Student Study Notes – Canadian PPL
Aviation Training: Pre-Solo Flight Basics

This version of my "Pre Solo Flight Basics" study notes is from January 1st, 2017. I'll update this document any time I find the need to make any changes, and as I continue to progress through additional training.

I am sharing these study notes for anyone else who is taking their PPL in Canada. These aren't intended as a replacement for proper training. I'm only sharing these notes as a supplement covering many of the key points that I decided that I really needed to memorize while going through my own PPL studies. The info in these notes comes from a large number of different sources: The Transport Canada Flight Training Manual, Transport Canada's Aeronautical Information Manual (AIM), various flight schools and instructors (in multiple provinces), and numerous other books and online sources. These notes are not always in any particular order, although I tried to keep similar topics together in many cases.

Please note that while I have made every effort to ensure that all of the information in these notes is accurate, based on the sources from which I learned, you should verify everything here against what you've learned in your own study programs. I (Jonathan Clark) shall not assume any liability for errors or omissions in these notes, and your official pilot training should always supersede any information presented herein. As the Canadian PPL curriculum is updated occasionally, I recommend that if you want to be 100% certain that everything in this set of study notes is correct, you should print a copy and ask your instructor to review these notes with you.

If the aircraft type is not specified in the notes below, you should always assume that they refer specifically to characteristics of a Cessna 172M, which is a common training aircraft, and the type that I have used most frequently. Know the characteristics of your own specific training/examination aircraft by memory!

To download PDF or audio MP3 versions of these notes, visit: http://djbolivia.ca/aviation.html

Let's Get Started – Pre Solo Flight Basics

Aircraft Familiarization

If you're flying VFR, your attention should be outside the plane at least 70-80% of the time.

Airspeed Indicator – Displays the speed going through the air, taking wind into account. Does not correlate to ground speed unless you're flying straight and level and there's no wind.

Attitude Indicator – Tells the pilot if the aircraft is nose-high or nose-low, and the amount of bank. This is the most important instrument for flight in clouds.

Altimeter – Height above sea level, not above the ground.

Vertical Speed Indicator – Shows the rate at which the aircraft is climbing or descending, in feet per minute.

Heading Indicator – Like a compass, but more stable during manoeuvres. Also known as directional gyro.

Turn Coordinator – Shows the rate of turn, and can indicate how long it takes to turn 180 degrees. The inclinometer (ball) helps make sure you're not slipping or skidding when you're turning.

Tachometer – Measures RPM's.

Other engine gauges:

- Fuel
- Oil temperature
- Oil pressure
- Fuel flow
- Exhaust gas temperature
- Vacuum
- Ammeter

VOR – Radio navigation instrument. This is the primary instrument used to define airways.

ILS – Very sensitive VOR, not in many small aircraft.

ADF – Another radio navigation instrument which is disappearing from common use. Also known as the Radio Compass.

COMM – Radio transceiver used for voice communications.

NAV – Radio used for navigation.

Transponder – Sends out a signal to ATC's secondary radar, to show where the aircraft is. If set to ALT, it gives them your altitude (known as a Mode C transponder).

Other important stuff:

- Mixture
- Throttle
- Trim
- Flaps
- Fuel selector
- Mags (magnetos)
- Primer

Documents

Remember this acronym: **AROWJIL**

A – Airworthiness
R – Registration
O – Operator's Handbook (POH)
W – Weight & Balance
J – Journey Log
I – Insurance
L – Licenses (personal, ie. PPL & medical)

Registration of the aircraft doesn't expire as long as there is no change in owner, address, or purpose.

Types of insurance:

1. Public or Third Party Liability – Mandatory, valid for damage done by the aircraft.
2. Passenger Liability – Optional for private, mandatory for commercial.
3. Hull Insurance – Optional. For damage to the aircraft itself.

Your license is only valid when accompanied by a current medical.

Radio License is valid for life, as long as you can talk. Issued by Industry Canada, not by Transport Canada.

Weights & Balances

See also my ground school study notes.

Every plane has a maximum weight for which it is certified to take off at. Performance will also change based on weight distribution.

Standard Empty Weight – Includes aircraft with standard equipment, oil, and unusable fuel.

Basic Empty Weight – Includes all optional equipment installed. Check POH/W&B/exam to double check whether oil is included, as this can vary from manufacturer to manufacturer.

Useful Load – Gross takeoff weight less basic empty. Includes usable fuel, pilot, crew, passengers, baggage, and freight.

Maximum Weight – Weight allowed for takeoff.

Maximum Ramp Weight – Slightly high than Maximum Takeoff Weight. Allows for a few extra pounds for ground Manoeuvring, ie. fuel burned during taxi and run-up.

Fuel & Oil Weights:
AVGAS – 6 pounds per gallon.
Oil – 7.5 pounds per gallon.

Zero Fuel Weight – Useful load weight but with no usable fuel.

Maximum Zero Fuel Weight – Maximum weight to which aircraft can be loaded with passengers, baggage, and crew, before the rest must be fuel. This is because too much weight in the fuselage will put too much stress on the wings while in flight when loaded beyond this value. Weight of fuel in the wings bends the wings down.

Moment – Weight multiplied by distance from a reference point or fulcrum.

