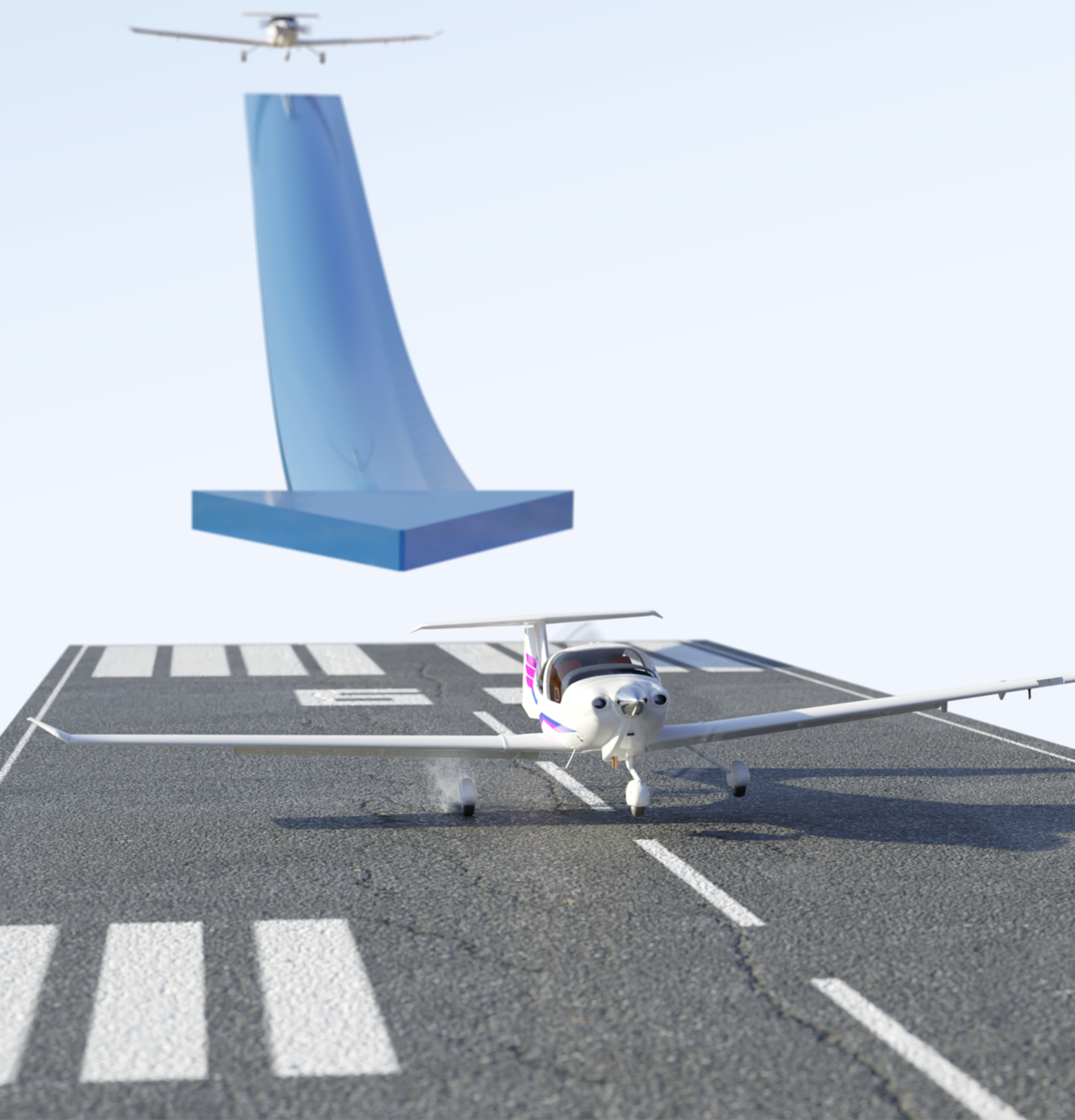
Trim should be set to the appropriate setting for the type of takeoff or maneuver to be performed. Pilots should place the aircraft in the attitude that the pilot wants and then trim the control pressures away. Trim can be used in straight and level flight, climbs, and even maneuvers such as slow flight. The trim control is usually a wheel. To use the trim, grab the trim wheel in the middle. If the trim wheel is moved up (towards the aircraft's ceiling), the airplane's nose will move down. When holding the trim in the middle of the wheel, the trim is moved down (towards the floor of the aircraft), and the nose will want to rise.

When the aircraft is properly trimmed, the pilot should be able to release the control yoke, and the airplane's attitude should not change. To check for proper trim while flying straight and level, release your hand from the yoke (if safe). Hover your hand in the same spot near the yoke, prepared to take over if the airplane changes attitude.

Here's a practical example of using the trim. If the pilot is in straight and level flight and has to pull the yoke towards them, the airplane has too much nose-down trim. In this case, the pilot should push the trim wheel towards the ground. The control pressures should become lighter. The trim is properly set once the airplane maintains straight and level flight. Make small changes and reevaluate. In this example, if the pilot trims too much, the pilot would switch from applying aft pressure to applying forward pressure. They would need to do this to keep the nose from rising.

The airplane will want to maintain the airspeed and power setting it is trimmed for. If the airplane is trimmed for 90 knots, the airplane will want to climb and descend at 90 knots. When climbing or descending, configure properly for the airspeed/attitude desired, and re-trim.

LANDINGS



NORMAL LANDING

Description

The normal landing is the procedure to transition from flight to ground operations. The normal landing is generally the landing that will be performed during flights. Always review the POH of the aircraft to be flown for the procedures and airspeeds related to landing that aircraft.

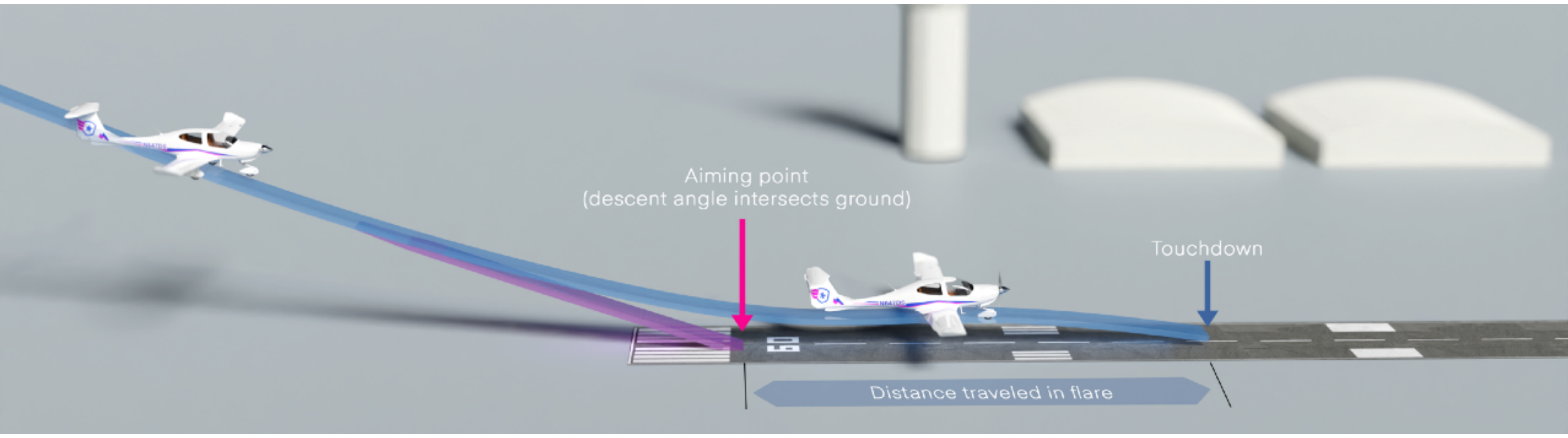
A normal landing starts in the downwind. For straight-in normal landing procedures, begin to configure on a 4-mile final approach.

In the downwind, perform the before-landing checklist before coming abeam the landing point. When abeam the landing point, reduce power to around 1,500 RPM. The nose will drop, so apply aft yoke. Add the first notch of flaps. The aircraft will tend to balloon, so be prepared for the nose to come up. Pitch for the VREF speed for the aircraft being flown.

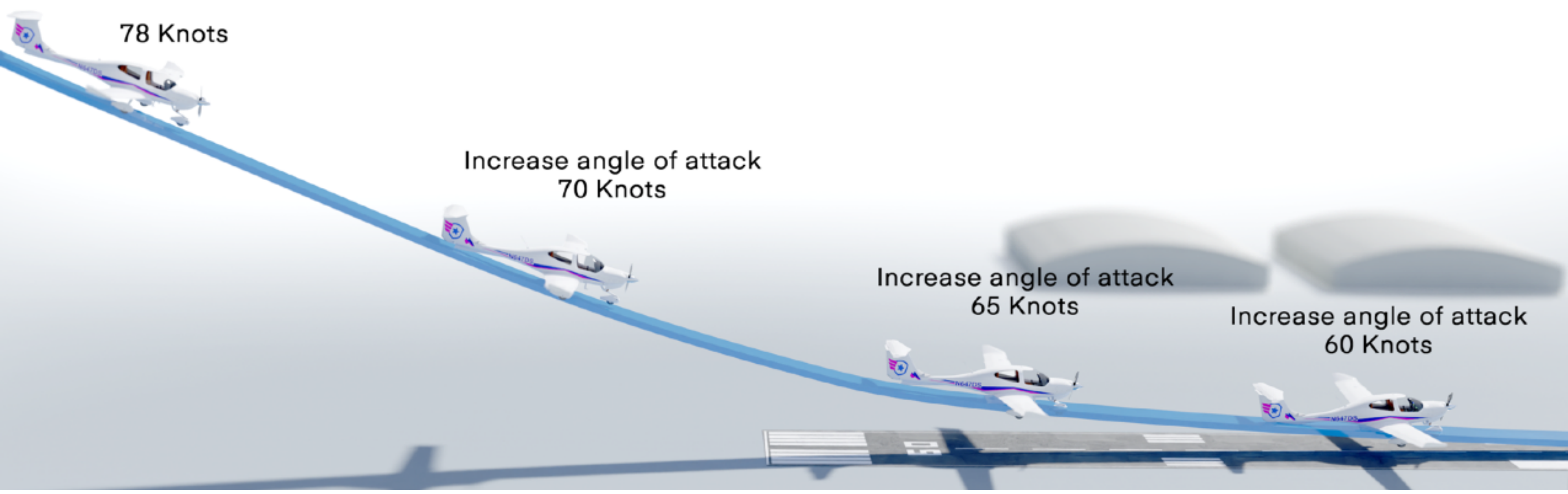
Allow the aircraft to descend around 350 feet per minute until the landing point is approximately 45° behind the pilot. Clear the base turn, and then smoothly roll into the turn. When turning, the nose will drop due to the loss of the Vertical Component of Lift (VCL). Smoothly apply aft yoke to compensate. Be sure to watch that airspeed; it is very important not to get slow.

Once on the base turn, add the next notch of flaps. Every time flaps are added, they create drag, so airspeed will decrease. Keep descending around 350 fpm. When the landing spot is approximately 45° from the pilot, prepare for the turn to final.

Clear the final approach, back past the aircraft's present position to ensure no aircraft are on an extended final approach. Once that is clear, begin the turn to final approach. Do not overshoot the runway, and maintain coordination. If the aircraft overshoots the runway, go around. Remember to watch that airspeed so the airplane doesn't stall. Once wings level on final approach, add the last notch of flaps. When looking at the runway, it should look straight up and down from the pilot's perspective. Identify an aiming point approximately 500' before the desired landing spot. Fly directly to the aiming point. The scan should be: "aiming point, aiming point, airspeed..." repeated until the aircraft reaches the aiming point.



Once the aircraft reaches the aiming point, the pilot should transition their eyes down to the end of the runway and bring the airplane to a level flight attitude. Smoothly reduce power to idle. The airplane should be about 10 feet above the runway. Allow the airspeed to bleed off. When the airplane begins to sink, smoothly apply aft yoke to begin the flare. The cowling should leave just a sliver of runway visible. Hold this attitude as the airplane continues to sink. Once the main wheels touch the ground, continue to hold the attitude until the front wheel touches down. Smoothly apply the brakes to slow the aircraft to taxiing speed and exit the runway where safe. Remember, the aircraft is not clear of the runway until it is completely past the hold short lines.



Normal Landing Procedure

1. Fly to aiming point
2. Level off
3. Power idle
4. Wait for the aircraft to sink
5. Smoothly flare
6. Stop flare if stop sinking
7. Touchdown main wheels
8. Touchdown nose-wheel
9. Smoothly apply brakes

ACS STANDARDS

Private

Airspeed +10/-5 kt with gust factor
Touchdown +400/-0 ft

Commercial

Airspeed +/- 5 kt
Touchdown +200/-0 ft

CROSSWIND LANDING

Description

The crosswind landing is performed in a very similar manner to the normal landing. The only difference is that pilot must make corrections to keep the wind from blowing the aircraft off the centerline of the runway.

The crosswind landing starts in the downwind. The aircraft may need to crab into the wind. Crabbing is a slight, wings-level pointing of the nose into the wind to maintain an aircraft's ground track.

On downwind, perform the before-landing checklist before coming abeam the desired landing spot. Always look for the wind sock to verify the direction and intensity of the wind. Once abeam the desired landing point, reduce power to approximately 1,500 RPM. The nose will want to drop, so smoothly apply aft yoke to get to the desired airspeed. Add the first notch of flaps, being aware the aircraft may balloon. Allow the aircraft to descend around 350 fpm until the desired landing point is approximately 45° behind the pilot. Clear the base turn, and begin the turn. Always look outside and inside at the airspeed to ensure the aircraft does not get too slow.

Once on base, add the next notch of flaps. Depending on whether the base turn has a headwind or tailwind, the turn may need to be shortened or extended compared to a normal landing. Clear the final approach course and begin the base to final turn, ensuring the aircraft does not get too slow.

Once on final, allow the aircraft to crab into the wind enough to maintain centerline with the runway. Add the last notch of flaps. If the crosswind is severe enough, landing with the second notch of flaps is acceptable. Add the gust factor to the V_{REF} speed. The gust factor is half of the gust speed added to the V_{REF} speed.

For example: V_{REF} = 66. Gust speed + crosswind = 16. V_{REF} 66 + 8 = 74. New V_{REF} speed = 74. This will be the final approach speed.

Crabbed Approach

Sideslip Approach

Identify the aiming point around 500' before the desired landing point. Fly directly to the aiming point. The scan should be "aiming point, aiming point, airspeed..." repeated until the aircraft reaches the aiming point. As the aircraft reaches the runway, transition away from a crab attitude and apply rudder to align the aircraft with the centerline of the runway. If only rudder is applied, the aircraft will be blown away from the centerline. Apply aileron to keep the aircraft aligned with the runway as well, turning into the wind. Fly the rest of the approach normally.

Once over the aiming point, level off, maintaining the wing low into the wind attitude. Smoothly reduce power to idle. Allow the airspeed to bleed off, and start the flare when the aircraft starts to sink. Maintain the wing-low attitude. The lower wheel will touch first, followed by the higher wheel, then the nose wheel. Once all three wheels are on the ground, smoothly apply the brakes to begin slowing the aircraft. Also, apply full wind correction with the yoke. Slow to taxiing speed and exit the runway where safe, constantly adjusting the wind correction while taxiing.

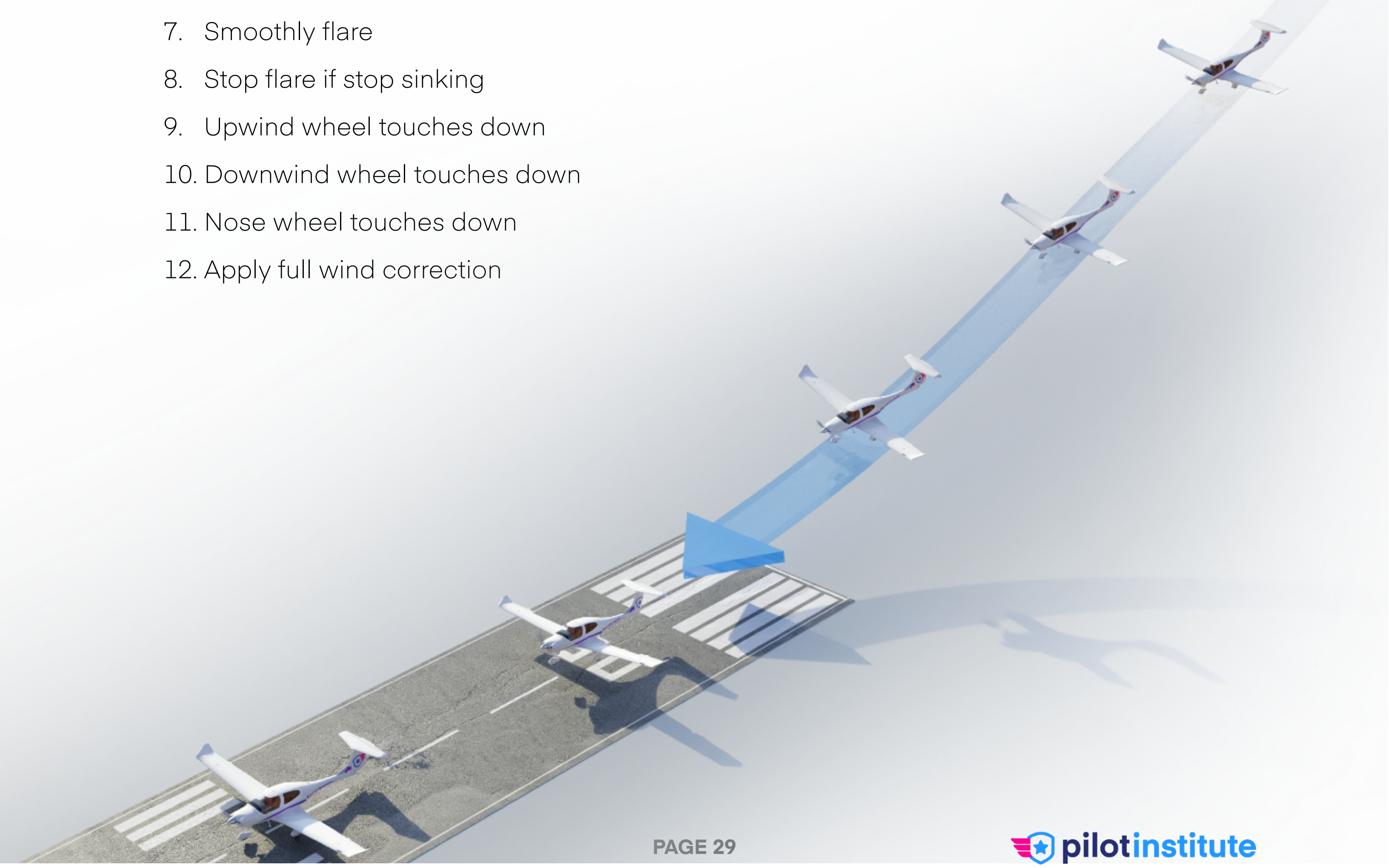
Crosswind Landing Procedure

1. Allow airplane to crab into the wind
2. Fly to aiming point
3. Transition to wing low method
4. Level off
5. Power idle
6. Wait for the aircraft to sink
7. Smoothly flare
8. Stop flare if stop sinking
9. Upwind wheel touches down
10. Downwind wheel touches down
11. Nose wheel touches down
12. Apply full wind correction

ACS STANDARDS

Private
Airspeed +10/-5 kt with gust factor
Touchdown +400/-0 ft

Commercial
Airspeed ± 5 kt
Touchdown +200/-0 ft



pilotinstitute

SHORT FIELD LANDING

Description

The short field landing is used when landing over an obstacle or when the runway is shortened. This is a precision maneuver designed to show the ability to land the airplane at a specific spot on the runway.

