VI.B. Traffic Patterns

References: Airplane Flying Handbook (FAA-H-8083-3), Pilot's Handbook of Aeronautical Knowledge (FAA-H-8083-25), Traffic Advisory Practices at Airports without Operating Control Towers (AC 90-42 - cancelled), Traffic Patterns for Aeronautical Operations at Airports without Operating Control Towers (AC 90-66 - cancelled), AIM

Objectives	The student should develop knowledge of the elements related to the proper procedures, rules, and elements of the traffic pattern at both a controlled and uncontrolled field. The student will be able to demonstrate this knowledge as required in the ACS/PTS.
Key Elements	1. Entry Procedures 2. Communication 3. Orientation
Elements	1. The Pattern 2. Controlled Field 3. Uncontrolled Field 4. Orientation to the Runway 5. Maintaining Proper Spacing 6. Wind Shear and Wake Turbulence
Schedule	1. Discuss Objectives 2. Review material 3. Development 4. Conclusion
Equipment	1. White board and markers 2. References
IP's Actions	1. Discuss lesson objectives 2. Present Lecture 3. Ask and Answer Questions 4. Assign homework
SP's Actions	1. Participate in discussion 2. Take notes 3. Ask and respond to questions
Completion Standards	The student understands the rules and elements to a proper traffic pattern and is comfortable arriving and departing from a controlled or uncontrolled field.

Instructor Notes:

Introduction:

Attention

Interesting fact or attention-grabbing story

In order to depart or land at an airport we're going to have to use the traffic pattern, I guess it's pretty important, huh?

Overview

Review Objectives and Elements/Key ideas

What

Traffic Patterns involve the rules and procedures involved with flying a proper traffic pattern at a controlled and uncontrolled airport.

Why

Every flight begins and ends at an airport or other suitable landing area. For that reason, it is essential that the pilot learn the traffic rules, procedures, and pattern layouts that may be in use at various airports.

How:

1. The Pattern

A. Controlled - The pilot receives a clearance to approach/depart and pertinent pattern information

B. Uncontrolled - It's up to the pilot to determine traffic direction, and comply with the appropriate rules

C. If familiar with the basic rectangular pattern, approaches/departures will be easy at most airports

D. Standard Traffic Pattern

i. The Basics

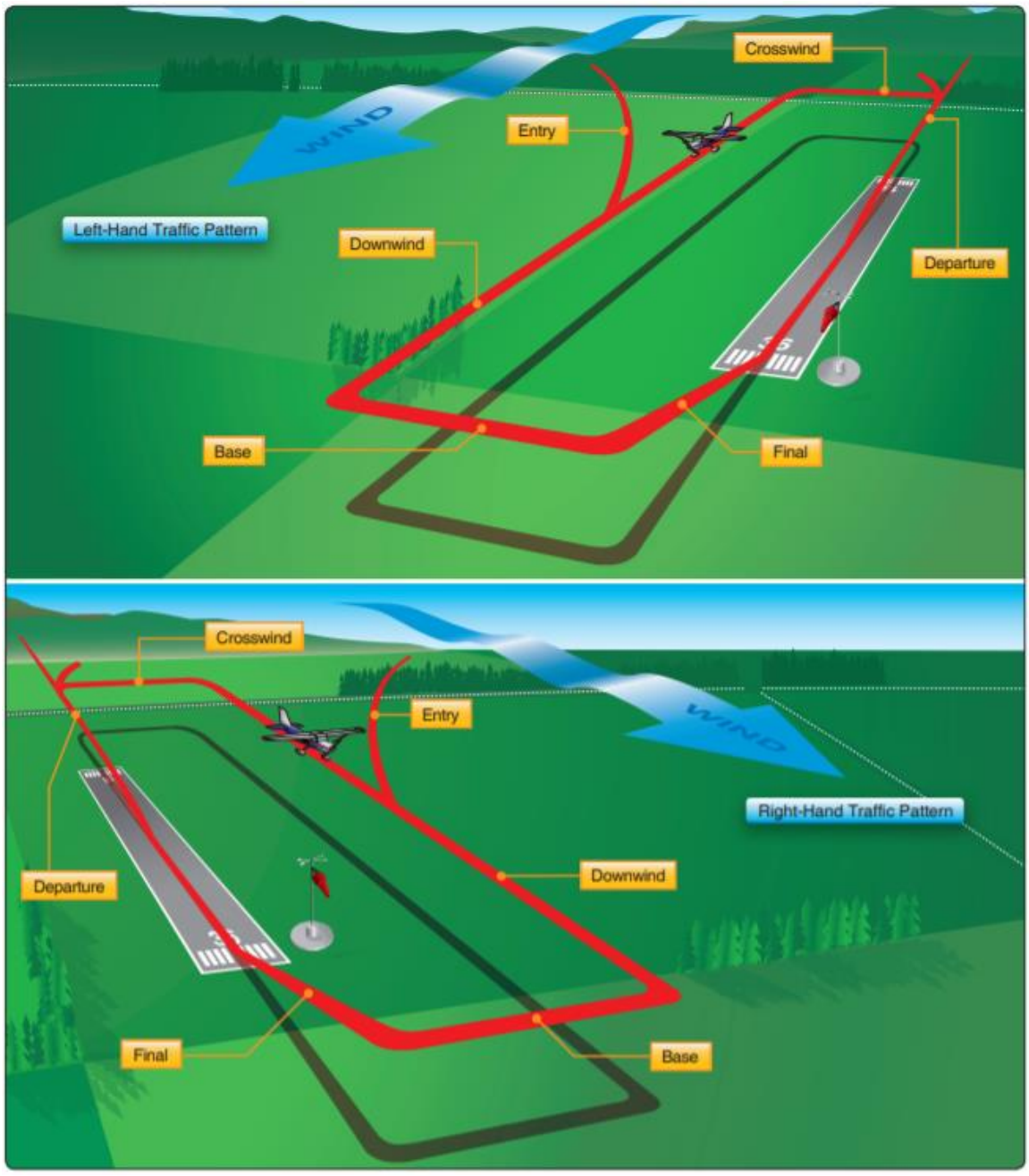
a. Pattern Altitude: Usually 1,000' AGL

- A common altitude is the key factor in minimizing collisions at uncontrolled airports
- The Chart Supplement will usually specify nonstandard pattern altitudes

