Chapter 5 Takeoffs and Departure Climbs

**Introduction**: 20 % of all aviation accidents occur during takeoff and departure climbs. More than half of these accidents are caused by a failure of the pilot. Takeoff is short compared to the rest of a flight but has the greatest amount of pilot workload.

* The Airplane manufacturer’s recommendations on operation take precedence over anything in the FAA Pilot Operating Handbook.

**Terms and Definitions:**

* **Takeoff and climb is usually divided into three separate steps:**

1. **Takeoff Roll (**Ground Roll**):** Airplane is accelerated from a stand still to an airspeed that provides sufficient lift to become airborne
2. **Lift-Off :** Lift from the wings overcome the planes weight. Usually occurs when the pilot rotates the nose up to increase angle of attack
3. **Initial Climb:** Plane leaves the surface and climb pitch attitude is established. Completed once a safe maneuvering altitude is established.

**Prior to Takeoff:**

* Check the airplane flying manual first for performance metrics of the plane to decide if a safe takeoff is possible.
* As density altitude increases propellor and climb performance decrease.
* All instruments should be checked for correct readings
* Controls should be checked for full, free and correct movement
* Pilot must make sure that paths are clear and announce intentions on the
* Pilot must announce intentions on the Common Traffic Advisory Frequency (CTAF) or to the traffic controller
* Do not take off directly behind other aircrafts, wake turbulence can destabilize a takeoff. If you must avoid the previous plane’s flight path
* Try to stay aligned with the runway centerline prior to and during

**Normal Takeoff:**

* Airplane is taking off heading into the wind.
* Check the AFM to see if a tailwind takeoff is approved with current conditions and runway length
* Check runway for obstructions
* Headwind improves airspeed gain allowing for relatively short takeoff

**Takeoff Roll:**

* + Use rudder pedals to steer until lift-off
  + Release brakes and advance throttle to full smoothly
  + Abrupt throttle increase can cause a sharp yaw to the left
  + Toes or balls of your feet should be on the rudder and not the brakes
  + Engine Torque and P-Factor lead increase pull the plane to the left
  + As speed increases the feel of pressure on the controls increases
  + Pressure increase = controllability increase
  + Use outside references to judge when the plane is in motion
  + Careful not to over control the plane

**Lift-Off:**

* Ideal takeoff attitude requires minimal pitch input
* Normal takeoff attitude achieves the speed for best rate of climb **(VY)**
* Pitch for V­­Y varies from plane to plane
* Takeoffs on rough ,smooth, hard, soft or muddy fields, or gusty air require a different procedure
* **Rotation:** Smooth pull back of the elevator after control surfaces gain effectivity
  + This should be done when the airspeed is enough to increase effectivity of the control surfaces
  + Don’t apply to much back pressure on the elevator or you will increase engine torque and could cause a stall
* The wings must be kept level during the climb, as engine torque will try to bank the plane
* Apply a right roll to the controls to counteract engine torque
* In strong winds an extra margin of speed should be gained before takeoff

**Initial Climb**

* Plane should be at an attitude that accelerates it to VY after lift-off
* Maintain proper back elevator or the plane could settle or descend
* The plane will accelerate as it becomes airborne
* Retract the flaps and landing gear (if applicable) when a positive climb rate has been established
* Maintain takeoff power until **500ft** above surrounding obstacles or terrain
* 500ft gives some altitude to work with incase of engine or equipment failure
* Airspeed is controlled through pitch adjustments
* Reference your pitch with the natural horizon and then glance at the airspeed indicator and repeat this cross-check several times throughout the takeoff
* Plane will lag in airspeed gain to its own inertia or weight
* Climb pitch will be lower if air density is low or the plane is heavy
* After reaching the correct altitude and airspeed, reduce power and back pressure to prevent overshooting
* In solo practice the plane will takeoff differently because the instructors weight is not present

**Common Errors in Normal Takeoffs and Departure Climbs**

* Not reviewing the AFM for performance charts
* Not clearing the area prior to taxiing
* Abrupt use of throttle
* Failure to check instruments for malfunctions prior to takeoff
* Not anticipating left turning tendency
* Overcorrect the left turning tendency
* Using only the airspeed indicator instead of cross-checking visual references
* Bad lift-off attitude
* Poor compensation for torque and P-factor, causing side-slip
* Overcontrol of the elevator and no trim
* Limiting scan areas to only dead ahead and not glancing at the wings
* Not maintaining VY
* “Chasing” and airspeed

**Crosswind Takeoff**

* Crosswind takeoff employs similar techniques as crosswind taxiing

**Takeoff Roll**

* + Pilot must apply aileron pressure into the crosswind
  + Raise the aileron on the upwind wing to prevent the wing from raising
  + Rudder and ailerons increase drag and force a longer takeoff roll
  + Apply aileron pressure in the direction the crosswind is coming from
  + The plane tends to weathervane into the wind direction. Combined with P-Factor the plane will need extra rudder to correct this
  + As the plane gains air speed the aileron pressure should be reduced to prevent an unintended roll
  + Some aileron pressure should be maintained to prevent the upwind wing from raising before time and “skipping”
  + **Skipping:** A series of small bounces where the plane attempts to fly then settles back down to the runway
  + Aileron pressure also helps the plane side slip into the wing

**Lift-Off**

* + As the nose wheel rises maintain aileron pressure into the wind
  + The downwind wing and wheel will lift before the upwind on
  + **If crosswind is excessive, hold the landing gear on the ground for longer during the takeoff roll to ensure a definite lift-off**
  + AS the plane rises it will begin to drift with the wind because of no ground friction to prevent

**Initial Climb**

* + As the plane gains speed in the climb relax the aileron to prevent banking further into the wind
  + The upwind wing will tend to be lower than the other one requiring rudder pressure stay on course
  + **Crabbing:**  Using both the rudder and aileron to point the plane to a heading that counteracts wind and leads it along the runway direction

**Common Errors on Crosswind Takeoffs**

* + Not reviewing the AFM/POH performance charts
  + Failure to clear the area before taxi
  + Not using full aileron initially before takeoff roll
  + Not using outside visual cues for plane centering
  + Side skipping due to poor aileron use
  + Inadequate rudder
  + Excessive aileron during late takeoff/ early liftoff
  + Bad drift correction

**Ground Effect Takeoff:**

* This is a condition of improved performance when the plane less than one wing span away from the ground.