Visualized Flight Maneuvers Handbook

For Low Wing Aircraft

Fourth Edition

For Instructors and Students

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Aviation Supplies & Academics, Inc.
Newcastle, Washington

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None of the material in this handbook supersedes any operational documents or procedures issued by the Federal Aviation Administration, aircraft and avionics manufacturers, flight schools, or the operators of the aircraft.

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PREFACE

The purpose of this handbook is threefold:

1. To provide the student with a more thorough understanding of the basic parts of each flight maneuver, in order to better prepare them for each flight instruction period;
2. To provide a foundation for later formal training for private, commercial, or flight instructor candidates;
3. To create a safer and more competent pilot.

This book should be used as a supplement to the current FAA Certification Standards for the certificate being sought. For a full discussion of each maneuver, refer to the *Airplane Flying Handbook* (FAA-H-8083-3). Airplane manufacturer recommendations should be checked before beginning any maneuver.

Maneuvers required by the FAA Certification Standards for the Sport, Private, Commercial, and Flight Instructor certificates are illustrated in this book. The minimum requirements established in the FAA Certification Standards for each certificate accompany each maneuver. Flight Instructor applicants are required to meet the Commercial Pilot skill level. For those maneuvers that are Private Pilot-only, the Flight Instructor applicant is expected to perform the maneuvers more precisely than a Private Pilot applicant, as determined by the examiner.

Where it is appropriate, space has been provided for you to enter the tire pressures, tank capacities, airspeeds, power settings, etc. that apply to the airplane being flown.

Before practicing each maneuver, remember to complete the necessary preparations. Memory aid: **AAACT** ("act")

Area	terrain appropriate for maneuvering, and emergency landing area available
Airspeed	maneuvering speed (V_A) or as designated by practical test standards
Altitude	as designated by practical test standards
Clearing turns	clear area for traffic
Technique	as designated by FAA Certification Standards

The maneuvers are visual, and require you to keep your center of attention outside the aircraft. When practicing the maneuvers, use outside references to perform the maneuver, then cross-check by scanning the instruments inside the cockpit—look outside, peek inside.

CONTENTS

AIRCRAFT REVIEW

Aircraft Model and Type:

