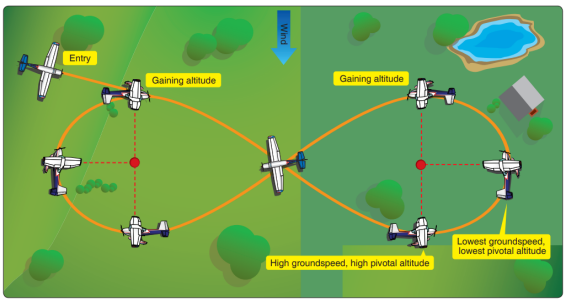
# Eights on Pylons

## Objective

To ensure the applicant learns the purpose of and can exhibit a clear understanding of eights on pylons and how to perform the maneuver properly.

## Purpose

Eights on pylons is the most complex ground reference maneuver. Mastering the maneuver refines precision aircraft control by combining moderately steep coordinated turns, constant airspeed climbs and descents, all while tracking outside ground references. It also introduces the concept of a pivotal altitude. It reinforces the need to keep situational awareness and scanning outside visual references while maneuvering at very low altitude.




## Schedule

- **Ground Lesson**: 15 minutes
- Initial
  - **Flight 1**: 30 minutes - *Introduction to Maneuver*
  - **Flight 2**: 30 minutes - *Improve Proficiency (Dual)*
- Solo
  - **Flight 3**: 30 minutes - *Improve Proficiency*
- Pre-Checkride
  - **Flight 4**: 20 minutes - *Demonstrate Proficiency*
- **Debrief**: 10 minutes (*per flight*)

## Equipment

- Pivotal Altitude Chart (see last page)

## Student Actions

- Ask any questions, receive study material for the next lesson.
- Watch linked video.
- Review listed references.

## Instructor Actions

- Deliver the ground lesson (below).
- Demonstrate the maneuver in flight.
- Debrief after each flight.

## Completion Standards

- **Ground**: Student can explain the purpose of the maneuver and how to execute it properly.
- **Flight**: Student can perform the maneuver to the applicable ACS standards.
  - See expanded Completion Standards below.

## References

- The UND AeroCast - Commercial Eights On Pylons
  - YouTube - https://www.youtube.com/watch?v=dx3WOSqGGTY
- FAA-H-8083-3B (Airplane Flying Handbook) - Chapter 6, Page 14-18 [Maneuver Description]
- FAA-H-8083-25B (Pilot's Handbook of Aeronautical Knowledge)
- FAA-S-ACS-7A (Commercial Pilot ACS) - Area V Task E
- FAA-S-8081-6D (CFI PTS) - Area X Task D
- Pivotal Altitude Chart (See next page)

## Ground Lesson Outline

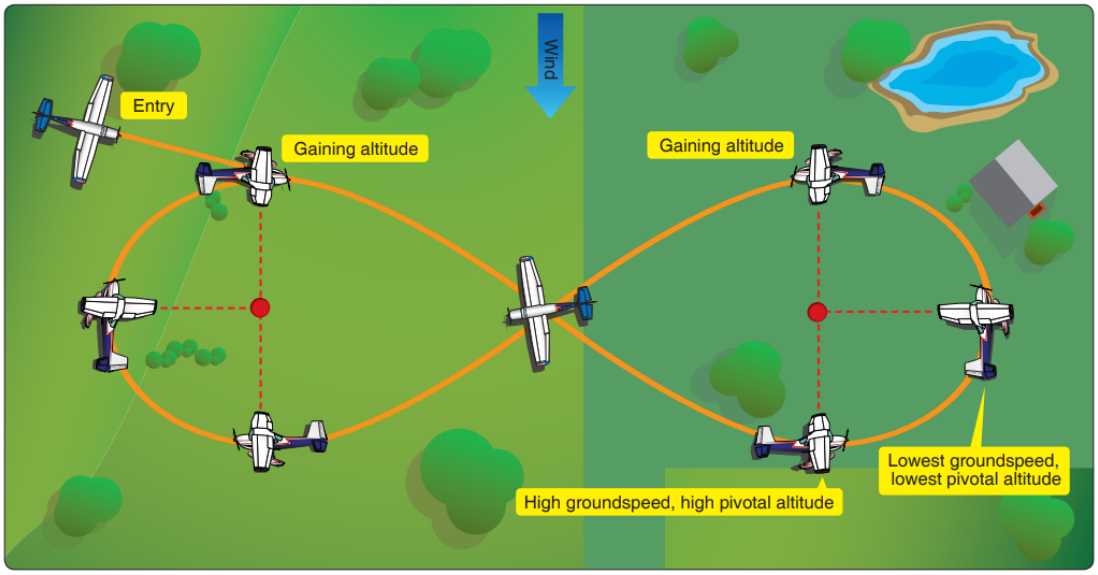
- Eights on Pylons
  - Pivotal Altitude
  - Depends only on Ground Speed
  - Bank angle depends on distance from the pylon
  - Pivotal altitude formula
- 'Maintaining the Pylon'
  - The 'double' correction
    - Pylon moves ahead = airplane too slow, too high -> descend, speed up, raises pivotal altitude
    - Pylon moves behind = airplane too fast, too low -> climb, slow down, lowers pivotal altitude
- Maneuver Setup and Choosing Pylons
- Safety considerations
  - Use of checklists
  - Emergency Landing Area
  - Visual traffic scanning
- Maneuver Description - step-by-step
  - Entry position, airspeed, etc.
  - Wing reference point / Pylon sight picture
- Expanded Completion Standards