b. Standard Traffic Patterns: Left Turns

- All turns are left unless otherwise noted (Chart Supplement, Tower Controller, Airport Markings, etc.)
- Turns should not be banked more than 30°
  - a Use rudder to maintain coordination; Do not use rudder to increase the rate of turn, this could result in a cross controlled stall

ii. Pattern Legs



a. Upwind Leg - The departure leg, flown parallel and in the same direction as runway heading
b. Crosswind Leg – The transition from the upwind leg to the downwind leg
   - Perpendicular to the upwind leg (90° turn)
   - Fly the crosswind leg to provide approximately ½ to 1-mile separation from the runway
c. Downwind Leg - Parallel to the runway of intended landing
   - The heading flown is opposite the landing runway
     a Ex: Landing runway 10, downwind heading is 280° (no wind)
   - Approximately ½ to 1 mile from the runway

- Before landing checks, and configuration (flaps, gear) are normally accomplished downwind
- Descent is normally started on the downwind leg when abeam the point of intended touchdown
- The downwind leg normally continues to a point 45° off the intended landing point, past the departure end of the runway
  - a The turn to the base leg is started at the end of the downwind leg
  - b This point can be adjusted as necessary based on circumstances
    1. Winds, other traffic, tower request, emergency situation, etc. can require adjustments

d. Base Leg - Perpendicular to the runway and the transition between downwind and final
- The ground track of the airplane should be perpendicular to the extended centerline
  - a Heading is 90° off the runway direction (with no wind)
- Continue the descent adjusting pitch and power as necessary to maintain airspeed, glideslope, and aim point
- Begin the turn to final in order to end up established on the extended centerline of the runway

e. Establishing Final Approach
- The base leg will be adjusted depending on wind conditions
  - a The stronger the wind, the closer the base leg should be to the runway because of the decreased groundspeed on final
    1. At a slower the groundspeed on final, it takes longer to reach the runway than it otherwise would, and therefore more altitude is lost in the descent
- The turn to final should be no closer than ¼ mile at an altitude appropriate for the glide slope selected
  - a A 3° glide slope is normal; a 3° glide slope means we descend 300’ every mile

f. Final - The final descent of the approach, aligned with the landing runway
- Adjust the turn from base in order to center the aircraft on the runway
- Crab into the wind in order to maintain ground track
- Adjust pitch and power as necessary to maintain airspeed, glideslope, and aim point
- Run through the Before Landing checklist again to ensure everything is complete, and ensure you have been cleared to land

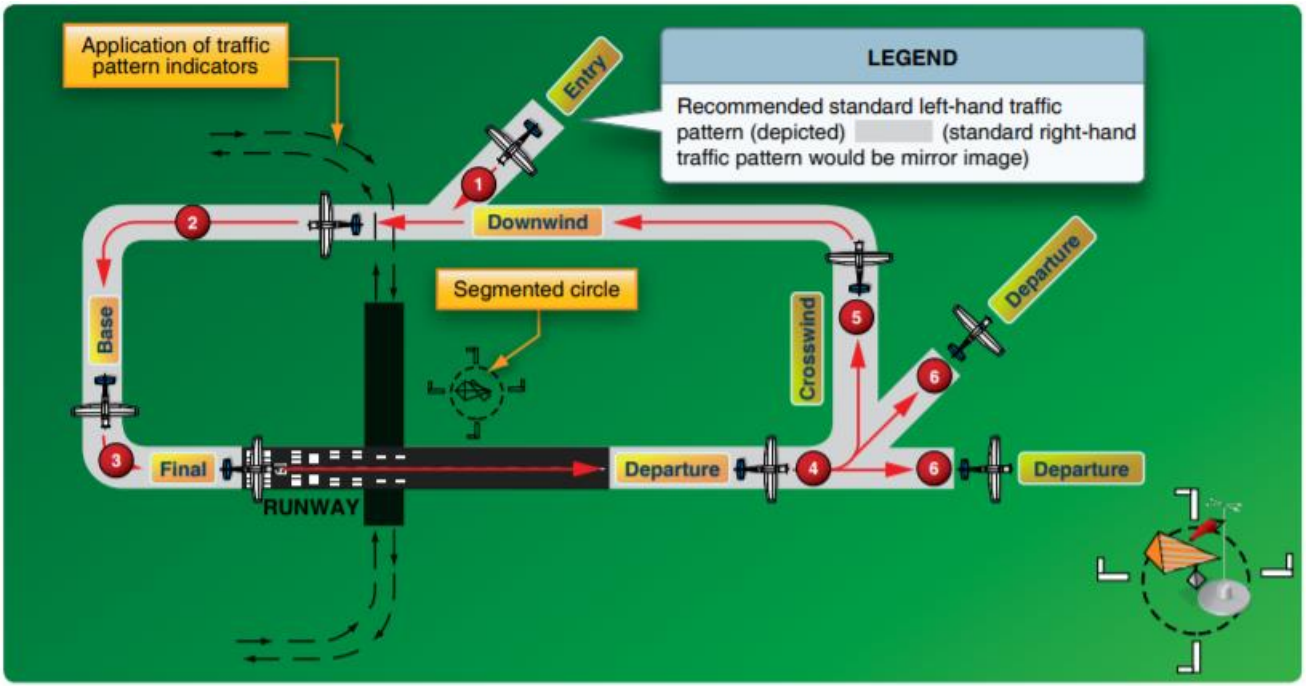
iii. Departing the Pattern
a. Climb out on the upwind leg
b. If remaining in the pattern, turn to the crosswind leg past the departure end of the runway and within 300’ of pattern altitude
c. If departing, continue straight out, or exit with a 45° turn to the left (or right, for a right pattern)

