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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 Pilot Practical Test Standards
  FAA Instrument Rating Practical Test Standards
  FAA Airplane Flying Handbook
  FAA Instrument Flying Handbook and Instrument Procedures
  Handbook
  Cessna C172R Skyhawk Pilot Information Manual
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 120 KIAS 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, and all other safety factors.

Transitioning between maneuvers
Flight crews may establish 90 KIAS between maneuvers, 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.
  o Set pitch and power, then trim!
  o 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.
  o Do not be excessively fast or slow when transiting from one maneuver to another.
  o For most maneuvers, a maximum of ≈ 90 KIAS prior to maneuver execution is sufficient for the C172R.
✓ 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 elevator control pressure, while related, are not the same thing.
  o Set the pitch using whatever elevator control pressure is necessary.
  o Maintain that pitch using elevator pressure and trim, if required.
  o The pressure necessary to maintain a particular pitch attitude will be different for different airspeeds.
  o Adjust elevator pressure to maintain pitch as airspeed changes during a particular maneuver. Typically, it means increasing elevator backpressure (pulling back on
the yoke) as airspeed decreases, and decreasing elevator backpressure (releasing the yoke forward) as airspeed increases.

✓ When “under the hood” in simulated instrument conditions, or any instrument conditions:
  
  o 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!
  
  o The artificial horizon now replaces your actual horizon.

  o 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.

  o Make the artificial horizon three times bigger in your mind than it actually is!

  o Just as your natural horizon outside would be the center of your scan, the artificial horizon now becomes the center of your scan.

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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 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. Ensure that the airframe and aircraft (doors, windows) are secured.
3. Ensure that the seatbelts and harnesses are securely fastened and any baggage is secured.
4. Verify the fuel selector is on BOTH.
5. Ensure the mixture is set as required for the conditions (see AFM/POH)
6. Set power to the Practice area setting (≈2000 RPM), or as appropriate
7. Verify that external lighting is set for maximum visibility (see AIM, operation Lights On)
8. Verify the magneto switch is set to BOTH.
9. Verify that engine instruments (oil temperature and pressure) are normal.
10. 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.

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.

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.
✓ A good operating practice is to place two fingers behind the throttle lock during takeoff and climb, to guard against the possibility of the seat sliding suddenly backwards during takeoff roll, rotation and initial climb, resulting in the pilot inadvertently reducing the power to idle while simultaneously pulling excessively on the yoke.
✓ 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 = 65 KIAS, Steady winds = 15 KIAS, Gusts = 25 KIAS, therefore gust factor is 25-15=10 knots, ½ gust factor is 5 knots, Final Approach speed = 65 + 5= 70 KIAS).

- 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.
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, 90 KIAS
- Downwind leg – 90 KIAS (∼1800-2000 RPM based on density alt)
- Midfield – “Before Landing” flows
- Abeam landing point – ∼1500 RPM or less, flaps 10°, descent -500 FPM, 80 KIAS
- Base leg – flaps 20°, 70 KIAS
- Final approach leg – flaps full, 65 KIAS (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 (79 KIAS).
3. Turn crosswind within 300’ of TPA, or as instructed by the control tower. Maintain Vy.

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<td>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.</td>
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<td>For departures opposite to the established traffic pattern, continue climbing to at least 500’ above TPA prior to turning on course.</td>
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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 90 KIAS (∼2000 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 90 KIAS (∼1800-2000 RPM, depending on density altitude, etc.).
3. At or just prior to downwind midfield, perform “Before Landing” flows.
4. At or just prior to abeam the intended landing point, reduce the power to ∼1500 RPM, and extend flaps to 10°. Begin a ∼500 FPM descent and maintain ∼85 KIAS.
5. At 45° to the intended landing point, or as directed by the control tower, turn BASE.
6. Ensure the airspeed is below Vfe (85 KIAS) and set flaps to 20°. Maintain ∼75 KIAS.
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 65 KIAS, adding $\frac{1}{2}$ the gust factor, as appropriate.

**NOTE**
Approaching in either CROSSWIND, STRONG GUSTY WIND or HIGH WIND, consider using less than full flaps.
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.

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TOUCH-AND-GO / STOP- AND- GO

Objective
Flight crews will develop the ability to safely transition into takeoff configuration immediately after landing, and execute an appropriate takeoff procedure.