To perform this maneuver, fly a normal landing.

On downwind, perform the before-landing checklist before coming abeam the desired landing spot. Always look for the wind sock to verify the direction and intensity of the wind. Once abeam the desired landing point, reduce power to approximately 1,500 RPM. The nose will want to drop, so smoothly apply aft yoke to get to the desired airspeed. Add the first notch of flaps, being aware the aircraft may balloon. Allow the aircraft to descend around 350 fpm until the desired landing point is approximately 45° behind the pilot. Clear the base turn, and begin the turn. Always look outside and inside at the airspeed to ensure the aircraft does not get too slow.

Once on base, add the next notch of flaps. Depending on whether the base turn has a headwind or tailwind, the turn may need to be shortened or extended compared to a normal landing. Clear the final approach course and begin the base to final turn, ensuring the aircraft does not get too slow.

After turning final, identify an aiming point closer to the intended landing point. Add the last notch of flaps. Approximately 200’ away from the desired landing spot is acceptable. The aiming point is closer to the landing point because the aircraft will travel slower and land sooner. Fly directly to the aiming point. The scan should be “aiming point, aiming point, airspeed…” repeated until the aircraft reaches the aiming point. Ensure the aircraft is using the short-field approach speed. This speed is normally 5-8 knots lower than the normal approach speed. Be careful that the aircraft does not get too slow and stall. If there is any concern, immediately conduct a rejected landing/go around. Add any wind correction needed for any crosswind to maintain alignment with the centerline of the runway.

As the aircraft approaches the aiming point, transition to a wings-level attitude and smoothly reduce power to idle. The aircraft will begin to sink, and when it does, begin the flare. This happens quickly. Hold the flare attitude until the aircraft touches down. Once the aircraft touches down, apply brakes heavily but do not lock them up. If they lock up, release the brake pedals and reapply. Apply full aft yoke to maximize aerodynamic braking. If performing a touch and go, call out "simulated maximum braking." This lets the instructor or DPE know the pilot would have applied maximum braking.

Short Field Landing Procedure

1. Fly to aiming point
2. Maintain short-field landing speed
3. Level off
4. Power idle
5. Wait for sink
6. Start flare
7. Main wheels touch down
8. Nose wheel touches down
9. Apply brakes heavily
10. Apply aerodynamic braking

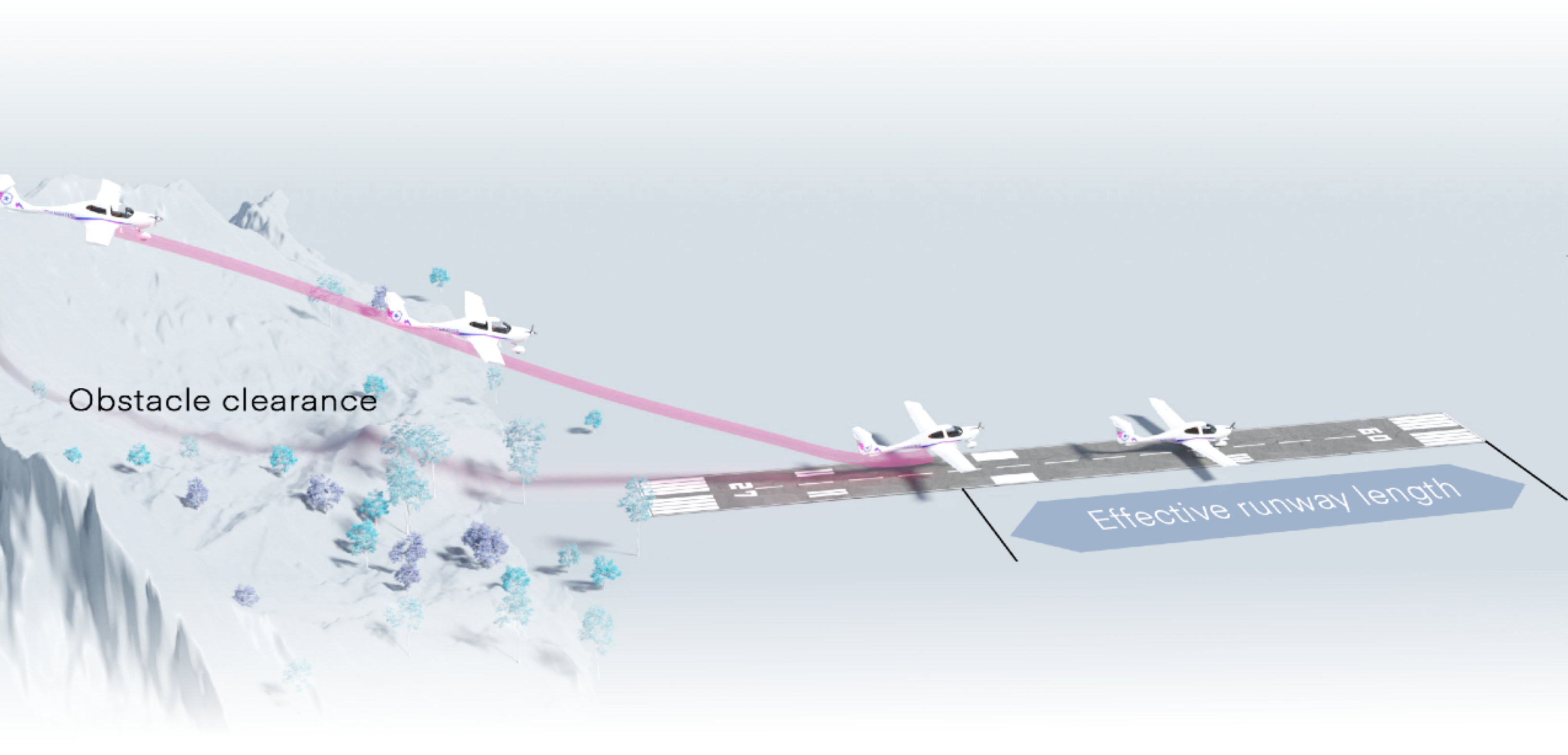
ACS STANDARDS

Private

Airspeed +10/-5 kt with gust factor
Touchdown +200/-0 ft

Commercial

Airspeed ± 5 kt
Touchdown +100/-0 ft



SOFT FIELD LANDING

Description

The purpose of a soft field landing is to transition from flight to ground operations while keeping the weight on the wings as long as possible. This helps during landings on a rough or soft surfaces and prevents the nose gear from digging into the surface and flipping the airplane.

To perform this maneuver, fly a normal landing.

On downwind, perform the before-landing checklist before coming abeam the desired landing spot. Always look for the wind sock to verify the direction and intensity of the wind. Once abeam the desired landing point, reduce power to approximately 1,500 RPM. The nose will want to drop, so smoothly apply aft yoke to get to the desired airspeed. Add the first notch of flaps, being aware the aircraft may balloon. Allow the aircraft to descend around 350 fpm until the desired landing point is approximately 45° behind the pilot. Clear the base turn, and begin the turn. Always look outside and inside at the airspeed to ensure the aircraft does not get too slow.

Once on base, add the next notch of flaps. Depending on whether the base turn has a headwind or tailwind, the turn may need to be shortened or extended compared to a normal landing. Clear the final approach course and begin the base to final turn, ensuring the aircraft does not get too slow.

After turning final, identify an aiming point closer to the intended landing point. Add the last notch of flaps. Approximately 500 feet away from the desired landing spot is acceptable. Fly directly to the aiming point. The scan should be "aiming point, aiming point, airspeed…" repeated until the aircraft reaches the aiming point. Ensure the aircraft is using the soft field approach speed.

Fly directly to the aiming point. Level off around 10 feet above the runway. Slowly reduce the power to around 1,200 RPM. Maintaining some power will keep the front wheel from dropping too quickly. As the aircraft begins to sink, begin the flare. The aircraft should touch down softly. As the aircraft touches down, both main wheels should be on the ground with the front wheel in the air. In this attitude, reduce the power to idle. As the front wheel slowly begins to fall, apply aft yoke to keep the front wheel off the ground as long as possible. Apply aft yoke to full deflection. When at full aft yoke deflection, the front wheel will slowly fall to the ground and touch down softly.

Maintain aft yoke to maximize aerodynamic braking. Remember, use brakes sparingly as the weight shift forward could cause the nose wheel to dig into the ground, collapse the gear, or flip the airplane.

Soft Field Landing Procedure

1. Fly to the aiming point
2. Level off
3. Power reduced to +/- 1,200 RPM
4. Wait for sink
5. Start flare
6. Main wheels touch down
7. Power idle
8. Increase AOA as aircraft slows
9. Full aft yoke deflection
10. Nose wheel touches
11. Smoothly roll to a stop with no brakes

ACS STANDARDS

Private

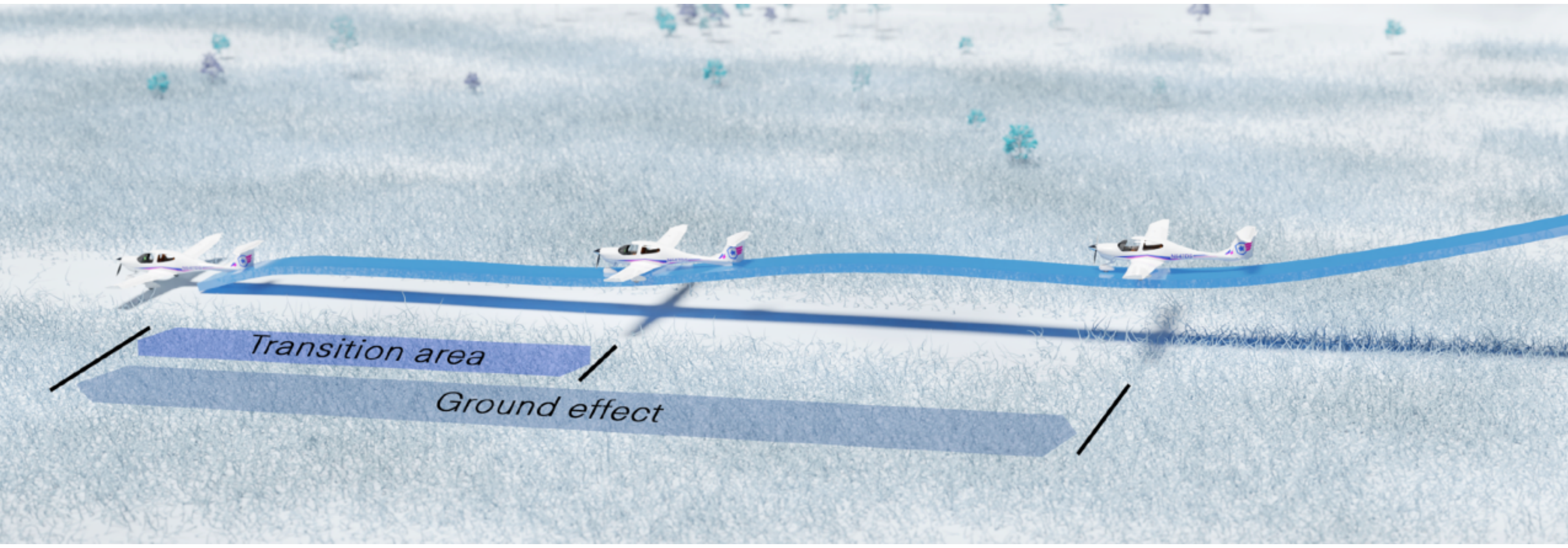
Airspeed +10/-5 kt

Nose-wheel control

Commercial

Airspeed ± 5 kt

Nose-wheel control



FORWARD SLIP TO LAND

Description

A forward slip to land has two purposes. The first purpose is to lose altitude without increasing airspeed. The second purpose is to adjust the aircraft's ground track during a crosswind approach.

To perform this maneuver, fly a normal landing.

On downwind, perform the before-landing checklist before coming abeam the desired landing spot. Always look for the wind sock to verify the direction and intensity of the wind. Once abeam the desired landing point, do not reduce power and maintain altitude. Begin slowing to V_{REF} speed. Add the first notch of flaps, being aware the aircraft may balloon. Once the desired landing point is approximately 45° behind the pilot. Clear the base turn, and begin the turn. Always look outside and inside at the airspeed to ensure the aircraft does not get too slow.

Once on base, add the next notch of flaps. When the landing spot is approximately 45° from the pilot, prepare for the turn to final. Clear the final approach course and begin the base to final turn, ensuring the aircraft does not get too slow.

After turning final, identify an aiming point around 500′ from the desired landing point. Maintain altitude 700′-1000′ AGL. Generally, begin the maneuver once the runway numbers are no longer visible under the cowling.

Smoothly reduce power to 1,500 RPM. Turn the nose into the direction of the crosswind by pushing on the rudder pedal in the direction to move the nose. Apply aileron to maintain alignment with the runway. As the airplane approaches the glide slope, smoothly begin releasing aileron and rudder pressure. Aim to end the forward slip aligned with a 3° glide slope.

If closer to the touchdown point, the slip must be performed closer to the runway. Caution must be used if the sink rate is excessive. If the slip becomes unsafe, initiate a go-around immediately.

Fly to the aiming point, and then perform a landing as normal.

Forward Slip Procedure

1. Maintain approximately 500 feet AGL
2. Fly a normal approach
3. Add rudder into wind
4. Use ailerons for directional control
5. Don't fall through the glide slope
6. Transition to normal approach and landing

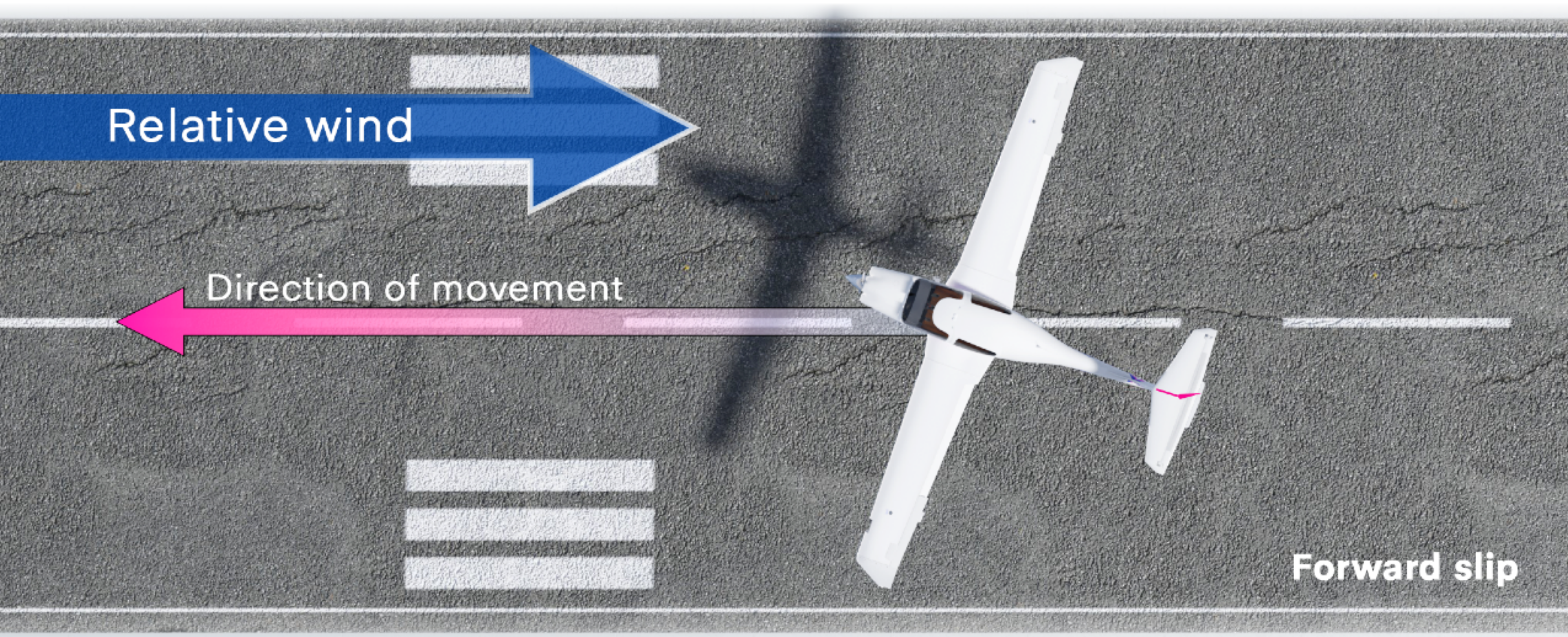
ACS STANDARDS

Private

Touchdown +400/-0 ft

Commercial

Not test



REJECTED LANDING/GO AROUND

Description

A rejected landing, commonly referred to as a go-around, is a maneuver pilots use to stop an approach and transition to a climb. This maneuver can be performed at any point during an approach, from the base turn to the flare. The pilot, instructor, DPE, or control tower can all call a go-around.

Generally, go-arounds are conducted on final approach with full flaps extended. When the decision is made to execute a go-around, the first step is to add takeoff power. Call out "going around" inside the airplane to let the instructor or DPE know you've made the decision to go around. Next, smoothly increase the pitch to establish a positive rate of climb. Be careful not to stall the airplane. Once the altimeter and vertical speed indicator indicate a climb, call out "positive rate of climb, flaps [flap degree at second notch]." Remove full flaps to the second notch of flaps. Allow the aircraft to continue to climb and accelerate to V_X. Once the aircraft reaches the V_X airspeed, call out "V_X, flaps [flap degree at one notch of flaps]." Continue to climb to V_Y, and once the airplane reaches V_Y, call out "V_Y, flaps 0" and ensure flaps are in the up position. Call the tower and announce the go-around. Maintain V_Y until the aircraft reaches maneuvering altitude or re-enters the traffic pattern.