The fulcrum of an aircraft is located at the Center Of Lift (Center Of Pressure, CP) on the wing. This is different than the Center Of Gravity (CG), which varies depending on loading.

Balance Principle – If the CG or the CP changes, then the elevator force must also change.

Datum Line – An arbitrarily selected point on the airplane from which all horizontal distances are measured for weight and balance purposes. Not the same as the fulcrum! Firewall is one such potential point.

Make sure you know on a CG graph which direction is an “aft” CG and which is a “fore” CG.

An aircraft with a CG in front of the fulcrum (CP) will want to "nose down". This is good, it's safer. It also cruises more slowly and is less susceptible to gusts.

You should prepare two weight and balance reports for each flight! One for takeoff and one for landing (fuel burned).

As a pilot, you should know whether the CG moves fore or aft as the fuel is burned.

Normal Category means non-aerobatic and non-training ops (ie. no spins/spirals), from +3.8 G's to -1.5 G's.

Utility Category is generally OK for training conditions. Only do spins when in this category, and only under the supervision of an instructor.

Walkaround

Walkaround notes:

- Will probably take up to fifteen minutes or more on a small plane like a Cessna.
- Take your time, do it right.
- Be systematic. Have a routine.
- You will check the entire exterior, some things in the interior, and the fluids.
- Never rush this or skip things.

Ancillary Controls

Never taxi with carb heat on, because the air is then unfiltered going into the carb.

Carb Ice forms inside the carburetor, whereas **Impact Ice** forms on the outside of the airplane, on the air intake filter.

The engine burns more fuel with carb heat on. You'll have less power too.

There is a temperature drop in a carb venturi for two reasons:

- Decrease in pressure (Bernoulli's principle).
- Fuel is vaporized, which takes heat from the surroundings.

MOGAS is much more susceptible to carb icing than AVGAS.

Know the difference between carb and throttle icing. Throttle ice is the same concept as carb icing, but occurs on the throttle plate. Usually occurs when the throttle is only partly open, hence the reason some manufacturers recommend carb heat to fix the problem, if operating below the green arc on the tach.

In a Cessna, always use **carb heat** when running at **less than 2100 rpm**.

Throttle adds air. Mixture adds fuel.

A richer mix (more fuel) cools the engine.

As an aircraft climbs, the air density decreases and the fuel/air mix becomes more rich.

EGT Gauge – The proper fuel/air mix will produce a given exhaust gas temperature, therefore, the pilot can adjust the fuel/air mix fairly accurately by observing the EGT gauge.

Environmental Controls – Vents and heat for pilot comfort.

Taxiing

Goals:

- Taxi centered on the yellow lines!
- While taxiing, have controls in the proper position (ie. ailerons centered or set to account for winds).
- Know the list of standards expected on a flight test.
- Always do a brake test right away.
- Hold back pressure, if needed, to keep the nose up.

Differential Braking – Braking only on one side to help a turn.

Learn your **marshalling signals**. They won't be on the flight test, but you need to learn them.

Control positions in **Quartering Winds**:

- Elevator neutral if wind is from the front, elevator down if behind.
- Ailerons into wind if the wind is from the front, or away from wind if from behind.

Attitudes & Movements

Attitude + Power = Performance

Attitude – Position of the airplane with reference to the horizon.

Movements – How controls are manipulated to achieve various attitudes.

Basic cruise in a Cessna 172 is 2200 rpm, around 105-110 knots.

Basic Attitudes:

- Cruise (pitch)
- Nose Up (pitch)
- Nose Down (pitch)
- Banked (roll)

Types of **Adverse Yaw**:

1. **Aileron Drag** – Drag on the down aileron (raised wing) will attempt to pull or veer the airplane's nose in the direction of the raised wing, which is the opposite direction of what is desired. This is the only type of adverse yaw that is caused by the ailerons.
2. **Gyroscopic Precession** – Created by the propeller, which usually rotates clockwise from the pilot's perspective. Nose down yaw left, nose up yaws right.
3. **Torque** – Twisting of the fuselage caused by the propeller. Makes the airplane want to roll to the left.
4. **Slipstream** – Airflow corkscrews around the fuselage. Tends to force the tail right (nose left).
5. **Asymmetric Thrust** – Related to "bite" of propeller when not vertical. Results in a tendency for the airplane to yaw around the vertical axis to the left.

Straight and Level Flight

Learn to use the trim wheel properly to control the plane's attitude. You should be able to let go of the control column and have the plane fly at the correct attitude if the trim is set correctly.

In a Cessna 172, a change in power of 100 rpm usually translates into a change in speed of about 5 knots.

To increase the airspeed, you need to push the nose down. But if you want to presumably maintain straight and level flight, you should first add power then push the nose slightly down to compensate, so you don't just start climbing.

There is a huge difference in fuel consumption between 2000 and 2400 rpm, with 2400 burning 50% more fuel.

Climbing

Climbing speeds for a Cessna 172:
V_Y – Best rate, 88mph
V_X – Best Angle, 68mph (or 65mph at 10 degrees flaps)
V_{S0} – Stall Speed, flaps extended, 40mph
V_{S1} – Stall Speed, flaps retracted, 49mph
V_R – Rotation, varies from say 52 to 58mph approximately
V_A – Design Manoeuvring Speed, 112mph calibrated, 115mph indicated

Max Crosswind is 17mph.