CAUTION
Intentional Touch and Go operations are not to be conducted after a simulated engine failure approach (power-off approach) which results in landing on a runway. This does not preclude a safety related go-around in case of a bounced landing.

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 rolls down the runway (for a touch and go) or comes to a complete stop (for a stop and go).

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 safe speed where the necessary transition steps to takeoff can be executed.

5. 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.
6. The PF will call out “FLAPS SET FOR TAKEOFF” and set the flaps, as appropriate.
   ✓ The PMF will visually verify that flaps are set for takeoff.
7. 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.
8. Execute the appropriate takeoff procedure as described in this manual.

NOTE
➢ Terminate Touch and Go / 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.

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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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TAKEOFFS, LANDINGS AND GO-AROUNDS

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 (55 KIAS)
- Climb at Vy (79 KIAS)
- 500’ AGL – Climb checklist
- 1000’ AGL – 1800- 2000 RPM (if leveling off in the pattern), or as required

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**. Visually verify outside that the flaps are in takeoff position. If not previously done, verify that the trim tab outside is in takeoff position.
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. Set full throttle. As the aircraft begins to accelerate, check that the engine is producing 100% power, appropriate to the airport elevation and density altitude (≈ 2065-2165 RPM).
6. Ensure that all engine instruments are indicating normal (oil temperature and oil pressure).
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 - 55 KIAS), rotate to establish a Vy climb pitch attitude and accelerate to Vy airspeed (79 KIAS).
10. 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.
11. Once the aircraft rotates, crab into the wind to maintain runway centerline, level the wings and ensure the airplane is coordinated (ball centered). These actions occur nearly simultaneously.
12. 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).

13. At 500’ AGL, initiate the “Climb” checklist. At 1000’ AGL, if leveling off and remaining in the pattern, reduce power to maintain traffic pattern airspeed, or as appropriate.

14. If departing the traffic pattern, continue climbing at $V_y$ (79 KIAS) or $V_{climb}$ (90 KIAS), as appropriate.

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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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, 65 KIAS (or as appropriate)
- 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 65 KIAS.
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. Crab into the wind to remain on extended runway centerline.
6. Coordinate pitch and power so as to maintain and the desired approach angle resulting in a smooth landing within the designated area.
7. 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.
8. 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.

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.

9. 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.
10. 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 AFM for crosswind component limitations.

11. 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.

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

13. 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.

14. Slow the aircraft to a safe taxi speed and taxi off the runway.

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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 - 10° and check trim set for takeoff!
- Maximize runway distance and STOP
- Hold brakes, set full power, check instruments – only THEN release brakes
- Rotate at Vr (51 KIAS)
- Climb at Vx (60 KIAS) until clear of obstacles
- Establish Vy pitch attitude
- Verify above 60 KIAS, then flaps from 10° to 0° (up)
- Accelerate to and climb at Vy (79 KIAS)

Procedures description:
1. At the hold short line, ensure the appropriate checklist is complete, flaps are set to 10° and trim is set for takeoff. Visually verify outside that the flaps are in takeoff position. If not previously done, verify that the trim tab outside is in takeoff position.
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. Get as close to the approach end of the runway as possible to maximize available takeoff distance.
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. Smoothly and positively set full throttle. Check that engine instruments display normal readings and 100% power appropriate to the airport elevation.
6. Release the brakes, allowing the aircraft to accelerate. Check that the airspeed indicator is functioning.
7. At manufacturer recommended airspeed Vr (55 KIAS), rotate to establish a Vx climb attitude and accelerate to Vx airspeed (60 KIAS).
8. Maintain Vx until all obstacles have been cleared. Once clear of the obstacles, establish a Vy climb attitude and accelerate to Vy airspeed (79 KIAS).
9. After establishing a positive rate of climb and out of usable landing area, apply brake pressure to stop wheel rotation.
10. At 500' AGL, initiate the “Climb” checklist, continue climbing and verify full power is set and being achieved.
11. At or above 1000’ AGL, smoothly reduce power if remaining in the pattern, or as appropriate
12. If departing the pattern, continue climbing at Vy (79 KIAS) or Vclimb (104 KIAS), as appropriate.
13. Monitor engine temperatures in climb and adjust climb speed, as appropriate.
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, 61 KIAS (or as appropriate for aircraft weight)
- Touchdown within 200 (Private Pilot) or 100 (Commercial Pilot) feet of your 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 61 KIAS.
4. 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. 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.
7. 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 while conducting a short-field approach at lower than normal approach airspeed, as it may result in an immediate increase in the rate of descent and a hard landing.
8. Immediately after touchdown, raise the flaps. Continue applying backpressure to the yoke, adjusting the rudder pressures as the airplane slows down. Apply maximum 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.

