CHAPTER 8
MANEUVERS

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References and Performance Standards obtained from the following:

- FAR / AIM
- FAA Private Pilot Practical Test Standards
- FAA Commercial Pilot Practical Test Standards
- FAA Flight Instructor Practical Test Standards
- FAA Instrument Rating Practical Test Standards
- Piper Cherokee Arrow II Pilot Information Manual
- FAA Advisory Circulars
TRANSITION AIRSPEEDS

At times it may be desirable for flight crews to establish transition airspeeds other than the normal cruise airspeeds, usually when transitioning to or from the practice area and between maneuvers. These airspeeds will:

- decrease the amount of time spent getting to and from the practice areas
- increase the number of training procedures that can be accomplished in any one training event

Transitioning to and from practice area

Flight crews may establish airspeed of up to 150 MPH (≈24”/2400 RPM) in transit to or from the practice areas if conditions permit, taking into account turbulence, maneuvering speed (Va), other traffic, the type of airspace operated in as well as all other safety factors.

Transitioning between maneuvers

Flight crews may establish up to 120 MPH (≈19”/2400 RPM) between maneuvers, 105 MPH (≈17” MP) for those maneuvers requiring a slower airspeed, or as otherwise required.

CHECKLISTS AND CALLOUT DURING MANEUVERS

As described in this manual, flight crews are reminded that they shall execute appropriate checklists and perform the required callouts during all operations. Refer to Cockpit Crew Coordination Procedures chapter in this manual.

GUIDANCE to BETTER MANEUVER EXECUTION

- When executing in-flight maneuvers, such as stalls, always remember the realistic scenario you are simulating (approach and landing scenario in case of power-off stall, etc.)
- Stabilize between maneuvers. For most maneuvers, the aircraft should be trimmed for straight and level flight at the correct airspeed.
  - Set pitch and power, then trim!
  - It is a lot more difficult to hold maneuver entry altitude if the airplane wanted to climb or descent before the maneuver was even started.
  - Do not be excessively fast or slow when transiting from one maneuver to another.
  - For most maneuvers, a maximum of 120 MPH prior to maneuver execution is sufficient for the PA28R200.
- Remember to keep looking outside in order to simultaneously scan for traffic and evaluate your pitch and bank in relationship to the horizon.
- Aircraft pitch attitude and stabilator control pressure, while related, are not the same thing.
  - Set the pitch using whatever stabilator control pressure is necessary.
  - Maintain that pitch using stabilator pressure and trim, if required.
  - The pressure necessary to maintain a particular pitch attitude will be different for different airspeeds.
  - Adjust stabilator pressure to maintain pitch as airspeed changes during a particular maneuver. Typically, it means increasing stabilator backpressure
(pulling back on the yoke) as airspeed decreases, and decreasing stabilator backpressure (releasing the yoke forward) as airspeed increases.

✔ When “under the hood” in simulated instrument conditions, or any instrument conditions:
  - Realize that the airplane does not “know” you are under the hood or in instrument conditions and will fly (and be flown) exactly the same way. Set pitch (and bank), set power, and trim!
  - The artificial horizon now replaces your actual horizon.
  - The artificial horizon is much smaller; therefore even tiny changes on the pitch and bank of the artificial horizon are actually huge changes outside on the actual horizon.
  - Make the artificial horizon many times bigger in your mind than it actually is!
  - Just as your natural horizon outside would be the center of your scan, the artificial horizon now becomes the center of your scan, except in partial panel situations.

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TAXIING

Objective

Flight crews will develop the ability to taxi safely while minimizing the use of brakes and allowing for the possibility of sudden brake failure.

CAUTION

Maximum taxi speed on aircraft parking ramp area shall be equivalent to slow walking speed.

Procedures description:

1. Both pilots shall, in turn, check brakes immediately during the initial movement after engine startup, and before commencing further taxiing from any parking space.
2. When moving in a straight line, minimize use of brakes.
3. When attempting to slow down, first reduce power to idle, and only then apply additional brakes, if needed.
4. When attempting to turn, in general:
   - Reduce power to idle.
   - Apply full rudder (no brake) in the direction of turn to engage nosewheel steering
   - If turn radius is insufficient, apply appropriate brake pressure on the pedal in the direction of turn.
   - Add enough power to keep the airplane moving while holding the brake.
   - Keep in mind that, while the above procedure is written sequentially, the steps occur almost simultaneously, and the overall goal is to minimize use of brakes
5. Prior to stopping after a turn, straighten the nosewheel by making both rudder pedals even with one another.
6. Always select appropriate taxi speed considering the possibility of brake failure, and the consequent need to bring the aircraft to a safe stop without using the brakes.
7. When positioning the aircraft for runup, consider a possibility of brake failure during high power phase of the runup. If possible, avoid pointing the airplane into a nearby obstacle or another aircraft on the runup area.

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PRE-MANEUVER CHECKLIST FLOW

Objective

Flight crews will use this procedure to prepare the aircraft for training maneuvers, while remaining in positive aircraft control and maintaining strict vigilance for traffic at all times.

CAUTION

This checklist shall be complete prior to starting any maneuver.
If multiple maneuvers are conducted in sequence, this checklist needs only be verified as complete during all subsequent maneuvers.

Procedure description:

1. Select an altitude that will allow for the maneuver to be recovered above the altitude specified for the maneuver.
2. Select an emergency landing field, as appropriate.
3. Ensure that the airframe and aircraft (doors, windows) are secured.
4. Ensure that the seatbelts and harnesses are securely fastened and any baggage is secured.
5. Ensure the mixture is set as required for the conditions (see AFM/POH)
6. Set power to the practice area setting for the desired initial airspeed 105-120 MPH (~17-19”/2400 RPM), or as appropriate
7. Verify the magneto switch is set to BOTH.
8. Verify the fuel selector is on the appropriate tank.
9. Verify that engine instruments (oil temperature and pressure) are normal.
10. Turn on the AUX fuel pump.
11. Verify that external lighting is set for maximum visibility (see AIM, Operation Lights On)
12. Verify that the flow has been completed by calling “Pre-Maneuver Checklist complete.”

CAUTION

Conducting the Pre-Maneuver Checklist during clearing turns is PROHIBITED.
CLEARING TURNS

Objective
Flight crews will conduct clearing turns in order to “see and be seen”, while retaining positive aircraft control and dedicating their **undivided attention** to scanning for traffic.

---

**CAUTION**
Conducting the Pre-Maneuver Checklist during clearing turns is PROHIBITED.

---

**Procedure description:**

1. Prior to initiation of Clearing Turns, ensure that Pre-Maneuver checklist has been completed.

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**WARNING**
Clearing turns shall be conducted before each maneuver.
Clearing turns are to be performed VISUALLY (eyes outside), with the Flight Crew continuously scanning for traffic.

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2. Ensure that the immediate area is clear of obstructions and other aircraft by initiating a combination of turns, first to the left and then to the right.

3. Prior to starting a turn in any direction, ensure that there are no aircraft in the immediate area for the direction of the turn.

4. Pick a horizon reference off of left wing. Entering a medium banked left turn, execute a 90° heading change and roll out on your reference.

5. During the turn continuously scan the area above, below and ahead of the aircraft.

6. Repeat the process to the right, thereby returning to the original heading.

7. One continuous left 180° turn will also suffice as a clearing turn if the flight crew wishes to reverse direction.

8. Once both turns (or one 180° turn) are completed and the flight crew has determined that the area is clear of other aircraft and obstructions, the maneuver may be initiated.

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AIRPORT OPERATIONS

SAFETY CONSIDERATIONS and SOPS

For any takeoff:

✓ BEFORE executing a takeoff, flight crews must ensure that the final approach and departure runway is clear at both controlled and non-controlled airports.
✓ Avoid fast taxi turns while entering the runway to prevent any possible fuel system unporting that could lead to engine hesitation or stoppage during takeoff.
✓ During takeoff, PF’s hand shall remain on the throttle at all times in the event an aborted takeoff becomes necessary.
✓ If a significant crosswind exists, hold the aircraft on the ground slightly longer than normal to ensure a smooth, positive liftoff.
✓ During strong gusty wind conditions, climb speeds should be increased by 1/2 the gust factor.
✓ Other than in an emergency, NO TURNS ARE TO BE MADE BELOW 400’AGL after takeoff.
✓ Turns after takeoff and during traffic pattern operations are limited to a maximum of 30° of bank, unless safety of flight necessitates exceptional maneuvering.

For all terminal and traffic pattern operations:

➢ If the airport is a non-controlled field and the runway in use cannot be determined before arrival, consider over-flying the airport at traffic pattern altitude +500’ (minimum) to determine the active runway. Execute an appropriate downwind entry to the correct runway.
➢ Large and turbine aircraft frequently fly 1500’ AGL patterns. Crossing 500’ above typical piston-engine/small aircraft pattern altitude of 1000’AGL places small aircraft at 1500’ AGL and may create a traffic conflict. Use sound judgment when selecting an over-flight altitude.
➢ Do NOT assume that lack of radio traffic at a non-towered field means a lack of other aircraft in the area. An aircraft may not be equipped with a radio, or may be transmitting on the wrong frequency.
➢ Straight-in VFR approaches to airports without an operating control tower are PROHIBITED. Flight crews may conduct a straight-in approach as part of an instrument approach procedure, provided it is not contrary to the active traffic pattern.

For any approach and landing:

✓ During gusty wind conditions, final approach speeds should be increased by ½ the gust factor (e.g. Approach speed: 90 MPH, Steady winds 15 KNOTS=17 MPH, Gust: 25 KNOTS=29 MPH, therefore gust factor is 29-17=12 MPH; ½ gust factor is 6 MPH; Final Approach speed: 90+6=96 MPH).
✓ Higher approach speeds and lower flap settings should be considered under turbulent air conditions.
✓ Remember: during crosswind, transitioning from crab method to wing-low method will increase aerodynamic drag, descent rate and power requirements to remain on the desired descent path.
CAUTION

During any takeoff and landing, “Following along” on the flight controls by the flight instructor is strongly recommended. This simply implies closely guarding the yoke, rudders and possibly the throttle, without actually interfering with the PF manipulation of the controls.

Avoid excessive pitch attitudes that can result in a tail strike. Instructors are reminded that they are responsible for ensuring that during takeoff and landing or any procedure, they must be prepared and then ACT if the student’s action or inaction places the flight in an unsafe condition.

The extra split second that it would take to move the hand from its resting position (i.e. on the knees) to the yoke can make a difference toward a negative outcome. That extra split second does not need to occur if the hand is already guarding the yoke, which may contribute to a positive outcome.

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TRAFFIC PATTERN
(Departures, Arrivals and Closed Traffic)

Quick reference:
- Closed traffic - Crosswind at TPA minus 300’ (typical) or as assigned by ATC
- Arriving from outside of traffic pattern - TPA by 1 mile out, 110-120 MPH
- Downwind leg – 110-120 MPH (≈ 18” / 2400 RPM)
- Landing gear down by midfield
- No later than midfield: “Before Landing” flows complete
  - GUMP check (SOP) no later than immediately after base to final turn
  - Abeam landing point: ≈ 15-16”, flaps 10°, descent ≈-500-700 FPM, 110 MPH
  - Base leg: flaps 25°, 100 MPH
  - Final approach leg: flaps full 40°, 90 MPH (or as appropriate)

Objective
Flight crews will develop the ability to safely conduct departures, arrivals and traffic pattern operations.

Departure Procedures:
1. Perform the appropriate takeoff procedure as described in this chapter.
2. Continue climbing to TPA at Vy (100 MPH).
3. Turn crosswind within 300’ of TPA, or as instructed by the control tower. Maintain Vy.

**NOTE**
If not remaining in the pattern, depart either straight out, on a 45° ground track in the direction of the traffic pattern, or as instructed by the control tower.
For departures opposite to the established traffic pattern, continue climbing to at least 500’ above TPA prior to turning on course.

4. While climbing on crosswind leg and prior to turning downwind, maintain extra vigilance for other aircraft in the traffic pattern. Momentarily reduce the pitch attitude if necessary to visually clear the area.
5. Upon reaching TPA, and if remaining in the closed traffic pattern, turn downwind and set the power to maintain 110-120 MPH (18”/2400 RPM). Continue at step 3 of the Arrival procedures.

Arrival procedures:
1. Once the active runway has been determined, establish the airplane on 45° to the middle point of the downwind leg, or as otherwise instructed by the control tower.
2. No later than by 1 mile prior to reaching the downwind leg, establish TPA and slow down to 110-120 MPH (18”/2400 RPM, depending on density altitude)
3. Prior to downwind midfield, deploy the landing gear.
4. No later than downwind midfield, perform “Before Landing” flows
   a. Begin landing gear verification callouts in accordance with Crew Coordination Procedures Chapter of this manual.
   b. Complete the GUMP check (SOP) at this point, or no later than after completing the turn base to final. Refer to Normal Procedures chapter of this manual.
5. Just prior to abeam the intended landing point,
   a. Reduce the power to ≈ 15-16” MP
b. Ensure that the airspeed is below Vfe (125 MPH) and extend flaps to 10°
c. Begin ≈ 500-700 FPM descent and maintain ≈ 110 MPH.

6. At 45° to the intended landing point, or as directed by the control tower, turn BASE.
   a. Set flaps to 25°, if appropriate for the altitude and position from the airport.
   b. Maintain ≈ 100 MPH on base.

7. Visually CLEAR the final approach and opposite base leg before turning final.

8. On final approach, deploy full flaps (see the following note) and maintain 90 MPH, adding ½ the wind gust factor, as appropriate.

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approaching in either CROSSWIND, STRONG GUSTY WIND or HIGH WIND, consider using less than full flaps.</td>
</tr>
<tr>
<td>If crabbing into the wind, hold the crab angle until ready to flare. Taking the crab out too soon with the rudder by aligning with the runway centerline (wing-low method) will result in an aerodynamic slip and immediate drag increase, and may result in excessive sink rate, requiring large power addition to maintain airspeed and the glide path.</td>
</tr>
</tbody>
</table>

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NOTE: All numerical values are approximate and must be adjusted for conditions.

Level off at TPA
Turn downwind
Scan for traffic!

Altitude: TPA
Airspeed 110-120 MPH
A likely collision area!
700 AGL
Continue climbing and turn crosswind

Abeam intended landing point:
Power 16" MP
Flaps 10 degrees
Descend at 110 MPH

Approximately:
Descent rate 700 FPM
Altitude loss 300 feet

Scan for traffic!
Approximately:
700 AGL
45 degrees to aim point
Turn and descend

Approximately:
Airspeed 100 MPH
Altitude loss 300 feet
Descent rate 700 FPM
Flaps 25 degrees

Approximately:
400 AGL
Flaps 40 degrees
Airspeed 90 MPH

WINDSOCK: Evaluate wind direction

STANDARD TRAFFIC PATTERN
STOP-AND-GO

Objective
Flight crews will develop the ability to safely transition into takeoff configuration immediately after coming to a full stop landing on a runway, and execute an appropriate takeoff procedure.

CAUTION
Intentional Touch and Go operations are prohibited.
This does not preclude a safety related go-around in case of a bounced landing.
This also does not preclude a safety related go-around in case where wheels are down on the runway, but it would be unsafe to continue to a stop.

Procedures description:
1. Ensure that the required traffic pattern has been conducted, as specified in this chapter and as appropriate to the actual conditions.
2. Ensure that the appropriate ATC clearance is issued for the type of operation planned.
3. Perform an appropriate landing procedure, as described in this manual.
4. Once on the runway, assure that the aircraft is in positive control at all times as the aircraft comes to a complete stop.

NOTE
The term “positive control” shall be interpreted to mean that the pilot is immediately correcting for and is maintaining centerline, with proper crosswind controls established and slowing down to a stop where the necessary transition steps to takeoff can be executed.

5. During the following steps, multi-crew operation is assumed. In case where single pilot operation is occurring, actual or simulated, the PF will make all callouts.
6. The PF will call out “FLAPS IDENTIFIED” and place the hand on the flap handle.
   ✓ The PMF will call out “FLAPS VERIFIED” after verifying the PF action.
7. The PF will call out “FLAPS SET TO _______” and set the flaps for takeoff, as appropriate.
   ✓ The PMF will visually verify that flaps are set for takeoff.
8. The PF will call out “TRIM SET FOR TAKEOFF” and set the trim for takeoff.
   ✓ The PMF will visually verify that trim is set for takeoff.
9. Execute the appropriate takeoff procedure as described in this manual.

NOTE
➢ Terminate Stop and Go operation and abort takeoff if insufficient runway remains, the aircraft is not properly or timely configured for takeoff, or positive aircraft control is lost.
LOW APPROACH

Objective

Flight crews will develop the ability and judgment to intentionally discontinue a visual or an instrument approach immediately prior to touch down, and execute a rejected landing / go-around procedure.

NOTE

This procedure may be requested by the flight crew or initiated by ATC.

Procedure description:

1. If on a simulated instrument approach at a towered airport, ensure that the flight crew is clear on the action required by ATC immediately following the low approach.
2. If on a simulated instrument approach at a non-towered airport, ensure that the intentions are transmitted on the appropriate frequency throughout the approach.
3. Plan and establish a stabilized approach to a runway, with the intention of not touching down.
4. Prior to where normal landing flare would take place, execute a go-around procedure, as described in this manual.
5. Communicate with ATC or on CTAF, as appropriate.
6. Verify the appropriate checklist flows.

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NOTE
The crosswind techniques described below apply to and must be utilized during all types of takeoffs and landings. During ground roll, rudder controls direction of airplane travel and ailerons compensate for crosswind drift. Once airborne, rudder keeps the ball centered and ailerons are adjusted to turn onto maintain a heading to remain over the runway centerline, with wings level (“crabbing into the wind”).

NORMAL AND CROSSWIND TAKEOFF AND CLimb

Objective
Flight crews will develop the ability to safely conduct a normal and/or crosswind takeoff and climb.

Quick reference:
- Flaps - 0° and check trim set for takeoff!
- Rotate at Vr (65 MPH)
- Pitch for and climb at Vy(gear down) : 95 MPH
- Positive rate and out of usable runway: retract the landing gear
- Climb at Vy(gear up): 100 MPH
- 500’ AGL : Initiate climb checklist
- 1000’ AGL:
  - 18”/2400 RPM (if leveling off and remaining in the pattern)
  - Full power or 25”/2500 RPM, if departing and as appropriate

Procedures description:
1. At the hold short line, ensure the appropriate checklist is complete, **flaps are set to 0° and trim is set for takeoff**.
   a. Visually verify outside that the flaps are in takeoff position.
   b. Verify that the trim is in takeoff position, which is slightly aft of neutral. Refer to the POH / AFM.
2. Contact the control tower for clearance, or at non-controlled airports, make a radio call.
3. Taxi the aircraft into position on the runway, after completing the final takeoff SOP items.
4. Check the windsock indications. Apply full ailerons into the wind if crosswind is present.
5. Right to left, set full power (Mixture/Prop/Throttle).
   a. As the aircraft begins to accelerate, check that the engine is producing 100% power, appropriate to the airport elevation and density altitude (≈ 29” MP at sea level).
6. Ensure that all engine instruments are indicating normal (oil temperature, oil pressure, etc.).
7. Verify airspeed indicator is functioning normally by observing proper needle movement.
8. Adjust the ailerons pressure into the wind, as needed, to control drift, and utilize rudder pedal steering to maintain runway centerline.
9. At manufacturer recommended rotation airspeed (Vr - 65 MPH), rotate to establish a \( V_Y \) climb pitch attitude and accelerate to \( V_Y \) airspeed with the gear down (95 MPH).
   a. As the aircraft rotates with the ailerons adjusted into the crosswind, the downwind wing will rise first and the downwind main wheel will lift off first.
   b. Ensure that proper aileron crosswind correction is held as long as necessary while any part of the aircraft is still on the ground. The amount of aileron pressure into the wind will vary depending on the amount of crosswind.
   c. Once the aircraft lifts off and all wheels positively leave the ground, crab into the wind to maintain runway centerline, level the wings and ensure the airplane is coordinated (ball centered). These actions occur nearly simultaneously.

10. Establish a positive rate of climb, as indicated visually and on the instruments (VSI and Altimeter).

11. Once in positive rate of climb and no usable landing surface remaining:
   a. Apply brake pressure to stop wheel rotation.
   b. Retract the landing gear.

12. Pitch for and accelerate to \( V_Y \) airspeed with the gear up (100 MPH).

13. Maintain runway centerline and an extended centerline ground track while crabbing into the wind with the aircraft coordinated at all times (uncoordinated flight increases drag and decreases climb performance).

14. At 500’ AGL, initiate the “Climb” checklist, and verify full power is set and being achieved.

15. At 1000’ AGL, if leveling off and remaining in the pattern, reduce power to maintain traffic pattern airspeed (18”/2400 RPM), or as appropriate.

16. If departing the traffic pattern, continue climbing at \( V_Y \) (100 MPH) or \( V_{climb} \) (110 MPH), as appropriate.
   a. Maintain full power if maximum climb performance is required or reduce the power to the climb power setting 25”/2500 RPM.

17. Monitor engine oil temperature in the climb and reduce the climb gradient, while increasing the climb airspeed, as necessary, to maintain proper engine cooling.

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NORMAL AND CROSSWIND APPROACH AND LANDING

Objective
Flight crews will develop the ability to safely and accurately execute approach, landing and rollout, under both normal and crosswind conditions.