## Common Errors

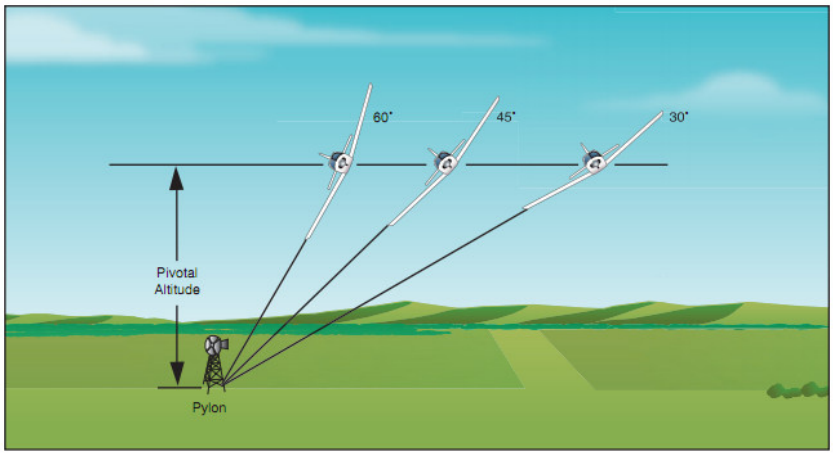
- **Attempting to maintain the pylon by use of the rudder**
- Failure to adequately clear the area above, below, and on either side of the airplane for safety hazards, initially and throughout the maneuver.
- **Poor selection of pylons.**
- **Failure to select a proper reference point on the wing for tracking the pylon**.
- Failure to establish a constant, level altitude prior to entering the maneuver.
- Failure to maintain adequate altitude control during the maneuver.
- Failure to properly assess wind direction.
- Failure to properly execute constant radius turns.
- Failure to manipulate the flight controls in a smooth and continuous manner.
- **Failure to apply coordinated aileron and rudder pressure, resulting in slips or skids.**
- Failure to maintain orientation as the maneuver progresses.

# Ground Lesson Content

- **Eights on Pylons** - From above, eights on pylons would appear to be flying a simple figure eight around two carefully chosen ground references. The main idea that sets this maneuver apart from normal turns around a point is the concept of a ***pivotal altitude***. That is, for every ground speed, there is some altitude at which points on the ground appear to remain stationary when in a constant bank angle turn. Because wind causes ground speed to vary, the maneuver will require varying amounts of climbing and descending to maintain the correct pivotal altitude.