E. Maintaining the Desired Ground Track (on any leg in the pattern)
i. The goal is to fly a rectangular pattern regardless of the wind direction or speed
a. The airplane will have to be crabbed into the wind in order to maintain a straight ground track
b. Maintain awareness of the wind direction in relation to the aircraft, adjust heading as necessary to maintain ground track
ii. Visual references are very helpful in maintaining ground track
a. Upwind: Glance behind briefly to ensure you are maintaining the runway centerline

b. Crosswind: Use the runway as a reference; note and correct for any drift to or from the runway
c. Downwind: Place the runway centerline on a reference point on the airplane
    - EX: Place the runway centerline on the edge of a stall strip or outside the fuel cap (whatever reference works for your comfort, the aircraft, and the local pattern procedures)
d. Final: Maintain the centerline, crab as necessary to correct for the wind
e. Familiar airports may have well known references for the pattern
    - Ex: Turn base over a field, or road intersection
    - These are helpful for learning the pattern, but these specific references will not exist at other airports; be sure to teach references that can be carried from airport to airport

iii. Common Error - Poor altitude or airspeed control
a. Maintain a constant crosscheck
    - 90% outside, 10% inside
    - Verify pattern altitude, the appropriate airspeed, configuration, etc.
b. Know the configuration and speeds for each leg of the pattern
    - For example, 95 knots, level flight, takeoff flaps, and landing gear on downwind. 85 knot descent on base, 75 knots and fully configured on final
    - Max speed in Class D airspace is 200 KIAS
c. Use small, controlled inputs to fly the airplane
    - Small, smooth inputs allow for much more precise control than large, jerky movements
d. At slow speeds, close to the ground airspeed control is very important
    - A stall within 1,000’ AGL could be unrecoverable

iv. Common Error - Improper correction for wind drift
a. Keep the pattern a rectangle, crab into the wind as necessary
b. Use the heading bug, or make a mental note of the wind direction from the ATIS/ASOS and adjust heading as necessary to correct for the wind
c. Use visual references



F. Legend for the Picture Above
   i. 1. Enter pattern in level flight, abeam the midpoint of the runway, at pattern altitude (1,000' AGL is recommended pattern altitude unless otherwise published)
   ii. 2. Maintain pattern altitude until abeam approach end of the landing runway on downwind leg
   iii. 3. Complete the final turn at least ¼ mile from the runway
   iv. 4. Do no overshoot final or continue on a track that penetrates the final approach of the parallel runway
   v. 5. After takeoff or go-around, continue straight ahead until beyond departure end of runway
   vi. 6. If remaining in the traffic pattern, commence turn to crosswind leg beyond the departure end of the runway within 300' of pattern altitude
   vii. 7. If departing the traffic pattern, continue straight out, or exit with a 45o turn (to the left when in a left-hand traffic pattern; to the right when in a right-hand traffic pattern) beyond the departure end of the runway, after reaching pattern altitude
   viii. 8. Do not continue on a track that penetrates the departure path of the parallel runway

2. Controlled Field

A. The pilot receives, by radio, a clearance to approach/depart as well as pertinent information about the pattern
B. ATC will specify pattern entry and departure procedures (Where/how to enter and depart)
C. During the pattern the controller may make adjustments (speed, legs lengths, turns for spacing, etc.)
D. Common Error - Failure to comply with traffic pattern instructions, procedures, and rules
   i. Know the rules and ensure you understand radio communications and instructions
      a. If you're unsure ask!
   ii. The traffic pattern can be very busy – numerous radio calls, checklists, configuration changes, and other aircraft
      a. Listen closely to ATC instructions while accomplishing other tasks
         - Do not become distracted or fixated on one task, divide your attention

- Remember to fly first – aviate, navigate, communicate

iii. Clear aggressively

3. Uncontrolled Field

A. Communication

i. There are 2 ways to communicate intentions and obtain airport/traffic info at an uncontrolled field

a. Communicating with an FSS providing advisories

- The FSS provides wind info, runway in use, altimeter setting, known traffic, NOTAMs, etc.
  - a They are not a controller - the FSS just provides information for your use
- Inbound aircraft should initiate contact approximately 10 miles out with altitude, aircraft type, and location
- Departing aircraft should transmit their tail number, type of flight, destination, services desired, and anything else applicable

b. Self-announced broadcast on the CTAF (frequency is found in the Chart Supplement and on sectionals)

- Announce your position and intentions on the CTAF frequency
- Monitor other aircraft calls on CTAF and coordinate actions as necessary to avoid hazards