An example of a radio call for a go-around at a towered airport: "Cessna 647DS is going around". The tower will issue a new clearance and may inquire as to the purpose of the go-around. Remember, fly the airplane first.

At un-towered airports, more needs to be announced.

"Payson traffic, Cessna 647DS is going around, will be entering a left downwind for runway 6, Payson traffic."

Remember the five Cs of a go-around: Cram (add power), Climb (positive rate of climb), Clean (remove flaps), Call (announce to the tower/traffic), and Click (instrument).

Rejected Landing/Go Around Procedure

1. Add power
2. Positive rate of climb
3. First notch of flaps up
4. VX
5. Second notch of flaps up
6. VY
7. Clean aircraft
8. Climb to the pattern to retry landing

ACS STANDARDS

Private

Climb attitude +10°/-5°
Maintain V_Y +10/-5 kt

Commercial

Climb Attitude ± 5°
V_Y ± 5

POWER OFF 180

Description

The purpose of this maneuver is to perform a gliding 180° turn and land at a certain point on the runway without the use of power.

This maneuver begins in the downwind. Before becoming abeam to the landing point, perform the before-landing checklist. Determine a touchdown point on the runway. When abeam the landing point, reduce power to idle. Begin pitching for best glide while maintaining altitude.

Once the best glide speed is established, continue flying straight for approximately 5-10 seconds. Then, slowly begin a constant turn toward the runway. Do not use flaps until landing is guaranteed.

If a heavy crosswind/headwind is present, start the turn earlier and wait to use flaps.

Generally, if landing is guaranteed, add the first notch of flaps when 90° to the runway. When 45° to the runway, add the second notch of flaps. Maintain the best glide speed to the aiming point. Level off at the aiming point and allow the airspeed to bleed off. Once the aircraft starts sinking, begin the flare.

Land as normal.

Adding flaps out of ground effect reduces landing distance. Adding flaps in ground effect increases float distance.

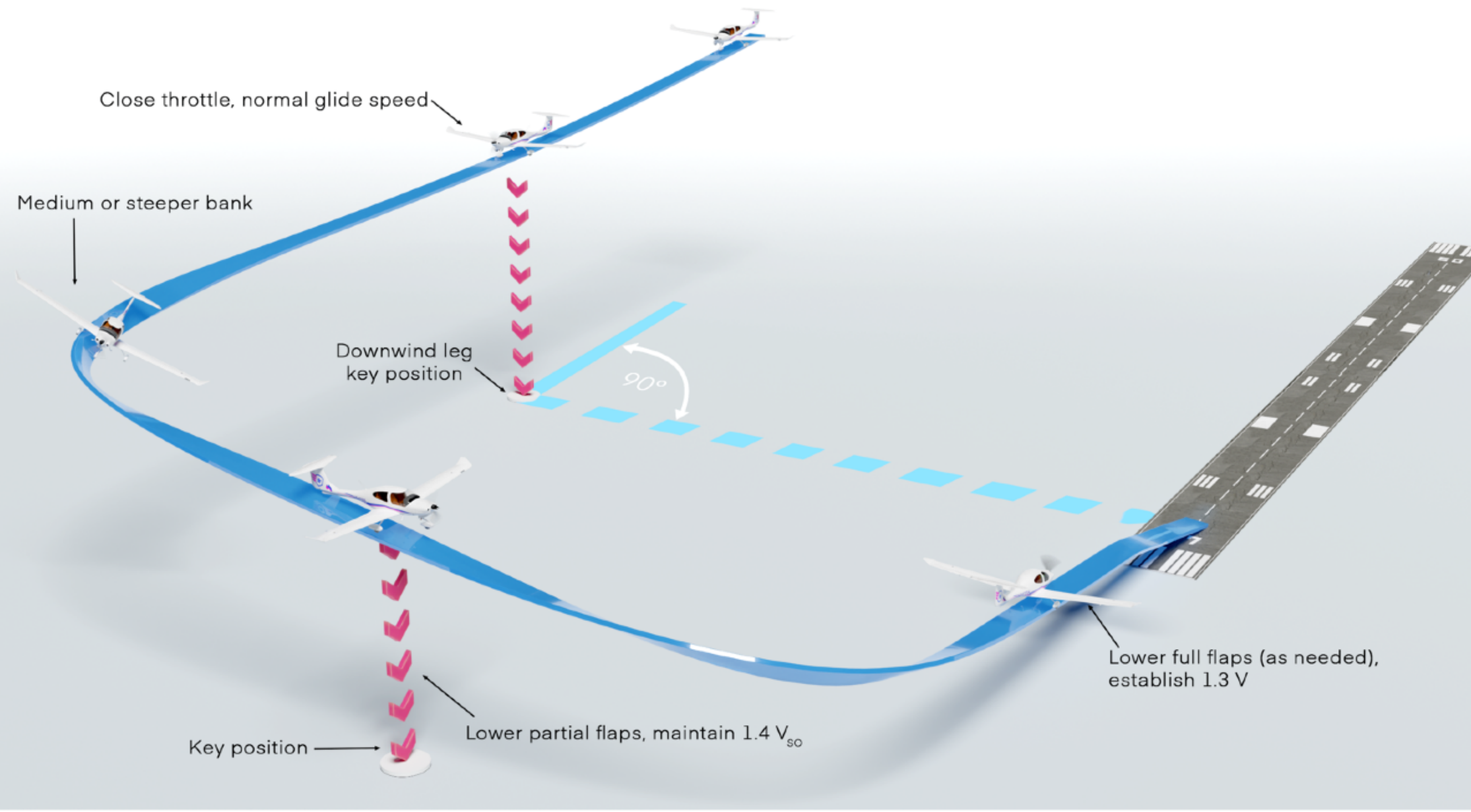
Power Off 180 Procedure

1. Power idle
2. Pitch for best glide
3. Continuous turn toward the runway
4. Slip if high
5. Flaps as needed once the runway is made

ACS STANDARDS

Private
Not tested

Commercial
Touchdown +200/-0 ft



FLAPLESS LANDING

Description

Pilots perform this maneuver to simulate a flap malfunction. It shows the differences between landing with and without flaps. Flaps increase drag and increase lift. They allow a steeper approach at a lower airspeed. The airplane will float significantly further than with flaps deployed. The aircraft will also stall at a higher airspeed in the clean configuration.

To perform a landing without flaps, begin in the downwind. Before coming abeam the desired landing point, perform the before landing checklist. When abeam the point, reduce power to 1,500 RPM and begin the descent. The approach speed must be faster, and the approach angle must be shallower.

Allow the aircraft to descend, and when the landing point is approximately 45° behind the pilot, clear the area and begin the turn to base. Ensure airspeed is maintained.

When on base, continue descending and maintain an airspeed of approximately +10 V_{REF}, ensuring the aircraft doesn't get too slow.

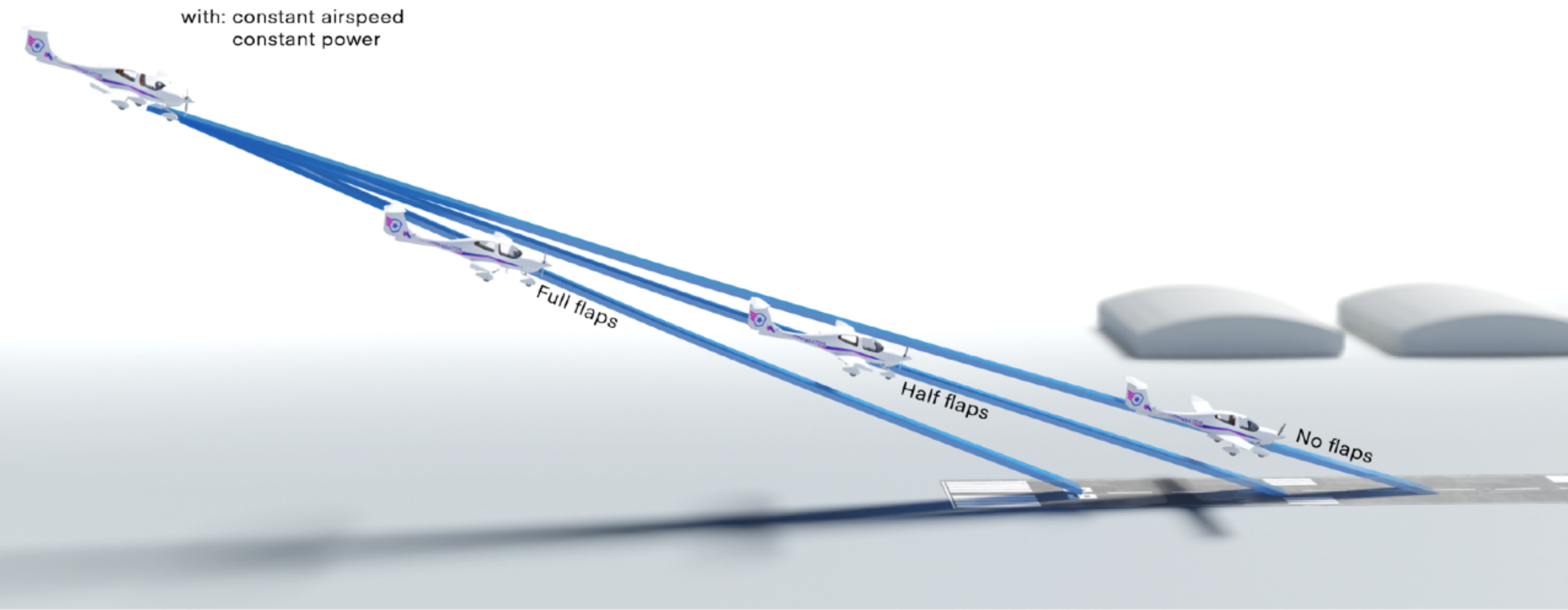
When approximately 45° to the runway, clear the final approach past the pilot's aircraft to ensure no other aircraft are on a straight in approach. Once clear, begin the turn to final. Do not overshoot the runway.

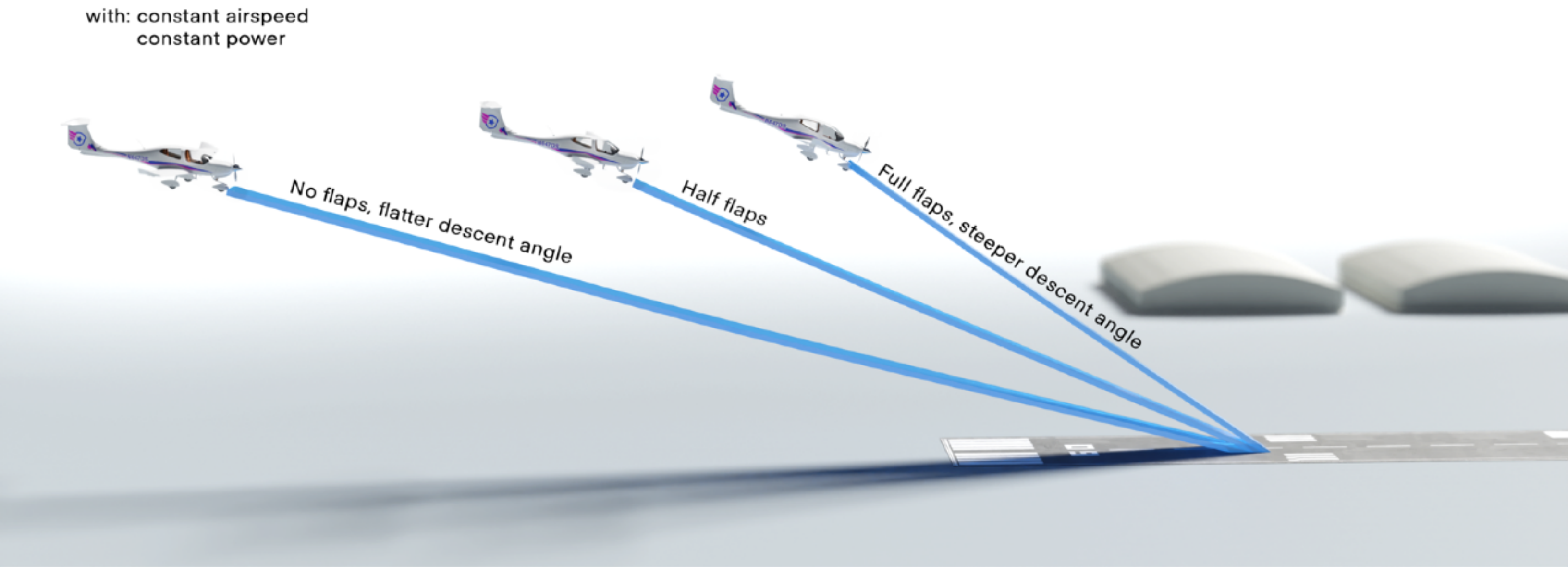
Once on final, pick an approach point approximately 800-1000 feet before the desired landing point. Fly a lower approach, aware of anything on the ground that may constitute a hazard. If hazards are identified, immediately perform a rejected landing/go-around.

Fly directly to the aiming point. The scan should be "aiming point, aiming point, airspeed..." repeated until the aircraft reaches the aiming point, making corrections along the way. Once the aircraft reaches the aiming point, level off and smoothly reduce power to idle. Allow excess airspeed to bleed off, and once the aircraft begins to sink, begin the flare. Once the main gear is on the ground, maintain the nose-up attitude until the front wheel touches the ground as well. Smoothly apply brakes to taxi speed and exit the runway where safe.

Flapless Landing Procedure

1. Approach lower than usual
2. Fly to aiming point
3. Level off
4. Power idle
5. Be aware of extended floating
6. Wait for sink
7. Flare
8. Main wheels touch down
9. Nose wheel touches down





GROUND REFERENCE

RECTANGULAR COURSE

Description

The rectangular course is a training maneuver that simulates a traffic pattern where the airplane must maintain an equal distance from all sides of the selected references. The pilot must maintain a constant altitude, airspeed, and distance from ground references.

The aircraft should be in the clean configuration. To perform the rectangular course, use the acronym PCARE. This starts with the pre-maneuver checklist. Then, perform a clearing turn. A clearing turn is a 90° turn to the left to check for traffic behind the airplane, followed by a 90° right turn back to the original direction. Don't forget to rescan the area. Always turn to the left because if aircraft overtake the airplane, they will pass on the right. If changing directions for the maneuver, clear the area when changing directions, and this counts as the clearing turn.

Next, choose the altitude at which the maneuver will be performed. Make a radio call, stating the aircraft's callsign or registration, location, altitude, and intentions. Last, pick an emergency landing location in the event of an engine failure or other emergency.

Per the Airmen Certification Standards (ACS), the maneuver must be performed between 600 to 1000 feet AGL. This means that the aircraft cannot descend below 600 feet AGL or climb above 1000 feet AGL. A good rule of thumb would be to use 800 feet AGL to allow some buffer on both sides of the maneuver.

To begin this maneuver, the airplane should enter the maneuver at a 45° angle on downwind. At the first turn, the wind will push the airplane away from the course. So, allow the airplane to crab into the wind to maintain a proper ground track with the ground references. This turn will be steeper because more than 90° is needed for the wind correction.

At the second turn, the turn will be less than 90° and should be a headwind. Maintain coordinated flight throughout the entire maneuver. Remember to look outside and scan for other traffic and hazards while maintaining airspeed and altitude.

At the third turn, the airplane should turn less than 90° and allow the airplane to crab into the wind to maintain proper ground track. This will be a medium bank. At the fourth turn, the airplane will turn more than 90° to enter downwind. This will be a shallower turn. The pilot then exits the maneuver at a 45° angle on downwind and resumes straight and level flight. Remember, the higher the ground speed, the steeper the bank angle.

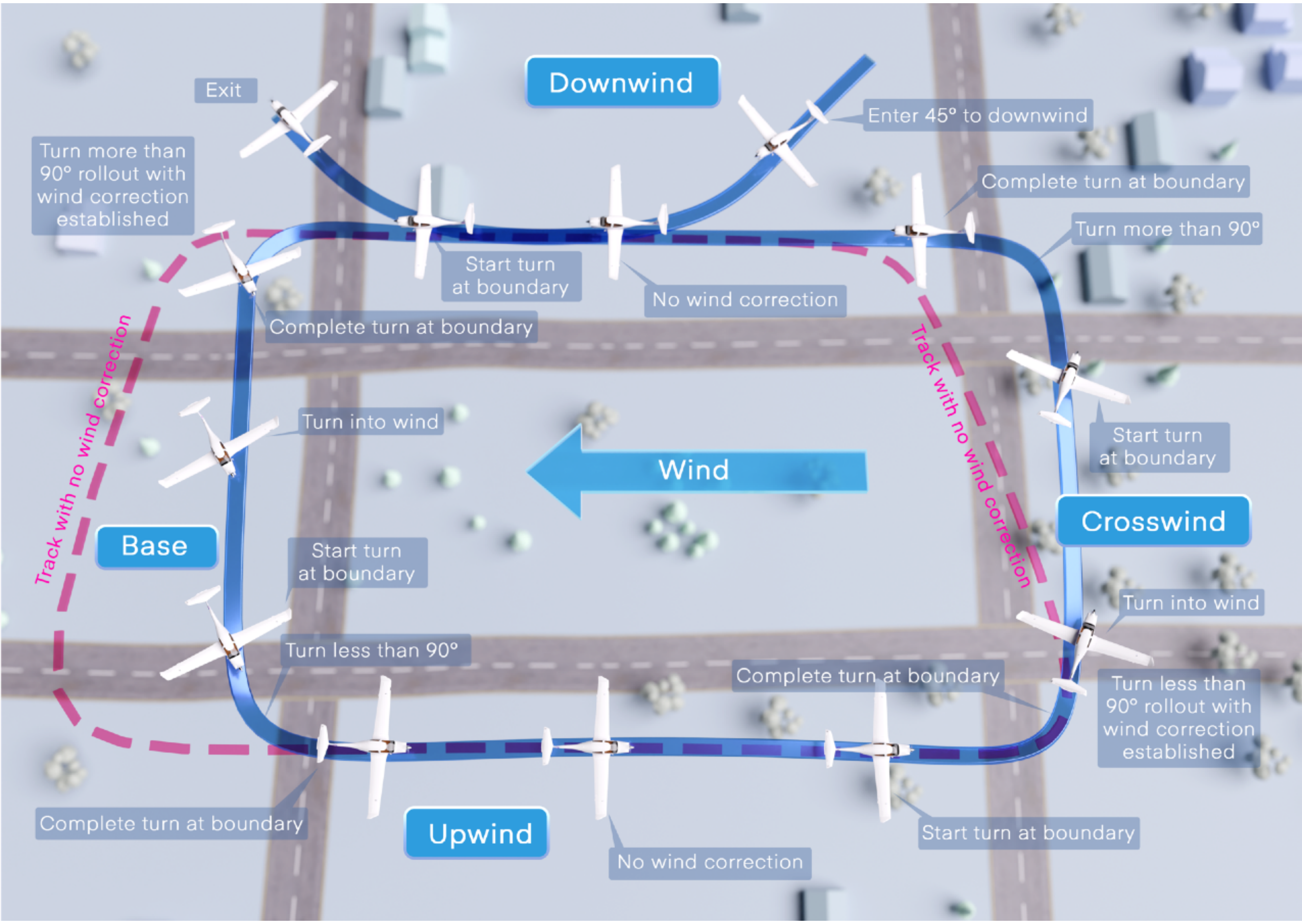
Rectangular Course Procedure

1. Clear the area
2. Determine wind direction
3. Select a suitable ground reference area
4. Establish airspeed and maintain altitude
5. Enter at a 45° angle to the downwind leg (right or left traffic)
6. Apply adequate wind-drift correction to maintain a constant ground track
7. Maintain altitude and airspeed
8. Return to cruise flight when re-established on the downwind

ACS STANDARDS

Private

600 to 1000 ft AGL
Altitude ± 100 ft
Airspeed ± 10 kt



S-TURNS

Description

The purpose of the S-turn is to compensate for wind during turns to cross a point and return at that point wings level.

