

VI. AREA OF OPERATION: GROUND REFERENCE MANEUVERS

One TASK.

A. TASK: RECTANGULAR COURSE

1. Exhibits knowledge of the elements related to a rectangular course.
2. Selects a suitable reference area.
3. Plans the maneuver so as to enter a left or right pattern, 600 to 1,000 feet AGL (180 to 300 meters) at an appropriate distance from the selected reference area, 45° to the downwind leg.
4. Applies adequate wind-drift correction during straight-and-turning flight to maintain a constant ground track around the rectangular reference area.
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.



RECTANGULAR COURSE

Normally, the first ground reference maneuver the pilot is introduced to is the rectangular course. [Figure 6-4] The rectangular course is a training maneuver in which the ground track of the airplane is equidistant from all sides of a selected rectangular area on the ground. The maneuver simulates the conditions encountered in an airport traffic pattern. While performing the maneuver, the altitude and airspeed should be held constant. The maneuver assists the student pilot in perfecting:

- Practical application of the turn.
- The division of attention between the flight path, ground objects, and the handling of the airplane.
- The timing of the start of a turn so that the turn will be fully established at a definite point over the ground.
- The timing of the recovery from a turn so that a definite ground track will be maintained.
- The establishing of a ground track and the determination of the appropriate "crab" angle.

Like those of other ground track maneuvers, one of the objectives is to develop division of attention between the flight path and ground references, while controlling the airplane and watching for other aircraft in the vicinity. Another objective is to develop recognition of drift toward or away from a line parallel to the intended ground track. This will be helpful in recognizing drift toward or from an airport runway during the various legs of the airport traffic pattern. For this maneuver, a square or rectangular field, or an area bounded on four sides by section lines or roads (the sides of which are approximately a mile in length), should be selected well away from other air traffic. The airplane should be flown parallel to and at a uniform distance about one-fourth to one-half mile away from the field boundaries, not above the boundaries. For best results, the flight path should be positioned outside the field boundaries just far enough that they may be easily observed from either pilot seat by looking out the side of the airplane. If an attempt is made to fly directly above the edges of the field, the pilot will have no usable reference points to start and complete the turns. The closer the track of the airplane is to the field boundaries, the steeper the bank necessary at the turning points.

Also, the pilot should be able to see the edges of the selected field while seated in a normal position and looking out the side of the airplane during either a left-hand or right-hand course. The distance of the ground track from the edges of the field should be the same regardless of whether the course is flown to the left or right. All turns should be started when the airplane is abeam the corner of the field boundaries, and the bank normally should not exceed 45°. These should be the determining factors in establishing the distance from the boundaries for performing the maneuver. Although the rectangular course may be entered from any direction, this discussion assumes entry on a downwind. On the downwind leg, the wind is a tailwind and results in an increased groundspeed. Consequently, the turn onto the next leg is entered with a fairly fast rate of roll-in with relatively steep bank. As the turn progresses, the bank angle is reduced gradually because the tailwind component is diminishing, resulting in a decreasing groundspeed. During and after the turn onto this leg (the equivalent of the base leg in a traffic pattern), the wind will tend to drift the airplane away from the field boundary. To compensate for the drift, the amount of turn will be more than 90°.

The rollout from this turn must be such that as the wings become level, the airplane is turned slightly toward the field and into the wind to correct for drift. The airplane should again be the same distance from the field boundary and at the same altitude, as on other legs. The base leg should be continued until the upwind leg boundary is being approached. Once more the pilot should anticipate drift and turning radius. Since drift correction was held on the base leg, it is necessary to turn less than 90° to align the airplane parallel to the upwind leg boundary. This turn should be started with a medium bank angle with a gradual reduction to a shallow bank as the turn progresses. The rollout should be timed to assure paralleling the boundary of the field as the wings become level. While the airplane is on the upwind leg, the next field boundary should be observed as it is being approached, to plan the turn onto the crosswind leg. Since the wind is a headwind on this leg, it is reducing the airplane's groundspeed and during the turn onto the crosswind leg will try to drift the airplane toward the field. For this reason, the roll-in to the turn must be slow and the bank relatively shallow to counteract this effect. As the turn progresses, the headwind component decreases, allowing the groundspeed to increase. Consequently, the bank angle and rate of turn are increased gradually to assure that upon completion of the turn the crosswind ground track will continue the same distance from the edge of the field. Completion of the turn with the wings level should be accomplished at a point aligned with the upwind corner of the field.