Quick reference:
- Conduct traffic pattern, as appropriate (see previous sections)
- Final approach leg – flaps full, 90 MPH (or as appropriate)
- Ensure all flows, callouts and landing gear verifications are complete
- Touchdown within 400 (Private Pilot) or 200 (Commercial Pilot) feet of your specified point

Procedures description:
1. Ensure that the required traffic pattern has been conducted, as specified in this chapter.
2. Adjust the final approach speed by adding ½ the gust factor, if appropriate, to the normal approach speed of 90 MPH.
3. Select the appropriate final flap setting based on the wind conditions and available runway (refer to Traffic Pattern Operations)

NOTE
If reduced flap setting is used due to crosswind conditions, take into account the increased landing distance requirements and ensure adequate runway distance exists.

4. Ensure that the aircraft is on a stabilized approach with a final flap setting prior to reaching 300’ AGL.
5. Ensure that all callouts and landing gear verifications are complete. Refer to the Crew Coordination chapter as well as Normal Flows and Checklists chapter in this manual.
6. Crab into the wind to remain on extended runway centerline.
7. Coordinate pitch and power so as to maintain and the desired approach angle resulting in a smooth landing within the designated area.
8. Transitioning to flare, correct for crosswind by aligning the airplane with runway centerline using the rudder, and maintaining the airplane over the centerline with the ailerons (the wing-low method). Maintain this crosswind correction throughout the flare.
9. During flare, slow the aircraft descent rate by simultaneously increasing the pitch and smoothly reducing the power to idle, while holding the established crosswind correction, so that the aircraft touches down smoothly onto the runway on the main gear at the designated touchdown point.

CAUTION
Avoid closing the throttle too early or too rapidly during flare before the aircraft is ready for touchdown, as it may result in an immediate increase in the rate of descent and a hard landing.

NOTE
Closing the throttle smoothly during flare will make the transition from approach to the touchdown smoother and easier as well. Avoid abrupt throttle changes.
10. Use of proper crosswind correction will result in the airplane touching down while banking slightly, on the **upwind main gear first**, followed by the downwind gear and then the nosewheel, all the while remaining over and aligned with the runway centerline.

11. **Continue “flying the airplane”** immediately after touchdown. Gently lower the nosewheel and continue deflecting the ailerons into the wind, adjusting the rudder pressures as the airplane slows down.

### NOTE
In any amount of crosswind, the aircraft bank attitude during touchdown will NOT be parallel to the ground. Avoid the temptation of leveling the wings just prior to touchdown. The bank angle may also appear to be steeper than it actually is, as it is unnatural to be in a bank close to the ground, but it must be accepted. As long as the aircraft is **over and parallel** with the runway centerline, with no drift, the resulting bank angle is a natural consequence of crosswind correction and must be accepted.

The greater the crosswind on landing, the greater the amount of bank will be during touchdown. Refer to the Aircraft Information Summary Chapter and the POH/AFM for crosswind component limitations.

12. Maintain back pressure on the yoke throughout the landing roll to avoid hard touchdown of the nose wheel. During the landing roll, crosswind correction inputs will have to be increased due to decreased control effectiveness as the airspeed decreases.

13. Maintain the aircraft’s longitudinal axis with the centerline, and slow the aircraft by applying the brakes as necessary.

14. Be cautious of an early brake application during crosswind conditions immediately after touchdown, as the **downwind main gear tire** will initially be off the ground or have very little weight on it. As a result, brake pressure can easily lock up that wheel, damaging the tire as it subsequently touches down with the brake engaged.

15. Slow the aircraft to a safe taxi speed and taxi off the runway, or as appropriate.
SHORT-FIELD TAKEOFF AND MAX PERFORMANCE CLimb

Objective
Flight crews will develop the ability to safely conduct a short-field takeoff and maximum performance climb in actual or simulated short-field conditions and with obstacles present.

Quick reference:
- Flaps - 25° and check trim set for takeoff!
- Maximize runway distance and **STOP**
- Hold brakes, set full power (M/P/T), check instruments – only **THEN** release brakes
- Rotate at Vr (60 MPH)
- Climb at Vx with landing gear down (85 MPH)
- Positive rate of climb is well established: Landing gear up
- Climb at Vx with landing gear up (96 MPH)
- Clear of obstacles:
  - Establish Vy pitch attitude, accelerate to and climb at Vy - 100 MPH
  - Verify airspeed and retract flaps in increments (25° to 10°, 10° to 0°)

Procedures description:
1. At the hold short line, ensure the appropriate checklist is complete, **flaps are set to 25° and trim is set for takeoff.**
   a. Visually verify outside that the flaps are in takeoff position.
   b. Verify that the trim is in takeoff position, which is slightly aft of neutral. Refer to the POH / AFM.
2. Contact the control tower for clearance, or at non-controlled airports, make a radio call. In both cases, request or announce a short delay (on the runway).
3. Taxi the aircraft into position on the runway, after completing the final takeoff SOP items.
   a. Get as close to the approach end of the runway as possible to maximize available takeoff distance.
   b. Ensure to remain clear of protruding obstacles, such as approach/rwy lights, etc.
4. Check the windsock indications. If crosswind is present, apply the crosswind techniques, as described in “Normal and Crosswind Takeoff and Climb” and elsewhere, throughout this procedure.
5. Apply and hold brakes to prevent aircraft movement.
6. Right to left, smoothly and positively set full power (mixture/props/throttle)
   a. Check that all engine instruments display normal readings and 100% power is being developed, appropriate to the airport elevation and density altitude.
7. Release the brakes, allowing the aircraft to accelerate. Check that the airspeed indicator is functioning.
8. At manufacturer recommended airspeed Vr (60 MPH), rotate to establish a Vx climb attitude and accelerate to Vx airspeed with gear down (85 MPH).
9. Establish a positive rate of climb, as confirmed visually and on instruments (VSI and altimeter).
   a. Ensure that there is no possibility of the aircraft settling back on the runway.
   b. Apply brake pressure to stop wheel rotation.
   c. Retract the landing gear in order to increase climb performance.
10. Accelerate to \( V_x \) with landing gear up (96 MPH) and maintain it until all obstacles are cleared.

11. Once clear of the obstacles, establish a \( V_y \) climb attitude and accelerate to \( V_y \) airspeed (100 MPH).
   a. Verify airspeed and retract remaining flaps in increments. First, retract flaps from 25° to 10°.
   b. Allow the aircraft to stabilize, then retract the remaining flaps from 10° to 0° during the climbout.

12. At 500’ AGL, initiate the “Climb” checklist, and verify full power is set and being achieved.

13. At 1000’ AGL, if leveling off and remaining in the pattern, reduce power to maintain traffic pattern airspeed (18”/2400 RPM), or as appropriate.

14. If departing the traffic pattern, continue climbing at \( V_y \) (100 MPH) or \( V_{climb} \) (110 MPH), as appropriate.
   a. Maintain full power if maximum climb performance is required or reduce the power to the climb power setting 25”/2500 RPM

15. Monitor engine oil temperature in the climb and reduce the climb gradient, while increasing the climb airspeed, as necessary, to maintain proper engine cooling.

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SHORT-FIELD APPROACH AND LANDING

Objective
Flight crews will develop the ability to safely and accurately execute a short-field, maximum performance approach and landing in actual or simulated short-field conditions and with obstacles present.

Quick reference:
- Conduct traffic pattern, as appropriate (see previous sections)
- Final approach leg – flaps full 40°, 83 MPH (or as appropriate)
- Ensure all callouts and landing gear verifications are complete
- Touchdown within 200 (Private Pilot) or 100 (Commercial Pilot) feet of the specified point
- Flaps up, maximum (safe) wheel braking, aerodynamic braking, minimal ground roll

Procedures description:
1. Ensure that the required traffic pattern has been conducted, as specified in this chapter.
2. If crosswind is present, apply the crosswind techniques as described in “Normal and Crosswind approach and landing” and elsewhere throughout this procedure.
3. Adjust the final approach speed by adding ½ the gust factor, if appropriate, to the short field approach speed of 83 MPH.
4. Set full flaps (40°) for maximum short field performance, or select the appropriate reduced final flap setting based on the wind conditions (refer to Traffic Pattern Operations).

NOTE
If reduced flap setting is used due to crosswind conditions, take into account the increased landing distance requirements and ensure adequate runway distance exists.

5. Ensure that the aircraft is on a stabilized approach with a final flap setting prior to reaching 300’ AGL.
6. Ensure that all callouts and landing gear verifications are complete. Refer to the Crew Coordination chapter as well as Normal Flows and Checklists chapter in this manual.
7. Coordinate pitch and power so as to maintain and the desired approach angle resulting in a smooth landing within the designated area.
   a. The PF should expect the pitch of the aircraft while maintaining short field approach speed to be somewhat different from the pitch during the normal approach speed.
8. During flare, slow the aircraft descent rate by simultaneously increasing the pitch and smoothly reducing the power to idle, so that the aircraft touches down smoothly onto the runway on the main gear at the designated touchdown point.
   a. The PF should realize that, at the short field approach speeds, the aircraft, while flaring, will potentially reach MCA sooner than during a normal landing, and adjust flare timing accordingly.

CAUTION
Avoid closing the throttle too early or too rapidly during flare before the aircraft is ready for touchdown, as it may result in an immediate increase in the rate of descent and a hard landing.
9. Immediately after touchdown, raise the flaps in order to put maximum weight on the main wheels prior to using the brakes.

10. Continue applying back-pressure to the yoke, adjusting the rudder pressures as the airplane slows down.

11. Apply maximum safe wheel braking without locking up the wheels.

**NOTE**
The term “maximum braking” shall be interpreted to mean maximum available braking that result in the aircraft coming to as rapid a stop as practical, under positive control without locking the brakes and damaging or blowing a tire.

12. Maintain increasing back pressure on the yoke throughout the landing roll to avoid hard touchdown of the nose wheel, and to maximize aerodynamic braking.

13. Minimize ground roll distance, slow the aircraft to a safe taxi speed and taxi off the runway, or as appropriate.

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SOFT-FIELD TAKEOFF AND CLimb

Objective
Flight crews will develop the ability to safely conduct a soft-field takeoff in actual or simulated soft-field conditions (mud, snow, slush, grass, etc.), followed by a maximum performance climb, if obstacles are present.

Quick reference:
- Flaps - 25° and check trim set for takeoff!
- Yoke full aft; weight off the nosewheel
- Maximize runway distance but DO NOT STOP
- On runway centerline - set full power (M/P/T)
- Maintain constant pitch, nosewheel off the ground, until airborne
- Immediately adjust pitch to remain in ground effect, and accelerate
- Initiate a climb when airspeed reaches:
  - Vx with gear down (85 MPH) with actual or simulated obstacle, or
  - Vy with gear down (95 MPH), if no obstacle
- Positive rate of climb is well established and out of ground effect: Landing gear up
- Continue climbing:
  - at Vx with landing gear up (96 MPH) with actual or simulated obstacle, or
  - at Vy with landing gear up (100 MPH) if no obstacle
- Clear of obstacles:
  - Establish Vy pitch attitude and climb at Vy - 100 MPH
  - Verify airspeed and retract flaps in increments (25° to 10°, 10° to 0°)

Procedures description:
1. At the hold short line, ensure the appropriate checklist is complete, flaps are set to 25° and trim is set for takeoff.
   a. Visually verify outside that the flaps are in takeoff position.
   b. Verify that the trim is in takeoff position, which is slightly aft of neutral. Refer to the POH / AFM.
2. Contact the control tower for clearance, or at non-towered airports, make a radio call.
   Complete the final takeoff SOP items.
3. Hold the yoke full aft (yoke in the lap) while taxiing the aircraft into position on the runway to take as much weight as possible off the nosewheel.

NOTE
Remember, even when on a paved runway, in other than actual soft-field conditions (mud, snow, slush, grass, etc.) you are still simulating taxiing on such a surface.

In order not to bog down in the soft surface:
DO NOT STOP the airplane until airborne.
Keep the weight off the nosewheel until stabilator is effective.

Keep the nosewheel off the ground once the stabilator is effective, and until airborne.

4. Maximize available runway distance while aligning the aircraft with the centerline, but DO NOT STOP and continue applying full aft yoke pressure.
5. Minimize use of brakes while turning, and move your feet off the brakes completely when aligned with the centerline.
6. Check the windsock indications. If crosswind is present, apply the crosswind techniques as described in “Normal and Crosswind Takeoff and Climb”, and elsewhere, throughout this procedure.

7. Smoothly and positively set full throttle.
   a. Simultaneously, compensate with the rudder to remain on the centerline and,
   b. release some of the aft yoke pressure in order to avoid a tail strike.

8. Check that engine instruments display normal readings and 100% power appropriate to the airport elevation.

9. As the aircraft accelerates and the nose comes off the runway, adjust the yoke backpressure to maintain a constant aircraft pitch with the nosewheel just off the ground.

   **NOTE**
   During the ground roll, to maintain a constant pitch and the nosewheel off the ground, the yoke aft pressure will typically have to be released with increase in airspeed due to increased stabilator effectiveness. The goal is for aircraft pitch in relation to the horizon to remain constant, and to adjust yoke pressures accordingly.

10. Utilize rudder pedal steering to maintain runway centerline.

11. As the aircraft leaves the runway, immediately lower the nose to remain in ground effect.

12. While remaining in ground effect, accelerate to:
   a. Vx with gear down (85 MPH) if actual or simulated obstacles are present, or
   b. Vy with gear down (95 MPH) if no obstacle.

   **NOTE**
   While accelerating in ground effect, forward pressure on the yoke may have to be increased significantly, but just enough to prevent the nose of the airplane from rising and leaving the ground effect prematurely as a result, before attaining the desired airspeed.

13. Upon reaching the desired airspeed as above, initiate a climb at:
   a. Vx with gear down (85 MPH) if actual or simulated obstacles are present, or
   b. Vy with gear down (95 MPH) if no obstacle.

14. Establish a positive rate of climb, as confirmed visually and on instruments (VSI and altimeter).
   a. Ensure that there is no possibility of the aircraft settling back on the runway.
   b. Apply brake pressure to stop wheel rotation.
   c. Retract the landing gear in order to increase climb performance.

15. If actual or simulated obstacles are present, continue at Vx with landing gear up (96 MPH) and maintain it until all obstacles are cleared.

16. Once clear of the obstacles, or right away, if there is no obstacle, establish a Vy climb attitude and accelerate to Vy airspeed with landing gear up (100 MPH).
   a. Verify airspeed and retract remaining flaps in increments. First, retract flaps from 25° to 10°.
   b. Allow the aircraft to stabilize, then retract the remaining flaps from 10° to 0° during the climbout.

17. At 500' AGL, initiate the “Climb” checklist, and verify full power is set and being achieved.
18. At 1000’ AGL, if leveling off and remaining in the pattern, reduce power to maintain traffic pattern airspeed (18”/2400 RPM), or as appropriate.

19. If departing the traffic pattern, continue climbing at $V_y$ (100 MPH) or $V_{climb}$ (110 MPH), as appropriate.
   
a. Maintain full power if maximum climb performance is required or reduce the power to the climb power setting 25”/2500 RPM

20. Monitor engine oil temperature in the climb and reduce the climb gradient, while increasing the climb airspeed, as necessary, to maintain proper engine cooling.

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Flaps set 25° and checked, as appropriate. Maximize Runway Distance. Maintain backpressure on the yoke to keep weight off the nosewheel. AVOID BRAKING OR STOPPING. Set full throttle. Check engine instruments and state "Full Power".

Adjust backpressure to hold the nosewheel off the runway until the aircraft lifts off.

Immediately apply forward pressure and lower the nose to stop climbing and remain in ground effect.

While in ground effect, accelerate to Vy climb speed.

Maintain Vy pitch attitude and continue climbing at Vy = 100 MPH, or as appropriate.

Maintain Vy. Once positive rate of climb is established, retract gear, then flaps, in increments.

SOFT-FIELD TAKEOFF (without obstacle)
**SOFT-FIELD TAKEOFF (with obstacle)**

- Flaps set 26° and choked, as appropriate.
- Maximize Runway Distance.
- Maintain backpressure on the yoke to keep weight off the nosewheel.
- AVOID BRAKING OR STOPPING.
- Set full throttle.
- Check engine instruments and state "Full Power".

- Maintain backpressure to hold the nosewheel off the runway.
- Complete callouts: "Engine indications normal"; "Airspeed alive";

- Adjust backpressure to hold the nosewheel off the runway until the aircraft lifts off.
- Immediately apply forward pressure and lower the nose to stop climbing and remain in ground effect.

- While in ground effect, accelerate to Vx climb speed.
- Upon reaching Vx, immediately begin climbing at Vx.

- Maintain Vx until clear of obstacles.
- Positive rate: Retract gear.

- Maintain Vy pitch attitude and continue climbing at Vy = 100 MPH, or as appropriate.

- When clear of obstacles:
  - Establish Vy pitch attitude.
  - Retract flaps, in increments.
  - Accelerate to Vy speed.

- End of Runway OBSTACLE HEIGHT (typical simulated obstacle 81 ft above ground level).
SOFT-FIELD APPROACH AND LANDING

Objective
Flight crews will develop the ability to safely and accurately execute a soft-field approach and landing in actual or simulated soft-field conditions (mud, snow, slush, grass, etc.)

Quick reference:
- Conduct traffic pattern, as appropriate (see previous)
- Final approach leg – flaps full 40°, 83 MPH (or as appropriate)
- Ensure all callouts and landing gear verifications are complete
- Touchdown softly in the first 1,000 feet of 1/3 of the runway, whichever is less
- Keep the nosewheel off the ground as long as possible
- Minimize braking and maintain forward movement, avoid stopping

Procedures description:
1. Ensure that the required traffic pattern has been conducted, as specified in this chapter.
2. If crosswind is present, apply the crosswind techniques as described in “Normal and Crosswind approach and landing” and elsewhere, throughout this procedure.
3. Adjust the final approach speed by adding ½ the gust factor, if appropriate, to the soft field final approach speed of 83 MPH.
4. Use full 40° of flaps, or select the appropriate final flap setting based on the wind conditions (refer to Traffic Pattern Operations)

NOTE
If reduced flap setting is used due to crosswind conditions, take into account the increased landing distance requirements and ensure adequate runway distance exists.

5. Ensure that the aircraft is on a stabilized approach with a final flap setting prior to reaching 300’ AGL.
6. Ensure that all callouts and landing gear verifications are complete. Refer to the Crew Coordination chapter as well as Normal Flows and Checklists chapter in this manual.
7. Coordinate pitch and power so as to maintain and the desired approach angle resulting in a smooth landing within the designated area.
   a. The PF should expect the pitch of the aircraft while maintaining soft-field approach speed to be somewhat different from the pitch during the normal approach speed.
8. During flare, slow the aircraft descent rate by simultaneously increasing the pitch and smoothly reducing the power to idle, so that the aircraft touches down smoothly on the main gear, with the nosewheel off the ground, in the first 1,000 feet or 1/3 of the runway, whichever is less.
   a. The PF should consider that, at typical soft-field approach speeds, the aircraft will potentially reach MCA sooner than during a normal landing, and adjust flare timing accordingly.
   b. Hold the airplane off the runway (1 ft or closer) as long as possible (“Stop the plane from landing”) by adding aft yoke pressure as the aircraft slows down. The aircraft should not touch down until it is no longer aerodynamically possible to continue holding if off.
c. It is acceptable to add a small amount of power just before touchdown in order to soften it. Add just enough power to hear the engine pick up speed. Anything more would typically result in excessive float and possibly ballooning.

**CAUTION**

*Avoid closing the throttle too early or too rapidly during flare, as it will likely result in an immediate increase in the rate of descent and a hard landing.*

9. Immediately after touchdown, continue “flying the airplane” by applying backpressure to the yoke, and adjusting the rudder pressures as the airplane slows down.

10. Maintain increasing back pressure on the yoke throughout the landing roll to avoid hard touchdown of the nose wheel and to maximize aerodynamic braking.

11. Do not allow the nosewheel to touchdown until it becomes unavoidable due to decreased control effectiveness.

12. As the nosewheel touches down, the yoke should be fully aft (“in the lap”) and remain there to take as much weight as possible off the nosewheel.

13. Slow the aircraft to a safe taxi speed and taxi off the runway, or as appropriate.
GO-AROUND / REJECTED LANDING

Objective
Flight crews will develop the ability to reach a timely go-around decision and smoothly execute a rejected landing / go-around procedure, transitioning from a descent in landing configuration into a maximum performance climb.

Quick reference – remember the five C’s:

Cram: Full power, level the pitch, flaps (if full) from 40° to 25° immediately
Climb: Ease into a climb, check for positive rate of climb (ALT/VSI increase)
Clean:
  • Retract the landing gear and accelerate to Vx(with obstacles) or Vy (without)
  • When clear of obstacles, flaps up in increments (25° to 10°, then 10° to 0°)
  • Continue climbing at Vy (100 MPH)
Call – announce go-around, as appropriate
Checklist – verify the appropriate climb checklist flows (Flaps? Gear? Airspeed?)

Procedure description:

1. Once the decision has been made to initiate a go-around (aka rejected landing), simultaneously establish a level pitch attitude, apply full power (mixture/props/throttle – full forward) and level the wings.
2. Immediately set flaps from 40° to 25° (if fully extended).
3. Establish a positive rate of climb by simultaneously easing into a climb, and cross-checking VSI and altimeter for needle reversal.
4. Once established in a positive rate climb as indicated visually and by needle reversal, with no possibility of ground contact and/or out of usable runway, retract the landing gear to increase climb performance.