The aircraft should be in the clean configuration. To perform S-turns, use the acronym PCARE. This starts with the pre-maneuver checklist. Then, perform a clearing turn. A clearing turn is a 90° turn to the left to check for traffic behind the airplane, followed by a 90° right turn back to the original direction. Don't forget to rescan the area. Always turn to the left because if aircraft overtake the airplane, they will pass on the right. If changing directions for the maneuver, clear the area when changing directions, and this counts as the clearing turn.

Next, choose the altitude at which the maneuver will be performed. Make a radio call, stating the aircraft's callsign or registration, location, altitude, and intentions. Last, pick an emergency landing location in the event of an engine failure or other emergency.

Per the Airmen Certification Standards (ACS), the maneuver must be performed between 600 to 1000 feet AGL. This means that the aircraft cannot descend below 600 feet AGL or climb above 1000 feet AGL. A good rule of thumb would be to use 800 feet AGL to allow some buffer on both sides of the maneuver.

To perform the maneuver, identify a long, straight visual reference. Roads, fence lines, and rivers are acceptable to use as references. Enter on the downwind. Once crossing the selected visual reference, begin the turn. The first turn will be the steepest as the wind is directly behind the airplane, pushing it away from the reference. As the airplane turns, the bank will get increasingly shallow until crossing the road wings level with a direct headwind. Then, begin a turn in the opposite direction. The headwind will push the airplane towards the visual reference point. Because of this, the initial turn will be shallower, then get increasingly steep. The airplane will be at its steepest point as it approaches the roadway and rolls wings level. Remember to stay coordinated.

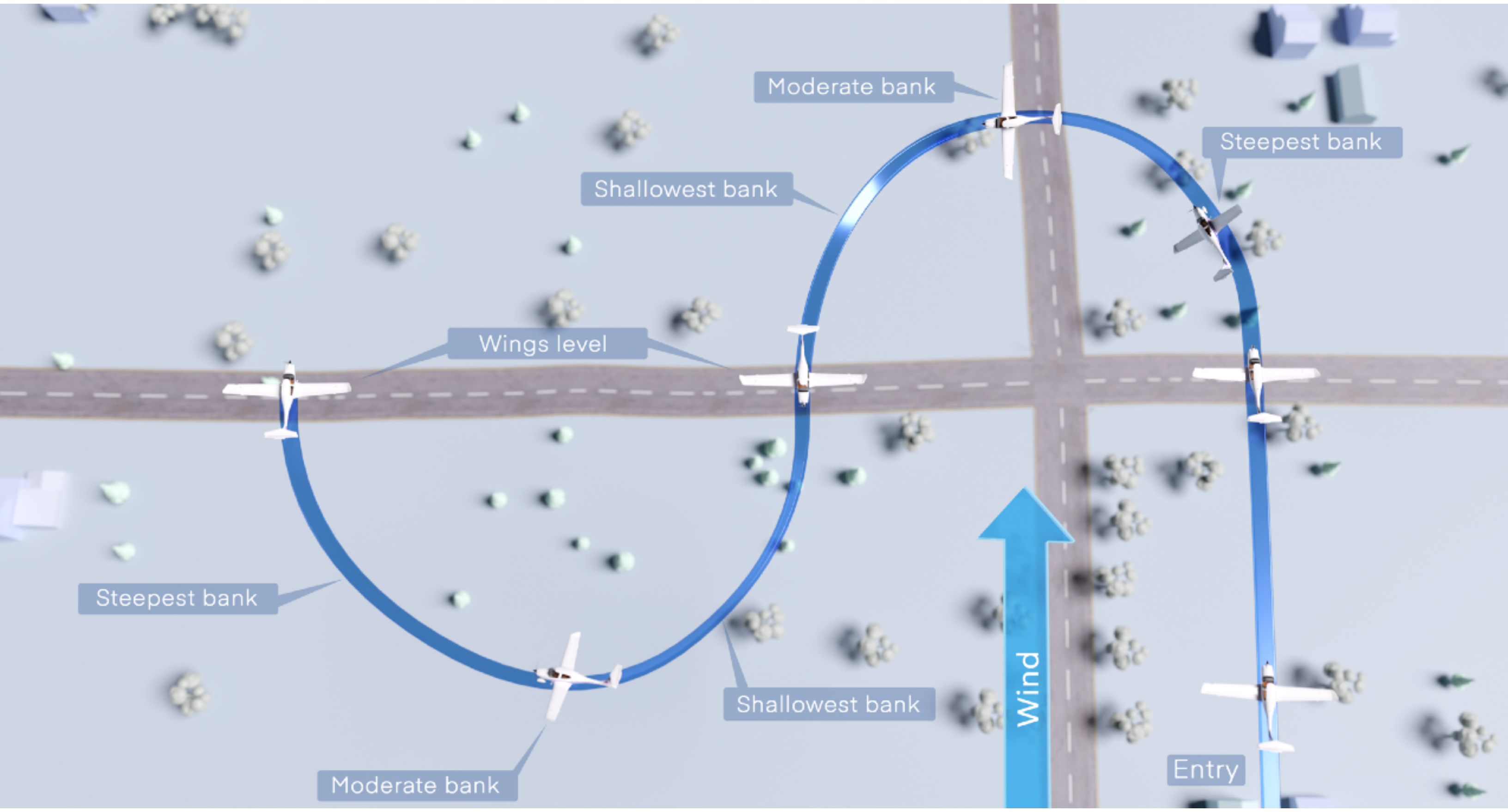
S-Turns Procedure

1. Clear the area
2. Determine wind direction
3. Select a suitable ground-based reference line that is perpendicular to the wind
4. Establish airspeed and maintain altitude
5. Enter on the downwind
6. Upon crossing the reference line, start a left or right 180° turn and adjust the bank angle to fly a constant radius turn
7. Maintain altitude and airspeed
8. Wings level crossing over the reference line
9. Repeat in the opposite direction
10. Once crossing the reference line again, return to cruise flight

ACS STANDARDS

Private

600 to 1000 ft AGL
Altitude ± 100 ft
Airspeed ± 10 kt



TURNS AROUND A POINT

Description

The purpose of turns around a point is to maintain a constant radius around a ground reference point while correcting for wind.

The aircraft should be in the clean configuration. To perform turns around a point, use the acronym PCARE. This starts with the pre-maneuver checklist. Then, perform a clearing turn. A clearing turn is a 90° turn to the left to check for traffic behind the airplane, followed by a 90° right turn back to the original direction. Don't forget to rescan the area. Always turn to the left because if aircraft overtake the airplane, they will pass on the right. If changing directions for the maneuver, clear the area when changing directions, and this counts as the clearing turn.

Next, choose the altitude at which the maneuver will be performed. Make a radio call, stating the aircraft's callsign or registration, location, altitude, and intentions. Last, pick an emergency landing location in the event of an engine failure or other emergency.

Per the Airmen Certification Standards (ACS), the maneuver must be performed between 600 to 1000 feet AGL. This means that the aircraft cannot descend below 600 feet AGL or climb above 1000 feet AGL. A good rule of thumb would be to use 800 feet AGL to allow some buffer on both sides of the maneuver.

To perform this maneuver, pick an object on the ground that will be easy to see and will not move. Enter the maneuver on the downwind. Just before the reference point comes abeam of the pilot, smoothly begin rolling into an appropriate bank. The closer the point is to the aircraft, the steeper the bank must be to maintain a constant radius around the reference point. Increase aft yoke to compensate for the loss of the VCL. Add power to maintain airspeed. The airplane needs a steeper bank when the wind pushes the aircraft away from the point. The bank must be relieved and shallowed out as the airplane comes around. When the wind is pushing the airplane towards the point, the bank will be at its shallowest.

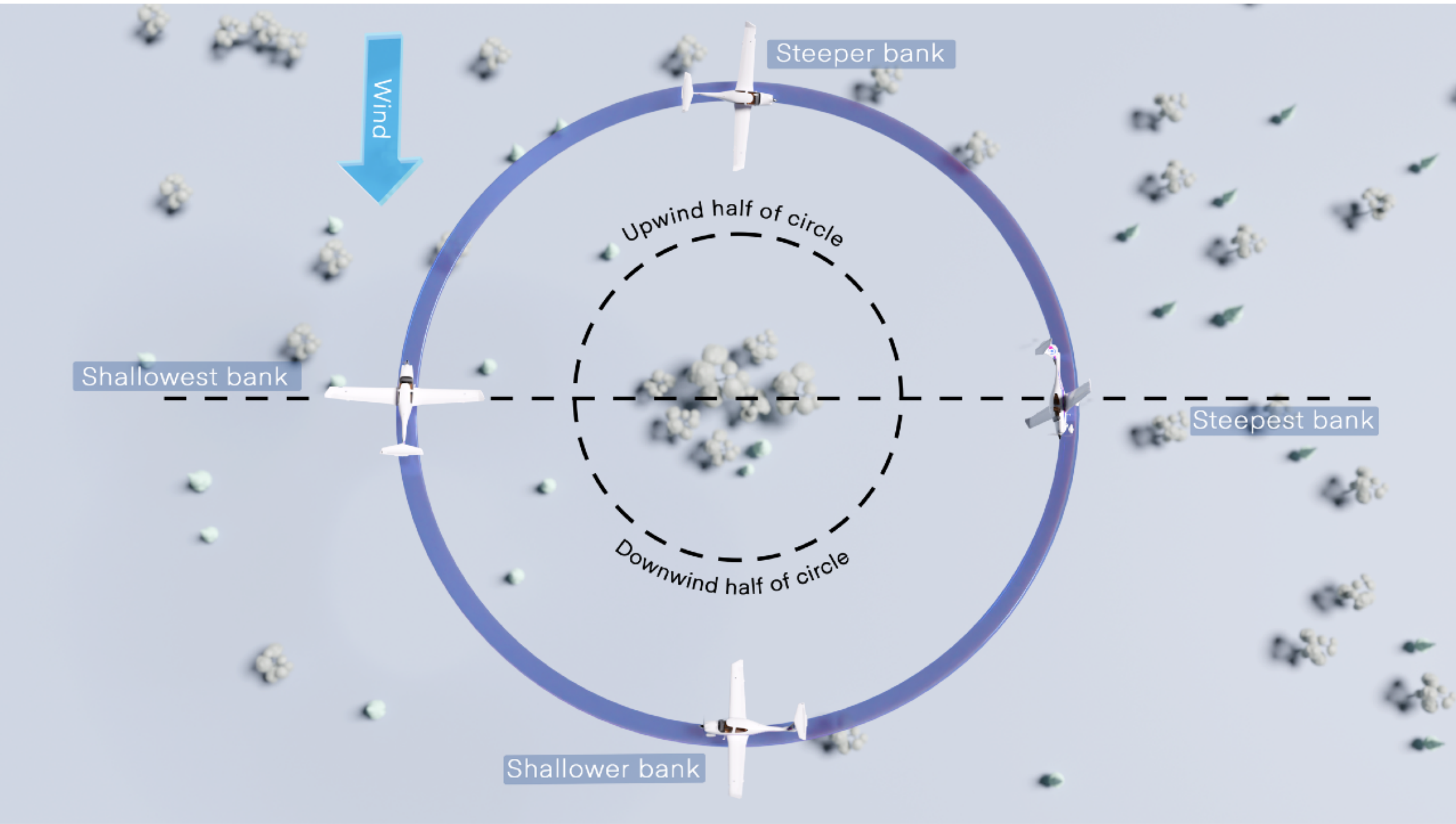
Turns Around a Point Procedure

1. Clear the area
2. Determine wind direction
3. Select a suitable ground-based reference point
4. Establish airspeed and maintain altitude
5. Enter on the downwind
6. Adjust bank angle to maintain a constant radius turn around the chosen point
7. Maintain altitude and airspeed
8. Once the 360° turn is complete, return to cruise flight

ACS STANDARDS

Private

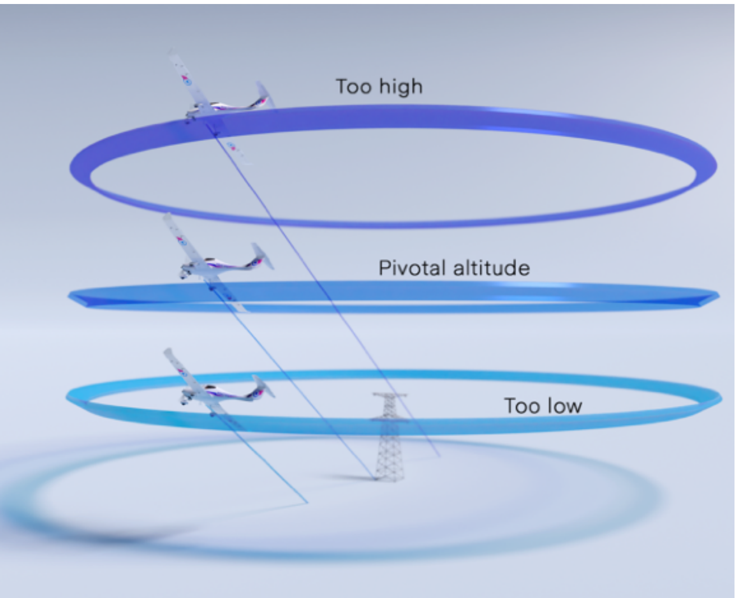
600 to 1000 ft AGL
Altitude ± 100 ft
Airspeed ± 10 kt



8S ON PYLONS

Description

The 8s on Pylons maneuver is a ground reference maneuver where the pilot maintains a pivotal altitude around two different points. The pivotal altitude is based on ground speed and is calculated by airspeed squared divided by 11.3 for knots or 15 for mph. For example, if an airplane travels at 100 knots, the pivotal altitude would be: 1002 divided by 11.3 = 884' AGL. As airspeed increases, pivotal altitude increases. As airspeed decreases, pivotal altitude decreases.



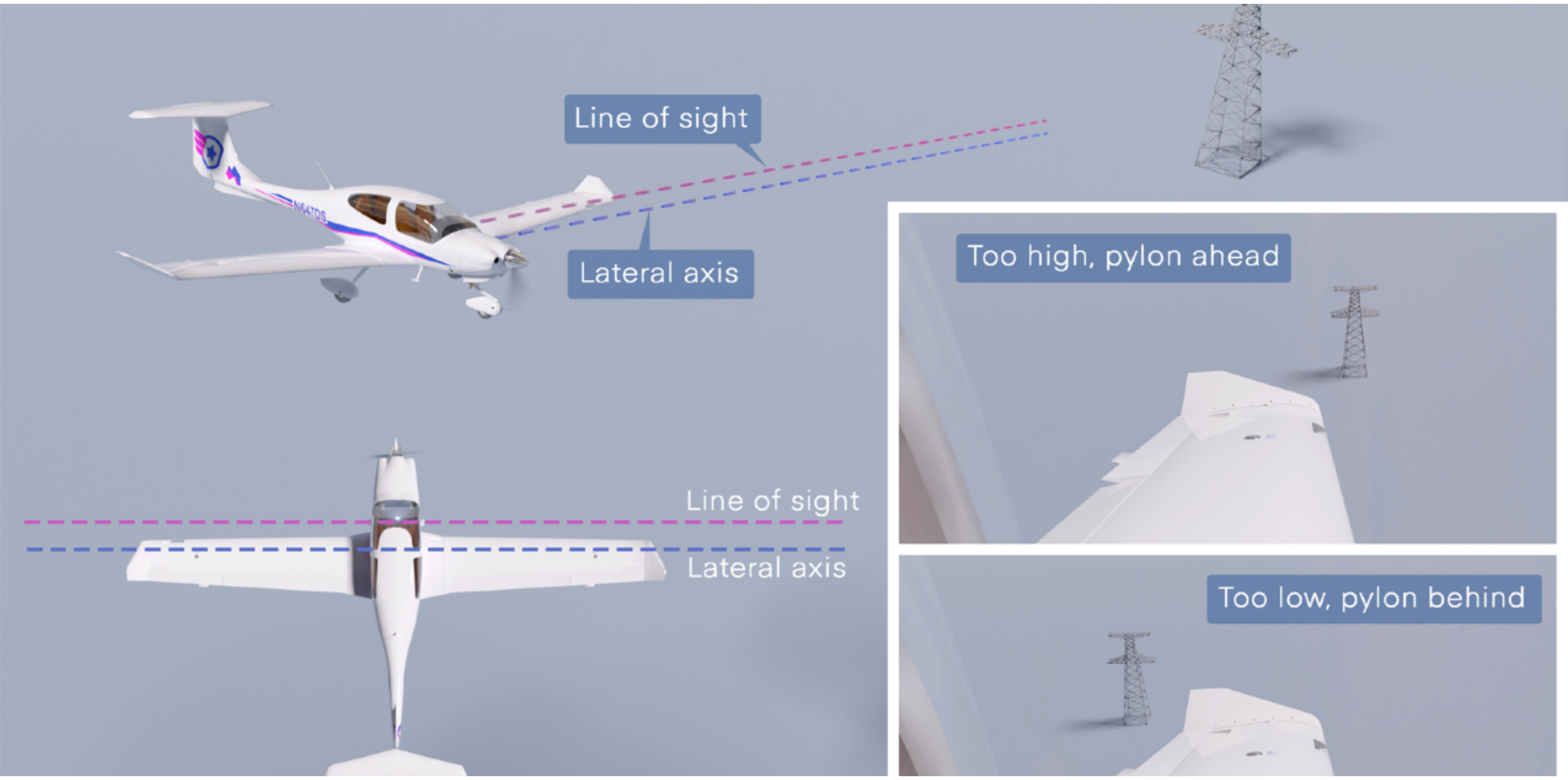
The aircraft should be in the clean configuration. To perform 8s on pylons, use the acronym PCARE. This starts with the pre-maneuver checklist. Then, perform a clearing turn. A clearing turn is a 90° turn to the left to check for traffic behind the airplane, followed by a 90° right turn back to the original direction. Don't forget to rescan the area. Always turn to the left because if aircraft overtake the airplane, they will pass on the right. If changing directions for the maneuver, clear the area when changing directions, and this counts as the clearing turn.

