

Flight Lesson: Basic Ground Reference Maneuvers

Objectives:

1. To understand the concepts and reasons of maneuvering by reference to the ground.
2. To be able to perform the three maneuvers required for the Private Pilot check ride.
3. Develops student's wind awareness
4. Develops the student's confidence maneuvering low to the ground
5. Develops the student's ability to fly precisely and accurately

Justification:

1. Airplanes are affected by wind
2. Traffic patterns and approaches are essential precise ground reference maneuvers
3. Required for Private Pilot check ride¹

Schedule:

Activity	Est. Time
Ground	0.75
Preflight/Taxi	0.25
Flight	1.25
Debrief	0.25
Total	2.50

Recommended Readings:

AFH	Ch 6: 6-1 to 6-9
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Elements Ground:

- ground reference maneuvers overview
- rectangular course
- turns around a point
- s-turns

Elements Air:

- rectangular course (optional)
- turns around a point
- s-turns

Completion Standards:

1. student understands the elements relating of ground references maneuvers
2. student is able to correct properly for wind and understands the importance of wind correction
3. student can consistently fly each of the three ground reference maneuvers with minimal assistance

Common Errors:

- failure to clear area
- failure to establish proper altitude prior to entry
- failure to establish appropriate wind correction
- gaining or losing altitude
- poor coordination
- abrupt control changes
- inability to divide attention between airplane control and maintaining ground track
- inadequate visual lookout for other aircraft

¹ PP PTS; AoO: VI. Ground Reference Maneuvers;

Presentation Ground:

Ground Reference Maneuvers (general)

1. :Maneuvers which are performed by reference to the track of the airplane over the ground while applying wind drift correction as needed by varying bank angle and/or heading to follow the predetermined track over the ground.
2. River analogy
 - (1) boat across still river
 - (2) boat across swift river w/o correction
 - (3) boat across swift river w/correction
3. Equivalent to airplane along a road
 - (1) airplane along road, no wind
 - (2) airplane along road w/wind w/o correction
 - (3) airplane along road w/wind, w/correction
4. The correction we use is called a Wind Correction Angle (WCA)
 - (1) *the acute angle difference between the ground track and the airplane heading*
 - (2) i.e., the angle that must be held into the wind to keep an aircraft on the desired ground track
5. Effects of wind during a turn
 - (1) 180° turn across a road with/without wind
 - (2) 360° turn along a road with various wind directions
6. Considerations for determining location
 - (1) good emergency landing area
 - (2) away from obstructions and congested areas
7. How do we determine wind conditions? why?
 - (1) Smoke, dust, local wind conditions, wind lines over water (foam parallels wind)
 - (2) determine wind condition to be able to enter downwind, and have our fastest GS, and thus steepest bank (max 45°) at outset of maneuver. this guarantees that all other banks will be less than 45°.
 - (3) a thing to note: wind at the surface can be as much as 30° different than winds at altitude due to surface friction.

PTS Standards			
initial altitude	600-1000 ft	initial airspeed	cruise
Δ altitude	±100 ft	Δ airspeed	±10 kts

Rectangular Course²

1. : Flying a rectangular pattern at constant altitude and constant airspeed around the edge of a field, allowing for wind effects
 - (1) altitude: 600-1000 AGL
 - (2) field (or road pattern) should have approximately 1 mile sides

² PP PTS; AoO VI; Task A;

- (3) flight should be done about $\frac{1}{2}$ to $\frac{1}{4}$ mile from the boundary
 - i. allows for good vision
 - ii. keeps bank angles reasonable - typically 30° (45° max as per PTS)