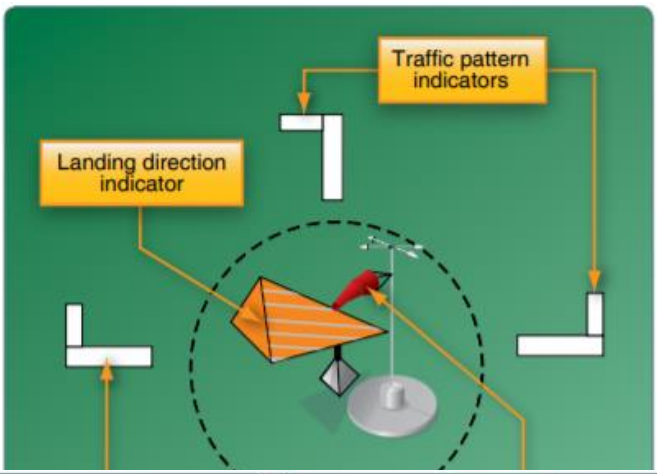
Facility at Airport	Frequency Use	Communication/Broadcast Procedures		
		Outbound	Inbound	Practice Instrument Approach
UNICOM (no tower or FSS)	Communicate with UNICOM station on published CTAF frequency (122.7, 122.8, 122.725, 122.975, or 123.0). If unable to contact UNICOM station, use self-announce procedures on CTAF.	Before taxiing and before taxiing on the runway for departure.	10 miles out. Entering downwind, base, and final. Leaving the runway.	
No tower, FSS, or UNICOM	Self-announce on MULTICOM frequency 122.9.	Before taxiing and before taxiing on the runway for departure.	10 miles out. Entering downwind, base, and final. Leaving the runway.	Departing final approach fix (name) or on final approach segment inbound.
No tower in operation, FSS open	Communicate with FSS on CTAF frequency.	Before taxiing and before taxiing on the runway for departure.	10 miles out. Entering downwind, base, and final. Leaving the runway.	Approach completed/terminated.
FSS closed (no tower)	Self-announce on CTAF.	Before taxiing and before taxiing on the runway for departure.	10 miles out. Entering downwind, base, and final. Leaving the runway.	
Tower or FSS not in operation	Self-announce on CTAF.	Before taxiing and before taxiing on the runway for departure.	10 miles out. Entering downwind, base, and final. Leaving the runway.	

B. Arriving

i. Observe other aircraft already in the pattern and conform to the traffic pattern in use

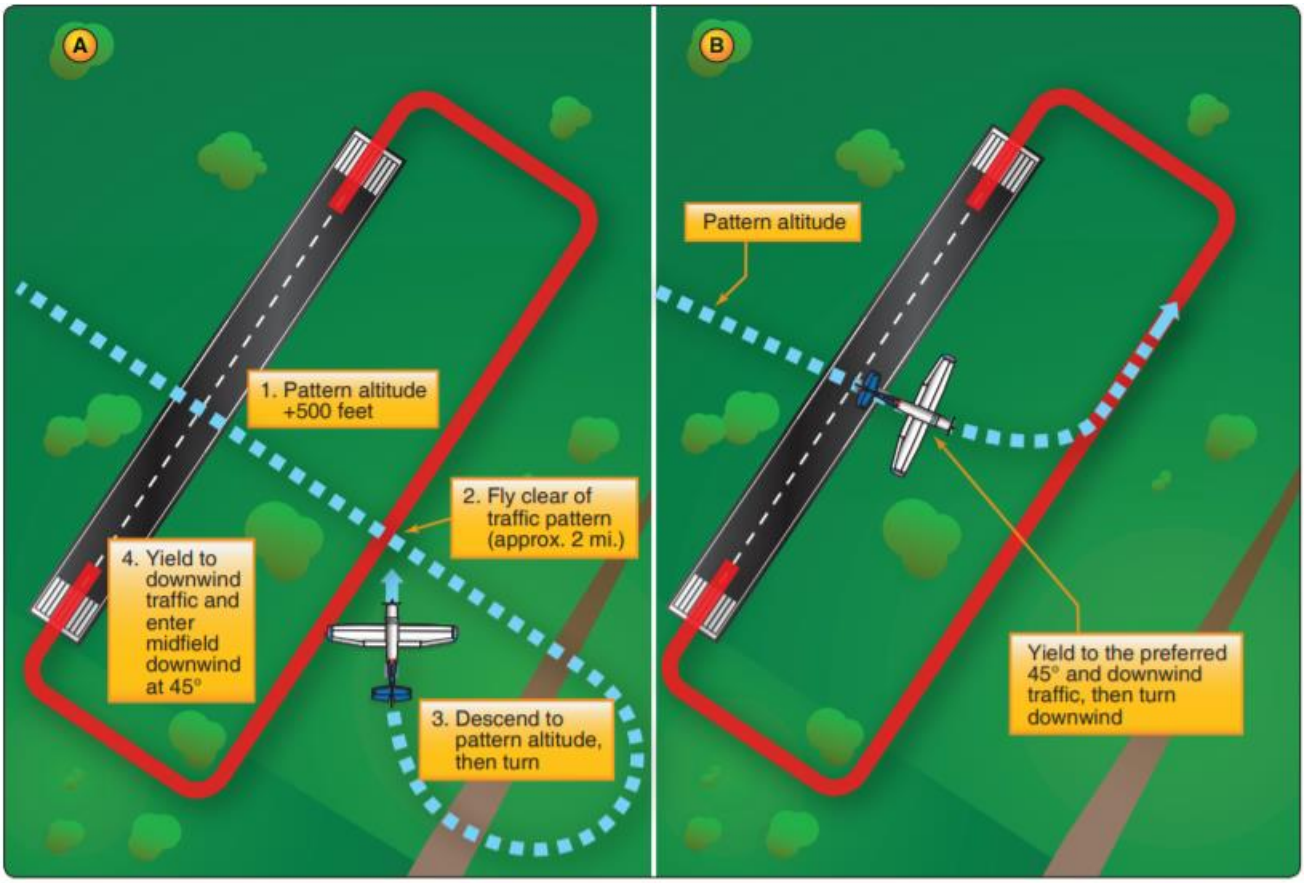
a. If other aircraft are not in the pattern, use traffic indicators and wind direction to determine the runway in use