Next, choose the altitude at which the maneuver will be performed. Make a radio call, stating the aircraft's callsign or registration, location, altitude, and intentions. Last, pick an emergency landing location in the event of an engine failure or other emergency.

To perform this maneuver, two ground reference points should be identified around a half mile apart. The hardest part of this maneuver is properly setting it up. To enter the maneuver, enter the first pylon at a 45° on downwind. When coming abeam the first pylon, roll into a 30° AOB. Don't forget that as the bank increases, the aircraft will want to descend. Correct this by increasing the AOA and add power to maintain altitude and airspeed.

Once these are set, do not touch the throttle until the completion of the maneuver. Place the pylon in line with the tip of the wing, and keep the pylon at that point. Unlike with turns around a point, the purpose of 8s on pylons is not to compensate for wind. 8s on pylons is to maintain a pivotal altitude and keep the pylon at the same point in reference to the aircraft. If the pylon begins to move behind the aircraft, the ground speed is increasing. Apply aft yoke to increase altitude. If the pylon is moving ahead of the reference point to the aircraft, airspeed is slowing. Apply forward yoke to decrease pivotal altitude and increase airspeed. Make small corrections and reevaluate. If the pylon starts to move, start a correction immediately. Excessive forward or aft yoke will increase or decrease airspeed significantly. One way to remember the correction is to note that the pylon's direction is the direction the yoke should move to provide correction. Don't forget to maintain coordination. The majority of this maneuver should be conducted by looking outside at the pylon, only cross-checking the instruments 10% of the time.

After completing the maneuver, exit at a 45° angle towards the second pylon. The airplane should be straight and level for no more than 3-5 seconds. As the second pylon approaches, roll into a 30° AOB in the other direction and perform the maneuver in the same manner as the first pylon. Remember to maintain coordination.



Groundspeed		Approximate Pivotal Altitude
Knots	MPH	
87	100	670
91	105	735
96	110	810
100	115	885
104	120	960
109	125	1050
113	130	1130

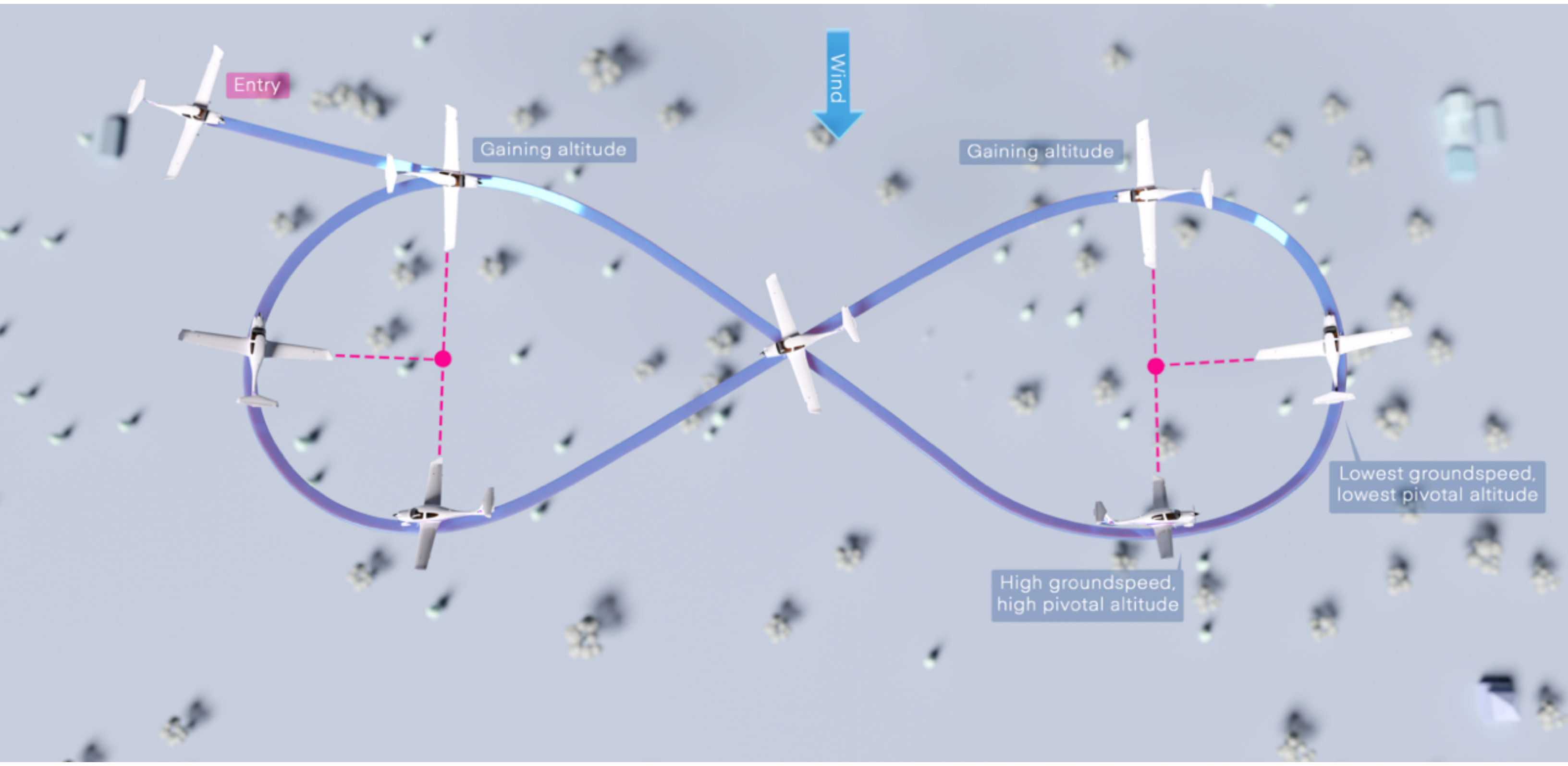
8s on Pylon Procedure

1. Clear the area
2. Determine wind direction
3. Select two reference points (pylons) that are perpendicular to the wind
4. Establish airspeed and maintain a pivotal altitude of approximately 800' AGL (Check
5. groundspeed)
6. Enter the maneuver halfway between the pylons, 45° from the downwind
7. Apply appropriate pitch corrections to compensate for changes in groundspeed and to maintain line of sight reference with the pylon (decrease pivotal altitude if the pylon moves in front of the reference line, increase pivotal altitude if the pylon moves behind the reference line)
8. Begin rollout to allow the airplane to proceed diagonally between the pylons at a 45° angle
9. Begin a second turn in the opposite direction
10. Exit the maneuver on the entry heading

ACS STANDARDS

Commercial

- Bank Less than 40°
- Maintain pivotal altitude
- Avoid slips and skids



SLOW FLIGHT & STALLS

SLOW FLIGHT

Description

The purpose of slow flight is to demonstrate the ability to maneuver the airplane at slow airspeed and high angles of attack. Slow flight can be used to create distance from other aircraft. Remember, the stall speed listed in the POH is at sea level. As altitude or density altitude increases, stall speed will increase. As airspeed will be very slow, left-turning tendencies are enhanced. Also, use caution for stall/spin awareness.

The aircraft should be in the clean configuration. To perform slow flight, use the acronym PCARE. This starts with the pre-maneuver checklist. Then, perform a clearing turn. A clearing turn is a 90° turn to the left to check for traffic behind the airplane, followed by a 90° right turn back to the original direction. Don't forget to rescan the area. Always turn to the left because if aircraft overtake the airplane, they will pass on the right. If changing directions for the maneuver, clear the area when changing directions, and this counts as the clearing turn.

Next, choose the altitude at which the maneuver will be performed. Make a radio call, stating the aircraft's callsign or registration, location, altitude, and intentions. Last, pick an emergency landing location in the event of an engine failure or other emergency.

The maneuver can be performed in the clean (no flaps) or dirty (full flaps) configuration. To configure, reduce power to around 1,500 RPM. If performing in the clean configuration, increase the angle of attack to maintain altitude as the aircraft slows. If performing in the dirty configuration, add flaps, one at a time, pausing approximately 2 seconds between each addition. Increase the AOA to maintain airspeed and add power to maintain altitude. Add trim to relieve control pressures.

The airspeed to maintain should be approximately 5 knots above the stall warning horn. Begin adding power to maintain altitude - pitch for the airspeed. Lowering the nose will increase airspeed. Raising the nose will decrease airspeed. Do not rush while configuring for slow flight. After properly configuring, tell the instructor or DPE, "maneuver ready," to indicate you are ready to begin maneuvering.

When climbing in slow flight, add full power. The airplane will climb slowly, and this is acceptable. Increase the angle of attack (nose up) to prevent an increase in airspeed. When descending, reduce power and decrease the angle of attack (nose down) to maintain airspeed.

When turning, do not bank more than 5°. Excessive banking could lead to a spin. Remain coordinated and remember the left-turning tendencies.

To recover from slow flight, add full power. If clean, slowly allow the airplane to accelerate back to cruise flight. If dirty, establish a positive rate of climb and remove the third notch of flaps. Once passing V_X, remove the second notch of flaps. Once past V_Y, remove the first notch of flaps and accelerate to straight and level flight. Re-trim and resume cruise flight.

Slow Flight Procedure

1. Identify slow flight speed
2. Reduce power to approximately 1,500 RPM
3. Add flaps (to full) for dirty, leave up for clean
4. Increase AOA to maintain altitude
5. Increase RPM to maintain altitude
6. Bank no more than 5 degrees in turns

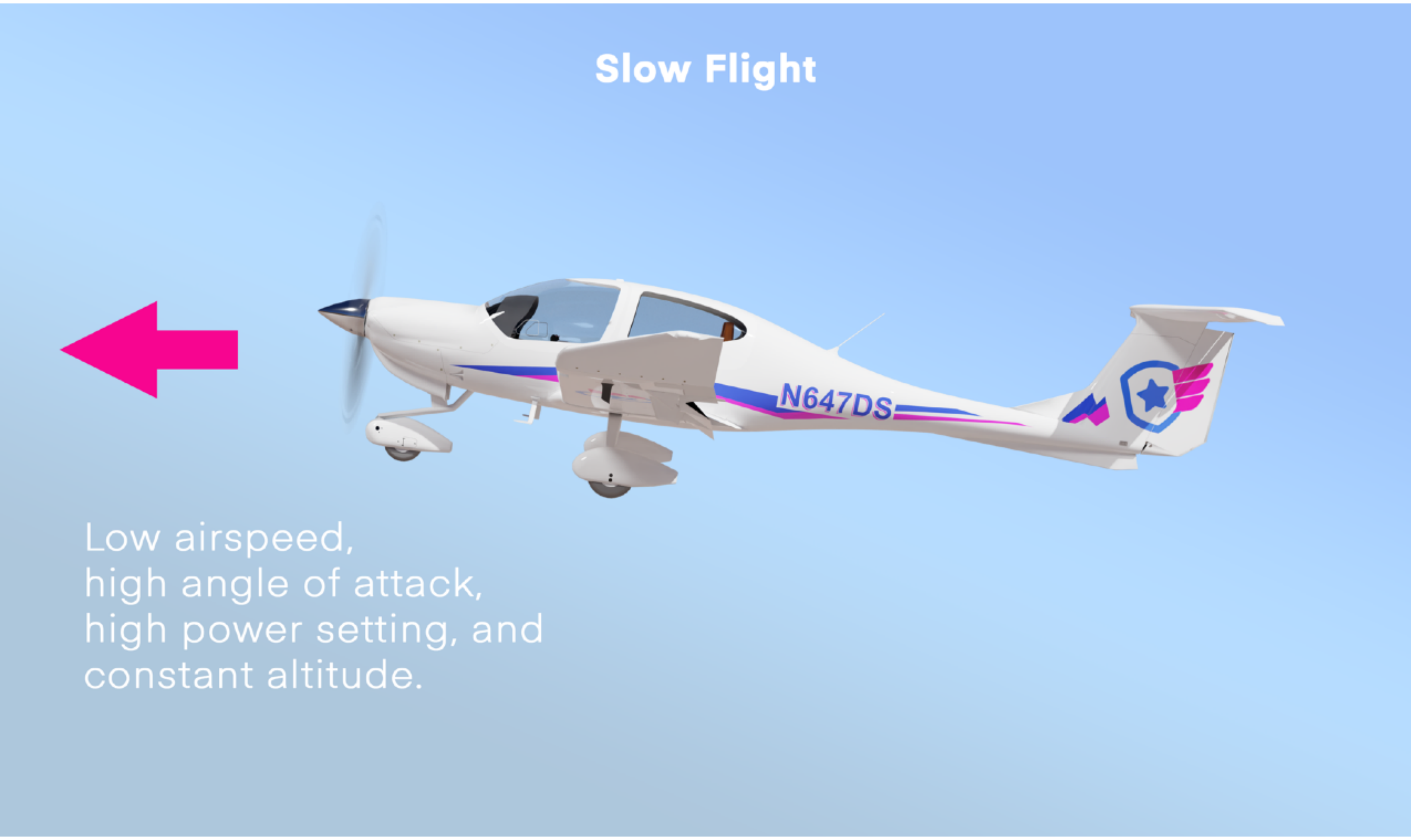
ACS STANDARDS

Private

Altitude ± 100 ft
Heading ± 10°
Airspeed +10/-0 kt
Bank Angle: ± 10°

Commercial

Altitude ± 50 ft
Heading ± 10°
Airspeed +5/-0 kt
Bank Angle: ± 5°

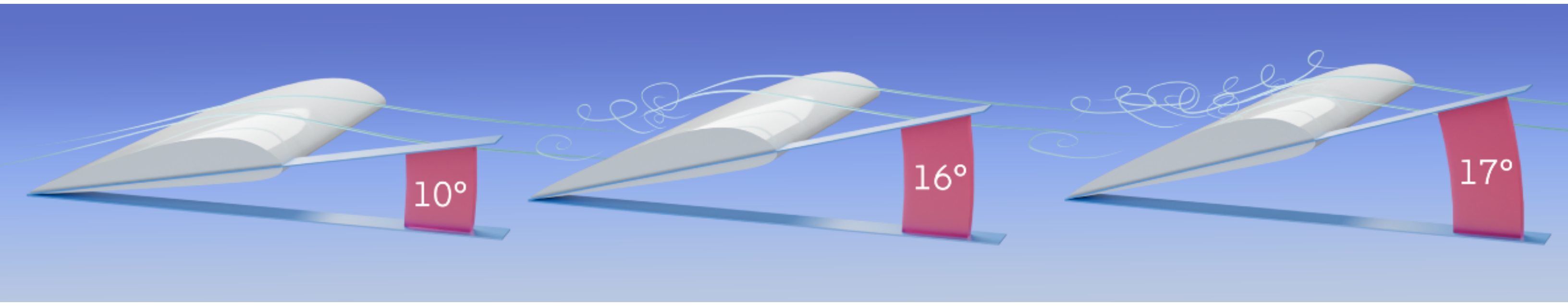


POWER OFF STALL

Description

The power-off stall simulates a recovery during an approach that results in a flare too high or stalling during approach. Power-off stalls can be performed while traveling straight ahead or in a turn up to 20°. Ensure coordinated flight is maintained throughout the entire maneuver. Prompt and proper recovery is crucial to ensure the aircraft does not spin or collide with the ground. The procedure for recovery is like the rejected landing/go around. Per the ACS, private pilot applicants will take the airplane to a full stall before recovering, while commercial applicants will recover at the first indication of a stall.

The aircraft should be in the clean configuration. To perform the power-off stall, use the acronym PCARE. This starts with the pre-maneuver checklist. Then, perform a clearing turn. A clearing turn



is a 90° turn to the left to check for traffic behind the airplane, followed by a 90° right turn back to the original direction. Don't forget to rescan the area. Always turn to the left because if aircraft overtake the airplane, they will pass on the right. If changing directions for the maneuver, clear the area when changing directions, and this counts as the clearing turn.

Next, choose the altitude at which the maneuver will be performed. Make a radio call, stating the aircraft's callsign or registration, location, altitude, and intentions. Last, pick an emergency landing location in the event of an engine failure or other emergency.

First, pick a visual reference outside the aircraft in the distance to maintain track. To configure, begin by reducing power to around 1,500 RPM. As the aircraft begins to slow, wait until the airspeed is in the white arc and begin adding flaps. Pause for around 2 seconds between each addition of flaps until the flaps are full. When full flaps are added, wait until the aircraft reaches its V_{REF} (final approach) speed. Pitch down to maintain this airspeed, simulating an approach. Maintain the pitch-down airspeed for 3 seconds, then bring the nose of the airplane back to level. Reduce power to idle and allow the airspeed to bleed off.

The first indication of a stall will be the stall warning horn. When the stall warning horn comes on, call out "stall horn." Maintain a nose-level attitude, tracking towards the visual reference and maintaining coordination. The next warning of a stall will be the buffet. The buffet can best be described as small vibrations through the airplane as the air begins to separate from the airfoil. Call out "buffet" as this occurs. Maintain coordinated flight and nose-level attitude. Next will come the stall. The nose of the aircraft will drop, even as the pilot applies aft pressure on the yoke. Call out "stall" when this occurs.

If in a turn, recover first level the wings. Simultaneously apply full power and reduce the angle of attack by applying forward yoke. Once the stall warning horn turns off and airspeed increases, begin increasing the AOA for a climb. Once a positive rate of climb is established, call out "positive rate of climb" and remove the third notch of flaps. Maintain altitude, and as the airplane accelerates past V_X, call out "V_X" and remove the second notch of flaps. After the airplane passes V_Y, call out "V_Y" and remove the first notch of flaps. Allow the airplane to accelerate back to cruise speed and resume straight and level flight.