<table>
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<th>NOTE</th>
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<td>During a go-around, flight crews should use Vx climb airspeed and flaps at 25° if obstacle clearance is required and until all obstacles have been cleared.</td>
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5. Pitch for and accelerate to Vx, 96 MPH (with obstacles) or Vy, 100 MPH (without obstacles).
6. When clear of obstacles, if any:
   a. Pitch for and accelerate to Vy (100 MPH)
   b. Verify airspeed and retract remaining flaps in increments. First, retract flaps from 25° to 10°.
   c. Allow the aircraft to stabilize, then retract the remaining flaps from 10° to 0° during the climbout.
7. Continue climbing at Vy (100 MPH).
8. When aircraft is under complete control and safely established in a climb, transmit the go-around intentions on the radio, as appropriate.
   a. This step may occur earlier in the go-around process as situation allows. Remember to fly the plane as your first priority.
9. If no aircraft is on the runway or departing, climb straight over the runway and maintain ground track along the runway extended centerline using coordinated rudder and aileron control inputs.
10. If an aircraft is on the runway or taking off, alter course somewhat to the right, or as directed by the control tower, just enough to keep the departing aircraft in sight.

**CAUTION**

*Flight crews are cautioned about altering course toward a parallel runway unless authorized to do so by the control tower, due to the possibility of midair conflicts with other aircraft.*

11. Remember to continue climbing to TPA, or as otherwise instructed by ATC.
   a. Unless otherwise instructed by the control tower, ensure that, if remaining in the pattern, the turn to crosswind is not made until you are at least TPA – 300 feet (typically 700 AGL) and ≈ ¼ mile past the runway departure end.

12. Perform the Climb Checklist flow and verify the checklist as soon as practical.

**NOTE**

It has been noticed through experience and observation that there is often a common, improper tendency to level off when executing a go-around / missed approach at some intermediate altitude, and to accelerate in level flight, instead of continuing to climb, as is required. This altitude is often just slightly higher than the altitude at which the go-around / missed approach commenced. Unfortunately, it is also sometimes too low to clear obstacles, particularly at night or during instrument approaches, when visibility is restricted.

The initial level off and acceleration during a go-round, when started from a fairly steep, low power descent on final approach, probably makes the pilot’s body orientation systems perceive, incorrectly, that it is in a steep climb attitude (a form of illusion; refer to AIM), instead of the undesired level flight that is actually occurring.

To combat this tendency, recognize that such possibility exists, and cross-check instrument indications to ensure that the aircraft is in a positive rate of climb at the correct airspeed.

**Remember: the first and most important step of a go-around / missed approach is always the same: CLIMB IMMEDIATELY**

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180° POWER-OFF ACCURACY APPROACH AND LANDING
(Simulated Emergency Approach and Landing to Runway)

Objective
Flight crews will develop the ability to conduct an accurate power-off approach from downwind abeam the selected landing point (“key position”), while becoming familiar with aircraft glide characteristics under a simulated engine failure scenario.

Quick reference:
- Appropriate ATC clearance received and Before Landing checklist flows complete
- Position on downwind, 1000’AGL, abeam landing point (“key position”)
- Power to idle, establish and maintain Best Glide airspeed: 105 MPH
- Continuously evaluate wind strength and direction
- When appropriate, turn base, evaluate ground track and glidepath
- Use flaps and slip as needed to control descent rate, while remaining at Best Glide airspeed
- Touchdown no more than 200 ft beyond specified landing point (Commercial Pilot) or safely on the runway (Private Pilot)

Description:
1. Ensure that all necessary arrival procedures, checklists, Before Landing flows and downwind landing gear verification have been completed prior to starting the procedure, and that appropriate ATC clearance has been obtained.
   a. If at non-towered airport, inform the traffic about the intent to conduct a short approach, and ensure that it will not disrupt the traffic flow.
2. Select a touchdown point no more than 1/3 or 1000’ down the landing runway, whichever is less.
3. At 1000’ AGL and abeam the intended touchdown point on downwind leg (“key position”), reduce power to idle and establish best glide airspeed, 105 MPH
   a. Immediately evaluate both wind strength and direction, as they will be some of the greatest factors in determining when to begin turning base, and the consequent ground track to take toward the runway.
   b. A strong tailwind on downwind and, consequently, a strong headwind on final approach, will necessitate an earlier turn toward the runway, and significantly reduce the glide distance on final.
4. After turning base, evaluate the glide, and adjust aircraft ground track, as necessary, to ensure the runway and the desired point are reached.
5. Apply flaps and utilize slips, as necessary, to adjust the rate of descent.
   a. Utilizing flap setting of 40° will add significant drag and reduce the glide distance.
   b. The pilot should be cautious in deciding when to deploy full flaps, in order not to undershoot the desired landing point.
   c. Typically, due to inherent high drag and high descent rate of the PA28R200 with gear down, flaps down and propeller full forward, it would be a rare situation when a forward slip would be required to further increase the descent rate.
6. Once clear of any obstacles, maintain the appropriate approach angle, and increase pitch as necessary so that aircraft touches down smoothly, in a positive pitch attitude, on the main gear at or no more than 200 ft beyond the designated touchdown point (Commercial Pilot).
   a. Student Pilots/Private Pilots practicing this maneuver during simulated emergency approach and landing to a runway, need only to touchdown safely on the runway where ability to stop safely before the runway departure end is never in doubt.

7. Upon touchdown, brake as necessary and slow to taxi speed.

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<tr>
<td>This procedure will only be conducted to a full-stop landing.</td>
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<tr>
<td>This does not preclude a safety-related go-around, regardless of whether the wheels made contact with the runway.</td>
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SLOW FLIGHT AND STALLS

MANEUVERING DURING SLOW FLIGHT
(Clean Configuration: FLAPS UP, GEAR UP)

Objective
Flight crews will develop the ability to recognize changes in the aircraft flight characteristics and control effectiveness at critically slow airspeeds in takeoff configuration, while maintaining positive aircraft control, altitudes and headings, as specified.

WARNING
The minimum altitude during any portion of this maneuver is 1,500’ AGL.

Quick reference:
- Stabilize at no more than 120 MPH, select and maintain ALT and HDG
- Throttle ≈ 12” MP
- Monitor AS, maintain ALT and HDG
- Below 115 MPH: Propeller full forward
- Approaching MCA – throttle ≈ 19” MP
- Maintain MCA just above Vs1 (71 MPH)
- When prompted, recover – Full Power, adjust pitch, maintain HDG and ALT

Procedures description:
1. Ensure that all pre-maneuver checklist items, clearing turns and a radio call are complete, as specified.
2. Configure the aircraft for straight-and-level flight. Choose a visual reference point on the horizon and note the heading to maintain during the maneuver.
3. Set the throttle to 12” MP. During the power reduction, maintain altitude by smoothly increasing pitch as airspeed decreases. Trim the aircraft if and as necessary.
4. When airspeed decreases below 115 MPH, increase propeller control to full forward, maximum RPM setting.
5. Approaching slow flight airspeed Vs1 (71 MPH), increase the power to ≈ 19” MP (this setting will vary based on density altitude).
6. Maintain airspeed and altitude by adjusting pitch and power.

NOTE
The required power setting to maintain slow flight airspeed will vary depending on aircraft weight, loading and density altitude. Typically, high density altitude power setting required will be significantly higher than lower density altitude power setting.

7. Perform straight-and-level flight, turns, climbs and descents using specified bank angles while maintaining flight at minimum airspeed.
   a. It helps to remember the following: “Pitch for airspeed, power for altitude”, as a quick reminder that the pitch required to remain at MCA must be held, while power adjustments are made to control aircraft altitude.
8. Recover the maneuver by smoothly applying power, adjust pitch to maintain the altitude as the airspeed increases, and trim the aircraft as necessary.
   a. Maintain HDG and ALT throughout the recovery.
9. Resume cruising at PX area power setting (19"/2400 RPM) or as specified.

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NOTE: Coordinated flight means the airplane is at the desired pitch and bank, while aligned with relative wind (ball is centered). Use whatever control inputs necessary to achieve coordinated flight during the Slow Flight maneuver.

Level power setting (approx. 19° MP/Prop Full RPH) will vary significantly with density altitude. It may be higher on a hot summer day, and lower on a cold winter day. Plan and adjust accordingly.

Reduce power to 12° MP. As airspeed decreases, adjust pitch attitude to maintain altitude. Below 115 MPH: Propeller Full Forward.

Reaching just above V\$_1 = 71 MPH
Adjust power to maintain level flight (approx. 19° MP). This is your level power setting, and it will vary.

Maintain: Altitude, Heading, Airspeed, Coordination.

Stabilize at MCA (Minimum Controllable Airspeed)
Make only SMALL changes to bank, pitch and power.

Perform straight and level flight, turns, climbs and descents, as specified. Throughout the maneuver, maintain MCA.

Increase power above level power to climb, if desired, while continuing to adjust the pitch for MCA.

Reduce power below level power to descend, if desired, while continuing to adjust the pitch for MCA.

Recovery: Smoothly apply full power. As airspeed increases, adjust pitch to maintain altitude.

Maintain heading, altitude and coordination.

Return to heading, altitude and airspeed, as specified.

SLOW FLIGHT - Clean Configuration
MANEUVERING DURING SLOW FLIGHT
(Landing/ Dirty Configuration: Flaps DOWN, Gear DOWN)

Objective

Flight crews will develop the ability to recognize changes in the aircraft flight characteristics and control effectiveness at critically slow airspeeds in landing configuration, while maintaining positive aircraft control, altitudes and headings, as specified.

Quick reference:

- Stabilize at no more than 120 MPH, select and maintain ALT and HDG
- Throttle ≈ 15” MP
- Monitor A/S, maintain ALT and HDG
- Below $V_{lo\text{ gear down}}$ (150 MPH) – Extend the landing gear
- Below $V_{fe}$ (125 MPH) – flaps down in increments, until 40° (full) by 90 MPH
- Below 115 MPH: Propeller full forward
- Approaching MCA: throttle ≈ 21” MP
- Maintain MCA just above $V_{s0}$ (64 MPH)
- When prompted, recover:
  - Full power, flaps from full to 25° immediately
  - Below $V_{lo\text{ gear up}}$ (125 MPH): Retract the landing gear
  - Maintain HDG and ALT
  - Passing into green arc, $V_{s1}$ (71 MPH) – flaps from 25° to 10°
  - Passing ≈ 90 MPH – flaps from 10° to 0° (up)

**WARNING**

The minimum altitude during any portion of this maneuver is 1,500’ AGL

Procedures description:

1. Ensure that all pre-maneuver checklist items, clearing turns and a radio call are complete, as specified.
2. Configure the aircraft for straight-and-level flight. Choose a visual reference point on the horizon and note the heading to maintain during the maneuver.
3. Set the throttle to 15” MP. During the power reduction, maintain altitude by smoothly increasing pitch as airspeed decreases. Trim the aircraft if and as necessary.
4. Below $V_{lo}$ (gear down) (150 MPH), extend the landing gear.
5. Below $V_{fe}$ (125 MPH), smoothly add flaps, in increments, until 40° (full).
   a. Aim to have the flaps completely down by 90 MPH (equivalent of normal final approach speed.
6. When airspeed decreases below 115 MPH, increase propeller control to full forward, maximum RPM setting.
7. Below $V_{fe}$ (125 MPH), smoothly add flaps, in increments, until 40° (full).
8. Approaching slow flight airspeed $V_{s0}$ (64 MPH), increase the power to ≈ 21” MP (this setting will vary).
9. Maintain MCA and altitude by adjusting pitch and power.
NOTE
The required power setting to maintain slow flight airspeed will vary depending on aircraft weight, loading and density altitude. Typically, high density altitude power setting required will be significantly higher than lower density altitude power setting.

10. Perform straight-and-level flight, turns, climbs and descents using specified bank angles while maintaining flight at minimum airspeed.
   a. It helps to remember the following: “Pitch for airspeed, power for altitude”, as a quick reminder that the pitch required to remain at MCA must be held, while power adjustments are made to control aircraft altitude.
11. Recover the maneuver by smoothly applying full power from right to left (M/P/T) and immediately bringing flaps from 40° to 25°. Adjust pitch to maintain the altitude as the airspeed increases, and trim the aircraft as necessary.
   a. Maintain HDG and ALT throughout the recovery.
12. Retract the landing gear.
   a. Ensure that this step is accomplished before Vlo gear up, 125 MPH
13. As the airplane accelerates past 71 MPH (green arc), retract flaps from 25° to 10°.
14. Passing through 90 MPH retract flaps from 10° to 0° (up).
   a. Ensure that this step is accomplished before Vfe, 125 MPH
15. Resume cruising at PX area power setting (≈ 19”/2400 RPM) or as specified.

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NOTE: Coordinated flight means the airplane is at the desired pitch and bank, while aligned with relative wind (ball is centered). Use whatever control inputs necessary to achieve coordinated flight during the Slow Flight maneuver.

Level power setting (approx. 21" MP/Prop Full RPM) will vary significantly with density altitude. It may be higher on a hot summer day, and lower on a cold winter day. Plan and adjust accordingly.

**Power**: 150 MP

**Below Vlo(down)**

- 150 MPH: Landing gear down.
- Below Vlo 125 MPH: Flaps down, in increments, until 40° by 90 MPH.
- Below 115 MPH: Propeller Full Forward.

**As airspeed decreases, adjust pitch attitude to maintain altitude.**

**Reaching just above Va = 64 MPH**

**Stabilize at MCA (Minimum Controllable Airspeed)**

**Adjust power to maintain level flight**

**Perform straight and level flight, turns, climbs and descents, as specified.**

**Maintain:**

- Altitude, Heading;
- Airspeed, Coordination

**Throughout the maneuver, maintain MCA.**

**Increase power above level power to climb, if desired, while continuing to adjust the pitch for MCA.**

**Reduce power below level power to descend, if desired, while continuing to adjust the pitch for MCA.**

**Make only SMALL changes to bank, pitch and power.**

**As airspeed increases, adjust pitch to maintain altitude. Immediately raise flaps from 40° to 25°. Retract the landing gear.**

**As airspeed reaches green arc, raise flaps from 25° to 10°.**

**Maintain heading, altitude and coordination.**

**Above 90 MPH, raise flaps from 10° to 0°.**

**Recovery:**

- Smoothly apply full power.
- As airspeed increases, adjust pitch to maintain altitude.
- Return to heading, altitude and airspeed, as specified.
POWER-ON STALL
(Take-off and departure stall in clean configuration: Flaps UP, Gear UP)

Objective

Flight crews develop the ability to recognize changes in the aircraft flight characteristics and control effectiveness as the stall approaches in the power-on (take-off and climb) configuration, and to make prompt and effective recovery either before the stall occurs (imminent stall recovery) or after the stall occurs (full stall recovery).

**WARNING**

The minimum altitude during any portion of this maneuver, including recovery, is 1,500’ AGL.

Quick reference:
- Setup – simulate takeoff and climb procedure
  - Power ≈12” MP
  - Maintain altitude and heading on entry
  - Below 115 MPH: prop full forward
  - Wait for Vr+10 MPH (75 MPH)
- Rotation and climb – simulate rotation and climb
  - At 75 MPH, add power to 22” and simulate rotation and climb
  - Simultaneously, add as much rudder as required to maintain coordination
- Stall entry – simulate a stall after rotation and climb close to the ground
  - Maintain heading or set angle of bank (up to 20°), as specified
  - Pitch up to simulate excessive climb pitch (~15° nose-up), and
  - Maintain as much rudder pressure as required to maintain coordination
  - Continue maintaining the pitch and induce imminent or full stall, as specified
- Recovery – recover from stall and simulate climbing away from approaching terrain
  - Reduce the angle of attack
  - Maintain coordination
  - Reestablish a safe climb pitch attitude

Procedure description:

1. Ensure that all pre-maneuver checklist items, clearing turns and a radio call are complete, as specified.
2. Configure the aircraft for straight-and-level flight and choose a reference point on the horizon and heading to begin the maneuver.
3. Reduce the power to ≈12” MP. During the airspeed reduction, maintain altitude by smoothly increasing pitch as airspeed decreases. Trim the aircraft for takeoff to simulate takeoff and climb conditions.
4. Below 115 MPH, increase the propeller control to Full Forward, Maximum Rpm.
5. Approaching Vr + 10 MPH (75 MPH), increase the power to 22” MP. The reduced power setting is used instead of full power to avoid excessive pitch attitude and its effect on the subsequent recovery.
6. Simultaneously with adding power, pitch up slightly excessively to simulate over-rotation and excessive climb pitch attitude (~15° nose up pitch).
   a. The desired pitch attitude should be just above the maximum pitch attitude where the aircraft can sustain a climb without stalling.
b. Thus, it will be the minimum pitch attitude required to induce a stall in timely fashion with full takeoff power.

c. The exact pitch attitude will vary with density altitude and other performance factors.

d. Simultaneously, be prepared for and **add as much rudder as necessary** to maintain coordination (ball centered).

e. Ideally, the ball should never leave center as power is added and pitch is increased.

f. Once established, maintain that excessive pitch attitude by outside visual references, only occasionally referring to the attitude indicator as a backup.

7. Maintain original heading or set up to 20° of bank, left or right, as specified.

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<tr>
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8. Continue simulating excessive pitch attitude that can occur after rotation / during climb.

   a. **Maintain that pitch attitude** by smoothly increasing backpressure as airspeed decreases until stall occurs.

   b. Remember to establish and maintain proper pitch as described in step 4, but do not continue pitching up excessively above what is required.

9. Recover from **IMMINENT STALL** or from **FULL STALL**, as specified.

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<tr>
<td>➢ <strong>FULL STALL</strong>: A sudden loss of control effectiveness, excessive sink rate, or sudden decrease in pitch attitude; The aircraft HAS stalled.</td>
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10. Initiate a recovery by promptly decreasing the angle of attack. If appropriate, level the wings.

11. Once the aircraft is no longer stalled, pitch for an attitude that ensures a minimal loss of altitude and positive climb rate.

12. Maintain positive climb rate and pitch for **Vx** or **Vy**, as appropriate, to simulate climbing away from approaching terrain.

13. Return to the specified altitude, airspeed and heading. Resume cruising at PX area power setting (≈19°/2400 RPM) or as specified.
NOTE: A Power-ON Stall simulates a stall that may occur after rotation and during climb

Power: 12" MP
Maintain altitude and heading
Below 115 MPH:
Propeller Full Forward

As airspeed decreases, adjust pitch attitude to maintain altitude.

Approaching
V₁+10 MPH = 70 MPH
Simulate rotation and establish excessive pitch attitude.
Increase power to 22" MP

Maintain:
Power setting;
Coordination;
Pitch attitude;
Heading

Announce "Imminent Stall!", as appropriate.

Imminent Stalls:
Recover immediately as specified.

Full Stalls: Induce full stall and recover as specified.

As flying speed returns, transition smoothly into Vᵧ (best rate of climb) pitch attitude.
Minimize altitude loss.

Maintain Vᵧ pitch attitude as the airplane accelerates to the Vᵧ speed of 100 MPH.
Then, maintain Vᵧ climb, as specified, to simulate climbing away from approaching terrain.

Return to heading, altitude and airspeed, as specified.

Power - ON Stall
POWER-OFF STALL
(Approach and Landing Stall in Dirty Configuration: Flaps DOWN, Gear DOWN)

Objective
Flight crews will develop the ability to recognize changes in the aircraft flight characteristics and control effectiveness as the stall approaches in the power-off (landing) configuration, and to make prompt and effective recovery either before the stall occurs (imminent stall recovery) or after the stall occurs (full stall recovery).

WARNING
The minimum altitude during any portion of this maneuver, including recovery, is 1,500’ AGL.

Quick reference:
- **Set up – simulate landing procedure**
  - Throttle ≈ 15” MP
  - Monitor A/S, maintain ALT and HDG
  - Below $V_{lo}$ gear down (150 MPH): Extend the landing gear
  - Below $V_{fe}$ (125 MPH): flaps down in increments, until 40° (full) by 90 MPH
  - Below 115 MPH: Propeller full forward
- **Approach – simulate final approach**
  - 90 MPH - establish normal descent to a simulated runway
- **Stall entry – simulate a stall during approach / flare close to the ground**
  - Reduce power to idle
  - Maintain heading or set angle of bank, as specified (up to 20°)
  - Increase pitch to flare pitch attitude
  - Hold flare pitch attitude and induce imminent or full stall, as specified
- **Recovery – recover from stall and climb away from simulated approaching terrain**
  - Reduce the angle of attack, add full power, then level the wings
  - Flaps from 40° to 25°
  - Establish $V_X$ or $V_Y$ pitch attitude to climb away from simulated terrain
  - Positive rate of climb:
    - Retract the landing gear
    - Flaps from 25° to 10°
  - Passing 90 MPH – flaps from 10° to 0° (full up)

Procedures description:
1. Ensure that all pre-maneuver checklist items, clearing turns and a radio call are complete, as specified.
2. Configure the aircraft for straight-and-level flight and choose a reference point on the horizon and heading to begin the maneuver.
3. Set power to $\approx 15”$ MP. During the airspeed reduction, maintain altitude by smoothly increasing pitch as airspeed decreases. Trim the aircraft as necessary.
4. Below $V_{lo}$ (gear down) (150 MPH), extend the landing gear.
5. Below $V_{fe}$ (125 MPH), smoothly add flaps, in increments, until 40° (full).
   a. Aim to have the flaps completely down by 90 MPH (equivalent of normal final approach speed.
6. When airspeed decreases below **115 MPH**, increase propeller control to full forward, maximum RPM setting.

