



# **Crosswind Landing Training**

**September 1, 2010**

Xwind, LLC  
**[xwindflight.com](http://xwindflight.com)**

# Xwind Crosswind Landing Training Outline

## *I. Introduction*

Thanks for purchasing high quality professional training from Xwind!

It is our mission at Xwind to provide the highest quality training for general aviation pilots who are seeking to expand their knowledge and skill related to crosswind landings. We sincerely welcome your feedback as we seek to raise skill level through information and use of the world first simulator dedicated to crosswind landing training.

All of the concepts and tips in this document refer to a tricycle gear airplane. Tailwheel airplanes are not directly addressed in this document. However, effective use of the rudder pedals will improve tailwheel skill as well.

Xwind was founded in June of 2006 after several years of research and development. Xwind, LLC holds a pending patent on the crosswind landing trainer. Xwind continues to promote the sale and use of the trainer while continuing to refine the technologies and techniques that help pilots gain and refine crosswind skill.

The notes here do not represent the only way to handle crosswinds. We strongly believe that this represents the best way when striving to improve crosswind landing skill. We guarantee that you can become much more effective at crosswind landings using the information here. When you become highly skilled at crosswind landings, you may vary many techniques and experiment with what works best for you and your airplane.

The goal of this training is not to encourage pilots to land in large crosswinds but to handle modest crosswinds with more confidence and more safety. **The vast majority of crosswind landing accidents occur in winds below 15 knots! (See Appendix: A)**

**G. Disclaimer:** All of the information presented here is based on years of direct experience and research. Every effort has been made to insure accuracy. We are confident that you will find the Xwind Crosswind Landing Simulator to be extremely helpful as you boost your crosswind landing skills. However, flight conditions, aircraft condition, and environmental conditions can vary greatly and we encourage you to test your new skills with a flight instructor in the real airplane before you assume crosswind landing proficiency. Therefore, Xwind shall not be liable for any direct, indirect, consequential, or special damages resulting from the use of this crosswind landing simulator.

## II. Terminology

In order to gain the most from your training experience, it is important that we share a common understanding of important terms and concepts. Here are some of the most important.

### A. **“Point your nose with your toes”** – *This is the number one and most important rule in crosswind landings.*

This refers to pointing the nose of the aircraft at the far end of the runway using the rudder pedals. The ideal perfect target for the nose is to point the nose of the aircraft exactly at the upwind corner of the runway at the far end of the field. It is much easier to have a very slight yaw into the wind at touchdown than it is to use too much rudder and yaw the plane downwind at touchdown.

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 dependant 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.

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 toes and all other aspects of crosswind landings will improve.

Many 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 your toes, this indicates that you should be aborting that landing.

B. **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. Don’t land with a tailwind. However, a quartering tailwind also produces a crosswind component.

C. **Crosswind Component** – That portion of the wind speed 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. If the wind is blowing across the runway at a 45 degree angle, the crosswind component is 70% of the wind speed. If the wind is blowing across the runway at a 30 degree angle, the crosswind component is 50% of the wind speed. Understanding and estimating the crosswind component can be very helpful.

D. **Crab** – This refers to a flight condition where the airplane’s track across the ground does not mach 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.

E. **Slip** – This describes the condition of flight when the flight controls are used in an uncoordinated fashion. There are only 2 uncoordinated conditions... 1) right rudder and left yoke 2) left rudder and right yoke. 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.

F. **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.

G. **Side Slip** - Describes a slip performed for the purpose of a crosswind landing. 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, Forward and Side, require uncoordinated or cross control of the airplane.

H. **Induced Roll** – 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 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.

I. **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. Adverse Yaw is caused by the aileron that deflects downward during a turn. 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 modern aircraft reduce this problem in various ways but do not eliminate it.

J. **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.

K. **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.

L. **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 provided information to the pilot about the quality of control of the aircraft's lateral position.

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.

M. **Drift** – The aircraft is drifting left or right when the 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, drift is always controlled by adjusting the bank angle.

N. **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 comes along and 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.

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 to 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.

O. **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 near or on the far end of the runway. The central vision is looking at the far end of the runway and must be kept absolutely stable and fixed. 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.