For going into a climb AND coming out of a **climb**, remember **APT**.

A - Attitude
P - Power
T - Trim

Remember to do a lookout first.

In a climb, torque and asymmetric thrust will combine to produce a moderate roll and yaw to the left. You must counteract with some right rudder pressure.

Winds change the steepness of a climb, but not the rate.

Your engine can overheat if a steep climb is maintained. Pay close attention to oil temperature and pressure. Pause the climb if necessary.

Hotter temperature and higher altitude and higher humidity makes it harder to climb.

Descents

Always do your lookout first.

Reduce power first, then attitude, then trim. This applies both at the start of the **descent** and also when coming out. Remember **PAT**.

P – Power
A – Attitude
T – Trim

Types of descents:
- Power On, En Route – most speed across the ground, shallow
- Power On, Approach – slower, still fairly shallow
- Power Off, Best Glide – coming in at 80mph (Cessna 172)

En Route – This descent features the highest groundspeed. Set power to 2200 rpm. High air speed (X axis), low rate of descent (Y). Attitude is slightly forward.

Approach – Power is 1500 rpm. Speed is about 80 mph. Standard for landings.

Best Glide – Engine has stopped. To practice, move the throttle to full idle, pitch up, then trim about three times. Set the attitude for 80 mph before trim.

Essentially, when descending, the power (throttle) affects your rate of descent, and pitch affects airspeed. They are actually slightly interrelated, but you can use this basic assumption to get started.

Any time the power goes below the green arc on the tachometer, you must add carb heat.

With a lengthy power-off descent, clear the engine occasionally by giving it a few seconds of throttle.

The rate and angle of descent are primarily affected by power/throttle, but are also somewhat affected by attitude/pitch, wind direction and speed, flap settings, gear setting, and density altitude.

Flaps will change the steepness AND rate of descent.

Putting flaps down makes your nose pitch up, so you need to pitch forward to counteract this. Flaps, if used properly, should not reduce your airspeed.

Turns

Classes of turns:
Gentle are less than 15 degrees
Medium are 15 to 30 degrees
Steep are greater than 30 degrees

Posture in a turn – Do not lean with the turn, or tilt your head. That makes you more likely to feel nauseated.

Always do a **lookout** before entering a turn.

Entry into a turn:
1. Lookout.
2. Roll into bank: ailerons deflected, then neutral.
3. Rudder to coordinate and control yaw.
4. Back pressure as required.
5. Lookout again.

Goals in a turn:

- Nose moves steadily and stays level on the horizon.
- Constant airspeed.
- Turn coordinator shows constant rate of turn.
- Ball is centered.
- Altimeter is steady.
- VSI remains steady.

Too much rudder in a turn (in the direction of the turn) produces a skid. Too little is a slip. Keep the ball in the middle.

Slips are safer than skids, but you should still avoid them unless you're attempting an intentional slip.

For a skid, think of a loose article on the dash. If it slides in a turn, away from the direction of the turn, you are skidding. Also, think of the tail swinging to the outside of the turn.

Slips are sometimes done on purpose. Skids can be unsafe and are never done. A skid could sometimes lead to a spin, which is very dangerous.

Steep turns are normally practiced at 45 degrees. Practical applications are almost always limited to emergency situations or canyon turns.

On a flight test, for your **steep turn**, you need to keep:
- Attitude within 100'.
- Speed within 10 knots.
- Bank within 10 degrees.
- Rollout to heading within 10 degrees.

"**CALL**" Check:
- Cabin – belts, gauges, cabin secure.
- Altitude – recovery by 2000' AGL.
- Location – orientation, not over built up areas.
- Lookout – look up, down, around.

"**HASEL**" Check:
- Height – recovery by 2000' AGL.
- Area – not over cloud, water, built up areas.
- Security – belts, cabin secure.
- Engine – oil temp and pressure green, carb heat on.
- Lookout – one 180° turn or two 90° turns.

Entry into a steep turn:
1. CALL check or HASEL check.
2. Fix on a landmark.
3. Roll into turn.
4. Pitch up to maintain altitude at 30° of bank.
5. Add a bit of power to maintain airspeed (maybe 50-100 rpm).

Key instruments to scan:
1. Airspeed (stable).
2. Altitude (stable).
3. Attitude (45°).

Recovery:

1. Begin rollout early (one half the number of the bank angle).
2. Rudder as needed.
3. Reduce back pressure on the control column as loading comes off.
4. Reduce power to cruise.

Load Factor – Ratio of the load on the wings to the aircraft's weight.

A higher load factor leads to a higher stall speed. So avoid steep turns at low speeds when you're close to the ground, ie. on approach for landing.

Common errors on Steep Turns:
- Forgetting to look out.
- Overbanking.
- Pulling back in an overbank (reduce bank first).
- Spiral dives.
- Insufficient power.
- Failing to roll out in anticipation of proper heading.
- Ballooning (gaining altitude on roll out).
- Lack of coordination.

Slow Flight

Slow flight is that airspeed range above the stall speed, but below the speed for maximum endurance (best glide, 80pmh in a Cessna 172).

Practicing slow flight helps you avoid stalls, and makes you better at handling and controlling the aircraft. You go through slow flight whenever you take off or land.

Slow flight is an important flight test item.