2. Configuration

- (1) airspeed - cruise
- (2) power - set
- (3) flaps - up

3. Procedure

- (1) clear the area! (maintain visual lookout throughout maneuver)
- (2) start downwind (or as close as possible)
 - i. since flying at highest GS, maximum bank will be required initially
 - ii. as GS slows, *decrease* bank to a medium bank to remain consistent distance from boundary
 - iii. the turn will be greater than 90° because of wind.
- (3) on crosswind
 - i. airspeed should be the same, GS should be slower
 - ii. establish WCA into the wind as necessary to keep a ground track parallel to the boundary
 - iii. ensure coordination
 - iv. since flying at a medium GS, bank will be medium initially
 - v. as plane turns up (and GS goes down) *decrease* bank to shallow to maintain constant distance from the boundary
 - vi. the turn will be less than 90° because of wind.
- (4) on upwind
 - i. airspeed should remain constant, GS will be slowest
 - ii. if square pattern, this leg will be longest (time-wise)
 - iii. since GS is slowest, bank will be shallow initially
 - iv. as GS picks up, *increase* bank to medium bank to maintain const dist from boundary
 - v. the turn will be less than 90° because of wind.
- (5) on crosswind
 - i. airspeed should remain constant, GS should be medium
 - ii. establish WCA into the wind as necessary
 - iii. since GS is medium, bank should initially be medium
 - iv. as GS picks up, *increase* bank to steep to maintain constant distance from the boundary
 - v. the turn will be greater than 90° because of wind.

Turns around a Point³

- 1. : *two or more complete circles of uniform radii or distance from a prominent ground reference point using a maximum bank of approximately 45° , while maintaining a constant altitude⁴*
- (1) altitude: 600 to 1000 AGL

³ PP PTS; AoO VI; Task C

⁴ ref. FAA-H-80803-3A: 6-6

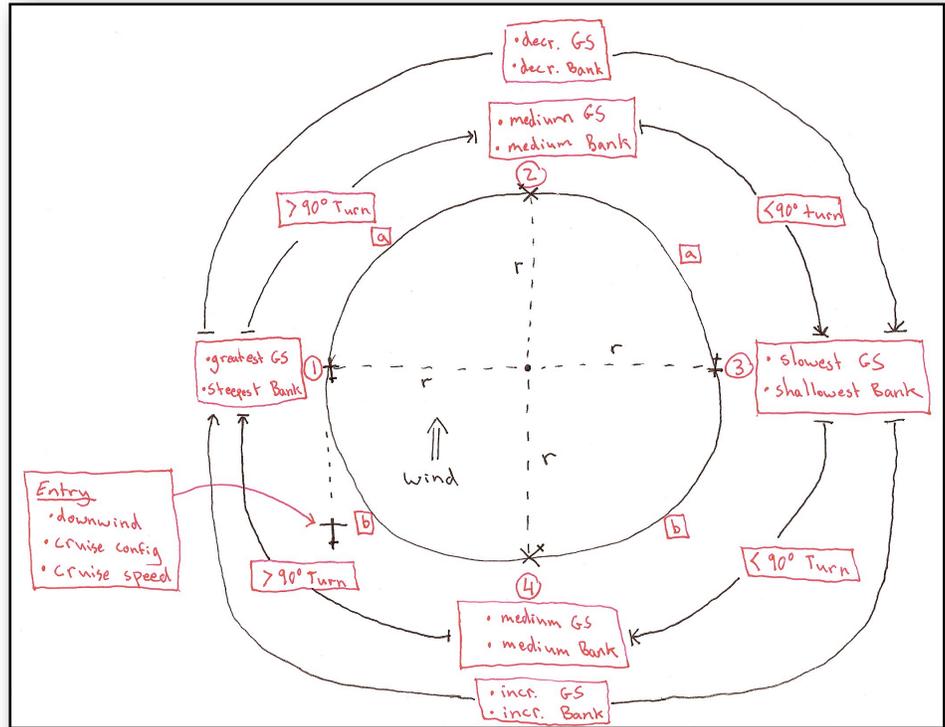
- (2) unless no wind, bank angle will constantly be changing to correct for different GS
- (3) Fastest GS = Steepest bank angle
- (4) distance away from point should be around 1/3 mile
- (5) due to non-exact wind estimate, 1st turn will probably not be perfect.