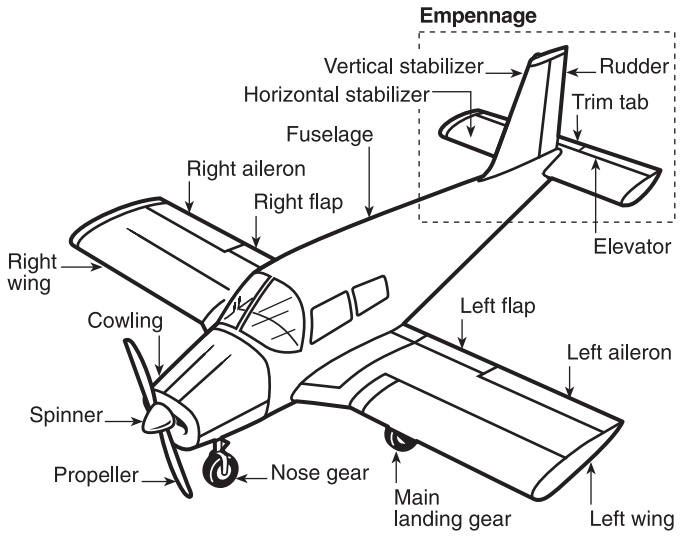
_____

1. What is the normal climb-out speed? _____
2. What is the best rate-of-climb speed (V_Y)? _____
3. What is the best angle-of-climb speed (V_X)? _____
4. What is the maximum flaps-down speed (V_{FE})?_____
5. What is the maximum gear-down speed (V_{LE})?_____
6. What is the stall speed in a normal landing configuration (V_{S0})? _____
7. What is the clean (flaps and gear up) stall speed (V_{S1})? _____
8. What is the approach-to-landing speed? _____
9. What is the maneuvering speed (V_A)? _____
10. What is the never-exceed speed (V_{NE})? _____
11. What is the maximum structural cruising speed (V_{NO})? _____
12. What engine-out glide speed will give you the maximum range? _____
13. What airspeed is used for a
    Short-field takeoff? _____ Short-field landing?_____
    Soft-field takeoff? _____ Soft-field landing?_____
14. What is the service ceiling? _____
15. What is the make and horsepower of the engine? _____
16. What is the estimated true airspeed at 5,000 feet and 65% power? _____
17. What RPM or combination of RPM and manifold pressure yields 65% power at 5,000 feet MSL? _____ RPM _____ MP
18. How many gallons of fuel are consumed per hour at 65% power at 5,000 feet MSL? _____
19. How many usable gallons of fuel can your aircraft carry? _____
20. Where are the fuel tanks located and what are their capacities?
    Main tank _____ gallons _____
    Left tank _____ gallons _____
    Right tank _____ gallons _____
    Rear tank _____ gallons _____
    Auxiliary tanks _____ gallons _____
21. With full fuel, 65% power, at 5,000 feet, allowing a 45 minute reserve, what is the maximum duration (in hours)? _____
22. What speed will give you the best glide ratio? _____
23. What is the octane rating and color of the fuel used by the aircraft? _____
24. How do you drain the fuel sumps? _____
25. What weight of oil is used? _____
26. Is the landing gear fixed, manual, hydraulic, or electric?_____ If retractable, what is the back-up system for lowering the gear? _____ _____
27. What is the maximum demonstrated allowable crosswind component for the aircraft? _____
28. How many persons will the aircraft safely carry with full fuel? _____
29. What is the maximum allowable weight the aircraft can carry in the baggage compartments? _____
30. What takeoff distance is required to clear a 50-foot obstacle at maximum gross weight at a pressure altitude of 5,000 feet and 90°F (assume no wind and a hard-surfaced runway)? _____
31. What would be the answer to Question 30 if the takeoff was made from sea level pressure altitude? _____
32. Does high humidity increase or decrease the takeoff distance? _____
33. What landing distance is required at 2,300 pounds at a pressure altitude of 2,000 feet and standard temperature (assume no wind or obstacle)? _____
34. How do you determine pressure altitude? _____ _____
35. What is your maximum allowable useful load? _____
36. Solve the weight and balance problem for the flight plan you intend to fly. If you plan to fly solo, also solve the problem for a 180-pound passenger in each seat. Does your load fall within the weight and balance envelope?_____ What is your gross weight?_____ If you solved the problem with 180-pound passengers in each seat, how much fuel could you carry?_____ Where would this fuel be tanked?_____ If you carry full fuel, how much baggage could you carry?_____ Where would this baggage be placed?_____

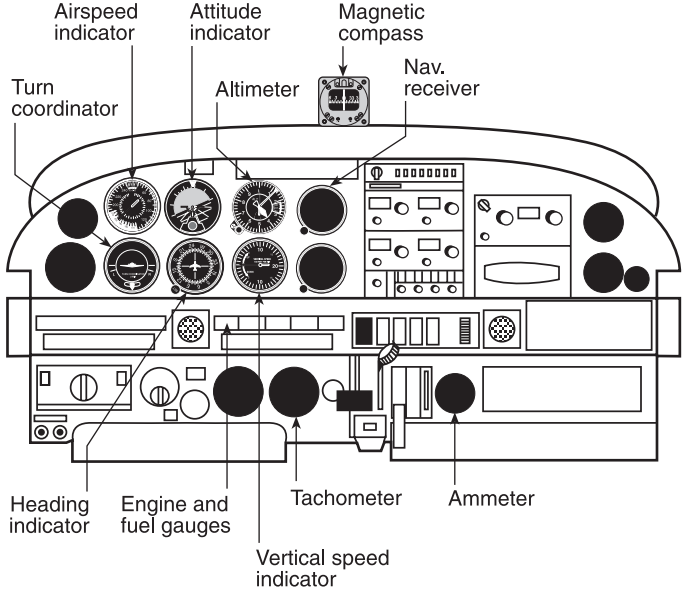
V Speeds

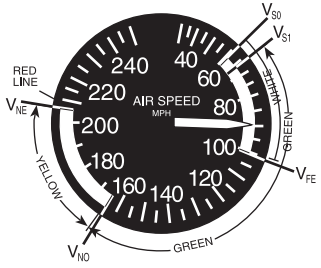
V_A	Design maneuvering speed
V_F	Design flap speed
V_{FE}	Maximum flap extended speed
V_{LE}	Maximum landing gear extended speed
V_{LO}	Maximum landing gear operating speed
V_{NE}	Never-exceed speed
V_{NO}	Maximum structural cruising speed
V_{S0}	Stalling speed or the minimum steady flight speed in the landing configuration
V_{S1}	Stalling speed or the minimum steady flight speed obtained in a specific configuration
V_X	Best angle-of-climb speed
V_Y	Best rate-of-climb speed