P. **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 key to good success.

Q. **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.

R. **Flight controls** – In order to achieve the quickest response from the aircraft, it helps to understand that every flight control movement should be done in two steps. If the nose of the aircraft is not pointed at the correct place, the fastest way to get it there is to deflect the appropriate rudder to the maximum and then release part of that deflection once the aircraft achieves the new correct position.

S. **Move the Feet** – You will be much more effective with rudder control if you learn to keep your feet moving even when they do not need to be. During the last part of the touchdown in a crosswind, the feet should be moving back and forth just ¼" of an inch at the rate of about 1 cycle per second or faster. This helps to keep the feet properly positioned and keeps the mind and body in the control loop for maximum control of the aircraft alignment. If you press and hold the rudder pedal with no movement, you will be less effective in maintaining control. The aircraft does not need to move, but the pedals should always be moving.

### **III. Crosswind Overview**

- A. “This is the most difficult thing to do in aviation” Richard Collins, May 2005 Flying magazine, (flyingmag.com)
- B. Crosswinds were consistently the number one weather phenomena cited in general aviation landing accidents every year from 1995 through 2003. (Appendix A, Latest data - ntsb.gov)
- C. The reported crosswind velocity for landing accidents is normally less than 15 Knots (Appendix A).
- D. Affect on big vs. small aircraft:
  - Aircraft landing at 55 Knot in a 20 Knot crosswind must crab 22 degrees.
  - Aircraft landing at 90 Knots in a 20 Knot crosswind must crab only 13 degrees.
  - The small aircraft pilot has more work to do in this wind.
- E. Why Crosswind landing is unique
  - Cross Control – not done in normal flight
  - All Visual and feel – much more than normal flight
  - Assertive or aggressive with controls – very different from normal flight
  - Very short duration of practice
  - Near the ground, less room for error
  - Hard to practice because the outcome must be successful
  - Hard to practice because there is some risk to tires and the airplane when pushing pilot limits

### **IV. Crosswind Landing Guide**

- A. Determine Crosswind Component
  - 15 Deg off nose = 25% of wind speed is crosswind
  - 30 Deg off nose = 50% of wind speed is crosswind
  - 45 Deg off nose = ~ 75% of wind speed is crosswind
  - More than 45 Deg = > 75% of wind speed is crosswind
  - Of course, determine if the wind is from the right or left
- B. First Rules to Prepare for a crosswind landing
  - If the wind is from the right, don't bank left during the slip, ever.
  - Know which way to crab as the aircraft enters final.
  - Estimate crosswind component.
  - Be sure to allow for a longer final.
- C. Approach Rules
  - Approach about 10 knots faster.
  - Approach steeper.
  - It is safer to lower the nose and fly down to the ground and then fly level.
  - If the plane falls 1 foot, no big deal. But it can't fall 10', not good.
- D. Headwind: The component of the wind that is blowing directly parallel to the runway.
  - Slows the forward groundspeed of a landing aircraft.
  - Requires a steeper approach for a normal power setting.

#### E. Turbulence from obstacles

- Air flowing over hills, trees, and building produces turbulence
- Turbulence can range from none to severe
- Turbulence may not differ much from gusts
- Turbulence may have more vertical components
- Turbulence can be small bumps or large waves
- The goal should be to get the aircraft close to the ground and stay near the ground.

#### F. Rules on Slipping

- The aircraft is slipping anytime the controls are crossed, aileron one way and rudder opposite.
- This is a high drag maneuver.
- This is one more reason the approach angle should be steeper.
- The more experience you have, the closer to the ground you should begin the slip.
- There is no difference between what is called the crab method vs. the slip method. It is simply commenting on how soon the slip begins prior to touchdown.
- No matter when the slip is started, you will want to learn to slip effectively in order to have strong crosswind landing skills in a light aircraft.
- With experience, most pilots learn to begin the slip very close to the ground. The wind is often lighter down low. Airplanes don't like to fly in a slip, and passengers hate slips.
- The method does not matter, but when you reach the ground, a slip needs to be established to give you the most control and to be the most gentle on your airplane when flying a light aircraft.