7. At **90 MPH**, establish a normal landing approach to a simulated runway and stabilize the aircraft.
   a. As soon as the aircraft is stabilized in landing approach descent, begin the next step.
   b. No particular altitude loss is required. As one suggested technique, a pilot may count “1-2-3” once the airplane is established in a stabilized descent before simulating flare.

8. Reduce throttle to **IDLE** to begin simulating landing flare.
   a. Maintain original heading or set up to **20°** of bank, left or right, as specified.

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9. Simulate landing flare pitch.
   a. Establish simulated landing flare pitch attitude that will induce a stall.
   b. **Maintain that pitch attitude** by smoothly increasing backpressure as airspeed decreases, until stall occurs.
   c. Remember to establish and maintain landing flare pitch, but do not pitch up excessively.

10. Recover from **IMMINENT STALL** or from **FULL STALL**, as specified.
    | NOTE |
    |------|
    | ➢ **IMMINENT STALL**: Buffeting, stall warning light, or rapid decay of control effectiveness (whichever occurs first); The aircraft is **ABOUT** to stall. |
    | ➢ **FULL STALL**: A sudden loss of control effectiveness, excessive sink rate, or sudden decrease in pitch attitude; The aircraft **HAS** stalled. |

11. Initiate a recovery by promptly decreasing the angle of attack. Simultaneously, apply full power to minimize altitude loss. If appropriate, level the wings.
   a. Immediately, retract flaps to from **40° to 25°**.

12. Once the aircraft is no longer stalled pitch for an attitude that ensures a minimal loss of altitude and positive climb rate.
   a. Pitch for Vx or Vy, as appropriate, to simulate climbing away from approaching terrain.

13. Establish a positive rate of climb
   a. Confirm it by outside pitch attitude reference and airspeed indications
   b. Confirm altimeter and Vertical Speed Indicator needles reverse their trends

14. Retract the landing gear.
   a. Ensure that this step is accomplished before Vlo gear up, 125 MPH

15. Retract flaps from **25° to 10°**.

16. As the airplane accelerates in the climb and past **90 MPH**, retract flaps to **10° to 0° (full up)**.
   a. Ensure that this step is accomplished before Vfe, 125 MPH

17. Maintain Vy pitch attitude and climb at Vy (**100 MPH**).
   a. Continue climbing at Vy away from simulated terrain.
18. Return to the specified altitude, airspeed and heading.
19. Resume cruising at PX area power setting (≈19”/2400 RPM) or as specified.

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DEMONSTRATION STALLS and MANEUVERS

ACCELERATED STALL (CFI demonstration only)

Objective

CFIs will develop instructional ability to demonstrate and PUIs the ability to recognize, avoid and recover from situations leading to accelerated stalls, while developing practical knowledge that demonstrates the relationship between increasing aircraft bank angle and the consequent increase of stall speed.

WARNING

The minimum altitude during any portion of this maneuver, including recovery, is 1,500’ AGL

Quick reference

- Accelerated Stall – banking excessively while maintaining altitude in a turn
  - Power ≈ 15” MP
  - Maintain altitude and heading on entry
  - Below 115 MPH: propeller full forward
  - Reaching 105 MPH:
    - Throttle to IDLE
    - Establish 45° of bank and maintain altitude
  - Induce an imminent stall within 90° of heading change
    - Note the (high) airspeed value at which the first stall indication occurs
    - Recover from imminent stall at the first indication of a stall
    - Point out the airspeed value at which the stall warning occurred
  - Explain what would happen if recovery was not effected immediately

Procedure Description:

1. Ensure that all pre-maneuver checklist items, clearing turns and a radio call are complete, as specified.
2. Configure the aircraft for straight-and-level flight and choose a reference point and/or heading to begin the maneuver.
3. Set the throttle to 15” MP, and trim the aircraft as necessary.
4. During the power reduction maintain altitude by smoothly increasing pitch as the airspeed decreases.
5. Below 115 MPH, increase propeller control to full forward, maximum RPM.
6. As the airspeed approaches 105 MPH, set the throttle to IDLE and establish a coordinated 45° bank, in the direction specified, while smoothly and firmly applying back pressure to maintain altitude.

WARNING

Flight crews shall ensure that the aircraft remains below $V_A$ at all times.
This speed restriction must be observed to prevent exceeding aircraft load limits.
7. Do not exceed 45° of bank.

**NOTE**
Establish the bank rapidly while firmly applying back pressure to maintain altitude, ensuring that the stall is reached and recovery initiated prior to completing 90° of heading change.

8. Continue to apply the back pressure until the **first indications of a stall**(imminent stall) occur within 90° of the heading change.
9. Announce, “Stall Warning” and initiate the recovery by reducing the pitch attitude.

**WARNING**
This maneuver may be flown to IMMINENT STALL ONLY.

10. Initiate a recovery **within 90°** of the entry heading by promptly and simultaneously applying full power, decreasing the angle of attack and leveling the wings.
11. Establish a climb speed of **96 MPH** ($V_X$) or **100 MPH** ($V_Y$) to simulate recovery close to approaching terrain, as specified.
12. Resume normal cruise or transition cruise flight.
13. Point out the airspeed at which stall warning occurred, and explain what would happen if immediate recovery action was not taken.
   a. Emphasize that whenever bank is increased in level turns, stall speed goes up.

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ELEVATOR TRIM STALL (CFI demonstration only)

Objective
CFIs will develop instructional ability to demonstrate, and PUIs the ability to recognize, avoid and recover from situations leading to elevator trim stalls, while developing practical knowledge that demonstrates how elevator trim set for approach airspeeds at low power settings can lead to an inadvertent stall should a high power setting be applied.

WARNING
The minimum altitude during any portion of this maneuver, including recovery, is 1,500’ AGL
This maneuver may be flown to IMMINENT STALL ONLY.

Quick reference:
- **Set up** – simulate landing procedure
  - Throttle ≈ 15” MP
  - Monitor A/S, maintain ALT and HDG
  - Below \( V_{lo \text{ gear down}} \) (150 MPH): Extend the landing gear
  - Below \( V_{fe} \) (125 MPH): flaps down in increments, until 40° (full) by 90 MPH
  - Below 115 MPH: Propeller full forward
- **Approach** – simulate final approach at IDLE power
  - 90 MPH - establish normal descent to a simulated runway
  - Power to IDLE and TRIM for hands-off 90 MPH descent
- **Stall entry** – simulate improper go-around while trimmed for final approach speed
  - Add FULL power
  - Allow pitch to increase excessively
    - Note excessive pitch attitude at which the first stall indication occurs
- **Recovery** – recover from stall and climb away from simulated approaching terrain
  - Reduce AOA, then level the wings
    - Overpower the excessive trim force with yoke pitch input
    - Trim rapidly to reduce adverse trim forces
  - Flaps from 40° to 25°
  - Establish \( V_X \) or \( V_Y \) pitch attitude to climb away from simulated terrain
  - Positive rate of climb:
    - Retract the landing gear
    - Flaps from 25° to 10°
  - Passing 90 MPH – flaps from 10° to 0° (full up)
- Explain what would happen if recovery was not effected immediately

Procedure Description:
1. Ensure that all pre-maneuver checklist items, clearing turns and a radio call are complete, as specified.
2. Configure the aircraft for straight-and-level flight and choose a reference point and/or heading to begin the maneuver.
3. Set power to \( \approx 15” \) MP. During the airspeed reduction, maintain altitude by smoothly increasing pitch as airspeed decreases. Trim the aircraft as necessary.
4. Below \( V_{lo \text{ (gear down)}} \) (150 MPH), extend the landing gear.
5. Below Vfe (125 MPH), smoothly add flaps, in increments, until 40° (full).
   a. Aim to have the flaps completely down by 90 MPH (equivalent of normal final approach speed.
6. When airspeed decreases below 115 MPH, increase propeller control to full forward, maximum RPM setting.
7. At 90 MPH, establish a normal landing approach to a simulated runway and stabilize the aircraft.
   a. Set the throttle to IDLE and re-trim the aircraft in a stabilized descent at 90 MPH at minimum (idle) power setting.
8. Apply full power and allow the pitch attitude to increase above the normal climb attitude by not applying sufficient forward elevator pressure to overcome the trim.
9. Announce “Stall Warning” and initiate the recovery at the first indication of a stall (imminent stall).
10. Initiate recovery by promptly and simultaneously decreasing the angle of attack, verifying full power, leveling the wings, and pitching for an attitude that will ensure a minimal loss of altitude and a positive rate of climb.
11. Re-trim the airplane, by first making large adjustments during the recovery in order to decrease large adverse trim forces, and then making fine adjustments once appropriate pitch has been established.
12. Immediately, retract flaps to from 40° to 25°.
13. Pitch for an attitude that ensures a minimal loss of altitude and positive climb rate.
   a. Pitch for Vx or Vy, as appropriate, to simulate climbing away from approaching terrain.
14. Establish a positive rate of climb
   a. Confirm it by outside pitch attitude reference and airspeed indications
   b. Confirm Altimeter and Vertical Speed Indicator needles reverse their trends
15. Retract the landing gear.
   a. Ensure that this step is accomplished before Vlo gear up, 125 MPH
16. Retract flaps from 25° to 10°.
17. Passing through 90 MPH retract flaps from 10° to 0° (up).
   a. Ensure that this step is accomplished before Vfe, 125 MPH
18. Once the recovery has been completed, continue in Vy or cruise climb, as required.
19. Resume normal cruise or transition cruise flight, as specified.
20. Explain what led to the stall entry, and what would happen if immediate recovery action was not taken.
   a. Emphasize the importance of taking immediate action and overpowering the incorrect trim setting and not letting it fly the aircraft into a dangerous attitude.
   b. Emphasize the importance of trimming rapidly to correct large adverse trim forces.
   c. Emphasize the importance of setting the proper pitch with the elevator regardless of trim forces, and then trimming for it, rather than flying with the trim.
CROSSED-CONTROL STALL (CFI demonstration only)

Objective
CFIs will develop instructional ability to demonstrate and PUIs the ability to recognize, avoid and recover from situations leading to crossed-control stalls, while developing practical knowledge on how the improper application of rudder and aileron can result in an unrecoverable situation close to the ground.

**WARNING**
The minimum altitude during any portion of this maneuver, including recovery, is 1,500’ AGL. This maneuver may be flown to IMMINENT STALL ONLY.

Quick reference:
- **Set-up - simulate landing procedure, but WITHOUT FLAPS**
  - Throttle ≈15” MP
  - Maintain altitude and heading on entry
  - Below Vlo down (150 MPH): Landing gear down
  - Below 115 MPH: Propeller full forward
- **Approach - simulate descent on base leg of traffic pattern**
  - Establish stabilized descent
    - Maintain 100 MPH
    - No flaps
- **Entry - simulate overshooting base to final, cross-controlled turn**
  - Power IDLE
  - Establish 30° bank turn
    - Use excessive rudder and opposite aileron
    - Add backpressure
  - Note improper control inputs and crossed control indications (ball)
- **Recovery - from imminent stall at the first indication of a stall**
  - Reduce AOA and release cross-controlled inputs
  - Add full power, level the wings and establish positive rate of climb
  - Retract the landing gear
- **Explain** what would happen if recovery was not effected immediately

Procedure Description:
1. Ensure that all pre-maneuver checklist items, clearing turns and a radio call are complete, as specified.
2. Configure the aircraft for straight-and-level flight and choose a reference point and/or heading to begin the maneuver.
3. Set power to ≈15” MP. During the airspeed reduction, maintain altitude by smoothly increasing pitch as airspeed decreases. Trim the aircraft as necessary.
4. Below Vlo (gear down) (150 MPH), extend the landing gear.
5. When airspeed decreases below 115 MPH, increase propeller control to full forward, maximum RPM setting.
6. Establish a stabilized descent at **100 MPH**, simulating decent on the base leg of a traffic pattern. **Do not use flaps for this demonstration.**

7. Smoothly set throttle to **IDLE** and re-trim the aircraft in the stabilized descent at **100 MPH**.

8. Initiate a **30°** bank in either direction.
   a. During the turn apply excessive rudder in the direction of the turn, while holding the bank constant (by applying opposite aileron pressure) and back elevator pressure to induce the stall.

9. Point out the improper crossed control inputs, and the indications of crossed controls reflected on the inclinometer (the ball) not being centered.

10. Announce, “Stall Warning” and initiate the recovery at the **first indication of a stall (imminent stall)**.

11. Recover by promptly and simultaneously decreasing the angle of attack, releasing the cross-controlled inputs, applying full power and, when appropriate, leveling the wings.

12. Pitch for an attitude that ensures a minimal loss of altitude and positive climb rate.
   a. Pitch for Vx or Vy, as appropriate, to simulate climbing away from approaching terrain.

13. Establish a positive rate of climb
   a. Confirm it by outside pitch attitude reference and airspeed indications
   b. Confirm Altimeter and Vertical Speed Indicator needles reverse their trends

14. Retract the landing gear.
   a. Ensure that this step is accomplished before Vlo gear up, 125 MPH

15. Once the recovery has been completed, continue in Vy or cruise climb, as required.

16. Resume normal cruise or transition cruise flight, as specified

17. Explain what would happen if immediate recovery action was not taken and a stall was allowed to progress with the flight controls crossed.
   a. Emphasize the importance of proper control inputs and simultaneous bank and inclinometer (the ball) indications in turns.

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SECONDARY STALL (CFI demonstration only)

Objective

CFIs will develop instructional ability to demonstrate and PUIs the ability to recognize, avoid and recover from situations leading to secondary stalls, while developing practical knowledge on how a rushed stall recovery can result in a second stall, delaying the overall recovery and increasing altitude loss.

WARNING
The minimum altitude during any portion of this maneuver, including recovery, is 1,500’ AGL

Quick reference:

- **Set-up – simulate landing procedure**
  - Throttle ≈ 15” MP, maintain ALT and HDG
  - Below \( V_{lo,\text{gear\ down}} \) (150 MPH): Extend the landing gear
  - Below \( V_{fe} \) (125 MPH): flaps down in increments, until 40° (full) by 90 MPH
  - Below 115 MPH: Propeller full forward
- **Approach – simulate final approach**
  - 90 MPH - establish normal descent to a simulated runway
- **Stall entry – flare and improper recovery from first stall leading to secondary stall**
  - Power to IDLE
  - Establish flare pitch attitude and induce the first stall
    - Recover with pitch only by reducing AOA, without using power
    - Simulate improper continuing recovery (excessive panic pull)
      - Pitch up excessively into a secondary stall
- **Recovery – recover from stall and climb away from simulated approaching terrain**
  - Reduce AOA, add full power, then level the wings
  - Flaps from 40° to 25°
  - Establish \( V_X \) or \( V_Y \) pitch attitude to climb away from simulated terrain
  - Positive rate of climb:
    - Retract the landing gear
    - Flaps from 25° to 10°
  - Passing 90 MPH – flaps from 10° to 0° (full up)

**Explain** how the rushed and improper recovery and excessive pitch resulted in a secondary stall and delayed the overall recovery

Procedure Description:

1. Ensure that all pre-maneuver checklist items, clearing turns and a radio call are complete, as specified.
2. Configure the aircraft for straight-and-level flight and choose a reference point and/or heading to begin the maneuver.
3. Set power to ≈15” MP. During the airspeed reduction, maintain altitude by smoothly increasing pitch as airspeed decreases. Trim the aircraft as necessary.
4. Below \( V_{lo,\text{gear\ down}} \) (150 MPH), extend the landing gear.
5. Below Vfe (125 MPH), smoothly add flaps, in increments, until 40° (full).
   a. Aim to have the flaps completely down by 90 MPH (equivalent of normal final approach speed)
6. When airspeed decreases below 115 MPH, increase propeller control to full forward, maximum RPM setting.
7. At 90 MPH, establish a normal landing approach to a simulated runway and stabilize the aircraft.
8. Reduce throttle to IDLE to begin simulating landing flare.
9. Simulate landing flare pitch.
   a. Establish simulated landing flare pitch attitude that will induce a stall.
   b. Maintain that pitch attitude by smoothly increasing backpressure as airspeed decreases, until stall occurs.
10. Announce, “Stall Warning” when stall is imminent, and “Full Stall” as full stall occurs
   a. Initiate the recovery by reducing the pitch attitude ONLY
   b. For this demonstration, do not add power during this step.

### NOTE

- **IMMINENT STALL:** Buffeting, stall warning light, or rapid decay of control effectiveness (whichever occurs first); The aircraft is ABOUT to stall.
- **FULL STALL:** A sudden loss of control effectiveness, excessive sink rate, or sudden decrease in pitch attitude; The aircraft HAS stalled.

11. Simulate an improper reaction to the first stall (panic pull) by adding excessive back pressure to induce another (secondary) full stall.
   a. Announce “Secondary Stall” as full stall occurs.
12. Initiate recovery by promptly decreasing the angle of attack. Simultaneously, apply full power to minimize altitude loss. If appropriate, level the wings.
   a. Immediately, retract flaps to from 40° to 25°.
13. Once the aircraft is no longer stalled, pitch for an attitude that ensures a minimal loss of altitude and positive climb rate.
   a. Pitch for Vx or Vy, as appropriate, to simulate climbing away from approaching terrain.
14. Establish a positive rate of climb
   a. Confirm it by outside pitch attitude reference and airspeed indications
   b. Confirm Altimeter and Vertical Speed Indicator needles reverse their trends
15. Retract the landing gear.
   b. Ensure that this step is accomplished before Vlo gear up, 125 MPH
16. Retract flaps from 25° to 10°.
17. Passing through 90 MPH retract flaps from 10° to 0° (up).
   a. Ensure that this step is accomplished before Vfe, 125 MPH
18. Maintain Vy pitch attitude and climb at Vy (100 MPH).
   a. Continue climbing at Vy away from simulated terrain.
19. Return to the specified altitude, airspeed and heading.
20. Resume cruising at PX area power setting (~19”/2400 RPM) or as specified.
21. Explain how improper recovery from the first stall led to a secondary stall.
   a. Point out the total altitude loss from both stalls and how it is greater than if the recovery was affected properly from the first stall.
   b. Emphasize proper recovery technique and pitch control to avoid a secondary stall.

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SPIN AWARENESS (Spin avoidance and recovery only)

**WARNING**

The Piper PA28R200 Arrow is NOT certified for spins.

SPINS are PROHIBITED.

The following guidance is for general, unintentional spin recovery only. It is not to be practiced or demonstrated in the actual aircraft.

Objective

Flight crews will develop knowledge regarding situations where unintentional spins may occur, and the procedures for recovery from such unintentional spins.

Quick reference:

- Consult POH / AFM for aircraft specific recovery procedures
- Remember: PARE – the generic spin recovery memory aid
  - P – power to idle
  - A – ailerons neutral
  - R – rudder opposite rotation
  - E – elevator forward

Procedure description:

1. Avoid situations where unintentional spins may occur, such as unintentional approaches to stalls, unintentional slow flight, prolonged flight below Vmc and uncoordinated flight at increased angles of attack.
2. If an unintentional spin does occur, perform the following steps in accordance with these manufacturer recommendations.
3. Retard THROTTLE TO IDLE.
4. Place and maintain ailerons in neutral position.
5. Apply and hold FULL RUDDER IN THE DIRECTION OPPOSITE OF ROTATION.
   a. If direction of rotation cannot be determined visually, use the turn coordinator miniature airplane to determine the direction of spin.
6. Just after the rudder reaches the stop, MOVE THE CONTROL WHEEL FULL FORWARD TO BREAK THE STALL.
   a. Hold all these control inputs in their respective positions until rotation stops.
7. WHEN ROTATION STOPS, NEUTRALIZE RUDDER.
8. RECOVER from the resulting dive with smooth backpressure on the yoke.
9. Avoid abrupt control movement during dive recovery, as to not exceed the positive limit load factor.
THE IMPOSSIBLE TURN (CFI Demonstration only)

Objective
CFIs will develop instructional ability to safely demonstrate a simulated gliding turn back to the runway after an engine failure on takeoff below 1000’ AGL, known as the “impossible turn.” PUIs will develop the ability to recognize changes in the aircraft flight characteristics following an engine failure, using various configurations, and to increase awareness of the importance of planning effectively for such a failure on takeoff.

WARNING

This maneuver demonstrates the importance of NOT attempting a turn back to the departure runway following an engine failure on takeoff and climb-out.

Conduct of this maneuver during actual takeoffs or outside of the following description is PROHIBITED.

NOTE

This maneuver is for demonstration purposes ONLY and does not appear as a required task in any current FAA Practical Test Standards.

The maneuver can and should be flown in various configurations, with various combinations of landing gear and takeoff flaps extended.