AIRPLANE FAMILIARIZATION



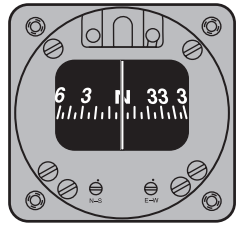
Flight Instruments



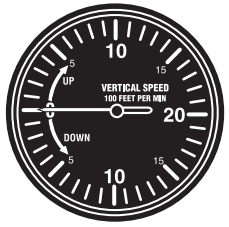


Airspeed Indicator
Pitot-Static System

Altimeter
Static System



Magnetic Compass



Vertical Speed Indicator
Static System

Turn Coordinator
Usually Electric

Attitude Indicator
Vacuum System

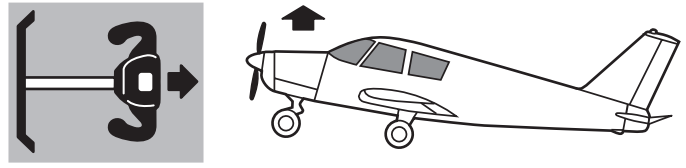
Heading Indicator
Vacuum System

Flight Controls

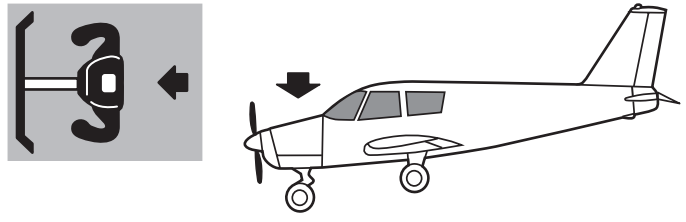
Elevators

The elevators provide control of the pitch attitude about the airplane's lateral axis. Elevators are the key to controlling the angle of attack.

- When control wheel (yoke) is pulled toward pilot, the nose pitches up.



- When control wheel (yoke) is pushed away from pilot, the nose pitches down.



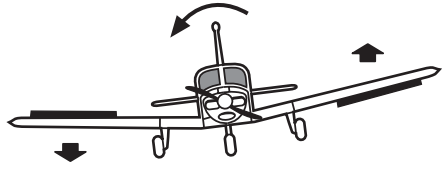
Continued

Ailerons

The primary use of the ailerons is to bank, or roll, the airplane around the longitudinal axis. Banking the wings results in the airplane turning in the direction of the bank.

- When control wheel (yoke) is turned to the left, left aileron is raised and airplane rolls to the left.

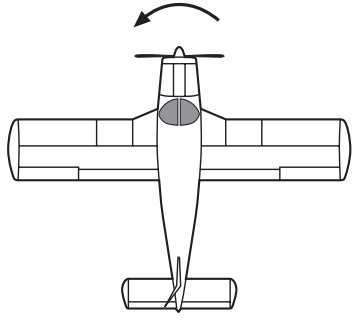
- When control wheel (yoke) is turned to the right, right aileron is raised and airplane rolls to the right.



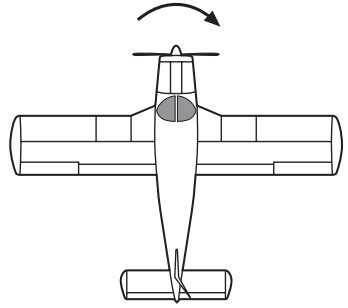
Rudder

The rudder is used to control the direction (left or right) of yaw about the airplane's vertical axis.

- When left rudder is pushed, the nose pivots to the left.



- When right rudder is pushed, the nose pivots to the right.



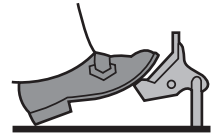
Cockpit Controls

Yoke

Hold yoke with your left hand. Your grip should be firm but relaxed.

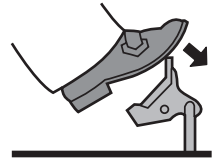
Rudder pedals

Place your heels on the floor and toes, or the balls of the feet, on the rudder pedals. Pressures can be exerted more accurately by the toes, or the balls of the feet, than by the instep.



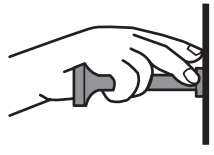
Brakes

To apply the airplane brakes, depress the top of the rudder pedals. Do the same when setting the parking brake.

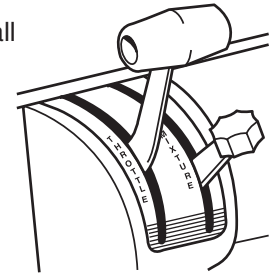


Throttle

Operate the throttle with the right hand. Hold the throttle so that small changes can be made smoothly.

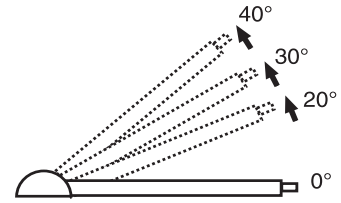


OR



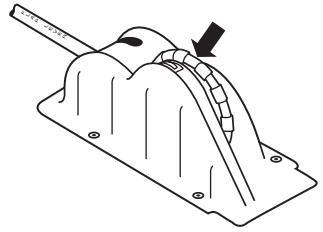
Flaps

Flaps increase the wing's lift by increasing its area or its camber. Flaps also cause drag because they extend beneath the wing. The lift/drag ratio is determined by the degree of flap extension. Using flaps lowers the wing's stalling speed, and increases the rate of descent without an increase in airspeed.

