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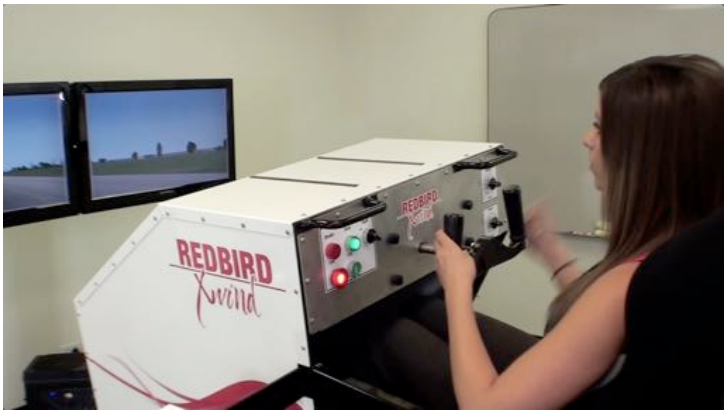
Crosswind Training Handbook



For the Love of Flight

revised 12/22/15

Crosswind Training Handbook
Introduction

Congratulations on your decision to enhance your pilot skills by incorporating Crosswind Concepts' training into your regimen. We're certain you'll come away with a much better appreciation for stick-and-rudder skills in crosswinds, but more importantly, much more confidence as a pilot.

This training guide is intended to prepare you for the concepts taught during the ground portion of our Maximum Demonstrated Crosswind training session. These concepts are critical to understanding the nature of, conditions for, and aerodynamics of crosswinds during the taxi, takeoff and landing phases of flight. Please read through the guide prior to your session and ask your instructors any questions that arise from your study.

Programs

Crosswind Concepts has two programs to help pilots in their pursuit of stick-and-rudder and crosswind landing excellence. They are:

Maximum Demonstrated Crosswind (MDC)

MDC is our most comprehensive training program that includes both ground and simulator elements. The ground discussion will help you understand the concepts necessary for a successful approach to crosswind operations. Topics include a review of aerodynamics and a discussion of crosswind operations during taxi, takeoff and landing.

The simulator session incorporates the use of our Xwind simulator in a building-block lesson plan intended to help develop the muscle memory and coordination necessary for successful crosswind approaches and landings. This is done in a non-threatening learning environment.

Forward Slip

This is an hourly refresher course for skills and proficiency. It is available to any pilot who has completed our MDC program. Self-directed sessions are available at our Centennial Airport (KAPA) facility. They will typically include 0.3 to 0.5 hours of self-directed refreshers for slips and crosswind "wing low" practice. Landings are accomplished with the help of an instructor and usually take 0.2 to 0.5 hours to

complete. They are a great way to maintain muscle memory and proficiency.

Simulation Session

The crosswind trainer is a motion simulation device that moves around the yaw and roll axes of flight and drifts along a track.

You will adjust your seat so that you have full rudder deflection and strap in. Your instructor will provide a safety briefing and then begin your session.

You'll begin by simply getting used to the feel of the trainer. Experience the full realm of motion by using the yoke and rudder pedals, and drift along the entire track. This is where the real fun begins.

Once you're used to the feel, your instructor will introduce you to some of the concepts discussed during the ground briefing. They start out with forward slips where you will enter and exit the slip while trying to maintain lateral position using coordinated inputs of rudder and aileron. Here the concept of bank angle controlling drift is emphasized. You will do forward slips using both left rudder and right rudder to develop the muscle memory and visual acuity for bank angle. Your instructor may also include an adverse yaw and induced roll demonstration.

Once forward slips are mastered, your instructor will introduce wind. You'll learn the concept of crab and note how the crab angle provides an indication of crosswind component. Then you will practice entering side slips. You will practice both left and right crosswinds and experience various crosswind components, including those that exceed the capability of the aircraft. When you are comfortable with this technique, your instructor will introduce gusts and turbulence. Here you will learn the importance and meaning of assertive aircraft control.

As you progress and begin to display the coordination and muscle memory, you'll be introduced to landings. Our proven technique of entering final approach in a crab, assessing the actual crosswind component from centerline, and pivoting into the "wing low" technique will come to life during this part of the session.