Simultaneously, as the wings are rolled level, the proper drift correction is established with the airplane turned into the wind. This requires that the turn be less than a 90° change in heading. If the turn has been made properly, the field boundary will again appear to be one-fourth to one-half mile away. While on the crosswind leg, the wind correction angle should be adjusted as necessary to maintain a uniform distance from the field boundary. As the next field boundary is being approached, the pilot should plan the turn onto the downwind leg. Since a wind correction angle is being held into the wind and away from the field while on the crosswind leg, this next turn will require a turn of more than 90°. Since the crosswind will become a tailwind, causing the groundspeed to increase during this turn, the bank initially should be medium and progressively increased as the turn proceeds. To complete the turn, the rollout must be timed so that the wings become level at a point aligned with the crosswind corner of the field just as the longitudinal axis of the airplane again becomes parallel to the field boundary. The distance from the field boundary should be the same as from the other sides of the field. Usually, drift should not be encountered on the upwind or the downwind leg, but it may be difficult to find a situation where the wind is blowing exactly parallel to the field boundaries. This would make it necessary to use a slight wind correction angle on all the legs. It is important to anticipate the turns to correct for groundspeed, drift, and turning radius. When the wind is behind the airplane, the turn must be faster and steeper; when it is ahead of the airplane, the turn must be slower and shallower. These same techniques apply while flying in airport traffic patterns.

Common errors in the performance of rectangular courses are:

- Failure to adequately clear the area.
- Failure to establish proper altitude prior to entry. (Typically entering the maneuver



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while descending.)

- Failure to establish appropriate wind correction angle resulting in drift.
- Gaining or losing altitude.
- Poor coordination. (Typically skidding in turns from a downwind heading and slipping in turns from an upwind heading.)
- Abrupt control usage.
- Inability to adequately divide attention between airplane control and maintaining ground track.
- Improper timing in beginning and recovering from turns.
- Inadequate visual lookout for other aircraft.

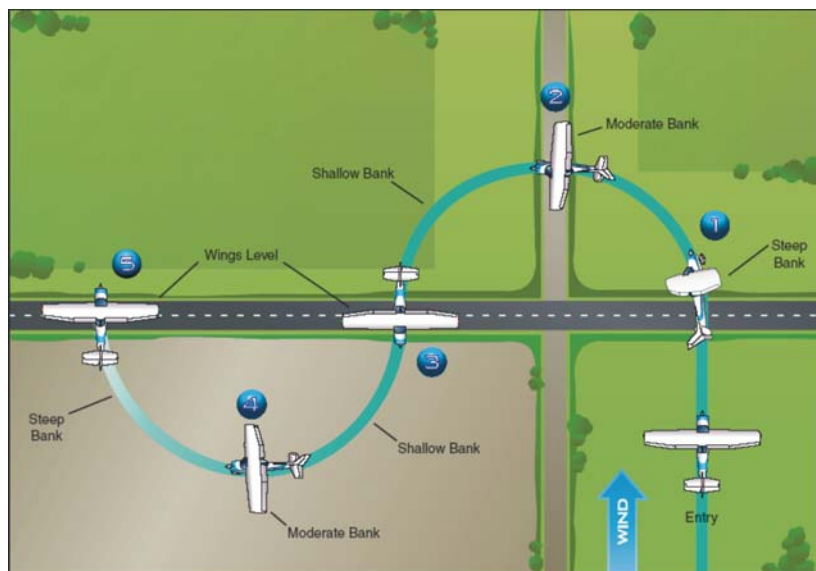
B. TASK: S-TURNS (ASEL and ASES) REFERENCE: FAA-H-8083-3.