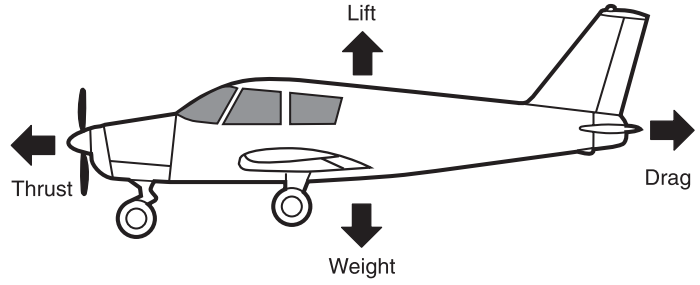


Trim Tab

The purpose of trim tab is to relieve control pressure on the flight controls. Set trim for airspeed (attitude) desired. The trim tab is operated by the trim wheel.



Forces Acting on the Airplane in Flight

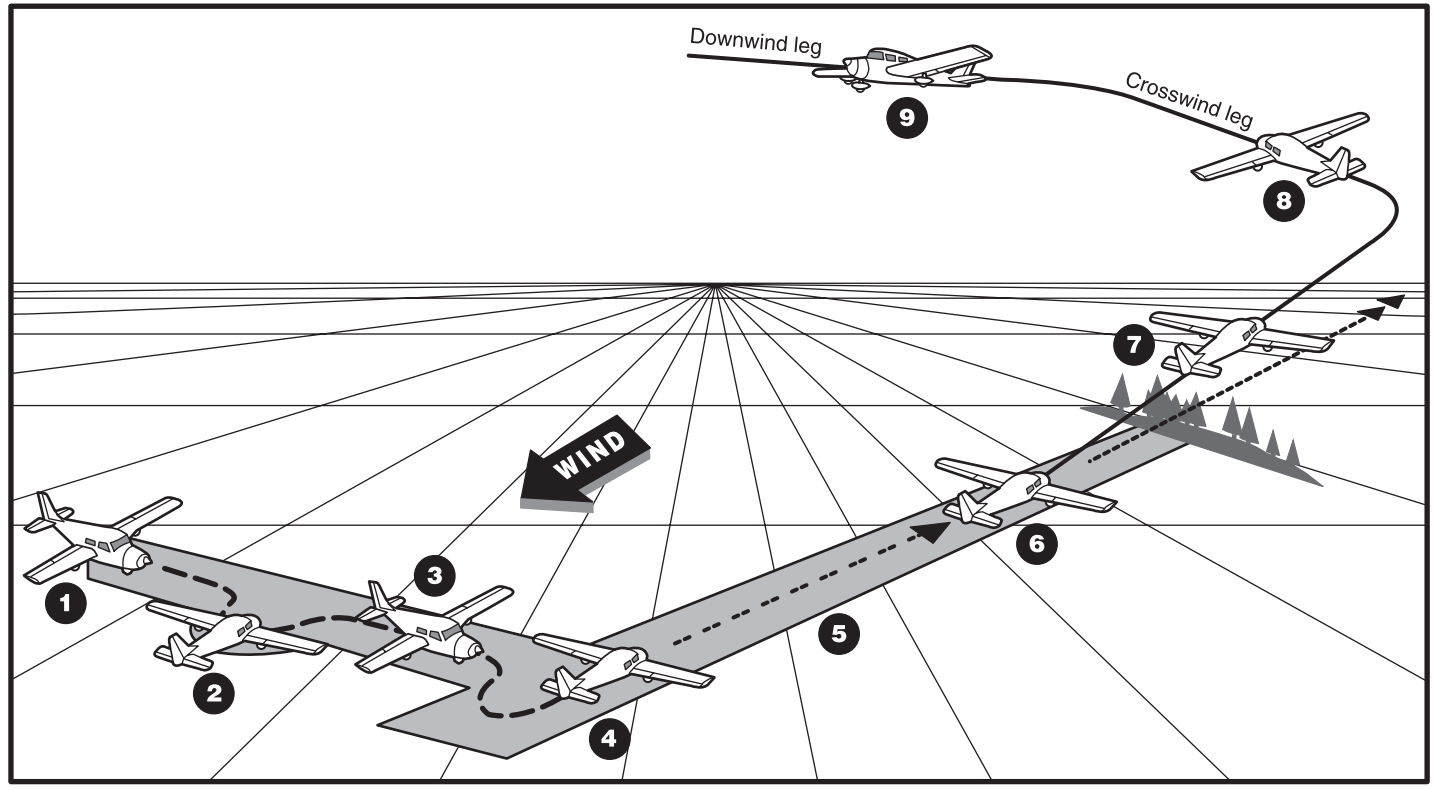


SHORT-FIELD TAKEOFF & CLIMB

(Private, Sport, Commercial, CFI)

Objective: Takeoff in the shortest possible distance, clear obstacles at the end of the runway, and climb out to the downwind leg of the traffic pattern.