Learning an **overshoot**, and recovery from slow flight, are both very important.

To enter **slow flight**:
- CALL check or HASEL check.
- Carb heat on.
- Reduce power to say between 1500 and 1700 rpm.
- Raise nose to maintain attitude.
- Put power back in (to maintain altitude) once airspeed reaches desired speed. Maybe 1900 to 2000 rpm.
- Trim it out.
- Lookout.

If you start to gain a bit of altitude in slow flight because you added back too much power, it's far easier to shed power than it would have been to get that altitude back because you didn't add enough power.

You might need some right rudder in slow flight.

If you're in slow flight and an examiner asked you to slow down even more, you can put the flaps down.

During slow flight, as in descents, your pitch controls your airspeed.

Recovery from Slow Flight:

1. Add full power.
2. Watch out, as the nose will begin to pitch up.
3. Watch out, as the plane will yaw to the left.
4. Carb heat cold.
5. Flaps up, but do it in stages if you start out with more than 20 degrees of flaps.
6. After reaching cruise speed, reduce power to 2200.
7. Trim.
8. Look out.

Common Errors during Slow Flight:

1. Forgetting your CALL or HASEL check.
2. Not adding power quickly enough (loss of altitude).
3. Right rudder is not correct.
4. Lack of coordination during turns.
5. Not putting flaps down during slower speeds.
6. Having a harder time turning right versus left.

Common Errors during Recovery:

1. Not pitching forward as power is applied.
2. Not corrective for adverse yaw.
3. Forgetting to raise flaps.
4. Forgetting to remove carb heat.

Stalls

A **stall** is a loss of lift and increase in drag that occurs when an aircraft is flown at an angle of attack that is greater than the angle for maximum lift, ie. when you lose smooth airflow over the wing.

Angle of Attack is what determines the stall.

A stall can occur at any airspeed, in any attitude, and with any power setting.

Two main types of stalls are Power-On and Power-Off. You will have to demonstrate both of these on a flight test.

When recovering from stalls, go carb heat cold and power full, then climb at V_Y. Lift gear and flaps, if appropriate, then trim.

Entry into a Power-Off Stall:

1. CALL check or HASEL check.
2. Carb heat hot.
3. Power off.
4. Rudder as required to maintain directional control.
5. Gradually increase elevator back pressure to full, while maintaining altitude.

Three signs of an approaching stall:

1. Slow flight characteristics appear.
2. Stall warning buzzer.
3. Buffeting.

At any time during a stall, the airplane (if a Cessna) will recover instantly if you let go of the controls. So don’t be too nervous when practicing stalls, as long as you have sufficient altitude.

Recovery:
1. Reduce elevator back pressure.
2. Allow the aircraft to dive and speed up.
3. Add power as required.
4. When the airplane is flying, pull out of the dive smoothly.
5. When safe, pitch gently for a climbing attitude.

Power-On Stall:
1. Follow steps for Power-Off Stall.
2. Directional control may be more difficult.
3. Nose will have to be raised higher to initiate stall.
4. At the stall, a pitch forward is more pronounced.
5. Wing drop is much more likely. If it happens, use abrupt opposite rudder and NO ailerons.

Never apply power when recovering from a stall if the nose is pointed below the horizon! That could just accelerate you into the ground at a low altitude.

Types of Stalls:
1. Power-On.
2. Power-Off.
3. Secondary stall.
4. Imminent stall.
5. Accelerated stall.

Power-Off stalls are normally practiced as normal landing approach conditions in simulation of an accidental stall occurring during landing approaches. They should be practiced with multiple flap settings. Try to be at normal approach speed (80 mph) before initiating entry.

Practice Power-On stalls at various flaps and power settings, including full power.

Secondary Stall – Happens when you make an incomplete or improper recovery from a stall, perhaps by pulling back too hard. To avoid, don't pull up during stall recovery until the aircraft has reached at least the best rate of climb speed (88 mph), before slowly raising pitch.

Imminent Stall – The airplane is approaching a stall but is not allowed to completely stall.

Airplanes can go into a stall at higher-than-normal airspeeds when excessive loads are imposed by abrupt or strong manoeuvres.

Mushing – Falling to the ground (like a leaf) with insufficient airflow over the wings to create lift.

Falling Leaf Exercise:
- Enter the stall, allow it to continue by holding the control column aft.
- Let the airplane mush.
- Careful rudder work is necessary to prevent wing drop.
- Airplane will oscillate in pitch as it tries to recover.
- Do this with an instructor.

Things that affect stall speed:
1. Weight and balance.
2. Power.
3. Flaps.

4. Bank angle.
5. Aircraft condition.
6. Retractable landing gear.

Common errors:
- Forgetting the CALL or HASEL check.
- Not even stalling.
- Holding the control column back during the stall.
- Pushing too hard forward.
- Entering a secondary stall.
- Stepping on the wrong rudder.
- Touching the aileron during a wing drop. This is the biggest problem.
- Exceeding V_{FE} in a dive with the flaps extended.

The biggest problem is using the ailerons to counter wing drop. You must learn to do it hands-off, and react with the rudder only.

Spins

Spin – A stall that has been aggravated by yaw. This results in an "autorotation" where the plane follows a corkscrew path (60^o of nose down attitude) in a downward direction.