- Look for L shaped indicators displayed with a segmented circle (the short part of the L shows the turn direction)
- Check these indicators well above pattern altitude (500' – 1,000' above pattern altitude)
- Pattern direction can also be determined in the Chart Supplement and on sectional charts



ii. When well clear of the pattern (approximately 2 miles), descend to pattern altitude
iii. Enter the pattern in level flight, at pattern altitude, at a 45° angle to the downwind leg, abeam the runway midpoint (preferred method, A - shown below)
   a. Entry while descending creates collision hazards and should be avoided
      - Since you cannot see below the cowling, you could unknowingly descend onto another aircraft in the pattern; always enter at pattern altitude and clear aggressively
   b. Adjust airspeed to blend into the traffic
      - Use airspeeds recommended by the manufacturer. Avoid flying too fast or too slow
      - Generally 70-80 knots for fixed-gear singles and 80-90 knots for high-performance retractable

c. Another method of entry, shown in in B below, is a midfield entry from the upwind leg side of the airport



C. Departing
   i. Monitor the radio for other traffic in the local area
   ii. Announce your intentions
   iii. Clear aggressively prior to takeoff and on departure
      a. Radio communication is not required at an uncontrolled field

D. Common Error - Failure to comply with traffic pattern instructions, procedures, and rules
   i. Know the rules and ensure you understand radio communications
      a. Follow the procedures established and in use at uncontrolled fields
   ii. The traffic pattern can be very busy – numerous radio calls, checklists, configuration changes, and other aircraft
      a. Listen closely to CTAF radio calls while accomplishing other tasks
         - Do not become distracted or fixated on one task, divide your attention
         - Remember to fly first – aviate, navigate, communicate
   iii. Clear aggressively, especially at uncontrolled airfields

4. Orientation to the Runway

A. Know which runway is in use and remain oriented with the runway
   i. Plan to enter properly visualizing your position in relation to the runway on the heading indicator
   ii. Confirm the runway number with the heading indicator during all pattern legs
      a. Downwind – reciprocal of the landing runway
      b. Base - 90° off (in the direction of the pattern)

c. Final – Same as the runway number

5. Maintaining Proper Spacing

A. Be aware of other aircraft in the pattern, as well as aircraft entering and exiting the pattern
   i. Use the tower/CTAF radio calls to build a mental image of the traffic around you and adjust to maintain separation
      a. At an uncontrolled field, announce your intentions
      b. At a controlled field, follow the controller's instructions and/or request permission to make a change
         - Ex: 360° turn on downwind, or an extended downwind to create space
   ii. As mentioned above, maintain airspeed to blend in with the other traffic
   iii. On downwind with another aircraft on final, delay the base turn until abeam/past the other aircraft
      a. This is a common technique to provide comfortable spacing at similar airspeeds
   iv. Adjust upwind as necessary to accommodate aircraft on downwind

B. The pilot is always responsible for seeing and avoiding whether at a controlled or uncontrolled field!

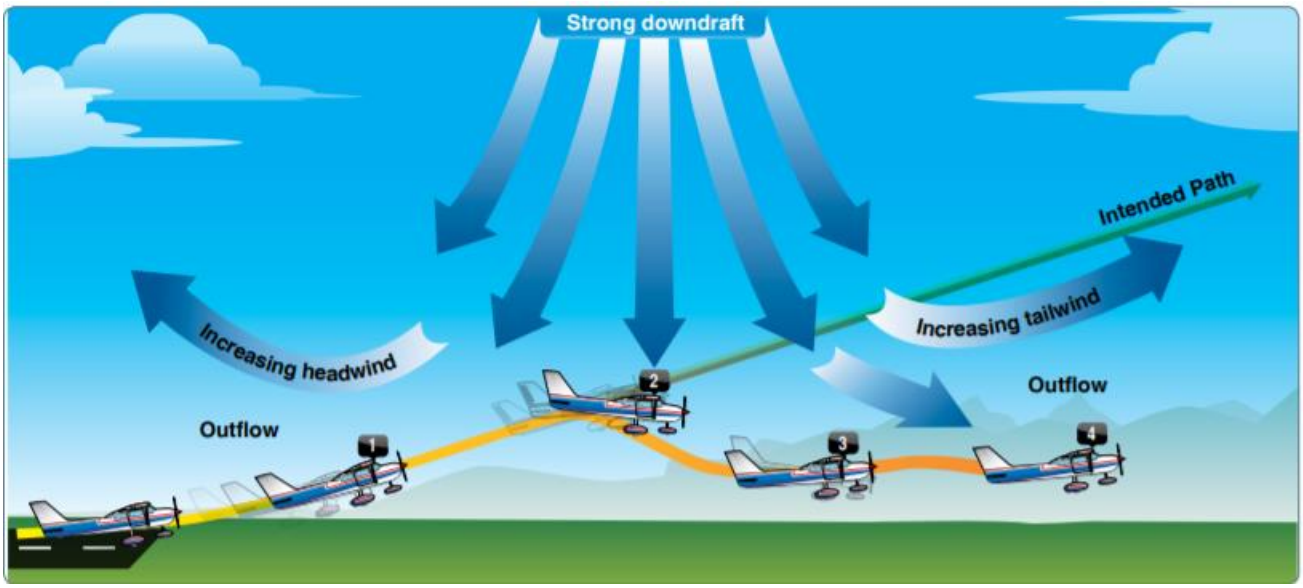
C. Common Error - Inadequate spacing from other traffic
   i. Don't fly faster than an airplane in-front of you, or turn too early following another plane
      a. Adjust your speed to blend in
      b. Wait until you are abeam the other aircraft before making your turn
   ii. Make adjustments if necessary
      a. Extend the downwind leg, configure and slow to final approach speed earlier than normal, use s-turns, etc.
      b. If absolutely necessary, depart the pattern and re-enter