#### G. Alignment control, Rudder

- Think of this as completely independent of Bank Angle Control
- **POINT YOUR NOSE WITH YOUR TOES! No matter what happens.**
- Ignore rudder position, what matters is keeping the aircraft aligned or parallel with the runway centerline.
  - Alignment is observed by noting where the aircraft is pointing. If a line was drawn from the tip of the tail cone out the tip of the spinner, correct alignment occurs when that line points all the way down to the center of the far end of the runway. (The center of the far end of the runway is the ALIGNMENT TARGET)
  - The rudder pedals should be used aggressively to always keep the nose of the aircraft pointed at the ALIGNMENT TARGET at all times no matter what the gusts or turbulence may do.
  - If the nose is not pointed at the ALIGNMENT TARGET at any time once the slip is started, you should abort the landing.
  - If the wind speed increases, the airplane will Yaw into the wind. More rudder will be required to keep the plane pointed at the alignment target.
  - You must learn to see the aircraft alignment with your peripheral vision while you look down at the far end of the runway. This is done by noting rivets or the frame of the airplane and where they indicate the airplane is pointed.
  - Assertively keeping the aircraft aligned makes controlling drift easier.
- The Xwind Simulator helps you learn to perceive and maintain this alignment

#### H. Lateral or left/right position Control, Bank Angle Control, Yoke

- Think of this as completely independent of Alignment, which is done with the rudder pedals as mentioned above.
- This is the second most important goal on any crosswind landing is to control bank. This goal must be number two after pointing the nose with the toes.
- **The Money is in the BANK! Bank control is key, not yoke position!!**
- Ignore yoke position, what matters is the angle of bank. If you watch for and find the correct bank angle, the airplane will stay over the centerline while the rudder pedals align the airplane. The bank angle that produces no drift is the BANK ANGLE TARGET.
  - Bank angle is observed by comparing the aircraft nose or cowling out the window to the horizon out in front of the airplane.
  - During a crosswind landing, do not bank downwind.
  - You are managing the angle of bank with the yoke. Angle of bank is what balances the downwind force and drifts the airplane to the center.

- Wind from the left requires left angle of bank when the rudder pedals start aligning the airplane to land.
- Wind from the right requires right angle of bank when the rudder pedals start aligning the airplane to land.
- If wind speed increases, this will be noticed by increased drift and a yaw into the wind, you must correct by first pointing the nose correctly and then increasing the bank angle to control drift. The BANK ANGLE TARGET for no drift increases when the wind increases.
- You must learn to see the bank angle of the aircraft by seeing it with your peripheral vision while you look down at the far end of the runway.
- The Xwind simulator helps you learn to see bank angle

#### I. Centerline Rule

- The centerline is for your reference as the pilot
- The centerline is not for the airplane nose wheel
- 100% of the landing and rollout should be on the centerline
- On the centerline means that your eyes should be sitting directly over the centerline
- If you normally stay over the centerline during landings, you will be able to quickly recognize drift.
- If you normally land 10 feet left of center, you will be slower to recognize drift because you are much further from the reference that allows you to detect the drift.
- The sooner you detect and begin to correct for drift, the better control you will have in a crosswind. Therefore, land on the centerline!
- Don't settle for the idea that that wind blew you off of the centerline. This is an indication that you need to improve your control.

#### J. Max Demonstrated Crosswind Component

- Manufacturers determine this mostly by the wind available during certification.
- This does not mean that it is illegal to land in stronger crosswinds.
- No extraordinary skill is expected to land at max demonstrated crosswind, but some is required.
- Unless you have plenty of experience, you should think of it as a maximum.
- Remember, this is the crosswind component not the wind speed.