Power Off Stall Procedure

1. Reduce power to approximately 1,500 RPM
2. Maintain altitude and add flaps as appropriate
3. At VREF, pitch down simulating final approach
4. Wait 3 seconds
5. Level off
6. Power idle
7. Maintain altitude
8. Call horn
9. Call buffet
10. Call stall
11. Add full power
12. Reduce AOA
13. Positive rate of climb

14. Remove 1st notch flaps
15. VX
16. Remove 2nd notch flaps
17. VY
18. Clean aircraft
19. Climb at VY

ACS STANDARDS

Private
- Heading ± 10°
- Bank Angle: < 20°
- If turning, ± 10° bank
- Complete by 1,500' AGL

Commercial
- Heading ± 10°
- Bank Angle: < 20°
- If turning, ± 5° bank
- Complete by 1,500' AGL

POWER ON STALL

Description

A power-on stall simulates an excessive nose-up attitude during takeoff or climb. It's important to maintain coordination and prepare for excessive left-turning tendencies. This is due to slow airspeed and high power input.

The aircraft should be in the clean configuration. To perform the power on stall, use the acronym PCARE. This starts with the pre-maneuver checklist. Then, perform a clearing turn. A clearing turn is a 90° turn to the left to check for traffic behind the airplane, followed by a 90° right turn back to the original direction. Don't forget to rescan the area. Always turn to the left because if aircraft overtake the airplane, they will pass on the right. If changing directions for the maneuver, clear the area when changing directions, and this counts as the clearing turn.

Next, choose the altitude at which the maneuver will be performed. Make a radio call, stating the aircraft's callsign or registration, location, altitude, and intentions. Last, pick an emergency landing location in the event of an engine failure or other emergency.

To perform the maneuver, pick a visual reference to maintain heading. Reduce power to 1,500 RPM and maintain a nose-level attitude to allow airspeed to bleed off. If the aircraft has retractable landing gear, lower the landing gear at the appropriate speed per the POH.

Once the aircraft reaches rotation speed (V_R), add full power and, at the same time, pitch up to around +20. Hold this attitude, maintaining coordination and ground track. Recover at the first indication or full stall, as specified by the instructor or DPE.

To recover, leave the power full and reduce the angle of attack by lowering the nose (aft yoke). Airspeed will increase, allowing the airplane to accelerate back to cruise speed and resume straight and level flight.

Power On Stall Procedure

1. Reduce power to approximately 1,500 RPM
2. Maintain altitude
3. VR
4. Add full power
5. Pitch up approximately 15 to 20 degrees
6. Be aware of left-turning tendencies
7. Call horn
8. Call buffet
9. Call stall
10. Recover by lowering nose

ACS STANDARDS

Private

Heading ± 10°
Bank Angle: < 20°
If turning, ± 10° bank
Complete by 1,500' AGL

Commercial

Heading ± 10°
Bank Angle: < 20°
If turning, ± 5° bank
Complete by 1,500' AGL

ACCELERATED STALL

Description

An accelerated stall is when the airplane stalls at a higher airspeed due to loads above +1G on the aircraft. The most common times accelerated stalls occur is during rotation when a pilot rotates too fast. They also occur during steep turns when the nose drops below the horizon and the pilot pulls back too fast to get the nose back up above the horizon.

The aircraft should be in the clean configuration. To perform the accelerated stall, use the acronym PCARE. This starts with the pre-maneuver checklist. Then, perform a clearing turn. A clearing turn is a 90° turn to the left to check for traffic behind the airplane, followed by a 90° right turn back to the original direction. Don't forget to rescan the area. Always turn to the left because if aircraft overtake the airplane, they will pass on the right. If changing directions for the maneuver, clear the area when changing directions, and this counts as the clearing turn.

Next, choose the altitude at which the maneuver will be performed. Make a radio call, stating the aircraft's callsign or registration, location, altitude, and intentions. Last, pick an emergency landing location in the event of an engine failure or other emergency.

First, pick an altitude allowing the aircraft to complete the maneuver above 3000' AGL. To perform the maneuver, slow the aircraft to below maneuvering speed by reducing power to around 1,500 RPM. Once below maneuvering speed, smoothly reduce power to idle and roll into a 45° angle of bank to the left or right.

Once established in the bank, maintain altitude and apply aft yoke pressure to the first indication of a stall. Once the stall warning horn comes on, roll wings level and smoothly apply full power. Allow the aircraft to accelerate to cruise speed and resume straight and level flight.

Accelerated Stall Procedure

1. Power to approximately 1,500 RPM
2. Reduce speed below maneuvering speed
3. Power idle
4. Roll into a 45-degree bank
5. Aft yoke
6. Recover at first indication of a stall
7. Add full power
8. Roll wings level

ACS STANDARDS

Commercial

Recover by 3,000' AGL
Bank Angle: 45°
Do not exceed V_A

pilotinstitute

STALL/SPIN AWARENESS

Description

A spin is an aggravated stall condition where one or both wings have exceeded the critical angle of attack and stalled. Many factors listed in the Airplane Flying Handbook can contribute to a spin. These include poor yaw control (coordination), left-turning tendencies, wind shear, and wake turbulence. Stalling in a slipping or skidding turn can also result in a stall.

Before each flight, review the POH for proper spin recovery procedures for the aircraft being used. The aircraft will travel in a corkscrew effect towards the ground. One of the wings generates a small amount of lift, and that wing determines the direction of the spin. When in a fully developed spin, the airspeed should go to zero. If the airspeed is increasing, the aircraft is not in a spin but in an unusual attitude.

The spin has different phases. The first is the entry, if being deliberately entered. Never perform a spin without a qualified instructor on board, and in an aircraft where intentional spins are prohibited. The second phase is the incipient phase. This usually lasts two turns, and it is where the aircraft is settling into the spin.

The next phase is fully developed, where the airspeed, vertical speed, and rate of rotation are stabilized. The last phase is the recovery phase. Always read and memorize the spin recovery procedures specific to the aircraft being flown. A generic procedure is below, and should be committed to memory.

Use the acronym PARE for recovery. The first step is to reduce power to idle. Leaving power in can aggravate the spin and increase the rotation speed. The next step is to move the ailerons level. After the recovery from the stall, having ailerons anything but level can cause another spin or spin in the opposite direction.

The next step is to apply full rudder in the opposite direction of the spin. This is the most important step to stop the rotation and regain control of the aircraft. Apply full opposite rudder until the spin stops. Then, briskly push forward on the yoke. Elevator down helps get the airplane out of the stalled condition. Once the aircraft gets out of the spin and stabilizes, slowly bring the nose up back to straight and level flight. Be sure to be careful to avoid airspeed above VA. When bringing the nose up, abnormal G forces, up to +3G, may be felt. This is normal. Allow airspeed to bleed off, and once the airspeed nears cruise, add power to return to cruise.

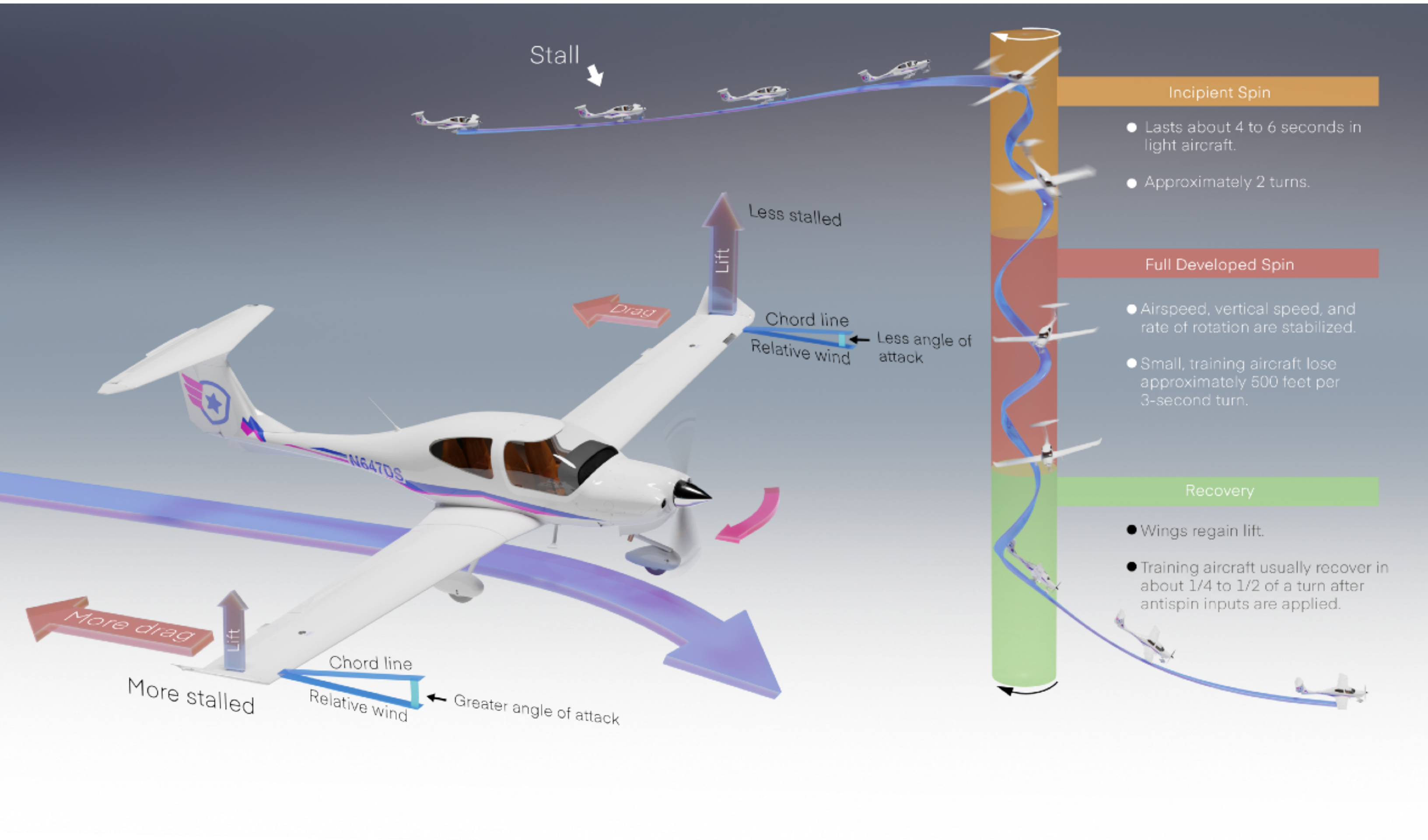
As mentioned in this guide, a spin can develop if a pilot overshoots final approach. The common scenario is a pilot overshoots final while turning from base. The overshoot is enough that a pilot banks 30° and does not want to bank any more, yet cannot get aligned with the runway. In an attempt to get back aligned with the runway, the pilot adds rudder. This puts the airplane into a skid. The pilot then fails to monitor the airspeed and stalls the airplane. The result is a spin that is only 300-400 feet above the ground. Even the most experienced spin instructors cannot recover from a spin in less than 600-700 feet. Many pilots and aircraft have been lost due to this scenario. It is of utmost importance that pilots understand this scenario and do not replicate it. If an approach is unsafe, unstable, uncoordinated, or slow, go around immediately.

Stall Awareness Procedure

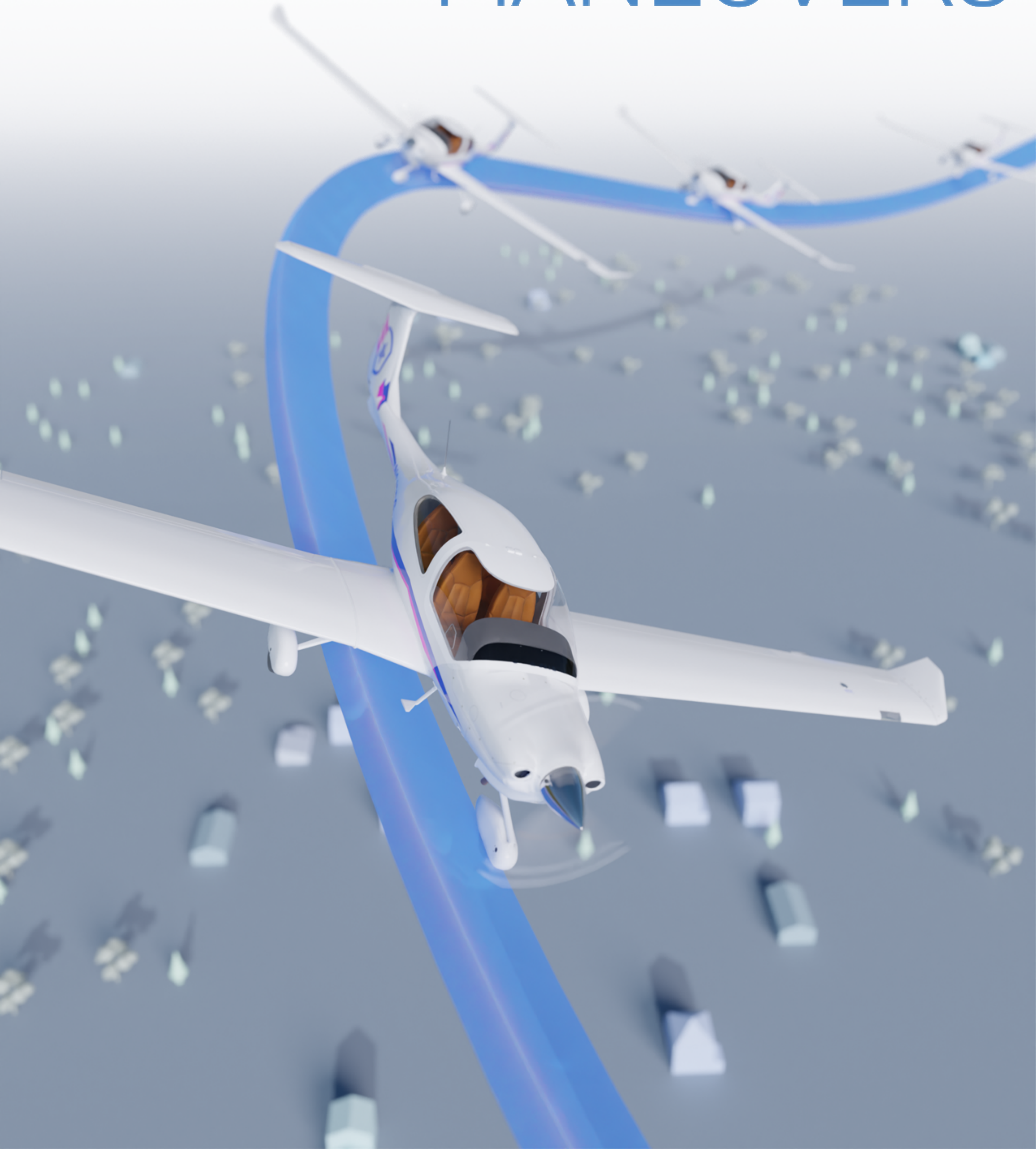
1. Power idle
2. Ailerons neutral
3. Rudder in the opposite direction of the spin
4. Elevator down

Spin Recovery Procedure

1. Reduce power to idle
2. Position ailerons to neutral
3. Apply full opposite rudder against rotation
4. Apply brisk forward elevator
5. Neutralize the rudder after spin rotation stops
6. Apply back elevator pressure to return to level flight



PERFORMANCE MANEUVERS



STEEP TURNS

Description

A steep turn is used to improve a pilot's control and awareness. The goal is to make their flight control inputs smooth and coordinated, while staying alert to outside references and hazards. Pilots also use steep turns to practice dividing attention between controlling the aircraft and scanning for traffic.

The aircraft should be in the clean configuration. To perform the steep turn, use the acronym PCARE. This starts with the pre-maneuver checklist. Then, perform a clearing turn. A clearing turn is a 90° turn to the left to check for traffic behind the airplane, followed by a 90° right turn back to the original direction. Don't forget to rescan the area. Always turn to the left because if aircraft overtake the airplane, they will pass on the right. If changing directions for the maneuver, clear the area when changing directions, and this counts as the clearing turn.

Next, choose the altitude at which the maneuver will be performed. Make a radio call, stating the aircraft's callsign or registration, location, altitude, and intentions. Last, pick an emergency landing location in the event of an engine failure or other emergency.

Once complete, establish an outside visual reference, such as a mountain peak or prominent object in the distance. Also note the entry heading on the directional gyro. Smoothly begin rolling into the turn. Once the turn reaches 30° angle of bank (AOB), give two full trim rotations up. A full rotation of trim would be the pilot pinching the trim wheel at the top (in a Cessna) or towards the front (in a Piper) and rotating it downward or rearward for nose up attitude.

Continue increasing the bank. Private pilots use a 45° AOB, and commercial pilots use a 50° AOB. Add power to maintain airspeed. As the airplane turns, it is normal to feel a little bit of G force pushing the pilot into the seat. Look outside at the sight picture of the horizon across the front of the airplane. If the nose starts to drop, pull back slightly to bring the nose back up. Use caution; pulling back too hard or too quickly can cause an accelerated stall. If the nose rises, apply forward pressure on the yoke to bring the nose back down. Maintain the angle of bank. Plan to roll out at half the bank angle from the entry heading.

When rolling out of the steep turn, there will be excessive trim to compensate for the loss of the VCL. The pilot will have to apply extra pressure forward on the yoke to maintain altitude. Once wings level and headed towards the visual reference, smoothly roll into a turn in the opposite direction. Then, repeat the maneuver in the other direction.

At the completion of the second turn and rolling out on the visual reference, retrim the airplane and return to straight and level flight.