In a spin, the wings are producing some lift and the airplane is forced downward by gravity, wallowing and yawing in a spiral path. This pattern results from the fact that one wing is more stalled than the other.

There is no practical application for a spin in normal flight. The only reasons we practice them are for recognition, avoidance, and recovery.

Three Stages of a Spin:
1. Incipient stage
2. Fully Developed stage
3. Recovery stage

How to Enter a Spin:
1. CALL check or HASEL check.
2. Carb heat hot.
3. Power to idle.
4. Gradually apply full back pressure on elevator.
5. Go full rudder left or right, just as the aircraft stalls.
6. Keep the control column fully aft, plus full rudder.

If you partially relax either input in step six, your spin may turn into a spiral dive!

A Cessna is very stable and resistant to entering a spin. You really have to screw up to enter a spin by mistake.

Characteristics During a Spin:
- Can be quite disorienting.
- Aircraft will be in a sixty degree nose down attitude, rotating around its vertical axis.
- You'll probably see all ground through the windshield, no sky.
- Airspeed will read as low, but not below the stall.
- Altimeter shows descending altitude.

- Gyros may topple due to excessive rotation on multiple axis.
- Inclinometer ball is useless.
- The low wing in the turn coordinator shows the direction of the spin.

Ironically, for many airplanes, if you let go of the controls, the airplane will recover on its own. You should still learn proper recovery procedures for safety.

How to **Recover from a Spin**:

1. Relax.
2. Power to idle.
3. Ailerons neutral.
4. Ensure flaps retracted.
5. Full opposite rudder.
6. Gentle forward pressure on the control column.
7. Hold until auto rotation stops.
8. Neutralize rudder.
9. Roll wings level using ailerons.
10. Ease out of the resulting dive.

External Factors:

- Power On makes a spin flatter and faster.
- Flaps make a spin flatter, and can result in structural damage.
- CG location: Aft is bad as it makes it harder to recover.
- Higher weight increases the spin's inertia.

The most likely way to enter a spin accidentally would be by turning with too much bank using rudder only, on the turn to final. It could also happen during an improper overshoot or an improper departure procedure.

Common Spin Practice errors:

1. Not stalling, which leads to a spiral.
2. Wrong way rudder.
3. Not releasing the back pressure.
4. Not relaxing the rudder pressure as the rotation stops.
5. Leaving the flaps down.

Spiral Dives

Spiral Dive – A steep descending turn in which the airspeed, rate of descent, and wing loading increase rapidly. Far more dangerous than a spin.

We learn about spiral dives and practice them for recognition, avoidance, and recovery. This is a flight test item.

Never enter a spiral intentionally while solo! It's too dangerous. You should only do it when the instructor is with you and has initiated the dive.

Accidental Entry:

1. A steep turn where the nose is allowed to drop excessively.
2. An attempted spin where the airplane didn't actually enter the spin, but the nose was allowed to drop and the airspeed built up.
3. When busy in the cockpit with other chores.
4. When becoming disoriented during instrument flying.

5. After losing the vacuum instruments.

Characteristics:

- Airspeed rapidly increasing.
- High rate of descent.
- Steep bank angle.

A plane in a spiral may descend as quickly as 18,000 feet/minute.

Recovery:

1. Throttle to idle.
2. Wings level. Aileron IS allowed, because you're flying.
3. Ease out of the dive.

Each of these steps must be completed separately and promptly.

Common Errors:

1. Adding power, which is really dumb. You're flying at the ground. You don't want to speed up.
2. Not using three separate motions for recovery. The three steps can NOT be combined.

Slips

Slip – The aircraft is placed in a banked attitude, but its tendency to turn is controlled with the rudder. The turn is then halted.

Why learn slips?

1. Counteract the effect of drift that is caused by a crosswind during landing.
2. Increase the rate of descent without increasing the airspeed.
3. Used to align with something.
4. It's a flight test item.

Types of Slips:

1. Side Slip.
2. Forward Slip.
3. Slipping Turn (a type of forward slip).

Side Slip:

- Useful to stay lined up with a particular direction of motion (ie. the runway centerline) during a cross wind.
- The longitudinal axis of the plane stays in line with the target.

Entering a **Side Slip**:

1. Lower a wing and apply just enough opposite rudder to prevent a turn.
2. The airplane's longitudinal axis remains parallel to the original flight path, but the airplane no longer flies "straight ahead."
3. From behind, it looks as if the airplane is aimed straight at the runway, but the plane has rolled partway.
4. The aircraft will be in a banked attitude as shown on the turn coordinator, but not turning.
5. The airspeed indicator and altimeter will have errors due to the position of the static port.

Forward Slip:

- One in which the airplane's direction of motion continues the same as before the slip was begun.

- Assuming that the airplane is originally in a straight flight, the wing on the side toward which the slip is to be made should be lowered by use of the ailerons.
- Simultaneously, the airplane's nose must be yawed in the opposite direction by applying opposite rudder. This means that the longitudinal axis is at an angle to its original flight path.

Entering a **Forward Slip**:

1. Use ailerons to bank into the wind.
2. Apply opposite rudder to prevent a turn.
3. Adjust the pitch gently forward to maintain the original attitude. The airspeed will have an error, so fly the attitude.
4. Stay in line with the runway centerline by adjusting aileron.
5. Be prepared to pitch your nose down slightly.