Quick reference:

- Select and brief:
  - Simulated “runway” altitude above 2000’ AGL
  - Simulated altitude at which engine failure will occur
    - Typically, 700’ above simulated “runway” altitude
  - Type of takeoff and landing gear/flaps configuration at the moment of simulated failure
  - Simulated “runway” heading and visual references on the ground
- Simulate takeoff and climb in the desired configuration:
  - Throttle 12” MP to slow down to simulated rotation speed at Vr
  - Below Vlo(down) 150 MPH, if used in the demonstration
  - Below Vfe 125 MPH, flaps 25°, if used in the demonstration
  - Below 115 MPH, Propeller full forward
  - Climb at Vx or Vy to the desired simulated engine failure altitude
- Simulate engine failure on takeoff and resultant pilot actions:
  - Throttle to IDLE
    - Maintain previous Vx or Vy pitch for 3 seconds
  - Turn, left or right, back toward the simulated runway
    - Maintain Best Glide airspeed
    - Do not exceed 45° of bank
    - Turn 240° from the original heading to intercept “runway” course
    - Establish on the simulated “runway” course
- Note and Explain altitude loss, descent rate, effects of landing gear / flaps configuration and potential consequences of the chosen course of action
Procedure description:

1. Ensure that all pre-maneuver checklist items, clearing turns and a radio call are complete, as specified.
2. Select an altitude that will allow the maneuver to be recovered above 2000’ AGL.
   a. Note and brief this altitude as simulated “runway” elevation.
   b. Brief the altitude above the simulated “runway” at which the simulated engine failure will occur (typically, 700’ for this demonstration), and the reasons for selecting that altitude
   c. Brief the type of takeoff and the landing gear/flaps configuration at the moment of the simulated failure, as follows:
      i. Gear up, flaps up
      ii. Gear up, flaps 25°
      iii. Gear down, flaps up
      iv. Gear down, flaps 25°
3. Pick suitable visual references on the ground below the aircraft for the simulated “runway”:
   a. Select a clearly identifiable point on the “runway” to serve as the simulated “departure” end.
4. Align the aircraft over and parallel to the simulated “runway” surface.
   a. Preferably, the airplane should be headed into the wind, if practical.
5. Set up the takeoff simulation to begin in the desired configuration:
   a. Set power to 12” MP in order to slow to $V_R$ (60-65 MPH), increasing pitch to maintain altitude.
   b. Below $V_{lo}$ (down) 150 MPH, extend the landing gear, if desired for the demonstration.
   c. Below $V_{fe}$ 125 MPH, set flaps to takeoff configuration of 25°, if desired for the demonstration.
   d. Below 115 MPH, set propeller control to the FULL INCREASE position.
6. As the aircraft reaches $V_R$, smoothly apply full power, adjust pitch as necessary and initiate a takeoff and climb procedure, as specified earlier in this chapter.
   a. Set pitch for a $V_Y$ climb, if simulating a normal takeoff procedure.
   b. Set pitch for a $V_x$ climb, if simulating a short or soft-field takeoff procedure.
   c. Maintain the gear and flaps configuration desired for the moment of the simulated engine failure
7. Simulate engine failure by smoothly reduce power to idle at either 700’ above the altitude at which the maneuver was initiated (the simulated “runway”), or at a different appropriate altitude, if desired for the demonstration.
a. Hold the previously established Vx or VY pitch attitude for approximately 3 seconds, to simulate the realistic reaction of an average pilot to an actual engine failure on takeoff situation.

8. Lower the pitch attitude to avoid a stall, and initiate up to 45° bank turn to the left or right, as specified.
   a. Establish Best Glide airspeed that does not induce stall warning indications.
   b. Note airspeed and descent rate.

9. Turn approximately 240° left or right, as specified, to a heading that would put the aircraft on course to intercept the landing “runway” final approach course,
   a. The simulated landing “runway” heading will be the opposite of the original simulated departure “runway” heading.

10. Upon reaching the simulated landing “runway” final approach course, turn to a heading that would establish the aircraft on the simulated “runway” final approach.

11. Note distance from the intended simulated landing runway approach end, current altitude in reference to the altitude at which the maneuver was initiated, and descent rate.

12. Smoothly recover the maneuver by initiating the go-around procedure as specified in this chapter.

13. Explain the noted results and consequences of the chosen course of action.

**CAUTION**

*Instructors shall reinforce the importance of NOT attempting a turn back to the runway after an engine failure on climb-out, and the associated importance of being prepared to conduct an emergency landing immediately after takeoff.*

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PERFORMANCE MANEUVERS

STEEP TURNS

Objective
Flight crews will develop the ability to turn the airplane at steep angles of bank, while maintaining altitude, coordination and division of attention between the primary outside visual references and secondary aircraft supporting instruments.

Quick reference:
- Pick a HDG and note the corresponding visual point on the horizon
- Maintain $V_A$ or 120 MPH, whichever is less, as well as the entry ALT, throughout
  - Power $\approx 19"/2400$ RPM (or as required for desiredairspeed)
- Add power ($\approx 21"$ MP), yoke backpressure and rudder rolling into the left turn
  - Complete 360° level left turn at 45° (Private Pilot) or 50° (Commercial Pilot) angle of bank
- Reduce power and pitch rolling out of the left turn, so as not to climb or accelerate
- Immediately transit into the right turn with no level flight in-between
- Add power, yoke backpressure and rudder rolling into the right turn
  - Complete 360° level right turn with at 45° (Private Pilot) or 50° (Commercial Pilot) angle of bank
- Reduce power and pitch rolling out of the right turn, so as not to climb or accelerate
- Roll out on the original heading, and maintain original altitude and airspeed

Procedure description:
1. Select an altitude that will allow for the maneuver to be recovered above 1500’ AGL.
2. The maneuver will consist of two 360° turns in opposite directions, commencing with the left turn first, followed immediately by the right turn with the rollout on the original heading.
3. Ensure that all pre-maneuver checklist items, clearing turns and a radio call are complete, as specified.
4. Configure the aircraft for straight-and-level flight at $V_a$ (maneuvering speed) for the actual aircraft weight, or 120 MPH, whichever airspeed is less ($\approx 19"/2400$ RPM).
5. Choose a primary visual reference point on the horizon, and note the corresponding heading as a secondary backup.

WARNING
Flight crews will ensure that the aircraft remains below actual $V_A$ for the aircraft weight at all times to avoid exceeding aircraft load limits.

6. Smoothly roll the aircraft into 45° (Private PTS) or 50° (Commercial PTS) bank level left turn. As the bank angle increases:
   a. Increase the throttle to $\approx 21"$ MP in order to maintain entry airspeed
   b. Apply back pressure on the yoke as necessary to maintain constant altitude
   c. Add sufficient rudder on the yoke as necessary to maintain coordination (ball centered)
   d. Trim, if necessary.
7. Maintain constant bank angle, altitude and airspeed during the turn.
   a. Once the desired angle of bank (45° or 50°) has been reached, do NOT change the bank angle unless unable to maintain the desired altitude and airspeed with even full power (typically may occur only during high density altitude situations)
   b. Note where the horizon intersects the cowling in order to maintain the entry altitude. Make smooth pitch adjustments to trace that point around the horizon throughout the turn.
   c. Control airspeed with small power adjustments, provided the airspeed deviation is not due to incorrect pitch and a loss/gain of altitude.
8. Smoothly initiate the rollout ≈½ the bank angle prior to the desired rollout heading (50° of bank would result in initiating the rollout ≈25° prior to the desired heading).
9. During the rollout, reduce the yoke pressure used to maintain altitude during the turn, and reduce power to the initial entry power setting.
   a. Failure to do so will result in aircraft wanting to climb and/or accelerate during transition from left to right turn.
10. Smoothly and positively roll into a level turn to the right.
    a. Note that, to remain coordinated (ball centered), more right rudder pressure may be needed in the right turn than the left rudder pressure was needed in the left turn. This is due to the left turning tendencies of the airplane.
11. Repeat the procedures from Steps 6 through 8 to complete 360° of turn to the right.
12. Upon completion of the right turn, return to the initial entry heading.
13. During the final rollout, relax control pressure used to maintain altitude during the turn, and reduce power to the initial entry power setting. Continue maintaining original entry airspeed, altitude and heading. Re-trim the airplane.
14. Resume PX Area cruise settings (≈19”/2400 RPM), or as specified.
CHANDELLES

Objective
Flight crews will develop the ability to conduct a chandelle using primarily visual references and minimum instrument references, utilizing maximum aircraft performance under given atmospheric conditions, and demonstrating mastery of the aircraft.

Quick reference:
- Straight and level at 120 MPH (≈19”/2400 RPM)
- Pick a 90° point (right or left, as appropriate) and note corresponding heading
  - The wind direction should be FROM the point, TOWARD the aircraft
  - Simultaneously:
    - Add full power, right to left (M/P/T)
    - Roll into 30° bank toward the point
    - Begin increasing pitch
  - Pitch up smoothly to arrive at max. pitch attitude by 90° point
- At 90° point:
  - Hold pitch attitude
  - Begin rollout to arrive to wings level by 180° point
- At 180° point:
  - Arrive with airspeed just above power-on stall
  - Wings level
  - Note the new altitude and hold it within 50’ as aircraft accelerates
- Execute a chandelle in the opposite direction, or as specified
- Resume normal cruise at the new altitude and heading

Procedures description:
1. Select an altitude that will allow for the maneuver to be completed above 1500’ AGL.
2. Ensure that all pre-maneuver checklist items, clearing turns and a radio call are complete, as specified.
3. Establish the aircraft in level cruise flight at 120 MPH using ≈19” MP/2400 RPM
4. Initiate this maneuver into the wind, inasmuch as practical, in order to avoid drifting away from the reference points and/or out of the practice area.
   a. Ideally, the direction of wind should be FROM the point and TOWARD the aircraft wingtip in the direction of the turn. That way, the first half of the turn is made directly into the wind.
5. Select a prominent reference point, or appropriate straight-line reference (such as a road) off the wing tip, while taking wind into consideration, as above.
   a. Note the 90° heading indicator reference that corresponds to the visual point, but only as a secondary backup.
6. Enter a coordinated turn in the direction of the 90° reference point by **simultaneously**
   a. Increasing the power to full, from right to left (M/P/T)
   b. Increasing the pitch
   c. Increasing the bank to 30°
7. During the first 90° of the turn:
   a. Maintain 30° of bank and full power.
   b. Gradually and smoothly increase the pitch attitude as to arrive to max. pitch attitude by 90° point.
8. After passing the 90° point and while continuing to the 180° point.
   a. The maximum pitch attitude is maintained so that the aircraft arrives at the 180°
      point just above the power-on stall speed.
   b. The bank angle is smoothly reduced at a constant rate. So that the aircraft arrives
      to 180° point wings level, with the initial reference point located off the wing tip.

9. At the 180° point, the highest point of the maneuver:
   a. Note the highest achieved altitude.
   b. Maintain this altitude +/- 50 as the aircraft accelerates.
   c. Return to straight-and-level flight and, upon reaching 120 MPH, execute a
      chandelle in the other direction, or as specified.

10. Execute the maneuver as a pair of chandelles, the first to the left followed by a second
    chandelle to the right, or as specified.

11. Resume normal cruise or transition cruise flight on the new heading and altitude.

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For Training Purposes Only
LAZY EIGHTS

Flight crews will develop the ability to conduct lazy eights using primarily visual references and minimum instrument references, utilizing maximum aircraft performance under given atmospheric conditions, and demonstrating mastery of the aircraft.

Quick reference:

- Straight and level at 120 MPH (≈19”/2400 RPM)
- Pick a 90° point and/or line reference and note corresponding heading
  - The wind direction should be FROM the 90° point, TOWARD the aircraft
  - Pick 45° and 135° points, if available
- Roll in smoothly
  - Pitch changes at faster rate than bank
  - Pitch and bank change continually; They are never static.
- At 45° point
  - ≈15° bank
  - Max. pitch-up
- At 90° point
  - ≈ 30° bank
  - Level pitch
  - A/S just above stall
- At 135° point
  - ≈15° bank
  - Lowest pitch-down
- At 180° point
  - Straight and level flight
  - Original entry altitude and airspeed
  - Execute symmetrical turn in the opposite direction
  - Resume normal cruise

Procedures description:

1. Select an altitude that will allow for the maneuver to be completed above 1500’ AGL.
2. Ensure that all pre-maneuver checklist items, clearing turns and a radio call are complete, as specified.
3. Establish the aircraft in level cruise flight at 120 MPH using ≈ 19” MP/2400 RPM
4. Initiate this maneuver into the wind, inasmuch as practical, in order to avoid drifting away from the reference points and/or out of the practice area.
   a. Ideally, the direction of wind should be FROM the 90° point and TOWARD the aircraft wingtip in the direction of turn. That way, the first half of the turn is made directly into the wind.
5. Select prominent references on or near the horizon at the 45°, 90°, and 135° points, while taking wind into consideration, as above.
   a. Selecting an appropriate straight reference line, such as a road, powerline, etc. off of the wingtip in the direction of turns will provide an effective reference line. Using another point off the opposite wingtip will help establish this line, as well.
   b. At minimum, a 90° degree reference point is required, whereas 45° and 135° points can be extrapolated from it, if none are available on the actual horizon.
c. Note the 90° heading indicator reference that corresponds to the visual point, but only as a secondary backup.

6. Initiate a coordinated, gradual climbing turn in the direction of the 90° reference point.
7. From the original heading to 45° point:
   a. Pitch increases toward maximum
   b. Bank increases toward ≈15°
   c. Pitch increases at a rate approximately three times more rapidly than the bank

8. Arriving at 45° point:
   a. Maximum pitch up attitude
   b. Bank angle ≈ 15°, which is ½ of the maximum bank angle

9. From 45° point to 90° point:
   a. Bank angle continues to increase toward maximum of ≈30°
   b. Pitch starts to decrease toward level

10. Arriving at 90° point:
    a. Level pitch attitude
    b. Airspeed just above (within 5-10 MPH) stall speed
    c. Maximum bank angle of ≈ 30°

11. From 90° point to 135° point:
    a. Pitch decreases below level
    b. Bank decreases toward ≈15°
    c. Positive elevator input is required to prevent pitch from becoming too low, as the aircraft wants to continue descending
    d. Positive aileron input is required to prevent the aircraft from overbanking past 30°, and to decrease the required bank below 30°

12. Arriving at 135° point:
    a. Lowest pitch down attitude
    b. Bank angle ≈ 15°, which is ½ of the maximum bank angle

13. From 135° point to 180° point:
    a. Pitch increases toward level
    b. Bank decreases toward 0°

14. Arriving at 180° point:
    a. Straight and level flight at the original entry altitude and airspeed

15. Execute a laterally and vertically symmetrical turn in the opposite direction.

16. On completion of the second symmetrical loop resume normal cruise or transition cruise flight, as specified.
180 degree point
Maximum bank angle
Level pitch attitude

135 degree point
Lowest pitch attitude
Bank angle at 50% and decreasing

45 degree point
Highest pitch attitude
Bank angle at 50% and increasing

Entry:
From straight and level flight
Turn into the wind

180 degree point
Arrive at level flight on entry altitude and airspeed

Complete a symmetrical loop
in the opposite direction

Decrease pitch
Increase bank
GROUND REFERENCE MANEUVERS

RECTANGULAR COURSE

Objective
Flight crews will develop the ability to plan and conduct a rectangular course while correcting for wind drift, maintaining a constant ground track, keeping situational/positional and traffic awareness, as well as being able to relate the applicable rectangular course concepts to traffic pattern operations.

Quick reference:
- Determine wind direction and terrain elevation
- Select a field:
  - A close approximation to a rectangle
  - Closely aligned with the wind
  - Near an emergency landing field
- Enter 45° to downwind
  - Maintain 120 MPH (≈19”/2400 RPM) and 1,000’ AGL
  - Roll out on downwind ≈ ½ from the field boundary
- Start turns abeam the next field boundary
- Vary rate of turn with groundspeed as to roll out ≈ ½ mile from the boundary
  - Higher GS requires greater angle of bank to maintain desired ground track
- Crab into the wind to maintain a constant ground track ≈ ½ mile from field boundaries
- Exit on the original downwind after completing the entire rectangle

Procedures description:
1. Determine terrain elevation
   - Plan to enter the maneuver at 1,000’ AGL.
   - Select the appropriate altitude to be maintained on the altimeter.
2. Determine wind direction:
   - Observe wind indications on the surrounding terrain, such as ripples on the water, smoke from smokestacks, etc.
   - Consider the winds reported at an airport nearest to the area where the maneuver is conducted.
   - Consider the winds reported at the departure airport.
   - Consider flying a “wind circle” to observe aircraft drift and thus deduce accurate wind direction.
3. Select a prominent rectangular area, away from obstructions, surrounded by four identifiable borders that approximates a typical traffic pattern.
   - One side of the rectangle should be approximately parallel to the wind direction.
   - Consider the possibility of low level engine failure and select a suitable emergency landing field.
NOTE
When selecting a practice area, flight crews will comply with minimum safe altitudes, consider the possibility of a necessary emergency landing and use common sense regarding the impact of their aircraft’s noise on the surrounding area.

4. Ensure that all pre-maneuver checklist items, clearing turns and a radio call are complete, as specified.

5. Establish the aircraft in level cruise flight at **120 MPH (~197°/2400 RPM)** at 1,000’ AGL and maintain it throughout the maneuver.

6. Establish an entry heading at **45° to the downwind** of the selected field

7. Plan to turn from the 45° entry as to roll out ≈ ½ mile from the field boundary on the downwind leg.

8. Establish the appropriate crab angle to maintain a uniform distance of ≈ ½ mile from the field boundaries on each leg.
   a. With the field that is perfectly aligned with the wind, no crab will be required on downwind and upwind legs of the rectangular course.
   b. As the wind in reality is rarely completely aligned with the selected field, crabbing appropriately may be required during each of the four legs.
   c. Plan to crab ahead of each leg, then monitor the drift once established on each leg, and adjust accordingly

9. As the aircraft reaches the next field boundary, initiate a turn so as to roll wings level ≈ ½ mile from the field boundary.

10. Vary bank angle according to the strength and direction of the wind to maintain a constant radius during the ¼ circle turns at the end of each field boundary, as to arrive at ≈1/2 mile away from the next boundary.
    a. A complete rectangular course will contain four quarter-circles, each with varying wind direction. Consequently, aircraft groundspeed will also vary during turns.
    b. To achieve constant turn radius and desired ground track, angle of bank must be varied with groundspeed. The higher the groundspeed, the higher the angle of bank needs to be to maintain a given circular groundtrack.

11. Predict and establish a proper crab into the wind on each leg, according to the strength and direction of the wind. This will result in constant distance and track along the field boundaries.
    a. The first turn, from downwind to crosswind, will require more than 90° heading change, as well as the fourth turn, from the opposite crosswind back to downwind.
    b. The second turn, from crosswind to upwind, and the third turn, from upwind to the opposite crosswind, will require less than 90° heading change.

12. The maneuver is complete after one complete circuit has been accomplished, with the aircraft departing on the downwind, at the point of the original entry.

13. Initiate a climb to an appropriate altitude, as specified.

14. Resume normal cruise or transition cruise flight.
For Training Purposes Only
S-TURNS ACROSS A ROAD

Objective
Flight crews will develop the ability to plan and conduct S-turns across a road while correcting for wind drift, maintaining a constant ground track and keeping situational/positional and traffic awareness.

Quick reference:

- Determine wind direction and terrain elevation
- Select a suitable straight line reference / road
  - Perpendicular to the wind
  - Near reachable emergency landing field
- Enter on downwind, perpendicular to the road
  - Maintain 120 MPH (\(\approx 19"/2400\) RPM) and 1,000’ AGL
- Vary the bank angle to achieve a constant ground track
  - Project a \(\approx 1/2\) mile radius half-circle to follow over the ground
  - Higher groundspeed (downwind) - steeper angle of bank
  - Lower groundspeed (upwind) – shallower angle of bank
- Wings level over the road only – no straight and level flight
- Exit on the downwind upon completion of the second half-circle

Procedures description:

1. Determine terrain elevation
   a. Plan to enter the maneuver at 1,000’ AGL
   b. Select the appropriate altitude to be maintained on the altimeter

2. Determine wind direction:
   a. Observe wind indications on the surrounding terrain, such as ripples on the water, smoke from smokestacks, etc.
   b. Consider the winds reported at an airport nearest to the area where the maneuver is conducted.
   c. Consider the winds reported at the departure airport.
   d. Consider flying a “wind circle” to observe aircraft drift and thus deduce accurate wind direction.

3. Select a road or other straight-line reference, running approximately perpendicular to the wind, away from obstructions.
   a. Consider the possibility of low level engine failure and select a suitable emergency landing field.

NOTE
When selecting a practice area, flight crews will comply with minimum safe altitudes, consider the possibility of a necessary emergency landing and use common sense regarding the impact of their aircraft’s noise on the surrounding area.

4. Ensure that all pre-maneuver checklist items, clearing turns and a radio call are complete, as specified.
5. Establish the aircraft in level cruise flight at 120 MPH (\(\approx 19"/2400\) RPM) at 1,000’ AGL and maintain it throughout the maneuver.
6. Enter on downwind, perpendicular to the selected reference line.
7. At this entry point directly over the reference line, heading downwind, initiate a 180° constant ground track and radius turn to the left, back toward the road.
   a. Project a $\approx \frac{1}{2}$ mile radius half-circle to follow over the ground on the current (downwind) side of the road in order to keep positional awareness.
      1. Maintain this constant ground track by modifying the bank angle in relation to groundspeed.
   b. During entry on the downwind, the groundspeed will be the highest and consequently the angle of bank will be the steepest.
      1. The higher the groundspeed, the steeper the angle of bank required to maintain a constant ground track, but do NOT exceed 45° of bank.
   c. Throughout this first turn, the wind will change from tailwind to left crosswind, and then to headwind.
      1. As the groundspeed decreases, the angle of bank has to decrease to maintain a constant ground track.
      2. Completing the turn into the headwind (upwind), the groundspeed will be the lowest and consequently the angle of bank will be the shallowest.
   d. Plan to complete the turn as to arrive wings level just as aircraft crosses over the reference line, heading upwind.