#### K. Transition from Flying to Driving or landing

- The pilot is trying to move from flying to driving the airplane.
- While flying, the pilot has complete control over:
  - Drift left and right
  - Alignment
- While “driving” the airplane on the ground:
  - There must be enough friction on the wheels to steer
  - And, enough control to keep the plane from “tipping”
- If the plane is moving too fast at touchdown
  - There will not be enough friction to steer
  - Once the plane is level on the ground, the pilot can no longer fly
  - Essentially, the pilot cannot “drive” or “fly” the airplane if it is too fast on the ground.
  - If the pilot tries to press forward too hard on the yoke, one or both rear wheels can be lifted off the ground and the pilot is almost guaranteed to lose control.
- So, the plane must slow down to land
  - This is the number one problem with crosswind landings, the idea that the airplane must be forced on the ground quickly at high speed.
  - The pilot will have much greater control and success doing the following:
    - Keep the airplane flying as long as it can
    - Land on one wheel and try to “fly” on that wheel as long as possible
    - When the airplane finally sits down on the other wheel, it is done flying and ready to fully “drive” on the ground.
    - Once on the ground, stay fully alert and be ready to go back to flight.
  - Approach Fast but LAND SLOW.



L. Downwind Risk:

- If the pilot is unable to stay on the centerline, there is not enough weight on the wheels.
- The wheels may be sliding or chattering
- If the plane is sliding downwind but correctly aligned, pull back on the yoke enough to lift the downwind wing or go back to flying until the plane slows down.
- Keep in mind that the pilot may land great, but if a large gust arrives from the front, the plane may go back above flying speed, be ready for this and simply return to flying in a slip.
  - If the plane refuses to stay on the centerline by sliding downwind, the pilot should be “flying” and not “driving” at that point.

M. Upwind Risk

- Once the airplane slows down, in very strong crosswind, the pilot may not have enough rudder authority to stop the airplane from weathervaning into the wind and the airplane could drive off the upwind side of the runway.
- If this occurs, be prepared to use downwind wheel brake to help correct.
- Again, if the airplane is departing the centerline and it cannot be stopped, action must be taken immediately such as adding power and going around or applying downwind wheel brake.

N. Go around

- Once the pilot decides to abort the landing and full power is applied and the airplane is starting to climb, it is very important to return to normal coordinated flight.
- Force the nose into the wind with rudder.
- Force the wings level with aileron.
- Clean up the airplane
- Normal right rudder
- Normal wings level
- The wings level normal climb will return back to the crabbed position that the airplane was in on the approach.

#### O. Posture of the Body

- Posture of the body is very important.
- Sit up straight
- The chin should be lifted (if glasses allow)
- Lean forward slightly
- The goal is to increase forward visibility and peripheral field of view
- Since almost all control is visual, it is vital to gain even a few more feet of peripheral information outside the airplane.
- Do not place papers and objects on the dash in the windshield. Keep the field of view completely clear. You need every inch of information outside the airplane.
- Do not lean away from the aircraft bank. If you are leaning opposite the airplane as it banks, you are moving your eyes and changing the visual field. You are also demonstrating that you don't really want to be in the airplane. You must go with the airplane to be more effective. You want to see and feel the changes, not lean away to avoid being part of the airplane. If you aggressively lean away from the aircraft bank, you are most likely not very effective with crosswinds.

#### P. Posture of the Feet

- It is vital that your feet are properly positioned on the rudder pedals for maximum effectiveness.
- First, during approach, flare, and touchdown, the heels of the feet must be lowered to the floor so that there is no risk of pressing a brake no matter how much force you apply to the rudder pedals.
- The toes should be jabbed forward at the base of the pedals to cause rudder action.
- This action takes advantage of the knee and ankle to get quick and lengthy throw on the rudder pedals.
- You can think of pointing your toe where you want to nose of the aircraft to be.
- You must insure that you can get complete and rapid rudder throw.
- Seat position is an important part of the foot posture.
- Position the seat so that you are not too close. It is better to reach with the toes than to have the entire foot in contact with the entire rudder pedal.
- If the center of the foot is at the center of the rudder pedal, the toes must be held up so as to not hit the brake and then the entire leg must move to actuate the rudder with no ankle action. This is a very awkward way to engage the rudder pedal and does not work very well.
- After landing and as the plane is slowed and it is clearly on the ground, then the feet can be raised off the floor to gently engage the brakes.
- You may need to raise the feet fast when you raise them because you will be applying rudder pressure for guidance. Just jump to the top for brakes and then gently apply brakes.