6. Wind Shear and Wake Turbulence

A. Wind Shear
   i. What is it?
      a. A sudden, drastic change in wind speed and/or direction over a very small area
      b. While wind shear can occur at any altitude, low-level wind shear is especially hazardous due to the proximity to the ground
         - Low-level wind shear is commonly associated with passing frontal systems, thunderstorms, temperature inversions, and strong upper level winds (greater than 25 knots)
   ii. Why is it dangerous?
      a. Wind shear can subject an aircraft to violent updrafts and downdrafts, as well as abrupt changes to the horizontal movement of the aircraft
      b. It can rapidly change the performance of the aircraft and disrupt the normal flight attitude, for example:
         - A tailwind can quickly change to a headwind causing an increase in airspeed and performance
         - A headwind can quickly change to a tailwind causing a decrease in airspeed and performance
      c. Microbursts
         - The most severe type of wind shear
            a Associated with convective precipitation into dry air at cloud base
         - Typical Microburst
            a Horizontal diameter of 1-2 miles

b Depth of 1,000'
c Lifespan of 5-15 minutes
d Downdrafts of up to 6,000 feet per minute
e Headwind losses of 30-90 knots (seriously degraded performance)
f Strong turbulence and hazardous wind direction changes

- Flying through a Microburst
  a During an inadvertent takeoff into a microburst, the plane may first experience a performance-increasing headwind (1)
  b Followed by performance-decreasing downdrafts (2)
  c Followed by a rapidly increasing tailwind (3)
    1. This can result in terrain impact or flight dangerously close to the ground (4)
  d An encounter during approach involves the same sequence of wind changes and could force the plane to the ground short of the runway



- Indications
  a Visual
    1. Intense rain shaft at the surface, but virga at cloud base
    2. Ring of blowing dust
  b Alerting Systems
    1. The FAA has invested in substantial microburst accident prevention
    2. LLWAS-NE, TDWR, and ASR-9 WSP systems installed at major airports
       a. Very few false alerts, and detect microbursts well above 90% detection rate requirement established by congress
    3. Many airports, especially smaller airports, have no wind shear systems
       a. AC 00-54 – FAA Pilot Wind Shear Guide
          i. Includes information on how to recognize the risk of a microburst encounter, how to avoid an encounter, and the best strategy for escape
          ii. Tailored to jet aircraft, but still very useful information

iii. Handling Wind Shear
  a. If at all possible, avoid it

- Never conduct traffic pattern operations in close proximity to an active thunderstorm
  - a Be alert for visual cues and any alerting systems
  - b Do not takeoff if wind shear is in the area
- LLWAS (Low Level Wind Shear Alerting System)
  - a If available can warn of impending wind shear
- PIREPS
  - a Can be very informational/helpful if a pilot has reported wind shear in the area

b. Approach into Wind Shear

- Follow the POH procedures. If none, general wind shear techniques include:
  - a Higher power and a faster airspeed during approach
    1. Add ½ the gust factor to the approach speed
  - b Stay as high as feasible until necessary to descend
    1. Altitude is your friend
  - c Go around at the first sign of an unexpected pitch or airspeed change
    1. Important to get FULL power and get the airplane climbing
    2. If the aircraft is descending toward the ground, ensure max power, and increase the pitch attitude as far as possible without stalling the airplane
       a. The intent should be to keep the airplane flying as long as possible in hope of exiting the shear

B. Wake Turbulence

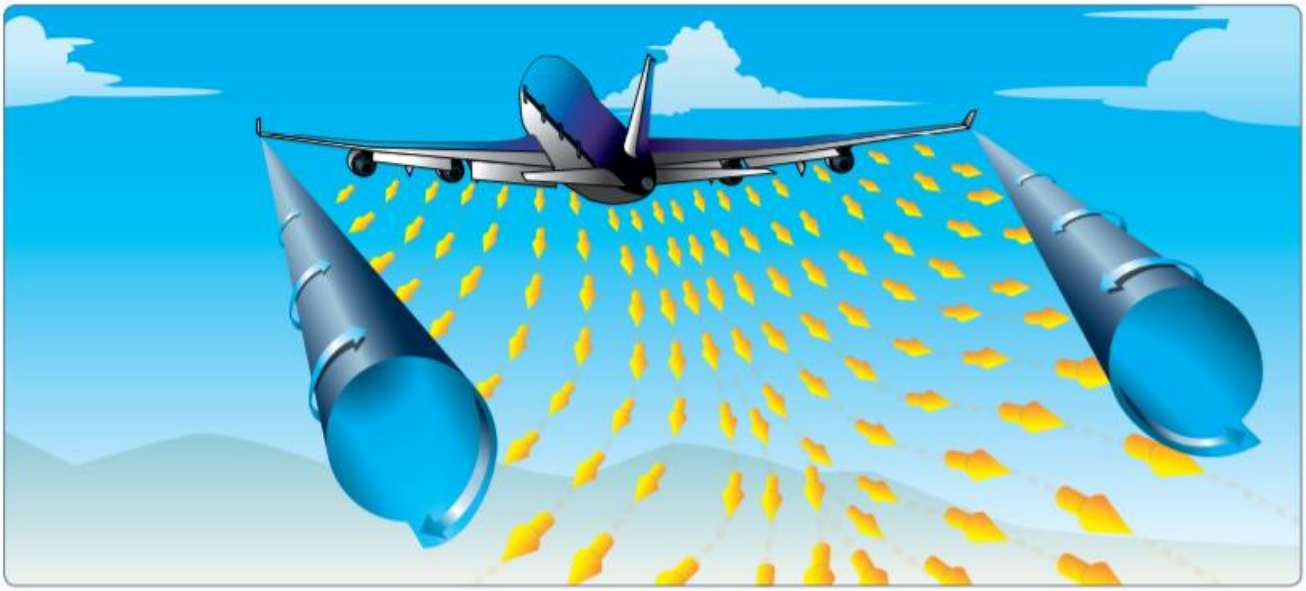
i. What is it?