8. At completion of the first turn the aircraft will be heading upwind, directly over and perpendicular to the straight-line reference, with wings momentarily level.
   a. There should be no straight and level flight between the two half-circles
   b. Wings level will occur momentarily just as aircraft crosses the reference line and the turn in the other direction will begin immediately.

9. At this intermediate point directly over the reference line, heading upwind, initiate a 180° constant ground track and radius turn to the right, back toward the road.
   a. Project a $\approx \frac{1}{2}$ mile radius half-circle to follow over the ground on the current (upwind) side of the road in order to keep positional awareness.
      1. Maintain this constant ground track by modifying the bank angle in relation to groundspeed.
   b. Making this turn on the upwind, the groundspeed will be the lowest and consequently the angle of bank will be the shallowest.
      1. Guard against steepening the angle of bank too soon as the combination of excessive bank and crosswind from the left will push the aircraft rapidly over the reference line (a common error).
      2. The lower the groundspeed, the shallower the angle of bank required to maintain a constant ground track.
   c. Throughout this second turn, the wind will be changing from headwind to left crosswind, and then to tailwind.
      1. As the groundspeed increases, the angle of bank has to increase to maintain a constant ground track.
      2. Completing the turn with the tailwind (downwind), the groundspeed will be the highest and consequently the angle of bank will be the steepest.
   d. Plan to complete the turn as to arrive wings level just as aircraft crosses over the reference line, heading downwind.

10. Exit the maneuver upon crossing the road after completing the second of the two turns.
11. Initiate a climb to an appropriate altitude, as specified.
12. Resume normal cruise or transition cruise flight.
S-turns across a road
TURNS AROUND A POINT

Objective

Flight crews will develop the ability to plan and conduct turns around a point while correcting for wind drift, maintaining a constant ground track and keeping situational/positional and traffic awareness.

Quick reference:

- Determine wind direction and terrain elevation
- Select a suitable point
  - Prominent and unique
  - Near a reachable emergency landing field
- Enter on downwind
  - Note a suitable horizon reference and a corresponding entry heading
  - Maintain 120 MPH (~19"/2400 RPM) and 1,000’ AGL
- Vary the bank angle to achieve a constant ground track
  - Project a ≈1/2 mile radius circle to follow over the ground
  - Higher groundspeed (downwind) - steeper angle of bank
  - Lower groundspeed (upwind) – shallower angle of bank
- Exit on the downwind after completing one turn (or as specified)
  - On the original horizon reference and the original entry heading

Procedures description:

1. Determine terrain elevation:
   a. Plan to enter the maneuver at 1,000’ AGL
   b. Select the appropriate altitude to be maintained on the altimeter

2. Determine wind direction:
   a. Observe wind indications on the surrounding terrain, such as ripples on the water, smoke from smokestacks, etc.
   b. Consider the winds reported at an airport nearest to the area where the maneuver is conducted.
   c. Consider the winds reported at the departure airport.
   d. Consider flying a “wind circle” to observe aircraft drift and thus deduce accurate wind direction.

3. Select a suitable ground reference point:
   a. The point should be prominent, unique and away from obstructions
   b. Consider the possibility of low level engine failure and select a suitable emergency landing field

NOTE
When selecting a practice area, flight crews will comply with minimum safe altitudes, consider the possibility of a necessary emergency landing and use common sense regarding the impact of their aircraft’s noise on the surrounding area.

4. Ensure that all pre-maneuver checklist items, clearing turns and a radio call are complete, as specified.
5. Establish the aircraft in level cruise flight at **120 MPH (≈19”/2400 RPM)** at **1,000’ AGL** and maintain it throughout the maneuver.

6. Enter the maneuver:
   a. Downwind
   b. Directly abeam the reference point
   c. ≈ ½ mile from the point horizontally over the ground

7. Initiate the first turn directly downwind and to the left.
   a. Project a ≈ ½ mile radius circle to follow over the ground in order to keep positional awareness.
   b. Maintain this constant ground track by modifying the bank angle in relation to groundspeed.
      i. During entry on the downwind, the groundspeed will be the highest and consequently the angle of bank will be the steepest.
      ii. The higher the groundspeed, the steeper the angle of bank required to maintain a constant ground track, **but do NOT exceed 45° of bank**.
   c. Throughout this first half of the turn, the wind will change from tailwind to left crosswind, and then to headwind.
      i. As the groundspeed decreases, the angle of bank has to decrease to maintain a constant ground track.
      ii. Completing the first half of the turn into the headwind (upwind), the groundspeed will be the lowest and consequently the angle of bank will be the shallowest.

10. At this intermediate point, after completing first half of the circle, heading upwind:
   a. Continue projecting a ≈ ½ mile radius circle to follow over the ground.
   b. Heading upwind, the groundspeed will be the lowest and consequently the angle of bank will be the shallowest.
      1. Guard against steepening the angle of bank too soon as the combination of excessive bank and crosswind from the right will push the aircraft rapidly over the point (a common error).
      2. The lower the groundspeed, the shallower the angle of bank required to maintain a constant ground track.
   c. Throughout this second half of the turn, the wind will be changing from headwind to right crosswind, and then to tailwind.
      1. As the groundspeed increases, the angle of bank has to increase to maintain a constant ground track.
      2. Completing the turn with the tailwind (downwind), the groundspeed will be the highest and consequently the angle of bank will be the steepest.

11. Exit the maneuver on the original entry horizon reference and heading, upon one complete 360° turn, or as specified.

12. Initiate a climb to an appropriate altitude, as specified

13. Resume normal cruise or transition cruise flight.
Turns around a point

- Entry: Downwind
- Exit: On original heading
- Decreasing Groundspeed
- Decreasing angle of bank
- Crab into the wind
- Slowest Groundspeed
- Shallowest angle of bank
- No crab
- Increasing Groundspeed
- Increasing angle of bank
- Crab into the wind

WIND
EIGHTS ON PYLONS

Objective
Flight crews will develop the ability to plan and conduct eights on pylons while adjusting for the effects of the wind on the groundspeed, referencing the selected points on the ground and keeping situational/positional and traffic awareness.

Quick reference:
- Determine wind direction and terrain elevation
- Select two suitable pylons
  - Proper distance apart (≈ 5 seconds level flight)
  - In line with each other perpendicular to the wind
  - Near a reachable emergency landing field
- Establish on 45° to the downwind toward the first (left) pylon
  - Maintain 120 MPH (≈ 19”/2400 RPM)
  - Note a suitable horizon reference and a corresponding entry heading
  - Attain the appropriate pivotal altitude (See below)
- Abeam the first pylon, turn left into the wind
  - Establish a constant bank (≈30-40°) to place the pylon on the lateral axis
  - Maintain the pylon on the lateral axis by varying pivotal altitude
  - Higher groundspeed, higher pivotal altitude
  - Lower groundspeed, lower pivotal altitude
  - “Pylon moves back, pull back” / “Pylon moves forward, push forward”
  - When pylon stops moving, in relationship to lateral axis, stop climbing or descending
- 45° to downwind after completing the first turn (≈90° to the original entry hdg)
  - Straight flight to the next pylon
  - Crab into the wind to maintain proper groundtrack
  - Attain the appropriate pivotal altitude
- Abeam the second pylon, turn right into the wind
  - Maintain pivotal altitude, as previously described
  - Exit on the 45° to downwind on the original pivotal altitude horizon reference, heading and airspeed
PIVOTAL ALTITUDE CALCULATION

Method 1: Using the formulas

The formulas:

PIVOTAL ALTITUDE = GROUNDSPEED (in KNOTS) SQUARED, then divide by 11.3

PIVOTAL ALTITUDE = GROUNDSPEED (in MPH) SQUARED, then divide by 15

Using either formula will result in the following table.

<table>
<thead>
<tr>
<th>GROUNDSPEED</th>
<th>APPROXIMATE PIVOTAL ALTITUDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>KNOTS</td>
<td>MPH</td>
</tr>
<tr>
<td>87</td>
<td>100</td>
</tr>
<tr>
<td>91</td>
<td>105</td>
</tr>
<tr>
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<td>110</td>
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<tr>
<td>104</td>
<td>120</td>
</tr>
<tr>
<td>109</td>
<td>125</td>
</tr>
<tr>
<td>113</td>
<td>130</td>
</tr>
</tbody>
</table>

Figure 6-12. Speed vs. pivotal altitude.

Method 2: Simplified rules of thumb

“110 x 10 = 1100”  --->  110 KNOTS Groundspeed implies 1,100’ pivotal altitude, or
“100 gets 900”  --->  100 KNOTS Groundspeed implies 900’ pivotal altitude,

Then, +/- 5 kts Groundspeed change equals +/- 100 feet pivotal altitude change

Thus the pivotal altitude can be easily deduced from memory in-flight and provide a value that is “close enough”, and well within the acceptable altimeter error.

If obtaining GS in KNOTS from GPS or other source / estimate, no MPH to knots conversion is required, and MPH does not need to figure in the pivotal altitude calculation. However, if original GS and/or wind speed was estimated in MPH, then to convert:

\[ \text{MPH} \times 0.87 = \text{KNOTS} \]
\[ \text{KNOTS} \times 1.15 = \text{MPH} \]

Compare the values in the simplified table below, derived from memory using the rules of thumb, to the table above, derived using the formula.
### Procedures description:

1. Determine terrain elevation.
   a. Once pivotal altitude (AGL) is determined, add it to the terrain elevation to get the MSL altitude that will be used on the altimeter.

2. Determine wind direction.
   a. Observe wind indications on the surrounding terrain, such as ripples on the water, smoke from smokestacks, etc.
   b. Consider the winds reported at an airport nearest to the area where the maneuver is conducted.
   c. Consider the winds reported at the departure airport.
   d. Consider flying a “wind circle” to observe aircraft drift and thus deduce accurate wind direction.

3. Select two appropriate ground reference points (pylons), away from obstructions.
   a. The pylons should allow for ≈5 seconds uninterrupted straight and level flight between them.
   b. The pylons, when in line with each other, should be perpendicular to the wind.
   c. Consider the possibility of low level engine failure and select a suitable emergency landing field.

### NOTE

When selecting a practice area, flight crews will comply with minimum safe altitudes, consider the possibility of a necessary emergency landing and use common sense regarding the impact of their aircraft’s noise on the surrounding area.

4. Ensure that all pre-maneuver checklist items, clearing turns and a radio call are complete, as specified.

5. Establish the aircraft in level cruise flight at **120 MPH** (∼19”/2400 RPM)
   a. The power setting required to maintain **120 MPH** at the selected pivotal altitude on entry will be maintained and not changed throughout the maneuver.

6. Enter the maneuver by flying at an angle 45° to the downwind.
   a. Attain the necessary pivotal altitude (as explained above) based on groundspeed.
   b. Maintain **120 MPH** level flight at the pivotal altitude.
c. The aircraft will bisect the two ground reference pylons.
d. The first turn around the pylon will be to the left into the wind.

7. As the lateral axis aligns with the pylon off the left wingtip:
   a. Bank as necessary to keep the lateral axis on the pylon (≈30°-40° bank)

8. As the turn continues and groundspeed initially decreases, then increases:
   a. To maintain the pylon on the lateral axis, adjust the pivotal altitude
   b. A lower pivotal altitude will be required in the upwind portion of the maneuver (lower groundspeed)
   c. A higher altitude will be required in the downwind portion of the maneuver (increased groundspeed).
   d. “Pylon moves forward (in relation to the lateral axis/wingtip reference) - push forward”
   e. “Pylon moves back (in relation to the lateral axis/wingtip reference) - pull back”
   f. As the pylon stops moving in relation to the lateral axis / wingtip reference, you have attained the pivotal altitude for the current groundspeed.

9. After completing the turn around the first pylon, roll out of the turn on a heading 45° to the downwind, and approximately 90° from the entry heading
   a. The aircraft will again bisect the two ground reference pylons, but in the other direction.
   b. Initiating the straight flight between the pylons, right away:
      i. Crab into the wind as necessary to maintain proper ground track.
      ii. Return to the appropriate pivotal altitude.
   c. The next turn around the second pylon will be to the right and into the wind.

10. Maintain level flight at **120 MPH** between pylons, using a crab as necessary to correct for the wind, and at pivotal altitude.

11. Enter the turn to the right around the second pylon.
    a. Compensate for groundspeed and pivotal altitude changes as described in steps 7 and 8, except that this time the turn is made to the right.

12. Continue the second turn to roll out on the initial entry heading, returning to the entry pivotal altitude, heading, and airspeed, and exiting the maneuver.

13. Climb to an appropriate altitude, as specified

14. Resume normal cruise or transition cruise flight.
Entry:
45 degrees to downwind
NOTE HEADING AND REFERENCE POINT ON HORIZON
Establish pivotal altitude

Roll out on previously noted transit heading
45 degrees to downwind
approx. 90 degrees to entry heading

Exit:
Original entry pivotal altitude, heading and airspeed

Lower Grounspeed
Lower Pivotal Altitude

Climb back to pivotal altitude
Level flight / Crab into the wind to the next pylon

First turn into the wind
Highest Grounspeed
Highest Pivotal Altitude

Second turn into the wind
Highest Grounspeed
Highest Pivotal Altitude

Note transit heading to the next pylon approx.
90 degrees to your right

Pivotal altitude decreases as Grounspeed decreases

Lower Grounspeed
Lower Pivotal Altitude
STEEP SPIRALS

Objective

Flight crews will develop the ability to plan and conduct a steep spiral, while correcting for wind drift, and to recognize the value of a steep spiral as a tool to rapidly decrease altitude in an emergency while remaining over a desired point in a power-off gliding configuration.

Quick reference:

- **Pick visual references:**
  - Reference on the horizon and corresponding heading
  - Prominent point on the ground
  - Near a reachable emergency landing field
- **Stabilize:**
  - Straight and level flight
  - Flaps and gear remain up
  - Below 115 MPH, propeller full forward
- **Enter the maneuver:**
  - Downwind
  - Over the point on the ground
  - 105 MPH and at idle power
- **Bank ≈ 45° to ≈ 55° maximum (do NOT exceed 60° at any point):**
  - Maintain 105 MPH throughout the maneuver
  - Vary bank angle between ≈ 45°-55° with groundspeed for constant ground track
  - Clear the engine each turn facing upwind
- **After three turns:**
  - Roll out on the original horizon reference and heading
  - Recover by 1,000’ AGL

Procedure description:

1. Select an altitude that allows for performing a series of **at least three (3) 360° turns with recovery from the maneuver no lower than 1000’ AGL.**
2. Ensure that all pre-maneuver checklist items, clearing turns and a radio call are complete, as specified.
3. Configure the aircraft for straight-and-level flight.
   a. Below 115 MPH, set propeller control to full forward, maximum RPM.
4. Choose a reference point on the horizon and note the corresponding heading.
5. Select a prominent reference on the ground over which the steep spiral will be conducted.
6. Enter the maneuver on downwind and nearly over the reference point
   a. Set the throttle to idle
   b. Maintain altitude and reduce the airspeed to **105 MPH**
7. Once established at 105 MPH, initiate a descending spiral
   a. Set initial bank to \(\approx 50^\circ\) and evaluate ground track.
   b. Maintain 105 MPH throughout the maneuver
8. During the turns, adjust bank angle as necessary to maintain a constant radius from the selected point
   a. Vary the bank between \(\approx 45^\circ\) to \(\approx 55^\circ\) to compensate for the wind in order to maintain constant ground track
   b. Steepen the bank on the downwind headings and shallow the bank on the upwind headings.
      i. Higher groundspeed requires proportionally steeper angle of bank, and lower groundspeed requires proportionally shallower angle of bank to maintain constant circular ground track, in relation to the wind speed and the desired radius of the turn
      ii. Since this is a “steep” spiral, both downwind and upwind angles of bank are “steep” (\(\approx 55^\circ\) and \(\approx 45^\circ\), respectively), but one is “steeper” and the other one is “shallower” in relation to one another.
   c. Do NOT exceed 60° during this maneuver at its steepest point
9. Ensure that during each 360° turn the engine is cleared by smoothly advancing the throttle momentarily, while heading into the wind.
   a. Clearing the engine ensures that power is still available for recovery, and doing it into the wind (upwind) minimizes disruption of the maneuver and the effect on the ground track by the momentary use of power
10. After completing three (3) turns, terminate the maneuver by applying full power and returning to cruise flight on the original reference point and heading, no lower than 1,000' AGL.
CROSS-COUNTRY PROCEDURES

DEPARTURE AND EN-ROUTE PROCEDURES (VFR)

Objective
Flight crews will be able to plan and conduct a cross-country departure and en-route procedures, and will develop the ability to correctly establish the aircraft on a cross-country route after departing an airport, using pilotage and dead reckoning as the primary means of navigation.

Procedures description:
1. The time-off should be recorded in the appropriate box on the navigation log upon departure.
2. The timer should be started upon departure and in any case no later than ≈500’ AGL.
3. Conduct a traffic pattern departure as specified earlier in this chapter.
4. Once the aircraft has departed the traffic pattern intercept the planned course.
   a. Depending on the direction of flight and runway used for departure, an appropriate intercept angle will be necessary to get on the course line.
   b. Verify position on the course line with the appropriate chart in-hand.
   c. Once established on the course line, maintain the planned compass heading, unless required otherwise by ATC and/or changing actual conditions.
5. When able, contact the Flight Service Station (FSS) and activate (open) the previously filed flight plan.
6. Level off at the predetermined altitude and complete appropriate checklist items as specified in this manual.
7. Establish the aircraft’s position in relationship to the charted Top of Climb (TOC) using, as specified, one or more of the following:
   a. Pilotage and dead reckoning
   b. Radio navigation
8. Complete a groundspeed (GS) check and determine ETA
   a. Compare the planned time at the current checkpoint to the actual elapsed time
9. Intercept and establish the aircraft on course by use of visual references and onboard electronic navigation systems, as appropriate and as specified.
10. Contact the appropriate Approach Control facility (ATC) and obtain flight following.
    a. In certain situations, this step may be accomplished, if appropriate, on the ground or during departure and initial climb, prior to contacting FSS and reaching TOC
11. Maintain course by the use of pilotage, dead reckoning and radio navigation, as specified.
12. Follow a pre-planned course by reference to landmarks and be able to demonstrate, as appropriate, the ability to :
    a. Navigate solely by Pilotage, as appropriate, and
    b. Navigate by using an airborne electronic navigation system(s).
13. Identify landmarks by relating surface features to chart symbols and be able to:
   a. Locate the aircraft’s position solely by Pilotage, as appropriate, and
   b. Locate the aircraft’s position using the navigation system(s).


15. Intercept and track a given course, radial or bearing, as appropriate.

16. Record and correct any differences between preflight groundspeed and heading calculations to those determined en-route.

17. Recognize and describe the indication of station or waypoint passage when using navigation systems, if appropriate, and be able to recognize signal loss and take appropriate action.

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DIVERSION PROCEDURES

Objective
Flight crews will develop and be able to plan and accurately execute a diversion to an alternate airport, using pilotage and dead reckoning as the primary means of navigation.

Procedures description:
1. Determine the aircraft’s present position and select a suitable alternate airport.
2. Estimate the approximate heading to the selected alternate, or use electronic navigation systems, as specified, and turn to that heading, noting time / starting timer as the turn begins.

   **NOTE**
   Adjust aircraft altitude as necessary to account for obstacles, airspace or the hemispheric rule.

3. Plot a course to the desired alternate on the appropriate sectional chart and/or electronic navigation systems, as specified, and determine the precise heading and distance to the selected alternate.
   a. Establish on the precise heading if different from the original estimated heading.

4. Using the distance calculated, a groundspeed estimate, and airborne electronic navigation systems, calculate an ETA and required fuel.

5. Contact ATC and/or FSS, as appropriate, to notify of the change of planned course and amend the current flight plan.
   a. When providing the ETE to the ATC/FSS based on the calculation in step 5, take into account the elapsed timer in order to provide the most precise time estimate available.
   b. Utilize the FSS to obtain NOTAMs and other pertinent information for the diversion airport.

6. On arrival and landing at the appropriate alternate, contact the FSS and close the active flight plan, if applicable.

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LOST PROCEDURES

Objective

Flight crews will be able to recognize the need for, and conduct, efficient lost procedures, while selecting the best course of action to be followed and maintaining positive aircraft control and situational awareness at all times.

Quick reference:

- **Climb**
  - If at low altitude, climb to obtain a better view of landmarks

- **Circle**
  - Equivalent of “pulling over” on the side of the road
  - Do not continue flying in some random direction if lost

- **Conserve**
  - There is no advantage in circling at high power
  - Conserve fuel by pulling back on power while circling
  - Maintain 105-120 MPH

- **Check**
  - Check your position using Pilotage
  - Utilize electronic navigation systems (VOR, GPS) if available

- **Call**
  - If unable to determine your position, call the nearest ATC facility or FSS
  - If in radar environment, call the radar facility first (Approach, Center)

- **Confess**
  - Confess that you are lost / “unsure of your position” and need help

- **Comply**
  - Comply with ATC/ FSS instructions once receiving help

Procedures description:

1. During times when a flight crew (single or multi-pilot) becomes unsure of their position, aircraft control must be maintained at all times as first priority.