Task: Check Manufacturer Recommendations

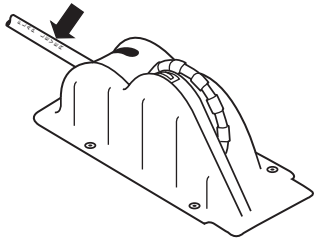


1

- Complete preflight inspection (*see* Page 4)
- Complete starting airplane check (*see* Page 6)
- Taxi to upwind runway

2

- Complete before-takeoff check (*see* Page 6a)
- Wing flaps 10° for short-field takeoff, or as recommended



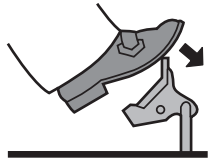
- Know local airport traffic pattern and altitude procedures

3

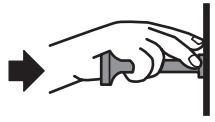
- Obtain takeoff and departure clearances, if required
- Look out and check that runway and approaches are all clear

4

- Position airplane at the end of the runway to ensure maximum runway available, and align with runway centerline
- Select a reference point straight ahead for tracking
- Hold toes on the brakes



- Apply full throttle smoothly and positively



- Release brakes as full power is reached

5

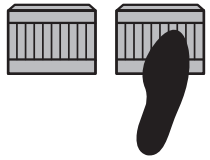
- Keep straight with rudder
- Keep wings level with aileron
- Check RPM for full power
- Check engine instruments are in the green arc
- Keep airplane full weight on main wheels until lift-off speed is attained

Continued

6

- Lift off at minimum recommended flying speed
  Manufacturer Recommended minimum lift-off speed _____ knots

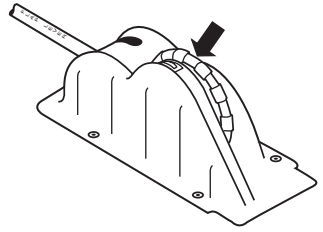
- Use right rudder to offset torque as required
- Keep right hand on throttle



7

- Establish the attitude that results in V_X with full throttle
  Manufacturer Recommended V_X _____ knots
- Maintain wings level with aileron, coordinate with rudder

- Retract flaps at a safe altitude and when clear of obstacles
- Retract gear after positive rate of climb is established, and a landing cannot be made on remaining runway
- Increase climb speed to V_Y
  Manufacturer Recommended V_Y _____ knots
- Trim off any control pressure



- Scan for traffic
- Maintain a straight track over the extended runway centerline

8

- Beyond end of runway and within 300 feet of traffic pattern altitude, make a climbing turn to crosswind leg (bank angle 20° maximum)
- Allow for wind drift to keep a square pattern
- Maintain climb speed and continue to climb to pattern altitude
- Level off at pattern altitude
- Scan for traffic

9

- Within 1/2 to 1 mile from runway, make a medium turn to downwind leg (bank angle 30° maximum)
- Scan for traffic
- To depart the traffic pattern, either climb straight out from the upwind leg, or turn 45° beyond the departure end of the runway after reaching pattern altitude

Evaluation:

- Position flight controls for existing wind conditions
- Use 10° (short-field takeoff) flap setting
- Clear the area
- Taxi into the takeoff position to allow maximum utilization of available takeoff area and align the airplane on runway centerline
- Advance throttle smoothly to takeoff power
- Rotate at recommended airspeed, lift off, and accelerate to the recommended obstacle clearance airspeed or V_X
- Establish pitch attitude for the recommended obstacle clearance airspeed or V_X and maintain that airspeed, (+10/-5 knots for Private and Sport, +5/-0 knots for Commercial and CFI) until the obstacle is cleared, or until airplane is 50 feet above the surface
- After clearing the obstacle, accelerate to V_Y, establish pitch attitude for V_Y, and maintain V_Y during the climb (+10/-5 knots for Private and Sport, ±5 knots for Commercial and CFI)
- Retract landing gear and flaps after a positive rate of climb is established
- Maintain takeoff power to a safe maneuvering altitude
- Maintain directional control and proper wind-drift correction throughout takeoff and climb
- Comply with noise abatement procedures
- Complete the appropriate checklist

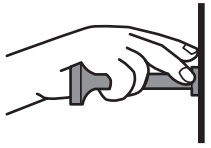
STRAIGHT & LEVEL FLIGHT

(Private, Sport, Commercial, CFI)

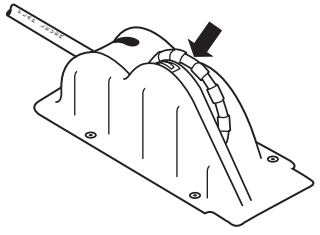
Objective: Maintain a constant heading and altitude.