As you touch down, you'll experience transitioning lateral control from bank angle to rudder. Here you'll learn the most important, and possibly most difficult, muscle memory after landing – maintaining full aileron deflection into the wind. If improper technique is used, the simulator will "take you to the weeds." This routine is repeated

until you're absolutely comfortable with the process. Our KAPA simulator provides a score and feedback relative to centerline, yaw and drift to help hone your skills.

After the session you will have a short debriefing with your instructor and then be on your way. Most likely you'll want to go out immediately and put your newly honed skills to the test!

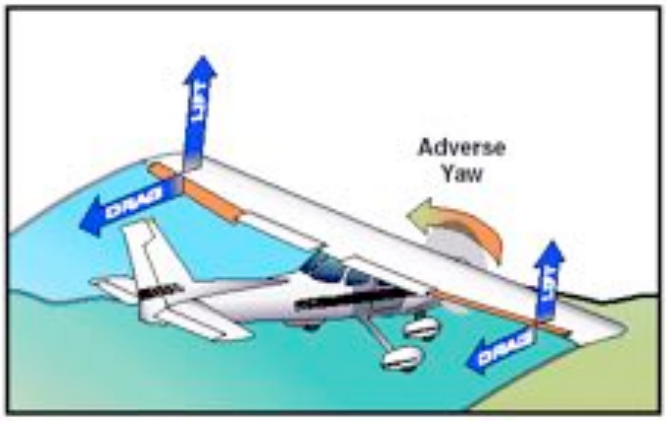
The MDC program is an approved FAA Safety WINGS program and also qualifies for a discount with Avemco Insurance in their Safety Rewards Program.

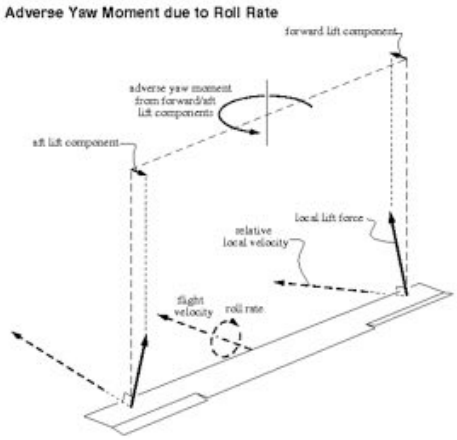
This program uses a very important building-block approach to learning. It is important that you master each stage before moving on to the next. Some folks can take longer to achieve this mastery and may require additional training to complete the MDC session.

General Terminology

(courtesy of XWind Operators Manual)

Adverse Yaw - Especially at low speed, such as in the landing configuration, turning the yoke will produce a yaw that is opposite or adverse to the direction of the developing roll. The further the yoke is turned from neutral, the more pronounced the adverse yaw. The pilot may need to adjust rudder pressure in order to reduce the impact of this unwanted yaw especially when maneuvering assertively in gusty crosswinds. The aileron that deflects downward during a turn causes adverse yaw. The wing that is asked to produce more lift with the downward deflected aileron will also produce more induced drag. This added drag pulls the wing backward or yaws the aircraft in a direction opposite to the desired roll. Most modem aircraft reduce this problem in various ways but do not eliminate it.