If you're having problems distinguishing the two slips, remember the "opposites" rule: a pilot "faces" to the side in a forward slip, and forward in a side slip.

Recovering from a slip:

1. Release the rudder pressure.
2. Simultaneously level the wings.
3. Adjust pitch and trim.

Slip vs. Skid:

- In a slipping turn, the tail of the airplane and the ball of the inclinometer are on the inside of the turn.
- In a skidding turn, the tail and the ball are on the outside of the turn.
- Skids can lead to spins, especially when descending. Very bad!

Slipping Turn – Put yourself into either a side slip or a forward slip, then add just a little bit of aileron.

Common Errors:

- Entering a skid.
- Changing the pitch attitude. Remember that the airspeed indicator is lying to you.
- Showing/doing the wrong type of slip.
- Slipping the wrong way. It's best to have the low wing into the wind.

Slips feel strange to passengers, so it might be nice to warn them in advance.

Takeoffs

Takeoffs are always optional. You may have less discretion with a landing though.

Takeoff – The transition from taxiing to flying. It includes the activities immediately before and after liftoff.

Take off as nearly into the wind as possible, if it's a normal takeoff.

Benefits of taking off into the wind:

- Shorter ground roll, so less runway is required.
- Lower ground speed after liftoff.
- Steeper climb rate, so better for clearing obstacles.
- Lack of side drift and shorter takeoff roll means less wear and stress on wheels and landing gear.
- Greater directional control.
- Proper circuit procedures will be followed.

If the speed of the wind at ground level is greater than the aircraft's stalling speed, a parked airplane will fly on its own. Never forget the tie-downs.

Procedures for Takeoff:

1. Ensure preflight checks are complete.
2. Have a Go/No-Go point ready.
3. Do you know emergency procedures?
4. Flaps? Either none or 10^{o}. Beyond 10^{o}, the flaps create more drag than lift.
5. Know wind speed and direction. Know what this translates into as a head wind and a cross wind. Check the wind sock to verify your METAR and ATIS info.
6. Check traffic.
7. Align aircraft with runway center line.
8. Control column neutral, although perhaps ailerons set for crosswind.
9. Applying throttle fully but smoothly, not too abruptly.
10. Right rudder may be required.
11. Rotate around 60mph (Cessna 172). Do it gently. Let the airplane go up on its own.
12. Climb, establishing an attitude that gives you about 88mph (Cessna 172).
13. Retract flaps when safe.
14. Climb straight ahead to 500' AGL.

For a Go/No-Go point, one rule that may be useful is the 70/50 guideline. If you don't have at least 70% of your required takeoff speed by the middle of the runway length, you should abort.

Air density is affected by pressure, temperature, and humidity. Think of it this way: Height, heat, and humidity make it harder to take off.

Lift and drag vary directly with the density of the air.

The density of air at 18,000 feet is half that of sea level.

Crosswind Takeoffs

Crosswind Takeoff – Any time the wind blows at any angle that crosses the runway.

Make sure you maintain a straight path down the runway centerline.

Challenges affecting Directional Control:

1. Weather-cocking (Keel Effect) – airplane wants to swing into the wind.
2. Dihedral – shape of wing.
3. Windward Wing – has more airflow, making it want to lift.
4. Sideways Drift – from wind pushing against fuselage.

Keel Effect – Airplane has more surface area behind the main wheels than ahead of them, causing the airplane to yaw into the wind. You'll need to counter with some opposite rudder.

Positive Dihedral – The "into wind" wing will have a greater angle of attack than the other wing, which generates lift and rolls the plane. Use some aileron to counter. Focus here on the shape of the wing being the cause.

Windward Wing Airflow – The "into wind" wing will have more airflow because it isn't blocked by the fuselage. This also lifts the wing and rolls the plane, so add aileron. Focus here on the fuselage as a wind blocker to one wing.

Sideways Drift – As well as wanting to rotate the plane, the wind tends to push the entire plane sideways, putting strain on the landing gear. This will be partially offset with the proper amount of aileron input.

Crosswind Takeoff Procedures:

1. Try to take off into the prevailing winds.
2. Have ailerons fully deflected into the wind.
3. Slowly reduce aileron deflection to neutral as you build speed on the takeoff roll.
4. Apply rudder as needed to stay on the runway centerline.
5. Go for a slightly more abrupt and definitive liftoff than usual, and at a slightly higher speed (perhaps 65 mph in a Cessna 172).
6. Don't let the aircraft settle back onto the runway.
7. Crab into the wind after liftoff to keep the flight path aligned with the runway centerline.

Try to avoid using flaps on a crosswind takeoff.

Crosswind components are determined by the sine of the angle of degrees deflection. To simplify, use the following chart:

00^o wind angle = 00.0% crosswind component
10^o wind angle = 17.4% crosswind component
20^o wind angle = 34.2% crosswind component
30^o wind angle = 50.0% crosswind component
40^o wind angle = 64.3% crosswind component
50^o wind angle = 76.6% crosswind component
60^o wind angle = 86.6% crosswind component
70^o wind angle = 94.0% crosswind component
80^o wind angle = 98.5% crosswind component
90^o wind angle = 100% crosswind component

An even more basic and approximate guide is this: Use the "minute hand of a clock" as a percentage rule, which works pretty well as a rough guide. Ie. for 10 degrees use 10 minutes, which is $1/6^{th}$ of an hour, or about 17 percent. For 15 degrees use 15 minutes which is $1/4^{th}$ of an hour, or about 25 percent. For 30 degrees use 30 minutes which is ½. For 45 degrees use 45 minutes which is ¾. Above that use 90%.