Task:

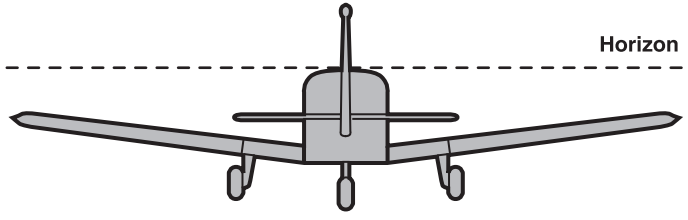
- Adjust power to cruise RPM



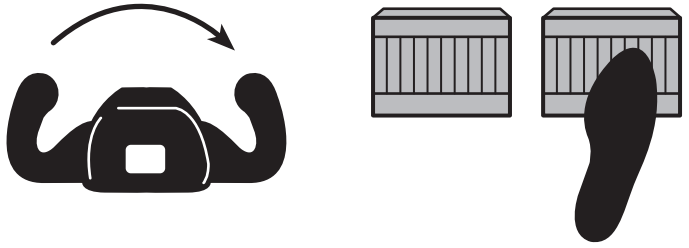
- Trim airplane to maintain hands-off attitude



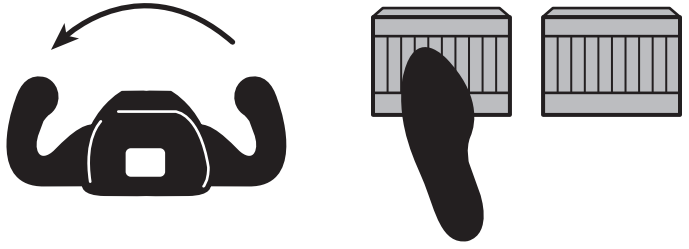
- Select an outside reference
- Maintain airplane nose constant in relation to the horizon, and wing tips equidistant below horizon



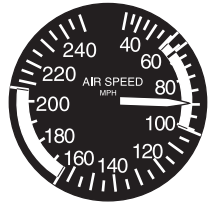
- If left wing is low, correct by using light right aileron plus right rudder pressure



- If right wing is low, correct by using light left aileron plus left rudder pressure



- After corrections, neutralize controls and trim airplane
- Check airspeed indicator for constant airspeed



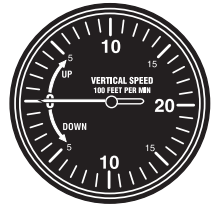
- Check heading indicator for constant heading

- Maintain coordination by keeping the ball in center

- Set movable dot on the attitude indicator to horizon line and maintain constant attitude

- Check altimeter for constant altitude. Make small corrections with elevator (yoke). Make larger corrections immediately with coordinated pitch and throttle.

- Vertical speed indicator should remain at 0



- For VFR flights, use outside visual cues as primary reference, cockpit instruments as secondary reference and as a cross-check (look outside, peek inside)
- Check fuel and engine gauges periodically

Evaluation:

- Maintain a definite heading, ±10°
- Maintain a definite altitude, ±100 feet
- Use definite power setting and airspeed, ±10 knots
- Trim for level flight
- For altitude deviations of less than 100 feet, correct with pitch; if you are off by more than 100 feet, use pitch and a small throttle adjustment
- In turbulence, use maneuvering speed (V_A)
- Use left hand on yoke, controlling yoke with thumb and two fingers and making tiny corrections
- Make smooth and coordinated control applications

SHALLOW & MEDIUM TURNS

(Private, Sport, Commercial, CFI)

Objective: Change or return to a desired heading by entering, maintaining, and rolling out of a shallow (0-20°) or medium (20-45°) level turn, using constant power and holding a constant altitude.

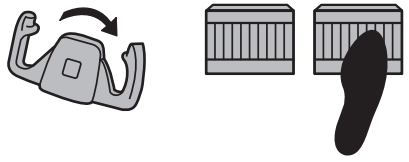
Task:

1

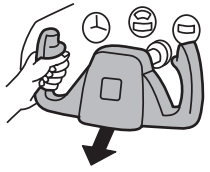
- Go to practice area where terrain is appropriate for maneuvering, and emergency landing area is available
- Set power to obtain maneuvering speed (V_A)
  Manufacturer Recommended V_A _____ knots
- Select an altitude to maintain
- Clear area for other aircraft
- Trim airplane for level hands-off flight
- Select a heading or reference point for rollout