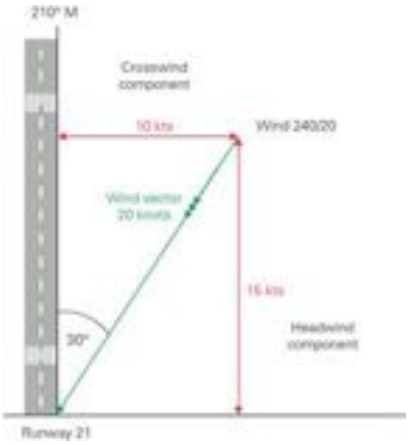


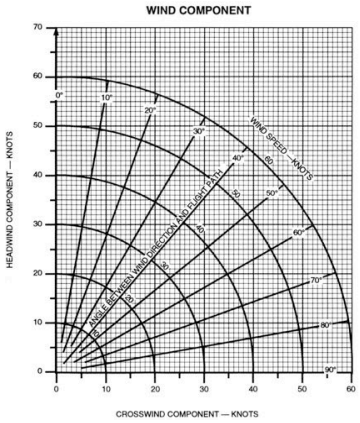


Induced Roll- There does not seem to be a great term to refer to this issue. However, when a rudder pedal is depressed without turning the yoke, the aircraft will yaw in the direction of the depressed rudder pedal and it will also begin to gently roll in the direction of the depressed rudder pedal. This roll is "induced" by pressing on the rudder pedal. If the pilot does not want the plane to roll during rudder application, then the induced roll must be overcome by turning the yoke in the opposite direction. Some yoke/aileron deflection will be required to avoid rolling and must be maintained in order to stop the induced roll. This situation occurs in a crosswind landing. This means that yoke deflection is required just to maintain a given bank angle. If the yoke is released while the nose is being aligned with the feet, the airplane will roll downwind.

Crosswind Component - That portion of the wind that is perpendicular to the runway centerline. If the wind is blowing parallel to the runway, there is a zero crosswind component no matter what the wind speed. If the wind is blowing perpendicular to the runway, the crosswind component is equal to the wind speed.

Understanding and estimating the crosswind component can be very helpful. This is especially helpful to learn from one landing to the next. If you know that you just landed in a 15-knot crosswind, it helps improve the confidence. If you have no idea, you have not learned what to expect for the next landing.





There are several techniques to easily estimate the crosswind component. We like to use the catchy phrase

"Thirty Degrees is Half"

This means that if the wind direction is 30° from the runway direction, exactly ½ (or 50%) of the velocity is crosswind component.

Pilots should consider all of the wind velocity to be crosswind component if it is 60° from the runway direction.

To estimate crosswind component for winds that aren't 30° or 60°, employ the "Rule of 1/6ths." For every 10° directional difference from the runway, consider 1/6th as crosswind component. So,

10°	=	1/6	
20°	=	2/6 (1/3)	
30°	=	3/6 (1/2)	"Thirty Degrees is Half"
40°	=	4/6 (2/3)	

50°	=	5/6
60°	=	6/6 (1)

There are other techniques that can be used to estimate crosswind component. The key is that one is used for every landing to know what crosswind component you are facing.

Crosswind Landing - Anytime the wind is blowing and it is not blowing directly down the runway, a crosswind landing must be executed by the pilot. The strength of the crosswind component will determine how hard the pilot must work to produce a safe and successful outcome.

Gusts - Changes in wind speed. These can be fast or slow. Keep in mind that a change in wind direction can appear as a gust in crosswind component.

Crab - This refers to a flight condition where the airplane's track across the ground does not match the airplane's heading due to wind blowing across the desired ground track. In a crosswind landing, an airplane may be traveling perfectly down the centerline of the runway but the nose is pointed off to the right or left depending on the wind direction. This is the crabbed position or the aircraft is in a crab. It is important to understand that this is normal flight for the airplane. If the plane is trimmed well, the pilot will be able to release all flight control and the airplane will maintain the desired ground track. It is a very stable condition and is used during the initial part of a crosswind approach to help assess the crosswind component and determine which way to "point your nose with your toes."

Slip - This describes the condition of flight when the flight controls are used in an uncoordinated fashion. For example, right rudder is depressed but the yoke is rolled to the left. Desired ground track is obtained by varying the bank angle and/or rudder pressure. Unlike the Crab, if flight controls are released, the aircraft will not maintain this condition.

Forward Slip - Describes a slip performed to produce high drag and high descent rate. The nose is forced away from the desired ground track with normally full rudder deflection, but the desired "forward" ground track is maintained by varying bank angle.

Side Slip - Describes a slip performed for the purpose of a crosswind landing – the "wing low" technique. The airplane's nose is forced toward the desired ground track or runway centerline and ground track is managed by varying the bank angle. To the airplane, forward and side slips are the exact same thing. But to the observer on the ground or in the plane, they look a bit different. Both types of slip require uncoordinated or cross control of the airplane.