## V. Summary of Tips

- A. At least know which way the wind is blowing before landing
  - It is best to also know the crosswind component by estimating it
- B. Approach Fast and Land Slow
  - The airplane must slow down to land well
- C. If faster than normal, aim earlier than normal
  - The aim point is not where you are looking
  - The aim point is where the airplane would hit the ground if you did not flare.
- D. Don't Overshoot on turn to final
  - Easier to set up if the turn to final is made very early
  - Turn early if the wind is in your face on base
  - Turn very early if the wind is at your tail on base
- E. Leave plenty of room for a long final
  - Time to evaluate the wind
  - Time to stabilize on the centerline
  - Time to stabilize the decent angle
- F. Stay over the Centerline at all times
  - This provides you with the very best information.
- G. Approach angle – Steeper is better
  - Steeper approaches mean the airplane could reach the runway with less power
  - Stall speed can't be reached as easily
  - Easier to fly "down" through the turbulence than to fly level through more of it.
  - It keeps the aircraft further from obstacles such as trees, buildings, and terrain
- H. Get to the ground and stay near the ground
  - Crosswind landings may not be smooth.
  - If the airplane hits turbulence and touches a tire and bounces, simply keep the plane near the ground.
  - Multiple "touches" of the runway are fine as long as the airplane stays close to the earth and continues to fly.
  - Focus attention on 80% flying 20% landing. Usually pilots are so anxious to land that the focus is 90% on landing. Just fly in a good slip near the ground and be patient.
- I. Mental Attitude = Assertive to Aggressive
  - The pilot must get results, be very assertive, you can always relax the controls.
  - Thing aggressive feet and gentle hands
- J. Use less than maximum flaps
  - Allows for slightly faster approach
  - Which provides slightly more control effectiveness
  - Plus, it just seems to work a little better
- K. It is easier to overcontrol and correct than it is to undercontrol and correct.
  - Example: If the pilot banks too much and starts to drift upwind, it is easy to drift downwind, simply level the wings.
  - However, if the pilot drifts downwind, it takes a seemingly large bank to stop the drift and then to begin drifting upwind.

- L. Never bank downwind
- Level flight will drift the airplane downwind.
  - Sometimes, it is important to be patient and allow the plane to drift downwind in level flight, otherwise, the drift speed downwind can get excessive and hard to arrest.
- M. Continue to “fly” even on the ground
- The flight control are still having a large effect initially, prepare to apply full aileron into the wind and continue to be assertive with the rudder pedals.
  - Keep the plane flying on the upwind wheel
- N. Gusts may make the plane come off the ground, this is OK, simply return to flying in a slip
- O. Multiple touchdowns are OK as long as the airplane stays close to the ground and aligned.
- P. If the airplane will fly on one wheel, keep doing it, this means the plane is not done flying
- As long as the plane is flying on one wheel, energy is being dissipated without skidding tires or burning brakes
  - It also indicates that the wind is capable of generating lift that might inhibit gaining enough friction to drive.
- Q. Good posture – Head high and look at the far end of the runway during landing
- Visibility is the key to control
  - If the pilots sinks back in the seat hoping all will go well, it will be a disaster.
  - The pilots face should be up in the window gaining information for good control
- R. Signs that you should go around in the air or on the ground:
- Unable to point the nose with the toes for any reason.
  - Unable to gently move back over the centerline for any reason.
  - Too far down the runway.
  - Aircraft goes back too high above the runway.
- S. Touchdown:
- If you are going to land with the aircraft not fully aligned, it is best to land with the nose of the airplane slightly crabbed into the wind.
  - This is better than using too much rudder and landing with a slight crab downwind.
  - So, if in down, allow a slight crab into the wind at touchdown.
    - This will allow you to handle more crosswind
    - This keeps you from running out of Aileron as fast
    - This keeps you from darting downwind at touchdown.