1. Exhibits knowledge of the elements related to S-turns.
2. Selects a suitable ground reference line.
3. Plans the maneuver so as to enter at 600 to 1,000 feet (180 to 300 meters) AGL, perpendicular to the selected reference line.
4. Applies adequate wind-drift correction to track a constant radius turn on each side of the selected reference line.
5. Reverses the direction of turn directly over the selected reference line.
6. Divides attention between airplane control and the ground track while maintaining coordinated flight.
7. Maintains altitude, ± 100 feet (30 meters); maintains airspeed, ± 10 knots.

Definition: A practice maneuver in which the airplane's ground track describes semicircles of equal radii on each side of a selected straight line on the ground.

Objective: to develop the ability to compensate for drift during turns, orient the flight path with ground references, and divide the pilot's attention.

- Enter the maneuver downwind. This will be your fastest groundspeed and you will establish your steepest bank.
- As you fly the first half of the maneuver your groundspeed will decrease and you will decrease your bank to maintain a constant radius.
- Just before crossing the road with a headwind you will be at your slowest groundspeed for the first half of the maneuver and also your shallowest bank for the maneuver.
- You should roll out wings level just as you cross the road with your wings parallel to the road and roll directly into your next turn.
- Once you have crossed the road you will enter the second half of the maneuver. Your groundspeed will be at its slowest during this half of the maneuver and you will establish the shallowest bank for this half of the maneuver.
- As you fly the second half of the maneuver your ground speed will increase and you will increase your bank to maintain a constant radius.
- Just before crossing the road you will be at your fastest groundspeed for the second half of the maneuver and also your steepest bank for the second half of the maneuver.



S-TURNS ACROSS A ROAD

An S-turn across a road is a practice maneuver in which the airplane's ground track describes semicircles of equal radii on each side of a selected straightline on the ground. [Figure 6-5] The straight line maybe a road, fence, railroad, or section line that lies perpendicularto the wind, and should be of sufficientlength for making a series of turns. A constant altitudeshould be maintained throughout the maneuver. S-turns across a road present one of the most elementaryproblems in the practical application of the turnand in the correction for wind drift in turns. While theapplication of this maneuver is considerably lessadvanced in some respects than the rectangular course,it is taught after the student has been introduced to thatmaneuver in order that the student may have a knowledgeof the correction for wind drift in straight flightalong a reference line before the student attempt tocorrect for drift by playing a turn. The objectives of S-turns across a road are to develop the ability to compensate for drift during turns, orientthe flightpath with ground references, follow an assigned ground track, arrive at specified points onassigned headings, and divide the pilot's attention. The

maneuver consists of crossing the road at a 90° angleand immediately beginning a series of 180° turns of

uniform radius in opposite directions, re-crossing theroad at a 90° angle just as each 180° turn is completed.

To accomplish a constant radius ground track requiresa changing roll rate and angle of bank to establish the

wind correction angle. Both will increase or decreaseas groundspeed increases or decreases. The bank must be steepest when beginning the turn onthe downwind side of the road and must be shallowedgradually as the turn progresses from a downwindheading to an upwind heading. On the upwind side, theturn should be started with a relatively shallow bankand then gradually steepened as the airplane turns froman upwind heading to a downwind heading. In this maneuver, the airplane should be rolled fromone bank directly into the opposite just as the referenceline on the ground is crossed. Before starting the maneuver, a straight ground referenceline or road that lies 90° to the direction of thewind should be selected, then the area checked to ensure that no obstructions or other aircraft are in theirimmediate vicinity. The road should be approached