In the absence of a published number, all aircraft must be certified to a minimum of 20% of the stall speed for a crosswind limitation.

Common errors on Crosswind Takeoff:

- No control inputs at all.
- Too much or not enough aileron down into the wind.
- Too much or not enough rudder to stay lined up with the centerline.
- Weak liftoff that results in settling back down onto the runway.
- Not crabbing properly to maintain a straight track after takeoff.

Landing

Landing – The transition from flying to settling down safely on the runway, including the approach.

Three phases:

- Approach.
- Level Off.
- Flare.

One of the keys to a good landing is a stable approach. It's best to have everything (power, attitude/speed, flaps, trim) set up well before final. Try to have it set up by "half base."

Steps to follow when about to turn base:

1. Carb heat hot.
2. Power back to 1500.
3. Pitch up a bit (close to cruise).
4. Trim down three times.
5. Pitch to 80 mph.
6. Flaps, if necessary.

If you feel a bit low on base, simply add a touch of power. It's easier to add a bit of power when low than to quickly shed altitude.

Three solutions when Approach is High:

- Reduce power.
- Add flaps.
- Forward slip.

Bloom Effect – When the threshold area seems to rapidly expand, and many suddenly get the feeling that the ground is suddenly approaching so rapidly that something must be done about it.

Control in the Flare:

- Rudders keep you pointed the right way.
- Ailerons keep you from drifting.

Steps for Landing:

1. Power to 1500 rpm, slow down.
2. Flaps, if required.
3. Trim.
4. Turn final, align with runway.
5. Establish a glide path to the runway.
6. Keep airplane in trim to the flare (try not to touch trim on final though, should have been set properly in base).
7. Reduce power to idle once runway is ensured.
8. Flare, but not too abruptly! You should level out and float for a bit, and flare once you start to sink.

Recovery from a **Bounce** or **Balloon**:

1. Maintain the landing attitude.
2. When starting to settle again, add a bit of power if necessary.
3. If it's bad, add power and overshoot. If you do this, avoid excessive pitch up.

Types of **Training Approaches**:

1. Low & Over.
2. Stop & Go.
3. Touch & Go.
4. Overshooting.

Low & Over – A normal approach, but instead of flaring and then landing, power will be added to maintain approximately flaring height. Good practice for approaches without actually landing.

Stop & Go – Aircraft will come to a complete stop, then after a brief pause, the takeoff will be initiated from the same position.

Touch & Go – Normal approach and landing, but then add power and take off again without stopping. This exercise allows the most practice takeoffs and landings in an hour.

Overshoot – Start your approach, but instead of landing, add power and climb out.

Overshoot Procedures:

1. Full power, smoothly not abruptly.
2. Carb heat cold.
3. Go to climb attitude.
4. Retract flaps if they are set to more than ten degrees.
5. Don't climb above circuit height.

Learn to always keep your right hand on the throttle during landings and takeoffs. You can fly with just your left hand on the control column.

Crosswind Landings

A **crosswind landing** is a landing with wind coming from any side. It is harder than a crosswind takeoff because the aircraft is becoming less controllable as it slows down, rather than more controllable.

Be aware that the winds may be a different direction and strength upon landing than when you took off, even when doing circuits.

Main Crosswind Landing Techniques:

1. Crab & Kick.
2. Slipping (also called Wing Low).
3. Combination.

Crab Method – Crab into the wind with wings perfectly level so the airplane's ground track remains aligned with the centerline of the runway. Straight out with a rudder kick at the last second. After the rudder kick, bank slightly into the wind with the ailerons, to stop the rolling tendency from the rudder input. Airspeed should be slightly higher than for normal landings.

As a student/learning pilot, the crab landing is not the safest or easiest option. The kick needs to be perfectly timed.

Wing Low – Touching down in a side slip. The pilot aligns the airplane's heading with the centerline of the runway, notes the rate and direction of drift, then promptly applies drift correction by lowering the upwind wing. Drift is controlled with aileron, and heading with rudder.

Once you touch down with wing low, don't release control inputs. You'll be slowing down, which means that controls become less responsive, so you actually have to start increasing aileron. Remember that when taxiing with a crosswind, you deflect the ailerons fully.

In a long final, it may be beneficial to do a crab until just before the roundabout is started, and then smoothly change to a sideslip for the remainder of the landing.

In a strong crosswind, the plane would obviously have to be banked quite steeply, which of course means heavy rudder. Some airplanes might not be technically capable of that much rudder. If full opposite rudder will not prevent a turn, the wind is too strong to safely land the airplane on that particular runway with those wind conditions.

If crosswinds are too strong for a safe landing, and no alternate runways are available, it might even be necessary to go to an alternate airport.

Flaps can and should be used during most approaches since they tend to have a stabilizing effect on the airplane. However, you would typically use less flaps with a crosswind. Full flaps may be used as long as the crosswind component is not in excess of the airplane's capability, or unless the manufacturer recommends otherwise.

