Nicoletta Fala
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X.C. Turns Around a Point

Objectives	The student should develop knowledge of the elements related to turns around a point as necessary in the Private Pilot ACS.
Key Elements	✈ Increased airspeed = increased bank ✈ Decreased airspeed = decreased bank ✈ Coordination
Elements	✈ Selecting a suitable altitude ✈ Selecting a suitable reference line ✈ Prior to entry ✈ Entry procedure ✈ Wind drift correction ✈ Division of attention ✈ Exit ✈ General rules
Schedule	1. Discuss objectives 2. Review material 3. Development 4. Conclusion
Equipment	✈ White board ✈ Markers ✈ References
Instructor's Actions	1. Discuss lesson objectives 2. Present lecture 3. Questions 4. Homework
Student's Actions	Participate in discussion Take notes
Completion Standards	The student understands the effects of wind on maintaining an equal radius around a reference point, and is able to make the necessary adjustments throughout the turns due to the airplane's changing position in relation to the wind.
References	FAA-H-8083-3B, *Airplane Flying Handbook* (Chapter 6)

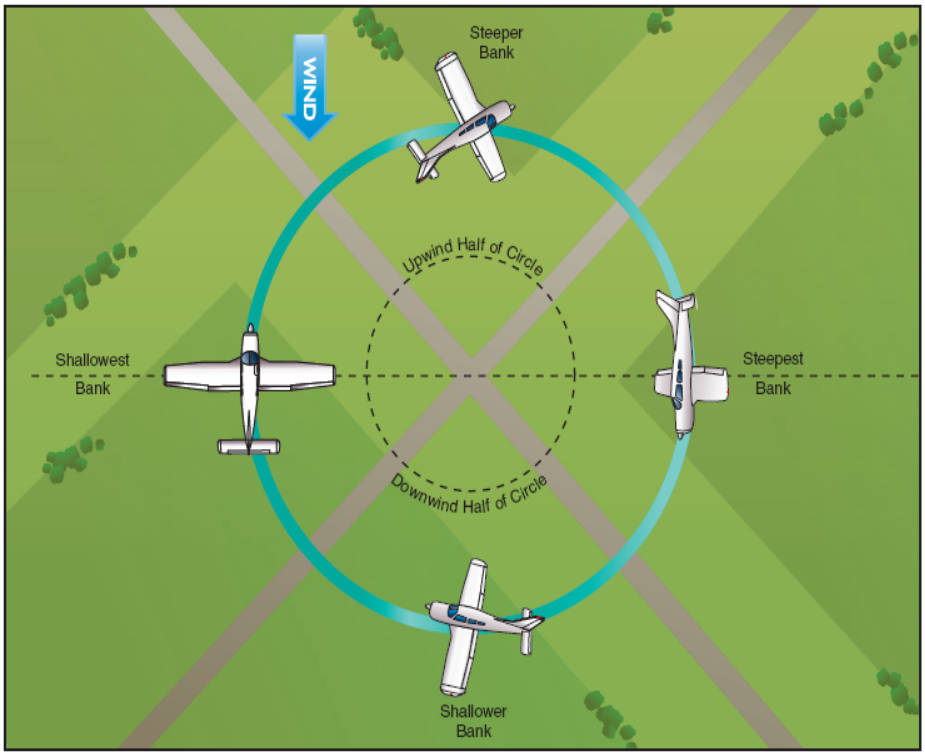
Instructor Notes

Introduction	Overview—review objectives and key ideas. What—the airplane is flown in a circle of uniform radius or distance from a prominent ground reference point using a maximum bank of approximately 45° while maintaining a constant altitude. Why—to develop division of attention between the flight path and ground references, develop recognition of drift towards or away from a prominent ground reference point while maintaining a constant altitude, and to perfect the turning technique and ability to correct for wind drift while in turns.
Selecting a suitable altitude	Entry altitude should be 600-1000' AGL. Maneuver restrictions are ±100'. At 600' AGL, there is no room for error below, and at 1,000' AGL, there is no room for error above—800' AGL is a good altitude for the maneuver.
Selecting a suitable reference point	The point should be prominent and easily distinguishable, but small enough to offer precise reference. Good examples are isolated trees, crossroads, intersections. Ponds are too big to use. References should be clear of populated areas, obstructions, and anything that could pose a hazard. The reference should allow for a nearby emergency landing area within gliding distance. CE—selection of a reference point with no suitable emergency landing area within gliding distance.
Prior to entry	✈ Pre-maneuver checklist: Lights ON; Fuel Pump ON; Mixture FULL RICH; Gauges GREEN ✈ Clearing turns ✈ Airspeed: trim for hands of level flight at V_A prior to entry
Entry procedure	Determine the direction of the wind by observing smoke or water, interpolating between the surface wind and forecast winds aloft, or flying a wind drift circle—a constant rate turn while watching a point, noting the movement of the airplane in relation to it. Position the aircraft to enter on the downwind (with a tailwind). Abeam the point, be on a 0.25-0.5 mile radius from the point. Note the entry heading and use it throughout the maneuver to maintain orientation and help in planning. CE—faulty entry procedure.
Wind drift correction	Once abeam the point, initiate a coordinated roll in, maintaining the constant radius reference with a steep bank angle up to 45°.