Crosswind Operations Terminology

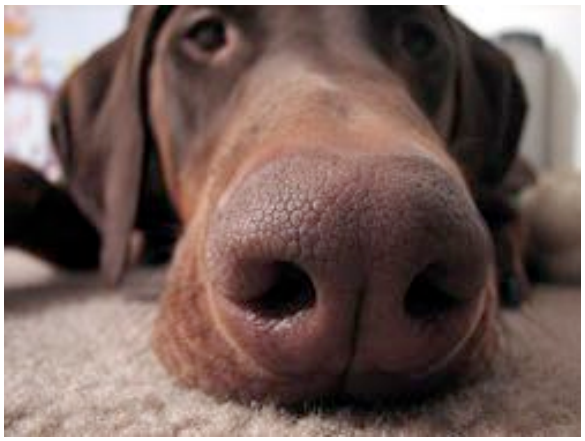
(courtesy of XWind Operators Manual)

Centerline - The line marked down the center of a runway used by the pilot for reference. Proper use of the centerline is to position the pilot's eyes directly over the line. This provides the pilot with the best possible information. It is easier to see the aircraft drift left or right when starting on the center rather than over an open patch of concrete with no reference line. This is why a pilot should seek to be over the centerline at all times. This provides information to the pilot about how the crosswind landing is progressing. A pilot positioned over the centerline will see drift faster than a pilot who is 10' away from the centerline.

If the pilot is not able to stay over the centerline or make gentle progress back to the centerline in the air or after touchdown, this indicates that the landing should be aborted.

Alignment - The airplane is aligned for runway touchdown when the nose of the airplane is pointing at the far end of the landing runway and the airplane is basically traveling down the runway. Alignment is directly achieved using the rudder pedals. "Point your nose with your toes!" It is possible to be aligned but not be over the centerline. Even if the airplane is not over the centerline, the pilot must still keep the aircraft aligned by pointing at the far end of the runway. The airplane can be aligned but entirely miss and land next to the runway, alignment is correct but lateral position is incorrect.

"Point your nose with your toes" - This is the number one and most important rule in crosswind landings. You must take this with you when you leave.




This refers to pointing the nose of the aircraft at the far end of the runway using the rudder pedals to do it. It is critical that the longitudinal axis of the aircraft be aligned with the runway centerline. If you err on one side of the centerline, it should be the upwind side. In many cases, pilots tend to overdo the crosswind correction and point the nose slightly downwind of the centerline. This can result in rapid loss of control once on the runway. Ideally you will have the centerline passing between your legs and through your sternum as a visual cue for alignment.

This rule (point your nose with your toes) should be the supreme object of any pilot landing in a crosswind. Our research has revealed that any pilot can vastly enhance crosswind landing capability if they will first assertively point the nose with the toes so that the aircraft is pointing at the far end of the runway at all times during the flare and touchdown. All other actions of the pilot are dependent on this ability. All other actions of the pilot can be improved if they learn to do this part well. We have discovered that

a pilot that allows the nose to depart from the far end of the runway during a gust, will have greater difficulty determining what action to take next.

If you learn only one thing, make sure it is this supreme rule. To say this another way, if the nose of the airplane is not pointed at the far end of the runway, you are doing it wrong and you should be going around if you can't fix it immediately!!

Most pilots are very eager to "steer" with the hands or the yoke and quite weak at pointing the nose with the toes. Learn to emphasize pointing the nose with your feet and other aspects of crosswind landings will improve.

Most loss of directional control accidents are directly related to the nose being pointed in the wrong place. Some pilots are not familiar with stomping rudder pedals to the floor to get results. Some are afraid to fully deflect the rudder pedals. Some are unsure and unwilling because they have never experienced it before. As the pilot, you are demanding obedience from your airplane.

Especially in a crosswind, the nose must point where you demand. If it moves, you should be using all you have to force compliance.

If for any reason, you cannot point the nose with you toes, this indicates that you should be aborting that landing.

Lateral Position - This refers to the left/right position of the aircraft over the runway. The desired lateral position is directly over the centerline at all times during a crosswind landing. Lateral position is directly controlled by bank angle and bank angle is controlled by yoke inputs. Notice that the yoke does not directly control lateral position whereas rudder does directly control alignment.