2. Climb to a higher altitude, if appropriate, to attain a better “birds eye” view.
   - Landmarks (ponds, etc) will not appear as they do on the map when at low altitude

3. Circle over the present position referencing a prominent landmark.
   - Use a shallow to medium bank to minimize the workload and **TRIM**
   - It is the equivalent of “pulling over” on the side of the road in the airplane
   - There is no benefit in flying in some uncertain direction when lost, as it will most likely result in getting further away from desired course and getting even more lost
   - If position was known some recent time in the past, by remaining over the same landmark you will not get any further away from the last known position
4. Conserve the fuel by utilizing appropriate power and mixture settings
   a. There is no advantage in circling while maintaining high power setting as it only wastes fuel
   b. Being lost means that fuel may become an issue once position is re-established, thus it must be conserved
   c. Maintain a comfortable **105-120 MPH** while circling

5. Check your position but do not waste time, especially if fuel may be a concern.
   a. Utilize navigational charts and airborne electronic navigation system to assist in determining aircraft position.
   b. Using the appropriate navigational charts and the airborne electronic navigation system, attempt to locate and identify any prominent landmark(s).

6. Call for help. If still unable to determine the position of the aircraft, contact the appropriate FSS or ATC facility for assistance
   a. Flight crews should note that radar assistance from an ATC radar facility is often the best course of action in an actual lost situation.
   b. If unable to determine the appropriate facility frequencies, or unable to establish contact: Transmit on the emergency frequency (121.5) stating approximate last known location and request assistance.
   c. Confess that you are lost and comply with the appropriate instructions from ATC and/or FSS.

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INSTRUMENT MANEUVERS

PRECISION and PRECISION-LIKE(APV) APPROACH

Objective

Flight crews will develop the ability to conduct a precision or a precision-like (APV) approach, by establishing on the approach and maintaining the prescribed glideslope / glidepath down to published minimums, while executing appropriate procedures, callouts and flows.

Quick reference:

- **3 min Prior to IAF / PT Turn inbound / Intercepting final approach course (if vectored)**
  - Approach brief complete
  - Descent checklist flows complete
  - 120 MPH (≈ 19”/2400 RPM)
- **3 min prior to FAF (Glideslope intercept)**
  - 105 MPH (≈ 17”/2400 RPM)
- **Approaching Glideslope intercept (1 dot low)**
  - Landing gear down
  - Flaps set 10°
  - Propeller Full Forward (below 115 MPH)
  - Before landing checklist flows complete
- **Descent at 105 MPH (≈ 17”/2400 RPM) on the glideslope**
- **By 500’ above DA – stabilized**

Procedures description:

1. Prior to being established on the approach, tune, identify and confirm operational status of all airplane and ground equipment necessary for the approach.
2. **Brief** the approach and complete/verify the descent checklist flows prior to IAF or equivalent.
3. If Procedure Turn is to be executed, unless indicated otherwise by approach chart or ATC:
   a. Consider distance and groundspeed when selecting the amount of time to fly outbound (2 min is recommended, unless otherwise dictated by conditions / ATC)
4. Slow down to **120 MPH** by establishing ≈ 19” MP / 2400 RPM by **3 min** prior to:
   a. IAF, if full approach procedure
   b. Procedure turn INBOUND, if executing a procedure turn
   c. Final approach course intercept, if being radar vectored
5. Slow down to **105 MPH** by establishing ≈ 17” MP / 2400 RPM by **3 min** prior to FAF (Glideslope / Glidepath intercept)
6. Approaching glideslope / glidepath intercept (one dot below GS needle and established on final approach course):
   a. Extend the landing gear
   b. Extend wing flaps to **10°**
c. Set propeller control to full forward, maximum RPM (ensure below 115 MPH)

d. Perform Before Landing checklist flows

7. On glideslope / glidepath, maintain **105 MPH** (**≈ 17” MP/ 2400 RPM**) and vary descent rate with power to remain on the glideslope / glidepath

   a. Consider the winds and the resulting ground speed when evaluating the necessary descent rate to hold the glideslope

   b. Headwind will require more power and tailwind will require less power to remain on the glideslope

      i. Winds change with altitude and thus power requirements will change

      ii. Manifold pressure will increase with decreasing pressure altitude if throttle is not adjusted, so some power adjustment may be necessary even if the wind is not a significant factor

   c. You may mentally estimate the approximate necessary descent rate to are main on 3° glideslope using the following formula:

      i. **Groundspeed x 5 = descent rate (FPM)**; suitable for mental math in flight

      ii. The more accurate formula is **GS(KIAS) x 5.3 = GS(MPH) x 4.6 = Descent rate (FPM)**

   d. **Example for GS of 105 MPH**: \((105 \times 5) = 525 \text{ FPM}\)

8. Note the altitude and time/distance, when crossing waypoints / LOM / OM (if any).

9. Ensure aircraft is fully stabilized by **500’** above DA/DH.

10. Execute a normal landing or a missed approach / go-around, in accordance with **FAR 91.175** requirements.

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**This space is intentionally left blank**
NOTE: Each IAP (Instrument Approach Procedure) may have different IAFs (Initial Approach Fixes). Not all IAPs require course reversal. For a particular IAP, course reversal may depend on IAF used. Review each IAP chart carefully!

By 3 minutes prior to IAF:
- Approach checklist complete
- 120 MPH (19”/2400 RPM)

3 MINUTES PRIOR TO FAF:
- 105 MPH (17”/2400 RPM)

ONE DOT BELOW GLIDESLOPE:
- LANDING GEAR DOWN
- FLAPS 10°
- PROPELLER FULL FORWARD
Before Landing Checklist Complete

At 500 Above DA:
- Begin altitude callouts

At DA:
- If NO VISUAL REFERENCE
- GO MISSED!

Precision approach
NON-PRECISION APPROACH

Objective
Flight crews will develop the ability to conduct a non-precision approach by establishing on the approach and maintaining the prescribed course down to published minimums, while executing appropriate procedures, callouts and flows.

Quick reference:

- 3 min Prior to IAF / PT Turn inbound / Intercepting final approach course (if vectored)
  - Approach Brief complete
  - Descent Checklist flows complete
  - 120 MPH (≈ 19”/2400 RPM)
- 3 min prior to FAF
  - 105 MPH (≈ 17”/2400 RPM)
- About to overfly FAF
  - Landing gear down
  - Flaps set 10°
  - Propeller full forward (below 115 MPH)
  - Before Landing checklist flows complete
- Descent at 105 MPH using ≈ 15”-17”/2400 RPM and 500 - 1000 FPM descent rate
- By 500’ above MDA – stabilized

Procedures description:

1. Prior to being established on the approach, tune, identify and confirm operational status of all airplane and ground equipment necessary for the approach.

2. Brief the approach and complete/verify the descent checklist flows prior to IAF or equivalent.

3. If Procedure Turn is to be executed, unless indicated otherwise by approach chart or ATC:
   a. Consider distance and groundspeed when selecting the amount of time to fly outbound (2 min is recommended, unless otherwise dictated by conditions / ATC)

4. Slow down to 120 MPH by establishing ≈ 19” MP / 2400 RPM by 3 min prior to:
   a. IAF, if full approach procedure
   b. Procedure turn INBOUND, if executing a procedure turn
   c. Final approach course intercept, if being radar vectored

5. Slow down to 105 MPH by establishing ≈ 17” MP / 2400 RPM by 3 min prior to FAF

6. Approaching FAF (just prior to, < 1 min from FAF and established on final approach course):
   a. Extend the landing gear
   b. Extend wing flaps to 10°
   c. Set propeller control to full forward, maximum RPM (ensure below 115 MPH)
   d. Perform Before Landing checklist flows
7. Descending from FAF, maintain **105 MPH using ≈ 15”-17” MP/ 2400 RPM** to achieve **500 to 1000 FPM** descent rate, or as appropriate, planning to arrive at MDA **prior** to MAP.
   a. When selecting your descent rate, consider mandatory altitudes, step-down fixes, the winds, the resulting groundspeed and time / distance remaining

8. Note the altitude and time / distance, when crossing waypoints / stepdown fixes (if any).
   a. Level off by adding power and maintaining **105 MPH (≈ 20” MP)** to comply with mandatory and step-down fix altitude restrictions, if any.
   b. Re-establish descent after passing the stepdown fix at or above the minimum altitude, by reducing power and maintaining the same airspeed.

9. Ensure aircraft is fully stabilized by **500’ above MDA**.

10. Execute a normal landing or a missed approach, in accordance with **FAR 91.175** requirements.

This space is intentionally left blank
NOTE: Each IAP (Instrument Approach Procedure) may have different IAFs (Initial Approach Fixes). Not all IAPs require course reversal. For a particular IAP, course reversal may depend on IAF used. Review each IAP chart carefully!

By 3 minutes prior to IAF:
Approach checklist complete
120 MPH (19" / 2400 RPM)

3 minutes prior to FAF
105 MPH (17" / 2400 RPM)

JUST BEFORE FAF:
LANDING GEAR DOWN
FLAPS 10°
PROPELLER FULL FORWARD
Before Landing Checklist Complete

At 500 feet above MDA
Begin altitude callouts

At MDA and MAP:
If NO VISUAL REFERENCE
GO MISSED!

Non-Precision Approach (off airport navaid)
NOTE: Each IAP (Instrument Approach Procedure) may have different IAFs (Initial Approach Fixes). Not all IAPs require course reversal. For a particular IAP, course reversal may depend on IAF used. Review each IAP chart carefully!

By 3 minutes prior to IAF:
Approach checklist complete
120 MPH (19° / 2400 RPM)

3 minutes prior to FAF:
105 MPH (17° / 2400 RPM)

JUST PRIOR TO FAF
LANDING GEAR DOWN
FLAPS 10°
PROPELLER FULL FORWARD
Before landing checklist complete

At 500 feet above MDA
Begin altitude callouts

At MDA and MAP:
If NO VISUAL REFERENCE
GO MISSED!

Non Precision Approach (on airport navaid)
MISSED APPROACH
(an integral part of any instrument approach)

Objective

Flight crews will develop the ability to mentally prepare for the missed approach as part of any instrument approach, recognize conditions requiring a missed approach, and to perform a missed approach while executing appropriate procedures, callouts and flows.

Quick reference:

- **Execute Missed Approach if** any one or more of the following exists:
  - Instructed by ATC
  - Excursion below MDA and requirements of FAR 91.175 are not met
  - Arrival at DA or MAP and requirements of FAR 91.175 are not met
  - Loss of required visual references on descent from DA/MDA
  - Loss of navigational guidance used to fly the approach
  - Loss of RAIM during GPS approach
  - Loss of glideslope / glidepath guidance on a precision approach
  - CDI deviation of more than 3/4 scale
  - Glideslope / Glidepath deviation of more than 3/4 scale
  - Loss of visual contact with the runway (due to IMC) during circling approach
  - Approach not stabilized by 500’ above DA / MDA
  - Unusual maneuvers required to recapture the approach lateral or vertical path
  - Unable to land on the runway using normal maneuvers after visual references have been established
  - Any other safety or regulatory reason that requires a missed approach

Remember the C’s:

- **Cram:**
  - Full power, level the pitch, flaps (if full) from 40° to 25° immediately
- **Climb:**
  - Ease into a Vy climb attitude (≈ 5° nose-up, initially) and maintain Vy
- **Clean:**
  - Check for positive rate of climb on ALT/VSI and maintain Vy
  - Landing gear up
  - Flaps up in increments (25° to 10°, then 10° to 0°)
- **Call:**
  - Announce Missed Approach on the appropriate radio frequency
- **Checklist:**
  - 500’ AGL – cruise climb (110 MPH, at 500 FPM climb rate *minimum*)
  - Verify the appropriate checklist flows (Flaps? Gear? Airspeed?)

---

**NOTE**

For missed approaches initiated prior to reaching the MAP, unless otherwise cleared by ATC, 
**continue flying the published approach course to the MAP**
at or above MDA / DA / DH before turning.

If the missed approach occurs from a circling approach, make an initial climbing turn 
toward the landing runway, and then maneuver to intercept the missed approach course.
WARNING
While missed approach is in essence a go-around executed on instruments, acceleration forces (due to transition from descent into climb and addition of full power) and poor visual cues can cause serious sensory illusions during its execution.

This may occur especially when transitioning between VMC and IMC, such as breaking out of IMC at minimums, going visual, then re-entering IMC again. An attempt to rapidly switch back and forth between visual and instrument references can disorient a pilot.

A focused and rapid instrument crosscheck is necessary to safely carry out the procedure. Once committed to missed approach in IMC, bear down on instruments and ignore the outside visual cues to mitigate the effects of sensory illusions.

Procedures description:
1. When it is determined that for any reason, or for one of the reasons listed above, missed approach is necessary, the PF / PIC will execute the missed approach immediately.
   a. Ensure that missed approach procedure is briefed prior to any IAP execution
   b. Remember that the first step of any missed approach is to climb
   c. If positional awareness is lost or direction of turns is uncertain, do not hesitate to ask ATC for a vector to fly as a last resort
2. Simultaneously establish a level pitch attitude, apply full power and level the wings.
3. Immediately set flaps from 40° to 25° (if fully extended for landing).
4. Establish a positive rate of climb:
   a. Simultaneously ease into a Vy climb pitch attitude (≈ +5 ° pitch on Al, initially)
   b. Cross-check VSI and Altimeter for needle reversal.
5. Once established in a positive rate of climb as indicated by ALT/VSI needles reversal, and at Vy airspeed:
   a. Retract the landing gear
   b. Smoothly retract flaps in careful increments. First, from 25° to 10° (if at 25°), then 10° to 0° (full up).
6. Maintain Vy pitch attitude throughout and confirm aircraft is climbing at Vy (100 MPH).
   a. After gear and flaps retraction is complete, make final pitch adjustments and trim.
7. When aircraft is under complete control and safely established in a climb, transmit the Missed Approach intentions on the radio, as appropriate.
   a. This step may occur earlier in the process, as situation allows.
   b. Remember to fly the plane as your first priority.
8. At 500’ AGL, transition to Cruise Climb (≈ 110 MPH), or as appropriate (attempt to maintain at least a 500 FPM climb)
9. While climbing, follow the published missed approach procedure path, or as otherwise instructed by ATC.
10. Perform the Climb Checklist flow and verify the checklist as soon as practical.
CIRCLING APPROACH
(an integral part of a full instrument approach)

Objective
Flight crews will develop the ability to plan for and conduct a circling approach, executed as a part of an instrument approach procedure, where the approach runway differs from landing runway, thus necessitating a circling maneuver.

Quick reference:
- Determine landing runway prior to executing IAP
  - As instructed by ATC, or
  - As appropriate for conditions at a non-towered AP
- Determine circling radius to remain within the obstacle protected area
- Prepare for the possibility of missed approach while circling
- Remember that “circling only” minimums on an IAP do not preclude landing straight-in if all other requirements are met
- If missed approach is executed while circling, make initial turn toward the selected runway

Procedure description:
1. Fly the instrument approach procedure as outlined earlier in this chapter, and as instructed by ATC.
2. Upon determining that a landing to another runway from the instrument approach is possible or necessary, initiate a turn in the appropriate direction.
3. Plan the circling approach so as to remain within the circling approach area as appropriate for the approach category of the aircraft being flown (see the diagram below).

**WARNING**
If at any time, visual reference is lost while conducting circle-to-land operations from an instrument approach procedure, flight crews will immediately initiate the appropriate missed approach procedure.

4. Maintain visual contact with the runway of intended landing and fly no lower than the published circling minimums.
5. Comply with ATC instructions and circling restrictions when choosing the appropriate pattern.
6. When the aircraft is in a position to execute a landing, initiate descent for the appropriate landing.
Circling Approach Area Radii

<table>
<thead>
<tr>
<th>Approach Category</th>
<th>Radius (Miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1.3</td>
</tr>
<tr>
<td>B</td>
<td>1.5</td>
</tr>
<tr>
<td>C</td>
<td>1.7</td>
</tr>
<tr>
<td>D</td>
<td>2.3</td>
</tr>
<tr>
<td>E</td>
<td>4.5</td>
</tr>
</tbody>
</table>

Radii (r) defining size of areas, vary with the approach category

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HOLDING

Objective

Flight crews will develop the ability to plan and execute an appropriate hold entry and procedure, while maintaining situational awareness and positive aircraft control.

Quick reference:

- **When 3 min or less to holding fix / clearance limit:**
  - Slow to 105 MPH (≈ 17” MP / 2400 RPM)
  - Holding pattern initial entry determined
  - Holding pattern (after being established) procedure determined
    - Direction of turns, leg timing or distance, wind correction estimate
  - EFC time obtained
- **Report entering the hold to ATC:**
  - To avoid forgetting critical items, use T’s memory aid
    - (Turn, Twist, Time, Throttle, Talk)
- **While in the hold:**
  - Triple the inbound leg’s wind correction angle on outbound leg
  - Adjust outbound leg timing to achieve desired inbound leg timing
  - If 3 min remains to EFC time with no ATC contact, query ATC
- **Exiting the hold:**
  - Comply with the ATC instructions
  - Report leaving the hold to ATC

---

**CAUTION**

*It is common for ATC not to issue EFC times to training aircraft practicing instrument procedures in VFR conditions (while not on an actual IFR flight plan).*

*BSU flight crews will be alert to a clearance limit that does not include an Expect Further Clearance (EFC) time when operating under IFR clearance, and request the EFC prior to entering the hold.*

---

Procedure description:

1. Reduce the speed to **105 MPH (≈ 17” MP/2400 RPM)** three (3) minutes or less prior to
   - a. a clearance limit when no clearance beyond the fix has been received, or
   - b. an assigned / requested holding fix
2. Determine the entry to be performed prior to reaching the fix, which shall comply with the FAA recommended procedures.
   - a. Draw out the holding fix, the holding pattern and the holding entry to maintain situational and positional awareness
   - b. If no instructions are received and no holding pattern is charted, plan to enter a standard hold to the right on the inbound track upon reaching the clearance limit
3. Determine the procedure to fly after the entry, paying particular attention to
   - a. Direction of turns during and after the entry once established in the hold
   - b. Time or distance used to determine the outbound / inbound legs
c. Estimated wind direction and speed, and the resultant estimated wind correction

4. When in the hold plan to fly the inbound leg as one of the following:
   a. One (1) minute for altitudes at or below 14,000’ MSL
   b. One and one-half (1 ½) minutes for altitudes above 14,000’ MSL
   c. If DME distance rather than time is specified, the appropriate charted distance
   d. Time or distance assigned by ATC

5. Report to ATC the time, altitude and location of the fix when reaching the hold.

6. When holding at a VOR / VORTAC, begin the turn to the outbound leg at the first complete reversal of the “TO / FROM” indicator on the OBS.

7. Begin the outbound leg timing abeam the fix or after completing the turn, whichever occurs later.
   a. If the abeam position cannot be determined, start outbound timing when completing the turn to the outbound heading.

8. Correct for winds in order to achieve the desired holding ground track and timing of the inbound leg
   a. On the outbound leg, triple the inbound drift correction (if inbound correction is 12° to the right, outbound correction should be 36° degrees to the left).
   b. On the outbound leg, increase or reduce the timing to achieve the desired inbound leg timing (typically 1 min).

9. Immediately advise ATC of any abnormal situations (e.g. turbulence, icing) that will require the aircraft to depart the holding pattern.

10. Contact ATC when desiring to leave the hold, or when EFC has been reached and further clearance / instruction has not been received.

11. After completing the holding procedure, leave the hold as instructed by ATC.

12. Report time, position and altitude when leaving the hold.

13. Resume the appropriate cruise airspeed, as instructed or requested.

**TYPICAL HOLDING ENTRIES**

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
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<tbody>
<tr>
<td>While entry into a hold shall be one of the FAA recommended entries below, flight crews should keep in mind that the main priority in holding is to remain on the protected side of the hold and to follow ATC instructions.</td>
</tr>
</tbody>
</table>

Standard holding pattern is to the right. One way to remember it is that it is the opposite of a standard traffic pattern at an airport. Another way to remember it is that if the aircraft’s path were a road, holding to the right would keep you away from the oncoming traffic.

Pay close attention to the charted holding pattern direction of turns and to ATC holding instructions, as left turn, non-standard holding patterns are very common.
Standard Holding Pattern (right turns) and entry zones

**Direct Entry – approaching from Zone (c)**
This is perhaps the easiest entry type, as it requires only a turn “directly” to the outbound leg. Cross the holding fix and then initiate a turn to the outbound leg at a standard rate in the direction specified in the clearance, or as published (right turns, or standard, in the above diagram).

**TearDrop Entry – approaching from Zone (b)**
After initially crossing the holding fix, execute a standard rate turn to a heading 30° from the outbound heading, toward the holding side (dashed track beginning in the (b) zone). Crossing the fix, start timing so that at expiration of one minute, or as specified by ATC, a standard rate turn is initiated toward the inbound holding course.

Complete the turn to a heading that will intercept (and then track) the inbound holding course. Remember that, during the teardrop entry, the first turn inbound will be made in the same direction as the consequent turns in the hold. In the above diagram, right turn is made after the entry to intercept the inbound course, and then right turns are made in the hold.

**Parallel Entry - approaching from Zone (a)**
After initially crossing the holding fix, begin a standard rate turn to a heading outbound from the fix that parallels the inbound holding course. On crossing the fix, start timing so that at the expiration of one minute, or as specified by ATC, the aircraft initiates a standard rate turn toward the inbound holding course.

The aircraft flight path carries it across the holding course into the protected holding area. Complete the turn to a heading that will intercept (and then track) the inbound holding course.
Note that during parallel entry and only during parallel entry, the initial turn is made in the
direction opposite of the consequent turns in the hold. In the above diagram, after paralleling the
inbound leg on the outbound heading on entry, a left turn is made, while the consequent turns in
the hold are to the right (standard holding pattern).