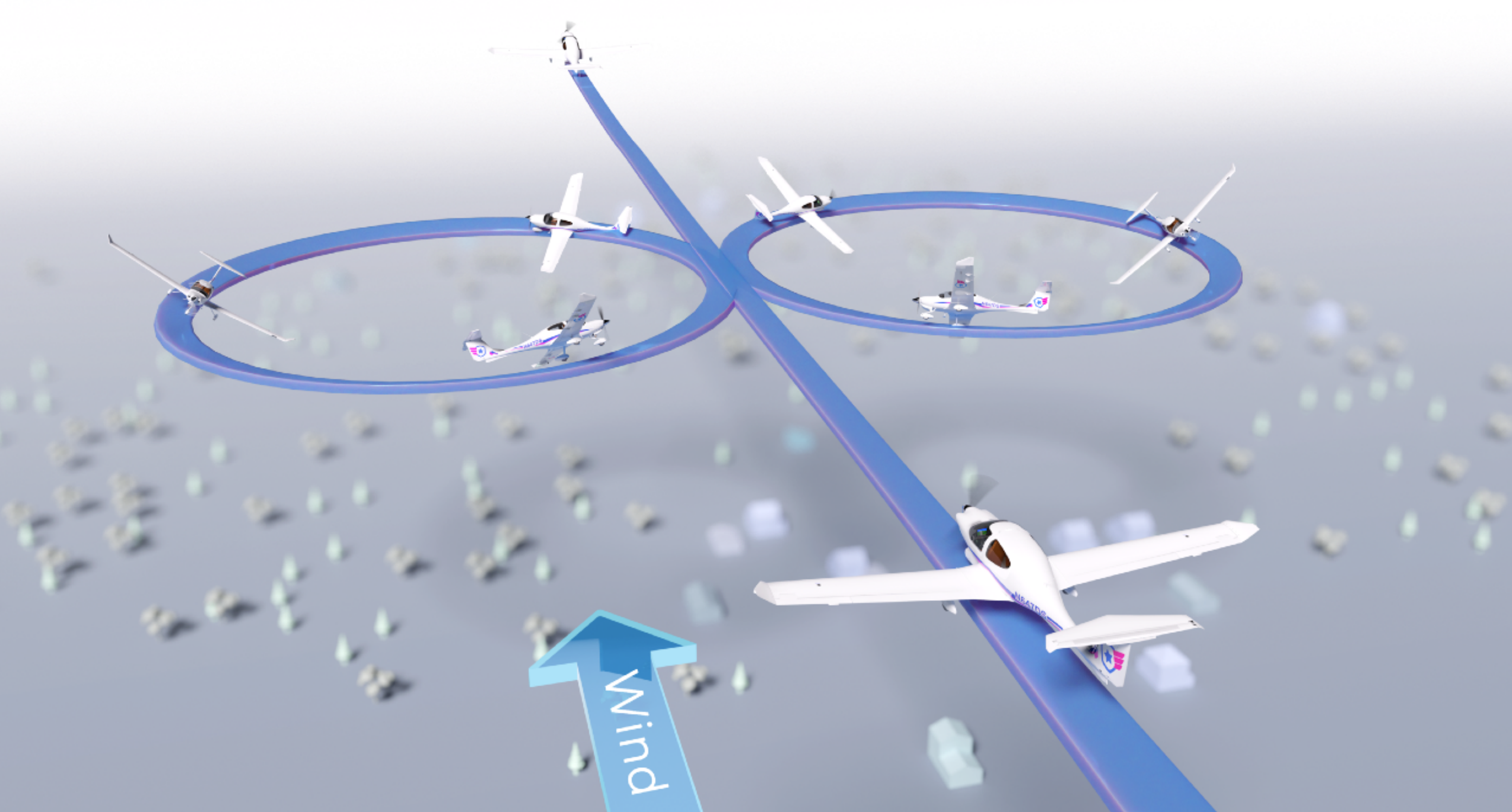
Steep Turns Procedure

1. Establish visual reference
2. Smoothly roll into turn
3. Add 200 RPM
4. 30° bank
5. Add two nose-wheels of trim up
6. Complete roll to desired bank
7. Prior to visual reference, begin rollout
8. Beware, trim will want to push nose up
9. Roll into a bank in the opposite direction
10. Prior to visual reference, begin rollout
11. Return to wings level on visual reference
12. Re-trim
13. Reduce power
14. Return to cruise

ACS STANDARDS

Private
- Bank Angle: 45°
- Altitude ± 100 ft
- Airspeed ± 10 kt
- Bank ± 5°
- Roll out ± 10° entry heading

Commercial
- Bank Angle: 50°
- Altitude ± 100 ft
- Airspeed ± 10 kt
- Bank ± 5°
- Roll out ± 10° entry heading



CHANDELLES

Description

The chandelle is a commercial certificate maneuver. It is a maximum-performance climbing turn from straight and level. Pilots attempt to gain as much altitude as possible while sacrificing airspeed. The maneuver concludes with the airplane in a nose-high attitude just above stall speed and slowly resuming straight and level flight, minimizing altitude loss.

The aircraft should be in the clean configuration. To perform the chandelle, use the acronym PCARE. This starts with the pre-maneuver checklist. Then, perform a clearing turn. A clearing turn is a 90° turn to the left to check for traffic behind the airplane, followed by a 90° right turn back to the original direction. Don't forget to rescan the area. Always turn to the left because if aircraft overtake the airplane, they will pass on the right. If changing directions for the maneuver, clear the area when changing directions, and this counts as the clearing turn.

Next, choose the altitude at which the maneuver will be performed. Make a radio call, stating the aircraft's callsign or registration, location, altitude, and intentions. Last, pick an emergency landing location in the event of an engine failure or other emergency.

To start the maneuver, choose the direction of the turn. Smoothly apply full power and roll into a 30° angle of bank. Once banked, smoothly apply aft yoke to achieve maximum pitch up at 90° in the turn. A good rule of thumb is pitching between 12°-15° will achieve the desired results. At the 90° point, maintain the maximum pitch-up attitude and slowly begin rolling the wings back level.

At the 180° point, hold the attitude for approximately 3 seconds, and the stall warning horn should sound. If the stall warning horn comes on early, too much pitch was used. If the stall warning horn does not come on, not enough pitch was used. When turning to the left, beware of the left-turning tendencies as the airspeed slows. Maintain coordination in the turn and remember stall/spin awareness.

Slowly lower the nose to allow the aircraft to accelerate. Do not lower the nose too fast, or the aircraft will descend. The goal is to keep the altitude that was just gained. As the aircraft accelerates, return to straight and level flight.

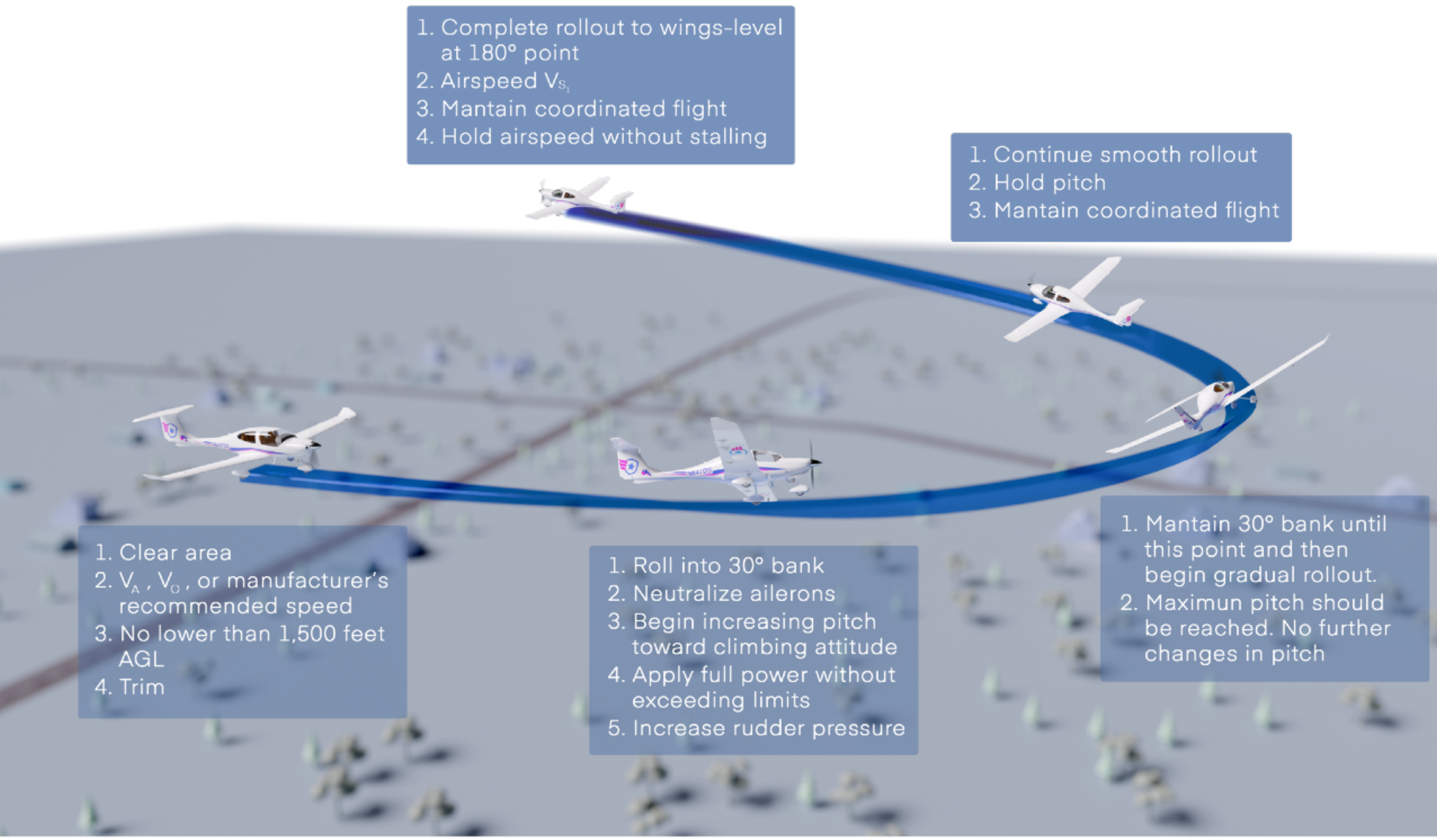
Chandelle Procedure

1. Clear the area
2. Establish airspeed and maintain altitude
3. Select a prominent reference point at 90°
4. Establish and maintain 30° of bank
5. Smoothly apply full power and gradually increase pitch to approximately 15° nose up at the 90° point (constant bank, increasing pitch)
6. At the 90° point, maintain pitch and gradually reduce bank to attain wings level upon completion of a 180° turn (constant pitch, decreasing bank)
7. Achieve and maintain minimum controllable airspeed (50-55 KIAS) at the 180° point
8. Lower the nose to allow airspeed to increase without losing altitude
9. Return to cruise flight

ACS STANDARDS

Commercial

Bank Angle: 30°
Roll out ± 10°
Airspeed above stall speed



LAZY 8S

Description

The lazy 8 is a commercial certificate maneuver to develop proper flight control coordination across a wide range of airspeeds and altitudes. This maneuver demonstrates the aircraft's over-banking tendency. When the airplane slows in a turn, the higher wing produces more drag and lift and the lower wing produces less drag and lift. This leads to a tendency to over-bank.

The aircraft should be in the clean configuration. To perform the lazy 8s, use the acronym PCARE. This starts with the pre-maneuver checklist. Then, perform a clearing turn. A clearing turn is a 90° turn to the left to check for traffic behind the airplane, followed by a 90° right turn back to the original direction. Don't forget to rescan the area. Always turn to the left because if aircraft overtake the airplane, they will pass on the right. If changing directions for the maneuver, clear the area when changing directions, and this counts as the clearing turn.

Next, choose the altitude at which the maneuver will be performed. Make a radio call, stating the aircraft's callsign or registration, location, altitude, and intentions. Last, pick an emergency landing location in the event of an engine failure or other emergency.

To perform the maneuver, pick reference points at 45°, 90°, 135°, and 180°. Begin by slowly increasing pitch and bank. Remember, the maneuver is called LAZY 8s. At the 45° point, the bank should be around 30° with maximum pitch up (around 12-15°). At the 90° point, the bank should be about 30° with minimum airspeed, maximum altitude, and a level pitch attitude. At the 90° point, the nose will drop through the horizon.

The airplane should reach the maximum pitch-down attitude (5-7°) at the 135° point. Allow the airspeed to increase and altitude to decrease and roll out wings level at the 180° point. Roll into another lazy 8 going in the other direction.

This maneuver sounds much more complicated than it is. As long as bank and pitch are applied, and the airplane slows down, it naturally wants to roll. The slower the aircraft becomes, the greater the lift/drag difference between the raised and lowered wing, the more it will want to roll. At the 90° point, the nose naturally wants to drop through the horizon. Use caution not to stall the aircraft, and keep stall/spin awareness in mind.

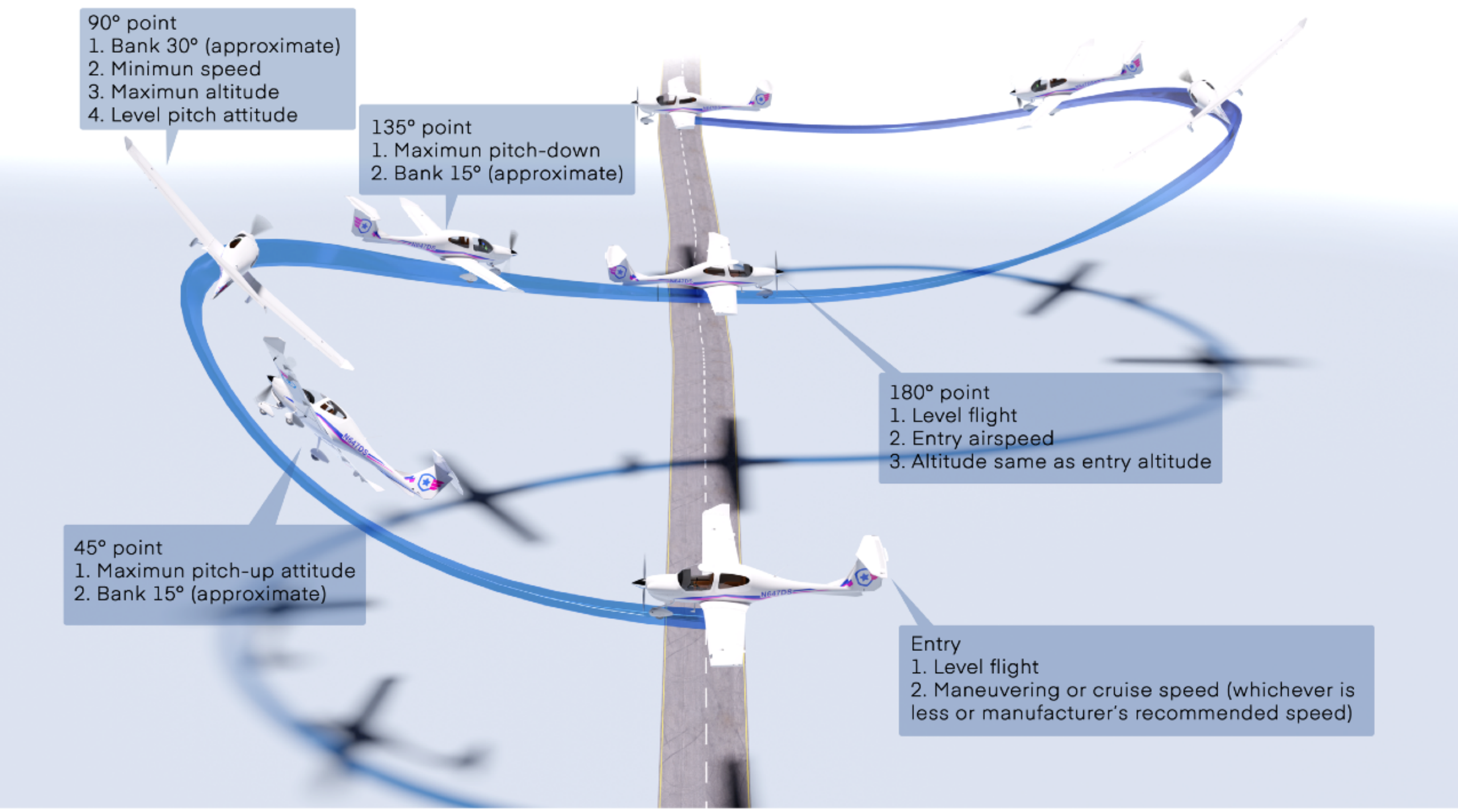
Lazy 8s Procedure

1. Clear the area
2. Establish airspeed and maintain altitude
3. Select prominent reference points at 45°, 90°, and 135° points
4. Simultaneously increase pitch and bank slowly to achieve approximately 15° pitch up and 15° bank at the 45° point
5. Reduce pitch and increase bank to achieve level pitch, approximately 30° bank, and minimum airspeed (50-55 KIAS) at the 90° point
6. Continue reducing pitch and reduce bank to achieve approximately 15° of pitch down and 15° of bank at the 135° point
7. Return to level flight at the entry airspeed and altitude at the 180° point
8. Repeat in the opposite direction
9. Return to cruise flight

ACS STANDARDS

Commercial

Bank Angle: 30° at steepest point
Constant pitch/bank/airspeed change
At 180° ± 100' from entry altitude
At 180° ± 10 kt from entry airspeed
At 180° ± 10° from entry heading



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STEEP SPIRAL

Description

The steep spiral is a maneuver used to descend over a certain point. This maneuver can be used to bleed altitude after an engine failure while directly over an airport. It can also be used if an emergency descent is conducted above clouds to go through an opening in the clouds to maintain VFR conditions.

The aircraft should be in the clean configuration. To perform the steep spiral, use the acronym PCARE. This starts with the pre-maneuver checklist. Then, perform a clearing turn. A clearing turn is a 90° turn to the left to check for traffic behind the airplane, followed by a 90° right turn back to the original direction. Don't forget to rescan the area. Always turn to the left because if aircraft overtake the airplane, they will pass on the right. If changing directions for the maneuver, clear the area when changing directions, and this counts as the clearing turn.

Next, choose the altitude at which the maneuver will be performed. Make a radio call, stating the aircraft's callsign or registration, location, altitude, and intentions. Last, pick an emergency landing location in the event of an engine failure or other emergency.

Pick a point on the ground to be used for reference. Consider turning on carb heat in high humidity or colder temperatures. To enter the maneuver, smoothly reduce power to idle and pitch for best glide speed. When best glide speed is achieved, trim the airplane for the airspeed. Then, smoothly roll into a bank not to exceed 60°. Remember to increase the AOA, or the airspeed will increase.

The wind will want to push the aircraft away from the point, so enter a steeper bank with a direct crosswind pushing the airplane away from the point and a shallow bank with a direct crosswind pushing the airplane towards the point. Constantly scan outside the aircraft for traffic or hazards. At the completion of each 360° turn, briefly add throttle to clear the engine.

Complete at least three turns and roll out on the predetermined visual reference. Add power, retrim, and return to straight and level flight.