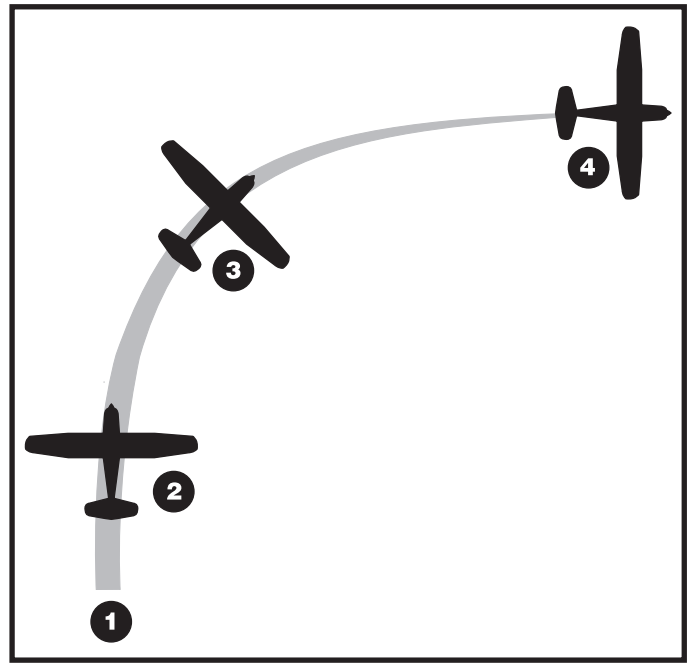
2

- Look outside, peek inside
- From straight-and-level flight, coordinate aileron and rudder to roll in direction of turn



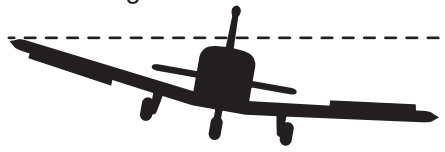
- Due to torque effect, more rudder is required for right turns
- Exert slight back pressure on the control column to maintain altitude





3

- Look outside, peek inside
- Select a spot on the horizon to maintain altitude and bank angle



- Maintain bank angle with aileron (reference attitude indicator)

- Maintain coordination with rudder (reference turn coordinator)

- Maintain altitude with the elevator, using back pressure on the control column (reference altimeter)

4

- Look outside, peek inside
- Anticipate rollout heading or reference point

- Roll out of the bank with aileron and coordinated rudder pressure, to return to straight-and-level flight

- Release elevator back pressure

Evaluation:

- Left turns are performed in the same manner as right turns
- Practice both right and left turns, returning to straight-and-level flight
- Roll out to predetermined headings
- Maintain altitude, ±100 feet
- Maintain bank angle, ±5°
- Maintain rollout heading, ±10°
- Maintain coordination at all times

RECTANGULAR COURSE

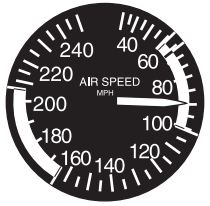
(Private, Sport, CFI)

Objective: Fly a ground track equidistant from all sides of a selected rectangular area on the ground, accounting for wind effects, and maintaining a constant altitude and airspeed.

Task:

1

- Find practice area where terrain is appropriate for maneuvering, emergency landing area available
- Select a rectangular area, 1/2 to 1 mile in length
- Set power to obtain maneuvering speed (V_A)
  Manufacturer Recommended V_A _____ knots