from the upwind side, at the selected altitude on a downwind heading. When directly over the road, the first turn should be started immediately. With the airplane headed downwind, the groundspeed is greatest and the rate of departure from the road will be rapid; so the roll into the steep bank must be fairly rapid to attain the proper wind correction angle. This prevents the airplane from flying too far from the road and from establishing a ground track of excessive radius. During the latter portion of the first 90° of turn when the airplane's heading is changing from a downwind heading to a crosswind heading, the groundspeed becomes less and the rate of departure from the road decreases. The wind correction angle will be at the maximum when the airplane is headed directly crosswind. After turning 90°, the airplane's heading becomes more and more an upwind heading, the groundspeed will decrease, and the rate of closure with the road will become slower. If a constant steep bank were maintained, the airplane would turn too quickly for the slower rate of closure, and would be headed perpendicular to the road prematurely. Because of the decreasing groundspeed and rate of closure while approaching the upwind heading, it will be necessary to gradually shallow the bank during the remaining 90° of the semicircle, so that the wind correction angle is removed completely and the wings become level as the 180° turn is completed at the moment the road is reached. At the instant the road is being crossed again, a turn in the opposite direction should be started. Since the airplane is still flying into the headwind, the groundspeed is relatively slow. Therefore, the turn will have to be started with a shallow bank so as to avoid an excessive rate of turn that would establish the maximum wind correction angle too soon. The degree of bank should be that which is necessary to attain the proper wind correction angle so the ground track describes an arc the same size as the one established on the downwind side. Since the airplane is turning from an upwind to a downwind heading, the groundspeed will increase and after turning 90°, the rate of closure with the road will increase rapidly. Consequently, the angle of bank and rate of turn must be progressively increased so that the airplane will have turned 180° at the time it reaches the road. Again, the rollout must be timed so the airplane is in straight-and-level flight directly over and perpendicular to the road. Throughout the maneuver a constant altitude should be maintained, and the bank should be changing constantly to effect a true semicircular ground track. Often there is a tendency to increase the bank too rapidly during the initial part of the turn on the upwind side, which will prevent the completion of the 180° turn before re-crossing the road. This is apparent when the turn is not completed in time for the airplane to cross the road at a perpendicular angle. To avoid this error, the pilot must visualize the desired half circle ground track, and increase the bank during the early part of this turn. During the latter part of the turn, when approaching the road, the pilot must judge the closure rate properly and increase the bank accordingly, so as to cross the road perpendicular to it just as the rollout is completed.

Common errors in the performance of S-turns across a road are:

- Failure to adequately clear the area.
- Poor coordination.
- Gaining or losing altitude.
- Inability to visualize the half circle ground track.
- Poor timing in beginning and recovering from turns.
- Faulty correction for drift.

- Inadequate visual lookout for other aircraft.

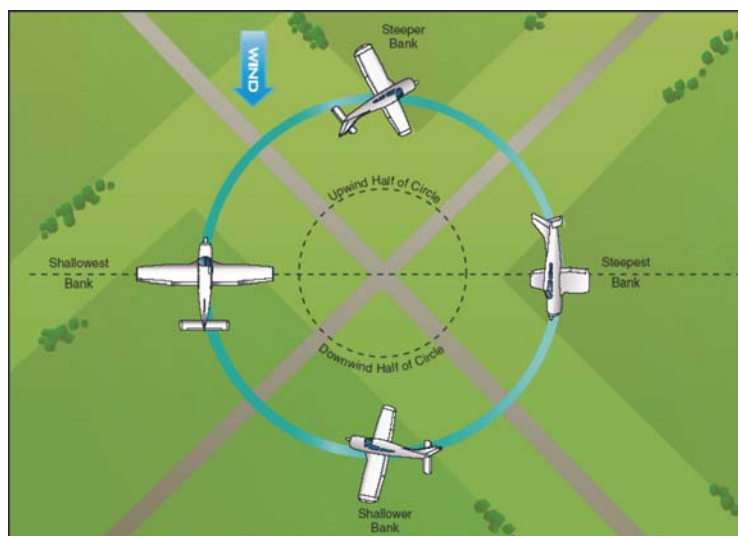
C. TASK: TURNS AROUND A POINT

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.

Definition: a training maneuver in which the airplane is flown in 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 constant altitude.

Objective: to help the pilot develop the ability to subconsciously control the airplane while dividing attention between the flight path and ground references and watching for other air traffic in the vicinity.