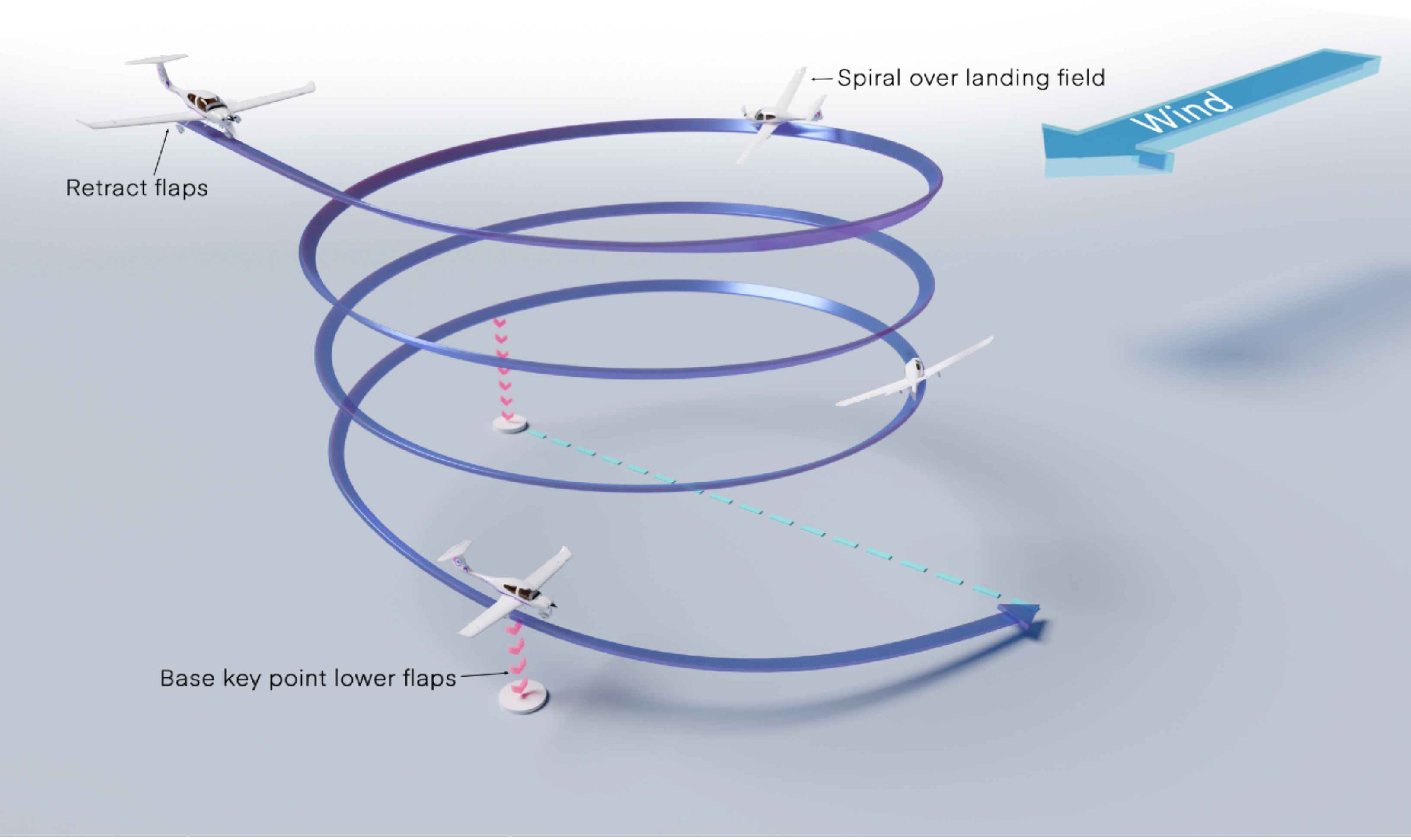
Steep Spiral Procedure

1. Pick a visual reference
2. Power idle (simulated engine failure)
3. Best glide
4. Roll into a bank not to exceed 60 degrees
5. Compensate for wind
6. Clear engine at completion of each turn
7. Complete three turns

ACS STANDARDS

Commercial

Bank Angle: no more than 60°
Airspeed ± 10 kt
Roll out ± 10°
Complete no lower than 1,500' AGL



EMERGENCY OPERATIONS

EMERGENCY DESCENT AND GLIDE

Description

An emergency can occur at any point during the flight. Pilots must prepare for and be ready to execute an emergency landing at any point during a flight. Understanding emergency descents and glides will help pilots understand the aircraft's capability to operate without power.

The emergency descent is used to get down from altitude as fast as possible to the ground and land. This maneuver should be regularly practiced during flight training. Pilots must judge each emergency on a case-by-case basis. In an in-flight fire, the pilot must get down to the ground as fast as possible. Causes vary from faulty fuel lines to loose oil filler caps.

To perform the emergency descent, always review the POH of the aircraft being flown to obtain the proper procedure. A generic procedure depends on the emergency. In General Aviation aircraft, an in-flight fire is the most common scenario that requires a pilot to descend as fast as possible. Always simulate an emergency by pulling power to idle for engine failures. Also clear the engine regularly, and apply carb heat in high humidity or cooler temperatures.

During a simulated engine fire, pull power to idle. Then, SIMULATE by touching the relevant control and saying what procedure the pilot would follow. For example, when the instructor calls “engine fire,” the pilot pulls power to idle. Then the pilot touches but does not articulate: “mixture cutoff, fuel selector off, battery off, alternator off, magnetos off, beginning descent.”” The pilot would then push the nose down, increasing airspeed to around 140 knots.

The purpose of this speed is to blow the fire out. Increase bank to 30-45° to the left. This is because if an aircraft is on an airway, it could collide with an aircraft directly below if it descends straight down. The turn to the left is because if the aircraft is being overtaken, the passing aircraft will pass on the right.

In the descent, the instructor may call “fire out.” Transition to the airplane’s best glide speed. The best glide speed will allow the aircraft to gain the most distance per thousand feet of altitude lost. For example, if an aircraft has a glide ratio of 9.5, this will be 9,500 feet per 1,000 feet of altitude lost. To translate to NM, divide 9,500 by 6076 (feet in a NM). For 9,500, this will equal 1.6 NM per thousand feet lost. So, if an aircraft is 8,000 feet AGL with a 9.5 glide ratio, it will be able to glide 12 NM.

Remember the emergency procedure: ABCDE. A – airspeed, best glide. B – Best place to land. C – Checklist, troubleshooting checklist. D – Declare an emergency, transponder 7700, mayday, mayday, mayday, [reason for emergency], number of souls on board, fuel on board in time (4 hours of fuel). E – Execute an emergency landing. Don’t forget to increase the AOA during gliding turns, as the aircraft will want to lower its nose and increase airspeed, therefore decreasing gliding distance. Beware of wind direction. A headwind will decrease gliding distance, while a tailwind will increase it.

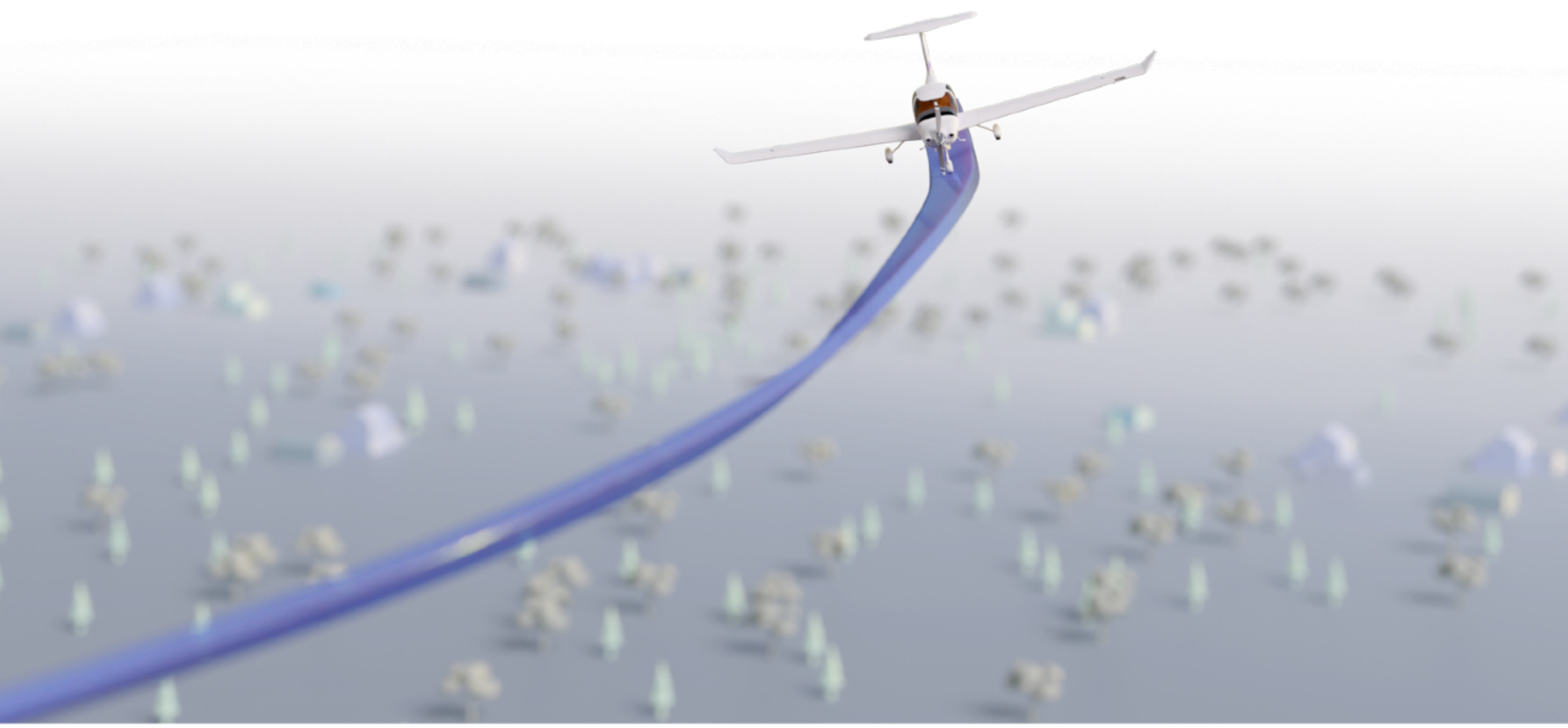
When approaching with no engine power, do not use flaps until landing is guaranteed. Flaps increase drag and lift, so they will slow the aircraft down but use caution not to land short of the desired landing spot. If simulating the maneuver, recover by at least 1,000’ AGL.

Emergency Descent and Glide Procedure

1. Emergency checklist shutting fuel off
2. Nose down to the yellow arc
3. Bank between 30 and 45 degrees
4. Examiner/instructor calls "fire out"
5. Level off
6. Pitch for best glide
7. Examiner/instructor calls "recover"
8. Smoothly add power
9. Return to cruise

ACS STANDARDS

Private/Commercial
- Bank 35-40°
- Airspeed +0 / -10 kt
- Level off ± 100 ft



FAULTY APPROACH PROCEDURES

There are times when pilots may continue approaches that have uncorrected errors. These can cause the airplane to be in an undesirable position to land. This section will cover some of these undesirable positions. If a pilot has concerns about an approach, always go around.

Low Final Approach

A low final approach can occur when pilots descend too much, fly out too far before turning base, and allow power to get too low. This is dangerous as the aircraft may collide with objects on the ground. When the runway begins looking "a little too flat," or the VASI or PAPI is showing the aircraft too low, pilots need to correct for this.

To correct for this, increase power and level off (stop the descent) to intercept the correct sight picture and approach angle towards the runway. Once established properly, perform the landing as desired.

High Final Approach

Pilots can be higher on the final approach if they keep the power too high, fly too close to the runway, have excessive airspeed, or don't fly out far enough when beginning the descent. To correct for this, reduce power (to idle if necessary) and apply forward yoke to lower the nose and maintain airspeed, and apply full flaps.

Flaps will significantly increase drag, slowing the aircraft. This allows the lowering of the nose to maintain airspeed and a steeper approach. If airspeed is excessive, do not dive towards the runway. This will result in too much airspeed to bleed off, resulting in an excessively long float. If airspeed is excessive, slow down and allow the aircraft to sink. Just before intercepting the proper approach angle, begin adding power back in to prevent sinking through the approach angle. Once established on the proper approach, perform the landing as desired.

Slow Final Approach

A slow final approach can result in an excessive sink rate or a potential stall. Slow approaches will result in a shorter landing distance, and, during the round out, can result in a hard landing. Pilots must beware of their final approach speed, using the scan of "aiming point, aiming point, airspeed…" until the aircraft reaches the aiming point. If the aircraft is low, add power and lower the nose to obtain the proper airspeed. If the aircraft is still too slow, go around immediately.

High Round Out

Sometimes, aircraft level off high above the runway. Prior to the aircraft sinking, pilots will begin to round out, which increases the angle of attack and can increase altitude slightly. This approaches the critical angle of attack, where the airplane will stall and land hard on the runway.

To prevent this, when leveling off, allow the aircraft to begin to sink to begin the flare. If the aircraft stops sinking, hold whatever input has been made to the flare attitude until the aircraft begins sinking again. When the aircraft resumes sinking, continue the flare attitude.

Late or Rapid Round Out

Rounding out too late can cause the aircraft to "land flat" or on all three wheels simultaneously. It could also lead to "wheelbarrowing," where the front wheel touches first. If the round-out is rapid, this sudden increase in the angle of attack can cause the aircraft to climb. If the aircraft climbs, maintain a level attitude and allow the aircraft to begin to sink. Do not push the nose over towards the runway; a prop strike may occur. If airspeed is too slow, insufficient runway is available, or the pilot has any concerns about landing on the runway, go around immediately.

Floating During Round Out

Excessive airspeed tends to cause excessive floating during round out. This is caused by diving toward final approach or entering the round out with excess airspeed. When the aircraft levels off, the airspeed must bleed before it begins to sink. This can cause problems on shorter runways or if precision is needed for an approach.

Ensure the appropriate V_{REF} speed is being used. If on final approach and airspeed is excessive, go around immediately. If sufficient runway is available, maintain the round out until the aircraft starts to sink. Use caution; sudden inputs on the aircraft can cause it to "balloon" or climb due to the increase in the AOA. Once the aircraft starts sinking, begin the flare and land as normal.

Bouncing During Touchdown

Bouncing occurs when the aircraft approaches the ground with an improper attitude or excessive sink rate. The tires and landing gear absorb some of the impact. The bounce is caused by the inertia of the tail moving downward when the main wheels touch the ground. This increases the angle of attack on the wings. This increases lift, which causes the aircraft to go airborne briefly.

Back elevator is often applied as well when the pilot realizes the airplane is in the wrong attitude. Exercise caution during crosswind landings and maintain the correct wind correction. Do not push the nose down towards the runway; maintain the proper flare attitude. If the aircraft bounces, the best idea is to go around immediately.

Porpoising

Porpoising is where a bounce is improperly recovered, and the aircraft bounces again. Porpoising occurs when the aircraft has excessive speed or sink rate, or the pilot tries to force the aircraft onto the runway. To correct for a porpoising landing, if the bounce is slight, the pilot can add a small amount of power to cushion the landing.

Caution must be exercised as repeated bounces or porpoising can collapse the nose gear. If the aircraft is porpoising, the best corrective action is to immediately initiate a go-around and set up the landing again.

Wheelbarrowing

Wheelbarrowing tends to occur on the takeoff or landing roll when the weight of the aircraft is focused on the front wheel. This causes the front wheel to remain on the ground while little weight is on the rear wheels, which may become airborne. This causes the brakes to become ineffective. This also causes a loss of directional control. If wheelbarrowing occurs, smoothly apply aft yoke pressure to transfer the weight to the main wheels. When in doubt, go around immediately.

Hard Landing

A hard landing occurs when the weight of the aircraft is transferred from the wings to the landing gear rapidly. In this scenario, there is not enough cushion to help absorb the impact. The pneumatic wheels and landing gear struts are designed to take this force. However, the aircraft dropping even 6 inches is the equivalent of a 340 FPM rate of descent.

The higher the aircraft drops, the more the load is increased on the landing gear. Too much load can damage the landing gear or result in landing gear failure. If the round out is too high or the approach is too slow, go around immediately. If a slight correction is needed, slight power can be added to help cushion the landing.

Touchdown in a Drift or Crab

When on approach with a crosswind, always maintain the proper crosswind input to keep the ground track aligned with the runway. If the transition is not made from a crabbing input to the wing low method, the aircraft may touchdown at an angle. The tires create friction, which resists the sideward movement.

The inertia of the aircraft moving sideways is called "side-loading." The airplane will also want to align itself with the direction the wind is coming from (weathervane). If this is not corrected, this can result in a ground loop, which can cause the wing of the aircraft to strike the ground or cause the aircraft to roll over. The best method to prevent touching down in a drift or crab is to transition to the wing low method earlier or go around and set the landing up again.

Ground Loop

A ground loop is an uncontrolled turn commonly encountered on the takeoff or landing roll. A sudden gust of wind, weather-vaning, uneven runway, or soft spots on the runway can cause a swerve. When the airplane swerves, the inertia of the airplane continues and causes one wing to drop and strike the ground. If an aircraft touches down in a drift or crab, immediately straighten the aircraft using rudder and apply full yoke directly into the higher wing. Do not use brakes, as they can aggravate the situation.

Wing Rising After Touchdown

When landing in a crosswind, there may be times when a wing rises after landing. This is caused by a greater amount of wind striking the upwind wing, which also increases its AOA and lift. This causes a rolling motion towards the downwind wing. This can cause the aircraft to ground loop or lose directional control if no correction is provided. To correct this situation, apply full yoke in the direction the wind is coming from or into the higher wing.

Hydroplaning

Hydroplaning occurs when an aircraft lands on a runway covered with water, slush, or wet snow. Hydroplaning seriously affects the aircraft's controllability and braking on that surface. There are three types of hydroplaning: Dynamic hydroplaning, reverted rubber hydroplaning, and viscous hydroplaning.

Dynamic hydroplaning occurs when water is on the runway at least 1/10 of an inch thick. As airspeed increases, the water layer builds up enough pressure to equal the airplane's weight. This forms a “wedge” under the airplane's tires, lifting it off the runway. Once the tire is lifted off the runway, the tires no longer provide directional control, and the brakes are no longer effective.

Reverted rubber hydroplaning occurs during heavy braking, where the wheel is locked for an extended period of time. The tire generates enough heat to cause the rubber in the runway to revert back to its uncured state and act as a seal between the tire and the runway.

The water on the runway then turns to steam due to the heat, holding the tire off the runway. Reverted rubber hydroplaning generally occurs after a dynamic hydroplane when the pilot has locked the brakes trying to slow the aircraft. Pilots may not know when reverted rubber hydroplaning has occurred, and once started, it can occur at ground speeds as low as 20 knots.

Viscous hydroplaning occurs when a very thin film of water is over the runway; usually, no more than 1/1000 of an inch of water is required. The tire cannot get through the water and travels on top of the water. This occurs much lower than dynamic hydroplaning. If the runway is wet, it is best to use a grooved runway. If the brake locks, release the brake and smoothly reapply pressure to prevent the brake from locking up.