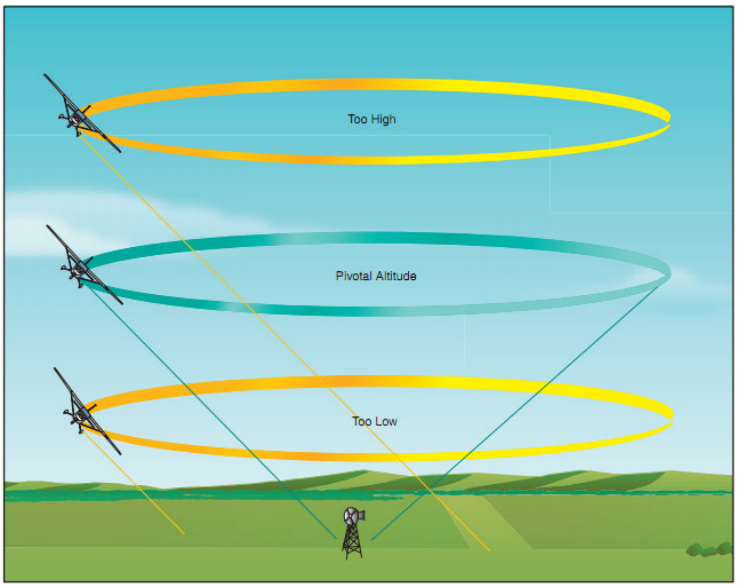



- An important property of pivotal altitude is that it depends *only on ground speed*. The bank angle required to hold a pylon in a fixed position at pivotal altitude depends on the *distance from the pylon*.




- When an aircraft is at pivotal altitude, viewing the pylon along a line parallel to the lateral axis (along the wing) results in the pylon remaining stationary relative to the reference point on the wing.
- Pivotal altitude (in *knots*) can be computed with the formula
  - `(Ground Speed x Ground Speed) / 11.3`
- **'Maintaining' the Pylon** - When an aircraft is above or below pivotal altitude, the pylon will appear to drift ahead or behind the wing reference point. Because pivotal altitude depends only on ground speed, there is a *double correction* that assists in maintaining the pylons
  - **Pylon moves ahead** -> Aircraft above pivotal altitude (too slow)
    - Aircraft should **descend**, which increases ground speed, and raises the pivotal altitude to meet the aircraft.

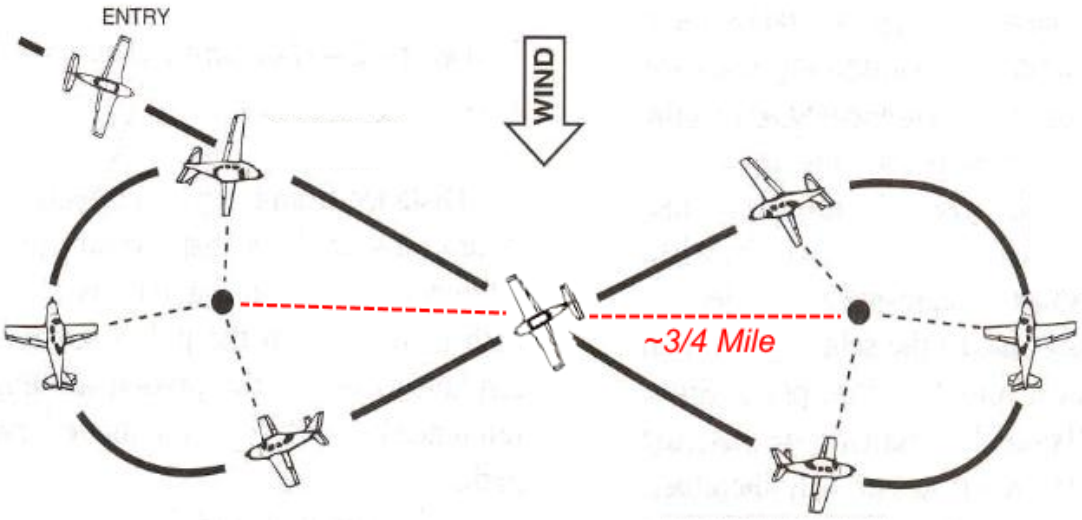
- **Pylon moves behind** -> Aircraft below pivotal altitude (too fast)
  - Aircraft should **climb**, which decreases ground speed, and lowers the pivotal altitude to meet the aircraft.