Drift - The aircraft is drifting left or right when its ground track is not parallel with the runway centerline. If the aircraft is being aligned properly or pointing at the far end of the runway, adjusting the bank angle always controls drift.

Assertive - Landing in a crosswind requires assertive use of the flight controls. Assertive refers to using any and all control deflection required and doing it quickly. Let's say an aircraft is in a slip inches from touchdown. It is properly aligned and stable over the centerline in a 5-degree bank. A gust forces the nose into the wind by 15 degrees. It is essential that the pilot assertively and quickly use rudder to force the nose back to the alignment target or the far end of the runway. If full rudder deflection is required to get results, it should be used. In fact, it should be expected that full deflection will be used for the rudder pedals momentarily to get quick results.

Likewise if turbulence pushes the bank to 0 degrees, the pilot should assertively force the bank angle back to 5 degrees because if the bank angle is allowed to stay at 0 degrees when 5 was required to keep the aircraft over the centerline, drift will begin to develop and the aircraft will move away from the centerline. It is reasonable for the pilot to input full yoke deflection until 5 degrees is reestablished and then reduce the yoke deflection to maintain 5 degrees once again. This is assertive use of the flight controls. This is often awkward because it is opposite of the type of flying done at altitude when gentle use of the flight controls is the best way to handle the airplane. However, in gusty conditions near the ground, assertive action is required for good control

If conditions are not gusty and rough, it can be helpful to be assertive with rudder and gentle with aileron. Most pilots do the exact opposite.

Assertive does not mean forcing the airplane to a position that it should not be in. If the pilot is unsure what the target bank angle is, it is not possible to assertively get there. Assertive control is to demand that the airplane be aligned according the pilot's plan and to bank according to the pilot's plan.

In general, it is more important to be assertive with the rudder pedals than it is to be assertive with the yoke. Most pilots are already likely to be too assertive with the yoke and not nearly assertive enough with the rudder pedals.

Central Vision - This is the small center field of view in each eye that is used for high focus, high detail, and high color resolution. During proper landing, the eye is focused at the same point as if you were driving a car at highway speeds. The central vision must be kept absolutely stable and fixed during the approach, flare, landing and rollout. If the eyes are moved around, the ability to perceive pitch and bank angle and all of the related issues will be diminished. If as a pilot you are not in the habit of leaving your eyes fixed in one place, this may be hard to improve. However, it is essential to long term success and greater predictability in your landings.

Peripheral Vision - The majority of crosswind landing visual cues are picked up through peripheral vision. It is the less focused non-central portion of the eye. All of the following items are evaluated or measured with the peripheral vision during a crosswind landing:

- Alignment
- Bank Angle
- Pitch
- Lateral Position
- Altitude

Ability to "see" these factors is what allows a good landing to occur. Learning to "see" with peripheral vision is the key to good success.

Local Weather Rules of Thumb

- If the altimeter setting from a reporting station west of the Continental Divide is greater than a station east of the Divide by 0.20" Hg, expect the potential for strong surface winds to develop. For example, Eagle (KEGE) reporting 30.20" while Rocky Mountain Metro (KBJC) reports 29.92".
- If the gust factor of reported winds is 7 knots or greater, expect turbulence.
- If wind speed changes by 5 knots every 1,000' in a winds-aloft forecast, expect turbulence. For example, winds at 9,000' MSL are forecasted as 260 degrees at 10 knots, and at 12,000' MSL are forecasted at 270 at 37 knots. The difference is 27 knots, well above 15 knots for the 3,000' difference rule of thumb.
- If the wind direction at the first reporting level in a winds aloft report is 90 degrees different or more than that at the surface, expect turbulence. For example, KBJC reporting winds 190 degrees at 15 knots, and winds aloft forecast for 9,000' MSL are 320 degrees at 25 knots.

Essential Take-Aways

Crosswind Landing Tips

- "Thirty Degrees is Half"
- "Point your nose with your toes"
- Maintain centerline with bank angle
- If either fails in flight or on the ground, go around.
- Never bank or yaw downwind
- Approach faster, land slow
- If skidding downwind, go back to flight
- Be assertive with rudder & easy with aileron