## ***VI. Other Crosswind Landing Factors***

- A. Night or low visibility
  - Fewer visual cues for something that is already hard
  - It will be harder to perceive alignment and drift because the aircraft frame is harder to see in peripheral vision
- B. Sun obscured runway
  - low visibility
  - Worse than night landing
- C. Contaminated Runway
  - Rain
  - Snow
  - Ice
  - Remember, the airplane must have enough friction on the wheels to “drive” after a successful landing. Slick runways indicate that small crosswinds could be uncontrollable.
- D. Short Runway
  - For a number of reasons, not the least of which is the distraction of it all, the pilot is very likely to eat up more runway during a crosswind landing.
- E. Narrow Runway
  - less room to detect a problem before departing the runway
  - Even more aggressiveness with the controls is required
  - Not dangerous, but experience is definitely required for significant wind
- F. Obstacles Nearby
  - Turbulence will be a factor
  - Obstacles also indicate less room when things go wrong
  - High or rough terrain can generate lots of turbulence
- G. Extra Speed Due to Turbulence
  - There is much discussion about this one.
  - If it is rough, you need a little more speed
    - Stay further from the stall speed
    - Provide more control effectiveness
  - Extra speed is good but you still must slow down to land

#### H. Airplane

- As mentioned before landing speed has a large affect on how much crosswind can be handled
- Airplane characteristics might mean one plane can handle a certain wind and another cannot no matter how skilled the pilot.
- Condition of the tires can be important, friction is required to “drive”.
- Aircraft weight matters, a heavier airplane will be easier to handle in a crosswind.

#### I. Practice / Currency

- The pilots assertiveness with the controls has a currency just like instrument flying or staying current as in the 3 takeoffs and landing every 90 days.
- I recommend that you should see 3 challenging crosswind landings within the preceding 90 days.
- If as a pilot you have not practiced crosswinds for a long time, be sure that you will be a bit rusty.

#### J. Passengers

- Most hate turbulence
- Most hate the feel of the slip
- Most detect your discomfort
- If it is pushing your limits too much, be a hero and land where it is safe and get a coke especially with passengers. You can push you limits more by yourself and with an instructor.

## ***VII. Crosswind Takeoff***

#### A. The initial rotation is the opposite of landing

- Once the airplane is airborne for sure, move to stable flight quickly
- Add the normal amount of right rudder for torque and P-factor no matter where the nose goes and level the wings
- This places the airplane in the best position to fly and in the correct crab for the centerline..
- A slip is high drag and the airplane does not want to fly well.

#### B. Do not go downwind of the centerline

- If the airplane was taking off in a 60 knot crosswind (which is ridiculous), it would be very helpful to get the nose into the wind quickly after takeoff to take advantage of the wind speed. If the airplane turns downwind, the 60 knot wind from the side is quickly changed into a tailwind. The airplane is actually loosing airspeed quickly.
- In addition
  - There is the obvious desire not to hit obstacles downwind.
  - The climb angle will be very shallow going downwind
- It would actually be advantageous to force the airplane upwind just a bit.
  - Steeper climb angle
  - Wind speed is adding to airspeed until stabilized

## ***VIII. Go Forth and Have Fun***

Crosswind landings are eventually fun for the experienced pilot. After experience, they are not viewed as dangerous, just challenging. The key is learning to recognize your own limits and the limits of your airplane. If we can ever help you further at Xwind, we want to do that. We always welcome feedback and input. Please let us know how at (317) 501-0733

## ***IX. Simulator Syllabus***

### A. Objective

The primary overall objective of the Xwind simulator is to instill automatic pilot reactions to wind, gusts, and turbulence.

Other portions of this objective include:

1. Muscle memory feel for proper slip
2. Muscle memory feel for aileron position after touchdown
3. Enhanced foot/eye coordination
4. Enhance hand/eye coordination
5. Willingness to use all available flight control throw when needed
6. Understanding of forces at play and correct actions to control them

### B. Safety Introduction

1. Entry/Exit right side only
2. E-Stop for Instructor
3. E-Stop for pilot
4. Seat Belt

### C. Simulator Introduction

1. No wind, play with controls
2. Run all the way to right side of track
3. Run all the way to left side of track
4. Do both at different speeds
5. No rudder – Note adverse yaw when moving yoke by watching yaw laser pointer
6. No Yoke – Note induced roll when moving rudder by watching bank angle
7. Forward slip right
8. Forward slip left
9. Add wind during the slip to show that forward slip is equal to side slip to the airplane