Ground Roll:
- Pay close attention while rolling: The rudder for steering is independent of the aileron being used to keep the wing low into the wind.
- When the plane is airborne, it moves with the air mass in which it is flying, regardless of heading and speed. On the ground, the friction of the wheels prevents that.
- The airplane wants to weathercock into the wind because it has a greater profile or side area behind the main landing gear than forward of it.

CRFI – Canadian Runway Friction Index, gives the braking effectiveness of a surface.

At times, a surface covered with ice, snow, or water will not allow a safe landing. Check a CFRI chart to determine the CRFI crosswind limits. These can be independent of the plane's maximum demonstrated crosswind component.

Common Errors during Crosswind Landings:
- Attempting to land in crosswinds that exceed the airplane's max demonstrated crosswind component.
- Inadequate compensation for wind drift on the turn from base leg to final approach, resulting in undershooting or overshooting.
- Inadequate compensation for wind drift on final approach.
- Unstable approach.
- Failure to compensate for increased drag during side slip, resulting in excessive sink rate and/or too low an airspeed.
- Touchdown while drifting.
- Overly excessive airspeed on touchdown.
- Forgetting about increased distances.
- Failure to use correct control inputs during rollout.
- Letting go when you land (you need more control authority, not less, as you slow down).

Losing control in a cross wind is the most common landing accident.

Circuits

Circuit – The specified path to be flown in the vicinity of an aerodrome.

Circuit Features:
- The circuit provides pilots with organization and standardization, like traffic rules.
- A well flown circuit will lead to a stable approach.

- The circuit incorporates climbs, cruise, and descents, so it's where you'll really learn to fly.
- Left hand circuits are usually the international standard.
- Typical circuit height is 1000 feet above ground level, although this can vary. Always check the CFS.
- Americans call the circuit "the pattern."

Do a good lookout at each turn on the circuit.

Typical spacing between the runway and the downwind leg is about one mile.

Power settings (in an ideal world):
- Full throttle on departure and crosswind.
- 2200 rpm on downwind.
- 1500 rpm upon turning base.

Radio calls at an **Uncontrolled** Airport:
1. Shortly after airborne.
2. When turning from departure onto circuit.
3. On downwind.
4. On final.
5. When you have exited the runway.

Departing an Uncontrolled Circuit:
- Leave the circuit, go any direction. Probably not preferrable to go left (on a left hand circuit) in case there are arriving aircraft coming straight in downwind.
- A turn back that goes toward the circuit should not be initiated until you're at least 500 feet above aerodrome elevation.
- Try to use the runway most closely aligned to being into the wind.

Joining an Uncontrolled Circuit:
- From upwind side, funnel into a point where you can cross the airport at midfield and join the circuit on downwind (best option).
- Can join straight in downwind if no conflict exists.
- Can cross field if 500' above circuit height, and then descend to circuit height, crossing back at that height to join the circuit. If you follow this procedure, do your initial teardrop turn away from the wind, so the majority of your teardrop is then into the wind.

Joining the Circuit at an MF (Mandatory Frequency) Airport:
- Aircraft may join the circuit straight in to downwind, 45° to downwind, or straight in to base or final.
- Be alert for other VFR aircraft entering from any of these positions, or for IFR straight in or circling approaches.
- You may have a FSS giving you information about weather and about traffic in the circuit.
- Be careful because an aircraft could, against the rules, come into an MF airport with no radio.
- If the MF airport has no advisory info available, treat it as an uncontrolled airport for joining the circuit.

No matter what type of airfield, if doing continuous circuits, you should always climb to circuit height after each takeoff before turning onto downwind.

At a controlled airport, there are a large number of ways to join the circuit, depending on what the controller tells you:
- From the upwind funnel, crossing the field at circuit height, and joining downwind.
- Straight in downwind.
- 45° onto downwind.

- Straight in base.
- Straight in final.

Never cross the aerodrome from the downwind side unless you are at least 500' above the circuit. Remember that aircraft could be crossing in the other direction at circuit height, to join the circuit.

If crossing from upwind to join the circuit, you should be at circuit height and also, you should join the downwind leg at a point abeam the midpoint of the active runway.

RONLY – Radio device with receive capabilities only.

NORDO/RONLY Arrivals:

- At a controlled airport, approach the circuit from the upwind side only, join the crosswind at circuit height, then join the circuit on the downwind leg.
- Know your PSTAR light signals.
- Transponder code 7600.
- You may be able to call the tower on a cell phone using the number published in the CFS.

If you are cleared by an ATC as "Cleared to the Circuit," then you must join the downwind leg at circuit height, or possibly crosswind then downwind.

Common Errors during Circuits:

- Not seeing or being aware of traffic.
- Improper joining procedures.
- Very tight spacing.
- Very wide spacing.
- Not on frequency.
- Missing that a circuit is non-standard.
- Not correcting for winds.

Conclusion

The topics included in a study of pre solo flight basics for aviation have a greater scope than I've covered here. It would also be wise to spend quite a bit of time studying the various publications that I've linked to on this page: http://www.djbolivia.ca/aviation.html

I have links there to several additional aviation-related publications.

Thanks for reading, I hope this was helpful to pilots in training. If you find any errors in the above information, feel free to contact me at jonathan.scooter.clark@gmail.com

- Jonathan Clark