- Enter the Maneuver downwind. This will be your fastest groundspeed and you will establish your steepest bank.
- As you fly the first half of the maneuver your groundspeed will decrease and you will decrease your bank to maintain a constant radius
- Once you have flown the first 180 degrees you will be flying directly into the wind and will be at your slowest groundspeed for the maneuver and also your • shallowest bank for the maneuver.
- As you fly the second 180 degrees of the maneuver your groundspeed will increase and you will increase your bank to maintain a constant radius.



TURNS AROUND A POINT

Turns around a point, as a training maneuver, is a logical extension of the principles involved in the performance of S-turns across a road. Its purposes as a training maneuver are:

- To further perfect turning technique.
- To perfect the ability to subconsciously control the airplane while dividing attention between the flight path and ground references.
- To teach the student that the radius of a turn is a distance which is affected by the degree of bank used when turning with relation to a definite object.
- To develop a keen perception of altitude.

• To perfect the ability to correct for wind drift while in turns. In turns around a point, the airplane is flown in 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 altitude. The factors and principles of drift correction that are involved in S-turns are also applicable in this maneuver. As in other ground track maneuvers, a constant radius around a point will, if any wind exists, require a constantly changing angle of bank and angles of wind correction. The closer the airplane is to a direct downwind heading where the groundspeed is greatest, the steeper the bank and the faster the rate of turn required to establish the proper wind correction angle. The more nearly it is to a direct upwind heading where the groundspeed is least, the shallower the bank and the slower the rate of turn required to establish the proper wind correction angle. It follows, then, that throughout the maneuver the bank and rate of turn must be gradually varied in proportion to the groundspeed. The point selected for turns around a point should be prominent, easily distinguished by the pilot, and yet small enough to present precise reference. [Figure 6-6] Isolated trees, crossroads, or other similar small landmarks are usually suitable. To enter turns around a point, the airplane should be flown on a downwind heading to one side of the selected point at a distance equal to the desired radius of turn. In a high-wing airplane, the distance from the point must permit the pilot to see the point throughout the maneuver even with the wing lowered in a bank. If the radius is too large, the lowered wing will block the pilot's view of the point. When any significant wind exists, it will be necessary to roll into the initial bank at a rapid rate so that the steepest bank is attained abeam of the point when the airplane is headed directly downwind. By entering the maneuver while heading directly downwind, the steepest bank can be attained immediately. Thus, if a maximum bank of 45° is desired, the initial bank will be 45° if the airplane is at the correct distance from the point.

Thereafter, the bank is shallowed gradually until the point is reached where the airplane is headed directly upwind. At this point, the bank should be gradually steepened until the steepest bank is again attained when heading downwind at the initial point of entry. Just as S-turns require that the airplane be turned into

the wind in addition to varying the bank, so do turns around a point. During the downwind half of the circle,

the airplane's nose is progressively turned toward the inside of the circle; during the upwind half, the nose is

progressively turned toward the outside. The downwind half of the turn around the point may be compared to the downwind side of the S-turn across a road; the upwind half of the turn around a point may be compared to the upwind side of the S-turn across a road. As the pilot becomes experienced in performing turns

around a point and has a good understanding of the effects of wind drift and varying of the bank angle and

wind correction angle as required, entry into the maneuver may be from any point. When entering the

maneuver at a point other than downwind, however, the radius of the turn should be carefully selected, taking

into account the wind velocity and groundspeed so that an excessive bank is not required later on to maintain

the proper ground track. The flight instructor should place particular emphasis on the effect of an incorrect initial bank. This emphasis should continue in the performance of elementary eights.

Common errors in the performance of turns around a point are:

- Failure to adequately clear the area.
- Failure to establish appropriate bank on entry.
- Failure to recognize wind drift.
- Excessive bank and/or inadequate wind correction angle on the downwind side of the circle resulting in drift towards the reference point.
- Inadequate bank angle and/or excessive wind correction angle on the upwind side of the circle resulting in drift away from the reference point.
- Skidding turns when turning from downwind to crosswind.



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