D. Crab to Slip

1. 20Knots from right, no gusts, no turbulence
2. Control direction of flight with bank
3. Move to Slip
4. Control lateral position with bank
5. Once stable move to Crab or Slip as fast as possible
6. Move to other side
7. Monitor student carefully and do not allow improper use of hands (turning downwind to enter slip)
8. Watch for proper posture

E. Demonstrate “Point your nose with your toes”

1. Pause sim and announce the wind will now be set to some unbelievable value and unknown direction, go
2. Set the wind to zero and enter run
3. If the student loses control, pause and note the nose position and tell them about no wind.
4. Then start back up with no wind and watch great control

F. Slip with Turbulence

G. Slip with Turbulence and Gusts

1. 10 Gust to 20
2. 5 Gust to 25
3. 20 Gust to 30

H. Touchdown mode and return to flight

I. Wind shear from right to left and vice versa

J. Unusual attitude recovery

K. Manual wind variations

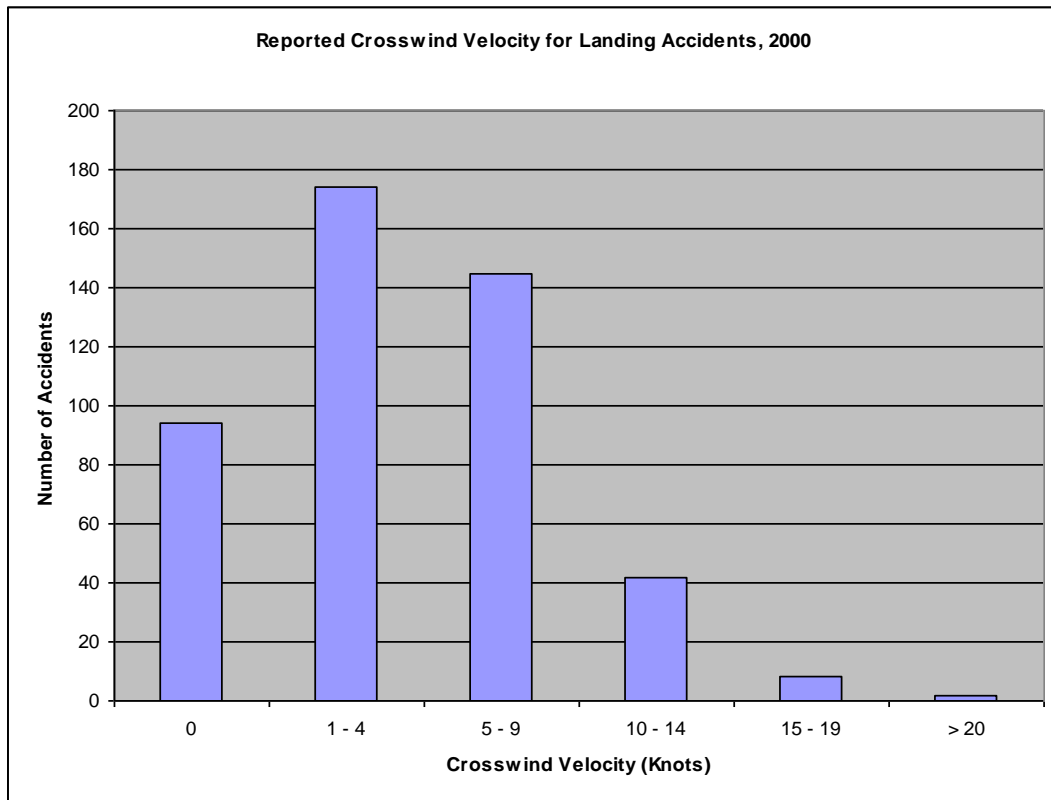
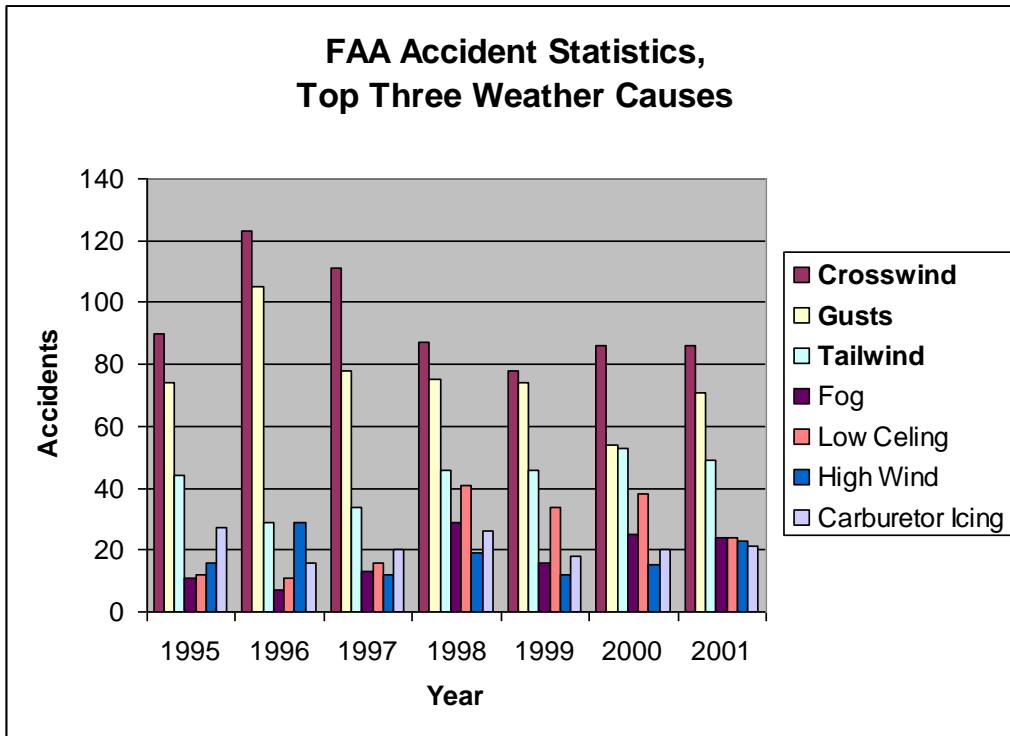
L. Demonstrate loss of ability to point the nose with the toes due to too much wind

