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 ride

Schedule:
<table>
<thead>
<tr>
<th>Activity</th>
<th>Est. Time</th>
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<tbody>
<tr>
<td>Ground</td>
<td>0.75</td>
</tr>
<tr>
<td>Preflight/Taxi</td>
<td>0.25</td>
</tr>
<tr>
<td>Flight</td>
<td>1.25</td>
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<tr>
<td>Debrief</td>
<td>0.25</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>2.50</strong></td>
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Recommended Readings:
<table>
<thead>
<tr>
<th>Activity</th>
<th>Est. Time</th>
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<tr>
<td>AFH Ch 6: 6-1 to 6-9</td>
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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.

<table>
<thead>
<tr>
<th>PTS Standards</th>
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<tr>
<td><strong>initial altitude</strong></td>
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<tr>
<td><strong>Δ altitude</strong></td>
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</table>

Rectangular Course

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

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2 PP PTS; AoO VI; Task A;
飞行应该在距离边界约1/2到1/4英里处进行。
1. 允许良好的视野。
2. 保持合适的坡度角度，通常为30°（45°最大，根据PTS）。

2. **配置**
   1. 空速 - 巡航
   2. 功率 - 设定
   3. 襟翼 - 提起

3. **程序**
   1. 清除该区域！（在整个机动过程中保持视觉瞭望）
   2. 开始逆风飞行（或尽可能接近逆风方向）。
      1. 由于以最高的GS飞行，初始将需要最大的坡度。
      2. 当GS变慢时，**减少**坡度到中等坡度以保持与边界的一致距离。
      3. 由于风向，转弯角度将大于90°。
   3. 在侧风条件下。
      1. 空速应保持不变，GS应较慢。
      2. 根据需要，将风角建立到迎风方向，以保持与边界平行的地面轨迹。
      3. 确保协调。
      4. 由于以中等GS飞行，初始坡度将为中等。
      5. 当飞机向上转弯（GS下降）时，**减少**坡度到较浅的坡度以保持与边界的恒定距离。
      6. 转弯角度将小于90°。
   4. 在上风条件下。
      1. 空速应保持不变，GS将是最快的。
      2. 如果是方形图案，此阶段将是最长的（按时间计算）。
      3. 由于GS最慢，初始坡度将为较浅的坡度。
      4. 当GS拾起时，**增加**坡度到中等坡度以保持与边界的恒定距离。
      5. 转弯角度将小于90°。

4. **转弯绕点**
   1. 两个或更多的完全圆的均匀半径或距离从一个显眼的地面参考点。
   2. 使用约45°的最大坡度，同时保持恒定的**高度**。
   3. 高度：600到1000AGL

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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 $\frac{1}{2}$ 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-Turns
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.

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

2. configuration
   (1) airspeed - cruise

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5 PP PTS; AoO VI; Task B
6 ref. FAA-H-80803-3A: 6-6
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.