- **Maneuver Setup and Choosing Pylons** - Eights on pylons are easy to perform with proper planning:
  - Select two pylons, approximately ¾ mile apart, on a line perpendicular to the wind.
  - Enter the maneuver diagonally downwind, at the highest ground speed, and therefore **highest pivotal altitude**. Determine the pivotal altitude before maneuver entry. (Consult the pivotal altitude chart) Plan the approach to turn onto the first pylon approximately ¼ mile downwind from the pylon.
  - As the aircraft turns around the first pylon, ground speed will gradually decay as the aircraft comes into the wind, requiring the aircraft to **descend** to hold the pylon.
  - As the aircraft returns to downwind and prepares to exit the pylon, the airspeed again increases, requiring the aircraft to **climb** to hold the pylon.
  - Fly wings level and climb back to the **highest pivotal altitude** while transitioning to the second pylon. Apply wind correction to ensure arrival at the second pylon at the correct distance.
- **Safety Considerations**
  - **Checklists** - Pilots should complete a pre-maneuver checklist before beginning the maneuver.
  - **Emergency Landing Area** - Due to the risks involved with maneuvering at low altitude, pilots should select a suitable emergency landing area.
  - **Visual Traffic Scanning** - Pilots must remember to keep up their traffic scan throughout the maneuver.

## Maneuver Description

- **Selecting a Ground Reference** - Select two prominent points, separated by approximately ¾ of a mile, which are easy to identify and are clear of hazards on the ground. The points should form an imaginary line which is perpendicular to the wind. The points should ideally be things like road intersections, selected over an unpopulated area. Do not choose things like houses or other structures as pylons which could cause a nuisance. *Because this maneuver is performed so close to the ground (generally below 1,000ft AGL), make sure that the chosen pylons are near a suitable emergency landing area, as gliding distance will be almost zero.*




- **Entry Position and Heading** - Aim to begin the maneuver by flying diagonally between the pylons (see above), to arrive at a position approximately a quarter mile abeam the first pylon.
- **Selecting a Wing Reference Point** - Select a point on the end of the wing, which lies on a line parallel to the lateral axis of the airplane. Do not select a point on a line that is at an angle to the wing. (See below)

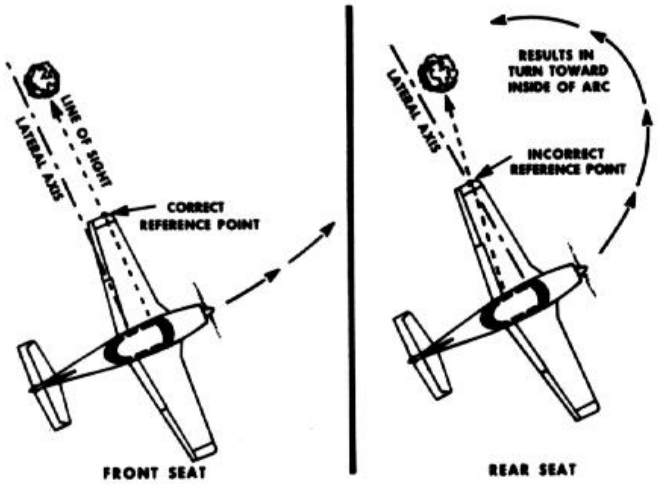



Figure 11–12 Select Proper Reference Point

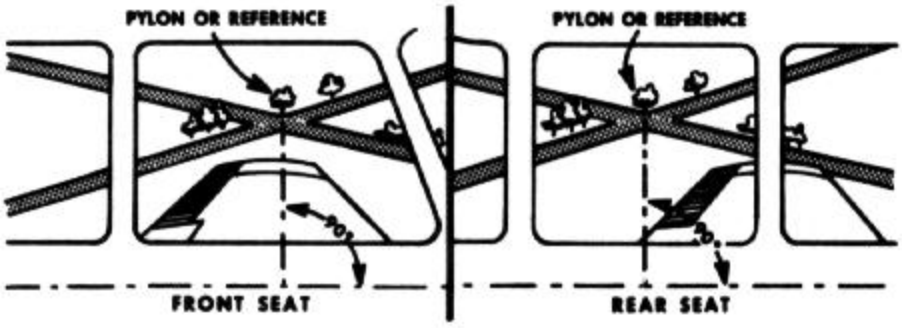
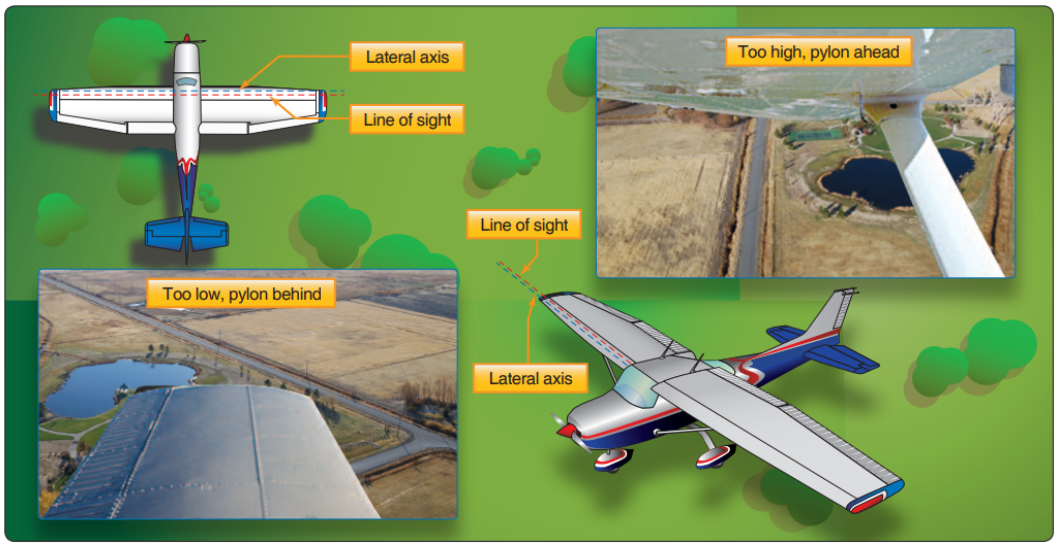