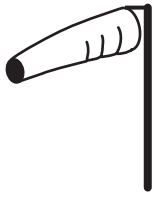


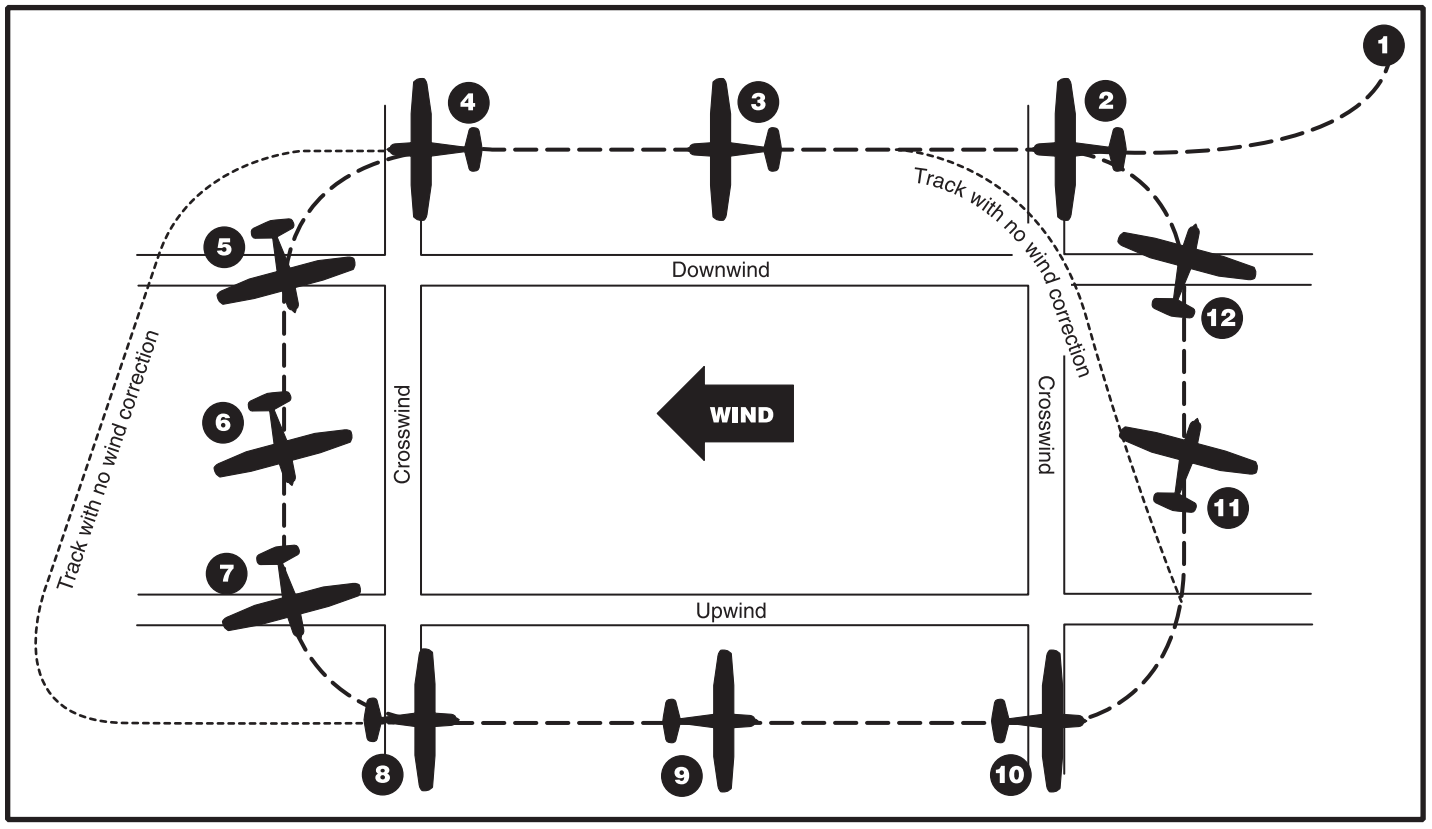
- Maintain traffic pattern altitude, 600 to 1,000 feet AGL
- Clear area for other aircraft

- Trim airplane for level hands-off flight

2

- Enter the maneuver 45° to downwind, with first circuit to the left





3

- Same indicated airspeed, fastest ground speed
- Maintain distance from boundary
- Crab angle is not required

4

- Steepest turn for fastest ground speed (maximum bank angle 45°)
- Ease off bank angle as the wind turns to a crosswind, and ground speed begins to slow

5

- Roll out of the turn wings-level, crabbing into the wind
- Turn will be more than 90°

6

- Maintain coordination and crab into the wind

- Same airspeed, medium ground speed
- Maintain distance from boundary

Continued

7

- Start the turn with a medium bank angle
- Reduce bank angle as ground speed slows

8

- Roll out wings-level, directly upwind
- Turn will be less than 90° to upwind leg

9

- Same indicated airspeed, slowest ground speed
- Maintain distance from boundary
- Crab angle is not required

10

- Start a shallow turn for the slowest ground speed
- Gradually increase to a medium bank angle as the ground speed increases
- Roll out wings-level with a wind correction angle and crab into the wind

11

- Turn will be less than 90°
- Same indicated airspeed, medium ground speed
- Maintain coordination and crab into the wind

12

- Start a medium turn, gradually increasing bank angle as ground speed increases
- Turn will be more than 90°
- Exit at point of entry at the same altitude and airspeed at which the maneuver was started, and reverse course

Evaluation:

- The closer the track of the airplane is to the field boundaries, the steeper the bank at the turning points
- Determine wind direction and speed
- Select ground reference area with an emergency landing area within gliding distance
- Plan maneuver to enter at traffic pattern altitude, 600 to 1,000 feet AGL, at an appropriate distance from the selected reference area, 45° to the downwind leg, with the first circuit to the left
- Apply adequate wind-drift correction during straight and turning flight to maintain a constant ground track around the rectangular reference area
- Divide attention between airplane control and ground track, maintain coordinated flight
- Exit at point of entry at the same altitude and airspeed at which the maneuver was started, and reverse course
- Maintain altitude (±100 feet for Private and Sport), maintain airspeed (±10 knots for Private and Sport)

INDEX

Visualized Flight Maneuvers Handbook

For Low Wing Aircraft

Fourth Edition

This comprehensive maneuvers manual is an excellent learning and teaching aid for instructors and students, covering all the flight maneuvers required for Private, Sport, Commercial, and Flight Instructor certification. Each maneuver is depicted in detail according to type of aircraft in which the lesson will take place, states the objective of the task, and lists the FAA Certification Standards required. Fully illustrated with fold-out pages that show each maneuver complete on a one-page spread so the reader will absorb all the visual/text information at once.

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