a. Wake turbulence, or wingtip vortices, are the byproduct of lift

- The difference between the high pressure below the wing and low pressure above the wing causes the air move outward, upward and around the wingtips, leading to two counter rotating cylindrical vortices extending off the wingtips

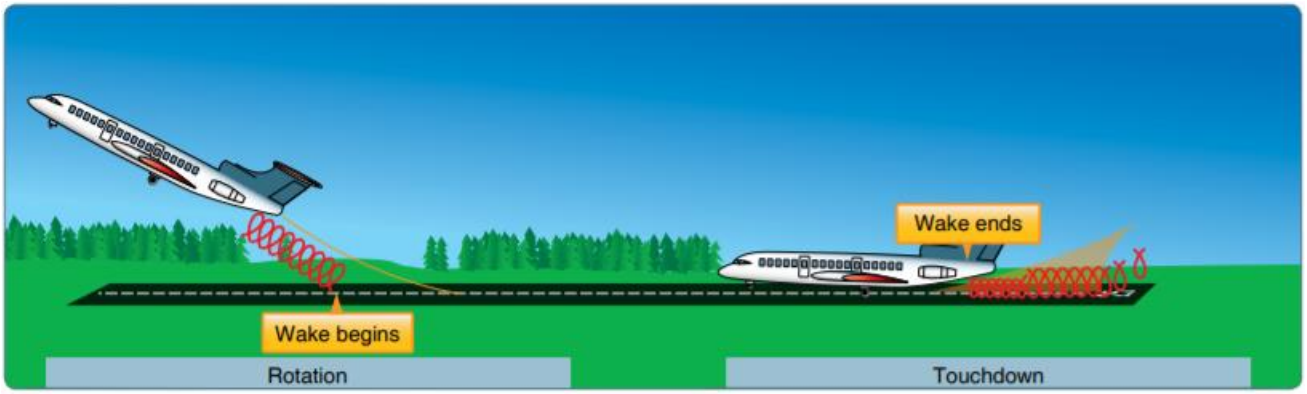
b. All aircraft generate wake turbulence during flight

- Generally, the larger the aircraft, the stronger the vortices
- Strength can vary
  - a Vortices are strongest when the pressure differential is the greatest, or when the aircraft is heavy, clean, and/or slow
    1. The turbulence from a “dirty” aircraft configuration actually accelerates the decay of the wake turbulence



i. Why is it dangerous?
   a. The rolling moments caused by the wake turbulence of a larger aircraft can be so strong that it exceeds the airplanes control authority
      - The rolling moments can be violent, and potentially unrecoverable
   b. If encountered at a close range, the turbulence generated by these vortices can damage aircraft components and equipment
   c. Wake turbulence can be encountered in any phase of flight
      - Although usually strongest during departure, aircraft generate vortices during cruise flight and on approach