Figure 11–11 Line of Sight to Pylon

- **Entry Altitude** - If you have ground speed information available, determine your initial pivotal altitude by referencing the pivotal altitude chart. If not, simply use your airspeed and add the estimated wind

speed. You will enter the maneuver at the highest groundspeed, and therefore the highest pivotal altitude.

- **Entry Airspeed** - The maneuver must be started at less than **Va** (maneuvering speed). Choose a normal level cruise flight airspeed and power setting, at least 5-10 knots below Va to account for a gain in airspeed as you descend around the pylons.
- **Bank Angle** - The bank angle is determined by the distance from the pylon, but must be *at all times less than* **40 degrees.**
- **Altitude** - Climb or descend as necessary to track the pylon. When the pylon moves behind the wing reference point, the aircraft is below pivotal altitude, and climbing will slow the ground speed and lower the pivotal altitude. When the pylon moves ahead of the wing reference point, the aircraft is above pivotal altitude, and descending will increase the ground speed and increase the pivotal altitude.




- **Between Pylons** - While transitioning between pylons, fly wings level and apply appropriate wind correction to avoid drifting downwind and maintain the correct distance to the next pylon.
- **Coordination** - While tracking a pylon, the continuous climbing and descending will produce a variable airspeed, requiring careful attention to proper coordination. **Do not use rudder to help track the pylon!** The entire maneuver should be flown in coordinated flight.
- **Recovery** - Continue the maneuver for as many loops as specified. Recover to straight and level flight after exiting the last pylon.
- **This is a visual maneuver!** Eyes should remain outside the cockpit as much as possible to scan for traffic and ensure proper tracking of the pylons. *In particular, this is a very low altitude maneuver. Keep a careful watch for obstructions or other ground hazards.*

## Expanded Completion Standards

- The pilot can explain the purpose of the eights on pylons maneuver and how the various factors affect the performance of the maneuver.
- The pilot can perform the maneuver to the following standards:
  - Pilot clears the area, performs a pre-maneuver checklist, establishes a speed *below* **Va**, and selects an approximate pivotal altitude for maneuver entry.
  - Pilot selects suitable pylons that will permit straight-and-level flight between the pylons.
  - Pilot enters the maneuver in the correct direction and position using an appropriate altitude and airspeed.
  - Pilot establishes the correct bank angle for the conditions, *not to exceed* **40°**.

- Pilot applies smooth and continuous corrections so that the line-of-sight reference line remains on the pylon.
- Pilot divides attention between accurate, *coordinated airplane control* and outside visual references.
- Pilot maintain pylon position using appropriate pivotal altitude, avoiding slips and skids.

## Pivotal Altitude Chart (print and bring along)

| Ground Speed | Pivotal Altitude - (GS*GS)/11.3 |
|---|---|
| 75 kts | 500 ft |
| 80 kts | 570 ft |
| 85 kts | 640 ft |
| 90 kts | 720 ft |
| 95 kts | 800 ft |
| 100 kts | 890 ft |
| 105 kts | 980 ft |
| 110 kts | 1070 ft |