M. Pause at various points and review tips

N. Close with questions



## Appendix: A



## **Appendix: B**

### Internet Links to Helpful Crosswind Tips and Videos

King Video Tips: <http://www.kingschools.com/webVideo/videoArchives.asp>  
100 Secrets to Perfect Landings: <http://www.kingschools.com/webVideo/videoArchives.asp>  
AOPA Not So Happy Landings: <http://www.aopa.org/asf/asfarticles/2005/sp0503.html>  
AOPA Videos: [https://flightraining.aopa.org/student\\_pilot/cross\\_country/interactive/](https://flightraining.aopa.org/student_pilot/cross_country/interactive/)

#### Other Helpful Links:

Aviation Digital Data Service (Weather): <http://adds.aviationweather.noaa.gov/>  
Aircraft Registration Database (Look up tail numbers): <http://registry.faa.gov/aircraftinquiry/>  
IFR Flight Tracker (Track any IFR flight): <http://flightaware.com/>  
Flight Planning (Weather and Flight Tracking): <http://fltplan.com/>  
Huge Number of Aviation Links: <http://www.landings.com/>  
NTSB by Month: <http://www.nts.gov/nts/month.asp>  
Skyvector Section Charts (Find any sectional data anywhere in the US): <http://skyvector.com/>  
Another Ton of Aviation Links: <http://www.thirtythousandfeet.com/home.htm>  
Flight Plan Form: [http://www.tristateaero.com/pdf/7233\\_1.pdf](http://www.tristateaero.com/pdf/7233_1.pdf)  
Whitts Flying: <http://www.whittsflying.com/>  
NASA Safety Reporting On-Line: [http://asrs.arc.nasa.gov/forms\\_nf.htm](http://asrs.arc.nasa.gov/forms_nf.htm)  
Airport Info: <http://airnav.com/>  
Aviation Human Factors Risk Forms: [http://www.avhf.com/html/Training/Training\\_Home.htm](http://www.avhf.com/html/Training/Training_Home.htm)