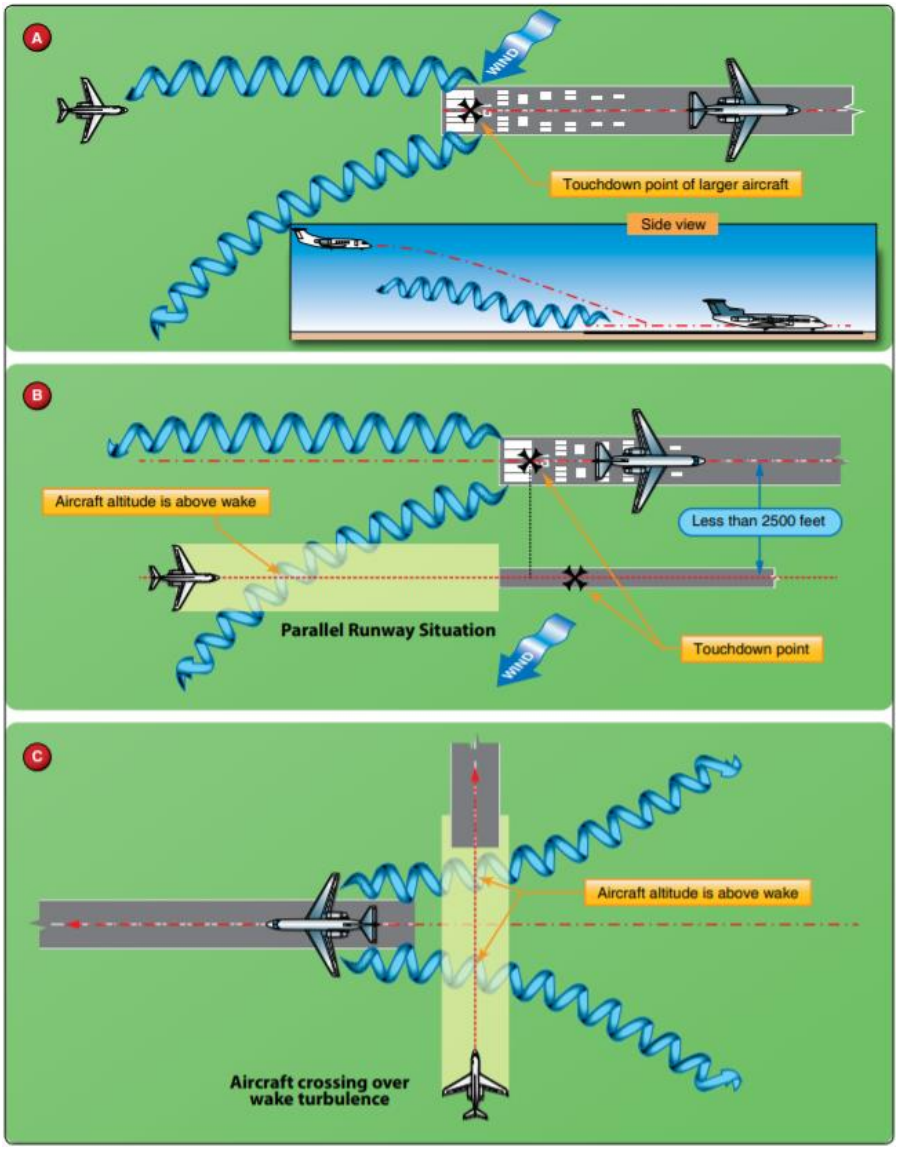
ii. Vortex Behavior



   a. Vortices are generated from the moment an aircraft leaves the ground, until it touches down
   b. Vortices tend to remain spaced a bit less than a wingspan apart, drifting with the wind, at altitudes greater than a wingspan above the ground
   c. Vortices tend to sink at a rate of several hundred feet per minute, slowing their descent and diminishing in strength over time
      - When the vortices of large aircraft sink close to the ground (100-200'), they tend to move laterally over the ground at a speed of 2-3 knots
        a A crosswind decreases the lateral movement of the upwind vortex and increases the movement of the downwind vortex

        b. A light quartering tailwind produces the worst scenario in which the wake vortices could be present along a significant portion of the final approach and extended centerline and not just in the touchdown zone as typically expected

iii. Avoidance Procedures
    a. Maintain adequate separation
    b. Approach
        - When behind a larger aircraft on the same runway— stay at or above the larger aircraft's approach flight path and land beyond its touchdown point
        - When behind a larger aircraft on a parallel runway closer than 2,500 feet—consider the possibility of drift and stay at or above the larger aircraft's final approach flight path and note its touchdown point (Figure B)
    c. Landing
        - When landing behind a departing aircraft on the same runway—land prior to the departing aircraft's rotating point
            a. Land beyond an arriving jet's touchdown point
        - When landing behind a larger aircraft on a crossing runway— cross above the larger aircraft's flight path (Figure A)
        - When landing behind a larger aircraft on a crossing runway—note the aircraft's rotation point and, if that point is past the intersection, continue and land prior to the intersection (Figure C)
            a. If the larger aircraft rotates prior to the intersection, avoid flight below its flight path Abandon the approach unless a landing is ensured well before reaching the intersection
        - When landing after a large aircraft executing a low approach, missed approach, or touch-and-go landing, it is prudent to wait at least 2 minutes prior to a takeoff or landing
            a. This is because vortices settle and move laterally near the ground, the vortex hazard may exist along the runway and in the flight path, particularly in a quartering tailwind
    d. Departing
        - When departing behind a large aircraft – rotate prior to the large aircraft's rotation point and climb above its climb path until turning clear of the wake
        - For intersection takeoffs on the same runway – be alert to adjacent larger aircraft operations, particularly upwind of the runway of intended use. If an intersection takeoff clearance is received, avoid headings that cross below the larger aircraft's path
        - When departing after a large aircraft executing a low approach, missed approach, or touch-and-go landing, it is prudent to wait at least 2 minutes prior to a takeoff or landing
            a. This is because vortices settle and move laterally near the ground, the vortex hazard may exist along the runway and in the flight path, particularly in a quartering tailwind



Common Errors:

- Failure to comply with traffic pattern instructions, procedures, and rules
- Improper correction for wind drift
- Inadequate spacing from other traffic
- Poor altitude or airspeed control

Conclusion:
Brief review of the main points
Every flight begins and ends at an airport or other suitable landing area, making patterns very important.

PTS Requirements:

To determine that the applicant:

1. Exhibits instructional knowledge of the elements of traffic patterns by describing:
   a. Operations at airports and seaplane bases with and without operating control towers.
   b. Adherence to traffic pattern procedures, instructions, and rules.

   c. How to maintain proper spacing from other traffic.
   d. How to maintain the desired ground track.
   e. Wind shear and wake turbulence avoidance procedures.
   f. Orientation with the runway or landing area in use.
   g. How to establish a final approach at an appropriate distance from the runway or landing area.
   h. Use of checklist.
2. Exhibits instructional knowledge of common errors related to traffic patterns by describing:
   a. Failure to comply with traffic pattern instructions, procedures, and rules.
   b. Improper correction for wind drift.
   c. Inadequate spacing from other traffic.
   d. Poor altitude or airspeed control.
3. Demonstrates and simultaneously explains traffic patterns from an instructional standpoint.
4. Analyzes and corrects simulated common errors related to traffic patterns.