Initially, steepest bank angle is necessary due to the direct tailwind/highest groundspeed. Faster groundspeed = steeper bank angle to maintain the desired turning radius; slower groundspeed = shallower bank angle.

First half of the turn—downwind half: starts with the steepest bank; ends at the shallowest bank. As the turn progresses, the aircraft will slowly be turning to more of a headwind, getting slower. Gradually reduce the bank angle to maintain the constant turning radius. Reduced bank angle = less back pressure required to maintain altitude.
CE—failure to maintain selected altitude and airspeed.
Keep the turn coordinated—as the bank angle is reduced, required rudder pressure will also reduce.
CE—uncoordinated flight control application.
Progressively point the nose into the wind (crab) to maintain the constant ground track. On downwind, the nose is turned toward the inside.
CE—improper correction of wind drift.
At the end of the first half of the turn, the bank angle should be at its most shallow point, since the aircraft is in a direct headwind and at its lowest groundspeed.

Second half of the turn—upwind half: opposite of the first half—slowly move from a shallow to a steep bank. As the turn progresses, the aircraft will be slowly turning back into the original tailwind, increasing its groundspeed, and needing an increased bank to maintain the constant turning radius. As the bank angle is increased, more back pressure is needed to maintain altitude.
CE—failure to maintain selected altitude and airspeed.
Stay coordinated—as back pressure is increased, rudder pressure will need to increase.
CE—uncoordinated flight controlled application.
Progressively point the nose into the wind (crab) to maintain a constant ground track. Upwind, the nose is turned towards the outside.
CE—improper correction of wind drift.
At the end of the second half of the turn, the bank angle should be returned to the original entry bank angle.



Division of attention

Maintain the outside reference by looking ahead of the aircraft's position and planning the entire turn.
CE—poor planning, orientation.
Divide attention inside/outside the cockpit with quick glances to verify altitude, airspeed, and bank angle. Scan for traffic while maintaining focus on the maneuver. Use the time when the bank is shallower as an opportunity to check for other traffic.
CE—poor division of attention

Exit

At least two turns should be completed before exit.
Initiate a smooth rollout on the initial entry heading.

General rules

The stronger the wind, the more the bank angle will have to be varied throughout the maneuver. The maximum bank angle should be 45° at the steepest point. Theoretically, if there were no wind, bank angle would be constant, as there is no wind to correct for.
The steeper the bank, the more back pressure is required to maintain altitude.
It is helpful to pick out targets along the flight path to maintain the circle and ensure the plane is in the right place at the right time.

Equations

$$Rate\ of\ turn = 1091 \times \frac{\tan(bank\ angle)}{velocity}\ \text{[degrees per second]}$$

$$Radius\ of\ turn = \frac{v^2}{11.26\ \tan(bank\ angle)}\ \text{[feet]}$$

Common errors

- Faulty entry procedure
- Poor planning, orientation, or division of attention
- Uncoordinated flight control application
- Improper correction for wind drift
- Failure to maintain selected altitude or airspeed
- Selection of a ground reference line without a suitable emergency landing area in gliding distance

Conclusion

Brief review of main points.
Bank is constantly changing to track a constant radius turn at each point on the circle, as the airplane's position relative to the wind is changing.

CFI PTS

Objective: To determine that the applicant:

1. Exhibits instructional knowledge of the elements of turns around a point by describing:
a. The purpose of turns around a point and their relationship to basic/advanced airmanship skills.
b. How to select a suitable altitude.
c. How to select a suitable ground reference line with consideration given to emergency landing areas.
d. Orientation, division of attention, and planning.
e. Configuration and airspeed prior to entry.
f. Entry procedure.
g. Wind drifts correction.
h. How to maintain desired altitude and airspeed from reference point.
i. Coordination of flight controls.

2. Exhibits instructional knowledge of common errors related to turns around a point by describing:
a. Faulty entry procedure.
b. Poor planning, orientation, or division of attention.
c. Uncoordinated use of flight controls.
d. Improper correction for wind drift.
e. Failure to maintain selected altitude or airspeed.
f. Selection of a ground reference line where there is no suitable emergency landing area within gliding distance.

3. Demonstrates and simultaneously explains turns around a point from an instructional standpoint.
4. Analyzes and corrects simulated common errors related to turns around a point.

PPL ACS

Objective: To determine that the applicant:

1. Exhibits knowledge of the elements related to turns around a point.
2. Selects a suitable ground reference point.
3. Plans the maneuver so as to enter left or right at 600 to 1,000 feet (180 to 300 meters) AGL, at an appropriate distance from the reference point.
4. Applies adequate wind-drift correction to track a constant radius turn around the selected reference point.
5. Divides attention between airplane control and the ground track while maintaining coordinated flight.
6. Maintains altitude, ±100 feet (30 meters); maintains airspeed, ±10 knots.
7. Maintains altitude, ±100 feet (30 meters); maintains airspeed, ±10 knots.