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VOR INTERCEPTING AND TRACKING

Objective
Flight crews will develop the ability to track and intercept desired VOR radials inbound and outbound.

Quick reference:
- **Tune, twist and identify**
  - Tune the appropriate VORs
  - Twist the OBS to the desired radial
  - Identify the VOR with a chart
  - If DME information is desired, use DME or GPS
- **Select intercept angle as appropriate for distance from station and winds**
- **Turn to the desired intercept heading**
- **Guard against reverse sensing**
  - Track to a VOR with a “TO” indication
  - Track from a VOR with a “FROM” indication
- **Anticipate the wind**
  - Establish wind correction early
  - Bracket to determine wind correction angle and heading

Procedure Description:
1. Tune NAV 1 and identify the desired Very-High Frequency Omni-Directional Range (VOR) facility.
   a. NAV 2 may be used as a standby source for the same VOR, or a second VOR
   b. The Morse code identifier of the facilities shall be confirmed by using an appropriate chart
2. Once the facility has been tuned and identified, determine aircraft position from the facility using all available electronic navigation systems.
   a. Appropriately certified GPS may be used in lieu of DME for distance from the station information
   b. Ensure that, if using a combination GPS/VOR receiver with a shared OBS dial, the OBS dial is connected to the VOR receiver and not the GPS receiver.

| NOTE |
| Ensure that the Heading Indicator and Magnetic Compass are aligned at all times by checking the alignment at least once every 20 minutes. |

3. Set the Omni-Bearing Selector (OBS) to the desired inbound or outbound course to the station to be flown, for example:
   a. To fly the 120° radial outbound, set 120° FROM;
   b. To fly the 120° radial inbound (aka 300° course to the station) set 300° TO.
4. Determine the initial intercept angle considering the distance from the facility, distance from the present course to the new course, and winds
   a. The greater the distance from the station or the further apart the radials, the greater the intercept angle.
5. Determine the intercept heading by noting the deflection indicated on the Course Deviation Indicator (CDI), and applying the desired intercept angle to the inbound / outbound course
   a. To intercept the 120° radial outbound at a 30° intercept angle, when the CDI is showing a deflection to the right, a heading of 150° should be used (assuming no wind).

6. Turn to the desired heading, in the direction that is closest to the present heading of the aircraft
   a. If the aircraft is heading 090°, and the intercept heading is 150°, the aircraft should be turned right.

7. Once the heading change has been made, monitor the quality of the selected intercept angle.
   a. If the CDI does not indicate progress towards the desired course in an appropriate time, verify that the aircraft is on the desired intercept heading.
   b. Verify the aircraft position relative to the desired course (this can be accomplished by centering a second CDI on the OBS2, or temporarily centering CDI on OBS 1).
   c. If appropriate, increase the intercept angle accordingly.

8. Once the CDI starts to center, initiate a turn to the desired inbound / outbound course heading so as to not fly through the desired course.
   a. Guard against reverse sensing by flying inbound (to) the VOR with a “TO” indication, and outbound (from) the VOR with a “FROM” indication

9. Once established on the desired radial, track the course inbound / outbound, as appropriate, by maintaining the appropriate aircraft heading, accounting for prevailing winds.
   a. Anticipate the necessary wind correction angle and establish it early, if practical
   b. Use bracketing technique to determine the actual wind correction angle while tracking the desired radial

10. Monitor the CDI at all times. Should the CDI show a deflection to the left or the right of on-course, a re-intercept angle of between 10° and 30° should be applied to the aircraft heading to return the aircraft to the proper course track.

11. Once the aircraft is established on the desired course track with appropriate wind correction, note the reference heading.

NOTE
A “reference” heading is that which maintains the desired course track once the track has been intercepted.
DME ARCS

Objective

Flight crews will develop the ability to plan and execute a DME arc, while maintaining situational and positional awareness and positive aircraft control at all times.

Quick reference:

- Tune, twist and identify
  - Tune the appropriate VORs
  - Set up the NAV 1 that will be used to fly the arc
  - Set up NAV 2 as backup/standby, as appropriate
  - Identify the VORs with a chart
  - Use GPS in lieu of DME receiver
  - Set OBS 2 to the approach course to be intercepted, if appropriate
- Estimate the lead distance to initiate turn onto the arc
- Estimate the initial heading to turn onto the arc
  - If tracking directly to or from the VOR this heading can be determined immediately
  - If vectored onto the arc (not on a radial), the heading will be determined at the entry point at the appropriate lead distance
- Turn to the desired initial heading when reaching the appropriate lead distance
- Twist and turn
  - Twist the CDI used to fly the arc in 10 degree increments
  - Turn in 10 degree increments to remain on the arc
  - To compensate for wind / correct the distance, turn earlier / delay turning, use 5-10° heading changes for larger corrections, as needed
- Do not overshoot the desired radial to be intercepted inbound / outbound to the VOR
  - Monitor approach course CDI on OBS 2, as required

Procedure Description:

1. Tune NAV 1 and identify the desired Very-High Frequency Omni-Directional Range (VOR) facility that will be used to fly the DME arc.
   a. NAV 2 may be used as a standby / backup source for the same VOR, another VOR or navigational / approach facility, as appropriate
   b. Set OBS 2 to the approach course to be intercepted upon completion of the arc, or as required
   c. The Morse code identifier of the facilities in both NAV 1 and NAV 2 shall be confirmed by using an appropriate chart
2. Once the facility has been tuned and identified, determine aircraft position from the facility using all available electronic navigation systems.
   a. Appropriately certified GPS may be used in lieu of DME for distance from the station information
   b. Ensure that, if using a combination GPS/VOR receiver with a shared OBS dial, the OBS dial is connected to the VOR receiver and not the GPS receiver.
NOTE
Ensure that the Heading Indicator and Magnetic Compass are aligned at all times by checking the alignment at least once every 20 minutes.

3. Track inbound or outbound on the specified radial, or follow vectors provided by ATC.
4. Estimate the distance when the turn onto the arc will be initiated based on groundspeed
   a. In small light aircraft, 0.5 NM is a close approximation at normal cruising speeds
      i. To enter a 10 DME arc from outside, start turning at 10.5 nm using this method
   b. If groundspeed is available, a more precise distance can be estimated by the taking \( \frac{1}{2} \) % of groundspeed for small airplanes
      i. To enter a 10 DME arc from outside with GS of 100 knots; \( \frac{1}{2} \)% of 100 knots is 0.5, so start the turn at 10.5 DME
5. When reaching the desired arc intercept distance (10.5 DME in the above example), initiate a standard rate turn in the direction of the arc rotation.
   a. The new heading to intercept the arc depends directly on the present VOR radial where the aircraft is located, not on the aircraft heading, which may or may not correspond to the radial
   b. If tracking directly TO or FROM the VOR, where the aircraft heading corresponds to the radial, use a 90 degrees heading change to the present aircraft heading / station bearing.
   c. If being vectored (not on a bearing directly to or from the VOR used to fly the arc), where the aircraft heading has no relation to the radial the aircraft is on:
      i. Determine the actual radial the aircraft is on at the desired arc intercept distance (10.5 DME in the above example) by centering the appropriate CDI just prior to reaching the distance
      ii. Turn to a new heading that is 90° to the radial determined in the previous step, regardless of the present aircraft heading
6. Twist the CDI used to fly the arc 10° in the direction of the arc.
7. When the CDI centers on the OBS display, turn the aircraft 10° in the direction of the arc, and twist the CDI a further 10° to the next radial to be crossed along the arc, so that the needle continues to center as the arc progresses.
   a. If departing from the desired distance due to wind / pilot input, delay the turn or initiate a turn sooner in the appropriate direction to recapture the desired distance
   b. If larger corrections are necessary, turn in 5-10° increments towards/away from the station, to correct for wind drift from/to the station.
   c. In any case, twist the CDI to the next setting each time it centers, in order to maintain positional awareness while making heading and distance corrections
8. Continue the steps 6 and 7 above, as appropriate, until reaching the lead-in radial (if published) or until arriving at approximately 3 – 5° prior to the selected approach course, at which point a turn will be made until the CDI centers and the aircraft intercepts
   a. If OBS 2 is available and was previously set to the desired approach course intercept, monitor it throughout the procedure to minimize the chance of flying through the approach course on the arc.
RECOVERY FROM UNUSUAL FLIGHT ATTITUDES

Objective
Flight crews will develop the ability to recognize unusual flight attitude situations, properly evaluate corrective action and timely recover by returning the aircraft to straight and level flight under positive control.

Quick reference:

- **NOSE UP** – airspeed decreasing!
  - Immediately reduce angle of attack FIRST regardless of the bank attitude
  - Add full power
  - Level the wings using the TC
  - Monitor ALT / VSI for trend reversal
    - When needles reverse their direction, it is ≈ level flight attitude
  - Maintain level flight attitude
  - When stabilized
    - Adjust pitch and power to maintain straight and level and ≈ 120 MPH

- **NOSE DOWN** – airspeed increasing!
  - Immediately reduce power
  - Immediately level the wings FIRST using the TC regardless of the pitch
  - Once wings are level, initiate smooth pull-out of the dive
  - Monitor ALT / VSI for trend reversal
    - When needles reverse their direction, it is ≈ level flight attitude
  - Maintain level flight attitude
  - When stabilized
    - Adjust pitch and power to maintain straight and level and ≈ 120 MPH

**NOTE**
Although the recovery procedures listed here occur in sequence, recovery from unusual flight attitudes requires that the listed actions be made nearly simultaneously.

Regardless, it is critical that the correct action is taken, rather than the first instinctual action. It is thus also critical, prior to taking the action, to properly evaluate the situation by taking a moment to determine whether the aircraft is in nose high or nose low unusual attitude.

**WARNING**
Unusual attitude training in actual instrument meteorological conditions is PROHIBITED.
Procedure Description:

Recovery From Nose-High Unusual Attitudes

The primary concern in recovery from nose-high unusual attitude is avoiding a stall, thus angle of attack must be immediately reduced and power added.

1. To recover from a nose-high attitude, when a lower than desired or rapidly decreasing airspeed is observed:
   a. Immediately apply forward elevator pressure to achieve a level pitch attitude
   b. Immediately increase power
2. Only after the angle of attack is reduced and power added, level the wings using TC
   a. Do not initially rely on the AI or HDG indications for pitch and bank information, as these vacuum instruments may have malfunctioned and/or tumbled
3. With wings level and confirmed by TC, monitor ALT and VSI for needle reversals
   a. As the ALT and VSI needles momentarily stop and reverse their trends, you are passing through approximate level pitch attitude
   b. Minimize control inputs at this point and continue monitoring instruments
4. As the aircraft stabilizes, continue to crosscheck the available flight instruments to maintain a level flight attitude.
   a. It may now be decided if AI and HDG can be relied on by confirming their indications against TC, AS, ALT and VSI, as well as magnetic compass
5. Re-establish appropriate power setting to maintain straight and level flight, or as required

Recovery From Nose-Low Unusual Attitudes

The primary concern in recovery from nose-low unusual attitude is avoiding a steep descending spiral, and resulting excessive descent rates, as well as exceeding safe airspeed limit and aircraft load factor. Thus, power must be reduced and wings leveled before a pullout is initiated.

1. To recover from a nose-low unusual attitude, when a higher than desired or rapidly increasing airspeed is observed
   a. Immediately reduce power
   b. Immediately level the wings using the TC
2. Only after the wings have been leveled and power reduced, initiate pull-out from the dive by smoothly applying back elevator pressure to achieve a level pitch attitude
   a. Do not initially rely on the AI or HDG indications for pitch and bank information, as these vacuum instruments may have malfunctioned and/or tumbled
   b. Judge the pressure required to control the pullout rate in relation to the airspeed, in order to remain within safe airspeed and load factor limits
3. With wings level as confirmed by TC and airspeed decreasing, monitor ALT and VSI for needle reversals
   a. As the ALT and VSI needles momentarily stop and reverse their trends, you are passing through approximate level pitch attitude
   b. Minimize control inputs at this point and continue monitoring instruments
4. As the aircraft stabilizes, continue to crosscheck the available flight instruments to maintain a level flight attitude.
   a. It may now be decided if AI and HDG can be relied on by confirming their indications against TC, AS, ALT and VSI, as well as magnetic compass
5. Re-establish appropriate power setting to maintain straight and level flight, or as required.

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TIMED TURNS

Objective

Flight crews will develop the ability to correctly execute turns to headings using a time reference and the magnetic compass as the only available directional resources.

Quick reference:
- Stabilize in level flight
- Determine the direction of the upcoming turn
- Determine the difference between current and desired heading
  - Divide it by 3 to obtain the needed time, in seconds
- Start timer, then roll into a standard rate turn
  - Remember: TIME, ROLL IN
- Reaching the elapsed time, as previously determined, roll out
  - Remember: TIME, ROLL OUT

Procedure Description:

1. Establish straight and level flight.
   a. Crosscheck the ASI, ALT, TC, and magnetic compass
   b. Set the stabilator trim for “hands off” flying
   c. Prepare the time reference that will be used (timer, watch, ac clock, etc.)

2. Determine the direction of the upcoming turn.
   a. Remember that the typical aviation fluid-filled magnetic compass card reads the opposite of the actual direction of turns
   b. Use any normally indicating compass card reference (OBS, HDG, etc) if confusion exists, to confirm the direction of the upcoming turn

3. Reference the magnetic compass for heading, then determine the difference, in degrees, between the current heading and the desired heading

4. Calculate the needed time, in seconds, to turn to the desired heading
   a. Divide the difference in degrees by 3 for a standard rate turn of 3° per second

   **NOTE**
   Proper timing requires a standard rate turn of 3° per second. Start the time and then roll into a standard rate turn for a specified amount of time and heading change
   (e.g. turning right from 270° to 090° = 180° desired heading change; 180°/ 3 = 60 seconds at standard rate, 3° per second turn).

5. Note the time / start the timer, then smoothly roll into standard rate turn in the desired direction using coordinated aileron and rudder and using the TC for bank reference.
6. After the calculated time has elapsed initiate a smooth roll out using coordinated aileron and rudder. Attempt to roll out at the same rate as the initial roll in.

7. Once the aircraft returns to straight-and-level flight, allow the magnetic compass to settle.

8. Once the compass card has stabilized, confirm the desired heading is achieved, and make small adjustments, if any.
   a. Since the typical aviation compass card reads backwards, it is easiest to visualize the desired heading mark on the compass card as the airplane.
   b. For small heading corrections of 10° or less, you can “fly” the desired heading mark on the compass card toward the heading reference line on the compass glass, using very small bank angle (≈5° or less).
   c. Make only momentary and slight bank changes when making small heading corrections, as even a 3 second turn at standard rate will change the heading approx. 10°.

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COMPASS TURNS

Objective

Flight crews will develop the ability to correctly turn using the magnetic compass and the knowledge of aircraft positional latitude as the only directional references.

Quick reference:

- Stabilize in level flight
- Determine the direction of the upcoming turn
- Determine the desired amount, in degrees, of overshoot or undershoot, if any
  - Memorize the references for YOUR latitude and airplane
- Remember:
  - OSUN “Overshoot south, undershoot north”
  - UNOS – “Undershoot north, overshoot south”
- Roll into a standard rate turn
  - Do not exceed ≈ 18° of bank due to compass limitations
- Roll out on the previously determined heading value, then make small adjustments
  - Remember:
    - The heading mark (on the compass card) is the airplane
    - “Fly it” in the direction of the course line (the reference line on compass glass) using slight bank of ≈5° or less

Procedure description:

1. Establish straight and level flight.
   - Crosscheck the ASI, ALT, TC, and magnetic compass
   - Set the stabilator trim for “hands off” flying
2. Reference the magnetic compass for heading, then determine the desired heading.
3. Determine the direction of the upcoming turn.
   - Remember that the typical aviation fluid-filled magnetic compass card reads the opposite of the actual direction of turns
   - Use any normally indicating compass card reference (OBS, HDG, etc) if confusion exists, to confirm the direction of the upcoming turn
4. Determine the amount of overshoot or undershoot needed for the desired heading (reference the examples and the illustration below)
   - Determine current positional latitude (e.g. 40° North)
   - When turning to the heading of North, UNDERSHOOT by degrees of latitude, plus lead by ½ the bank angle
   - When turning to the heading of South, OVERSHOOT by degrees of latitude, and also lead by ½ the bank angle
   - When turning to the headings of East or West, there is no lag so no additional overshoot or undershoot is required, except lead by ½ the bank angle.
e. Remember UNOS (“undershoot north, overshoot south”) and OSUN (“overshoot south, undershoot north”) memory aids

f. For headings between N, E, S and W, interpolate the amount of overshoot/undershoot required.

g. It is easiest to use previously memorized amounts of overshoot or undershoot for your specific latitude and airplane (refer to the illustration below as an example)

i. In advance, interpolate and memorize the overshoot/undershoot values for each possible heading in 30° increments (i.e. 000, 030, 060 etc. degrees)

ii. Round it to the nearest 5° for ease of memorization

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**NOTE**

To determine the bank angle necessary to maintain standard rate (3° per second) turn, for any given TAS, take 15% of the TAS (knots) value, or 13% of TAS (MPH) value, using one of the following:

**Formulas:**

\[ \text{TAS (knots) x 0.15} = \text{Angle of Bank for Standard rate, 3° per second turn} \]

\[ \text{TAS (MPH) x 0.10 + 5°} = \text{Angle of Bank for Standard rate, 3° per second turn} \]

Or

**Mental math:**

Divide TAS in knots by 10, then add half the answer

Divide TAS in MPH by 10, then add 1/3 the answer

**EXAMPLES, FOR TAS OF 120 KTAS = 138 MPH:**

**Formulas:**

\[ 120 \text{ KTAS x 0.15} = 18° \]

\[ 138 \text{ MPH x 0.13} = 18° \]

Or

**Mental math:**

\[ 120 \text{ KTAS} /10=12, \ 12/2=6, \ 12+6=18° \]

\[ 138 \text{ MPH} / 10 \approx 14, \ 14/3 \approx 4, \ 14+4=18° \]

5. Reference heading on the compass and initiate a turn in the desired direction using coordinated ailerons and rudder and the TC to establish a standard rate turn.
NOTE

Most aviation fluid compasses have a bank limitation of 18°.
When conducting compass turns flight crews must take this into account
and attempt to maintain standard rate bank angles,
regardless of weather conditions.

For practical purposes, due to this limitation, the compass turns are limited to airspeeds of 120
KTAS (138 MPH TAS) or below in the PA28R200

6. Roll out on the previously determined compass heading value, and allow the compass to
stabilize while maintaining straight and level flight

7. Once the compass card has stabilized, confirm the desired heading is achieved, and make
small adjustments, if any.
   a. Since the typical aviation compass card reads backwards, it is easiest to visualize
      the desired heading mark on the compass card as the airplane.
   b. For small heading corrections of 10° or less, you can “fly” the desired heading
      mark on the compass card toward the heading reference line on the compass glass,
      using very small bank angle (≈5° or less).
   c. Make only momentary and slight bank changes when making small heading
      corrections, as even a 3 second turn at standard rate will change the heading
      approx. 10°.

FOLLOWING THESE EXAMPLES, SEE THE SAMPLE ILLUSTRATION BELOW.

Example 1, turning to a cardinal heading:

Left turn from heading 120° to heading of North (360°) at 42° Latitude N, using standard
rate turn at 120 KTAS (138 MPH TAS)

1) From notes above, angle of bank required to maintain standard rate at 120 KTAS is
18°

2) Since turning LEFT, compass values will be higher than 360° for undershoot

3) Undershoot heading of 360 by 42°, and lead by ½ bank angle, so:
   a. (HDG 360°) + (Undershoot of 42°) = (HDG 042°)
   b. Lead by ½ bank angle of 18°, so lead by 9°
   c. (HDG 042°)+(9° lead) = HDG 051° ≈ HDG 050° (round to the nearest 5° for
      simplicity)

4) So turning LEFT from HDG 120° to the desired HDG of 360°, roll out when the
compass first indicates 050°
Example 2, turning to an intermediate heading:

Left turn from heading 120° to a NE heading of 030°, at 42° Latitude N, using standard rate turn at 120 KTAS (138 MPH TAS)

1) From notes above, angle of bank required to maintain standard rate at 120 KTAS is 18°

2) Since turning LEFT, compass values will be higher than 030° for undershoot
   a. However, we will not use the full latitude value, since we are turning toward a NE heading, and not N, so we have to interpolate

3) Since 42° undershoot would be required for N (360°), and none for E (090°), we have to interpolate for 030°
   a. 30° out of 90° (total between N and E) is 2/3 of the way between no undershoot (at E) and maximum undershoot (at N), so we need 2/3 of the total undershoot value
   b. 42° undershoot x 2/3 is 28°
   c. For HDG of 030°, then, undershoot would be 28°

4) Undershoot heading of 030° by 28°, and lead by ½ bank angle, so:
   a. (HDG 030°) + (Undershoot of 28°) = (HDG 058°)
   b. Lead by ½ bank angle of 18°, so lead by 9°
   c. (HDG 058°)+(9° lead) = HDG 067° ≈ HDG 065° (round to the nearest 5° for simplicity)

5) So, turning LEFT from HDG 120° to the desired HDG of 030°, roll out when the compass first indicates 065°
Magnetic Compass Turns for 42° North Latitude
Standard rate turn at 120 KTAS, with resultant AOB of 18°

Letter O implies "overshoot by ..."
Letter U implies "undershoot by ..."

Headings are approximate, rounded to nearest multiple of 5 for ease of use.