2. **configuration**

- (1) airspeed - cruise
- (2) power - set
- (3) flaps - up

3. **procedure**

- (1) select a suitable ground reference point
 - i. crossroads, isolated clump of trees, etc.
- (2) clear area! (maintain visual lookout throughout maneuver)
- (3) select rollout point (typically 720° from entry)
- (4) enter the maneuver downwind
- (5) abeam point, commence turn - **MAX 45°**
- (6) from downwind to upwind, gradually decrease your bank angle



- i. monitor ground track and maintain bank as necessary.

- (7) from upwind to downwind, gradually *increase* your bank angle

- i. monitor ground track and maintain bank as necessary.

- (8) rollout on proper heading (downwind) using appropriate lead

4. procedure applies similarly in both directions although view will be different

S-Turns⁵

1.: A series of 180° turns across a road (or a line of features) in which the airplane's ground track describes semicircles of equal radii on each side of the selected straight line.⁶

- (1) altitude: 600 to 1000 ft AGL
- (2) selected straight line should have at least a 1 mile length

2. **configuration**

- (1) airspeed - cruise

⁵ PP PTS; AoO VI; Task B

⁶ ref. FAA-H-80803-3A: 6-6

(2) power - set

(3) flaps - up

3. procedure

(1) select suitable area

i. straight road,
railway, other line
feature that lies
crosswind

ii. note: emergency
landing would be
90° to road

(2) clear area!

(3) approach the line
from the upwind
side so that initial
bank will be
steepest

i. max 45°

(4) above line, commence steepest bank (time so steepest bank is entered right at line)

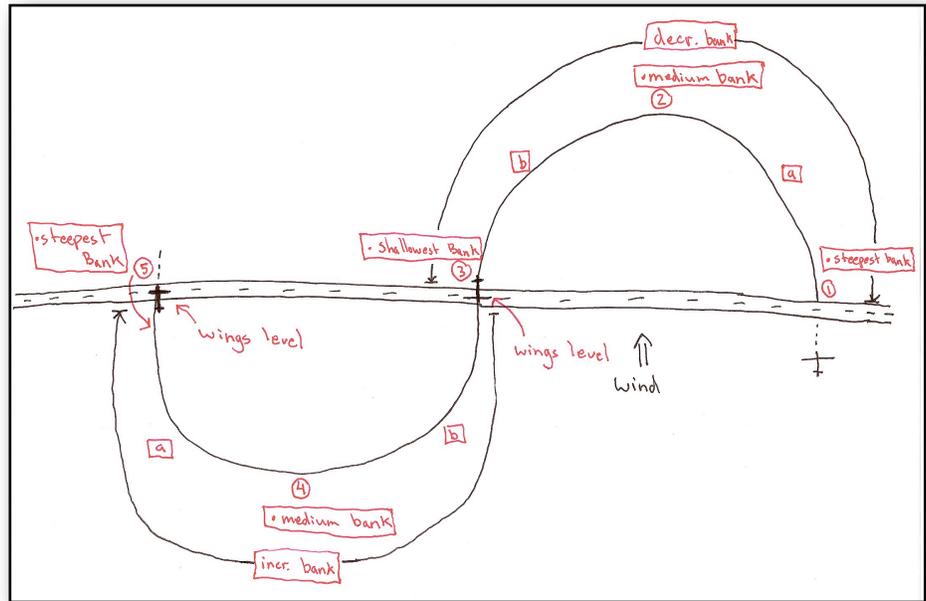
(5) gradually decrease bank as you turn upwind

(6) level wings when crossing the line

(7) apply shallow bank in opposite direction

(8) as plane turns downwind, gradually increase bank angle

(9) roll out when 4 half turns are complete



Presentation Air:

1. Rectangular Course (optional)

(1) already proficient because of traffic pattern

(2) practice in both directions if needed

2. Turns around a point

(1) practice in both directions

(2) practice throughout lesson and future lessons to assure proper proficiency for check ride

3. S-Turns across a road

(1) find suitable road and practice in both directions

(2) also continue practicing for check ride.