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

10. Minimize ground roll distance, slow the aircraft to a safe taxi speed and taxi off the runway.

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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** - 10° 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
- Maintain constant pitch, nosewheel off the ground, until airborne
- **Immediately** adjust pitch to remain in ground effect, and accelerate
- Initiate a climb at **Vx (60 KIAS)** with actual or simulated obstacle, or at **Vy (79 KIAS)**, if no obstacle
  - EstablishVy pitch attitude and climb at Vy (79 KIAS) when clear of obstacles
- **Flaps from 10° to 0° (up)** when:
  - Out of ground effect, and
  - Clear of obstacles, and
  - Above 60 KIAS
- Continue climbing at Vy (79 KIAS)

Procedures description:
1. At the hold short line, ensure the appropriate checklist is complete, **flaps are set to 10° and trim is set for takeoff**. Visually verify outside that the flaps are in takeoff position. If not previously done, verify that the trim tab outside is in takeoff position.
2. Contact the control tower for clearance, or at non-controlled 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 elevator is effective.
- Keep the nosewheel off the ground once the elevator 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. Simultaneously, compensate with the rudder to remain on the centerline and release some 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.

<table>
<thead>
<tr>
<th>NOTE</th>
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<tbody>
<tr>
<td>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 elevator effectiveness. The goal is for aircraft pitch in relation to the horizon to remain constant, and to adjust yoke pressures accordingly.</td>
</tr>
</tbody>
</table>

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 Vx (60 KIAS) if obstacles are present, or Vy (79 KIAS) otherwise.

<table>
<thead>
<tr>
<th>NOTE</th>
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<tbody>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>

13. Initiate a climb at Vx (60 KIAS) if obstacles are present, or at Vy (79 KIAS) otherwise.
14. Maintain Vx (60 KIAS) until all obstacles have been cleared.
15. Once clear of the obstacles, establish a Vy,climb attitude.
16. Verify above 60 KIAS, then retract flaps from 10° to 0° and accelerate to Vy airspeed (79 KIAS).
17. At 500’ AGl, initiate the “Climb” checklist, continue climbing and verify full power is set and being achieved.
18. At or above 1000’ AGl, smoothly reduce power if remaining in the pattern, or as appropriate
19. If departing the pattern, continue climbing at Vy (79 KIAS) or V,climb (90 KIAS), as appropriate.
20. Monitor engine temperatures in climb and adjust climb speed, as appropriate.

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MANEUVERS
For Training Purposes Only

- Flaps set 10° and checked, as appropriate.
- Maximize Runway Distance.
- Maintain back pressure on the nosewheel, off the runway.
- Set full throttle.
- Check engine instruments and state “Full Power.”

- Immediately apply forward pressure and lower the nose to stop climbing and remain in ground effect.
- Complete callsouts: “Engine indications normal,” “All things alive.”
- Maintain Vy+79 KIAS. Once positive rate of climb is established, retract flaps.
- Maintain Vy+79 KIAS.
- While in ground effect: accelerate to Vy+79 KIAS.
- While in ground effect, maintain Vy+79 KIAS. Continue climbing at Vy+79 KIAS, as appropriate.
- Maintain Vy pitch attitude and continue climbing at Vy+79 KIAS, or as appropriate.

- Adjust back pressure to hold the nosewheel off the runway until the aircraft lifts off.

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

Maintain Vy pitch attitude and continue climbing at Vy = 79 KIAS, or as appropriate.

When clear of obstacles:
- Establish Vy pitch attitude.
- Retract flaps above 60 KIAS.
- Accelerate to Vy speed of 79 KIAS.

End of Runway OBSTACLE HEIGHT (typical simulated obstacle 20 feet)

Maintain Vx=60 KIAS until clear of obstacles.

Upon reaching Vx, immediately begin climbing at Vx.

While in ground effect, accelerate to Vx climb speed of 60 KIAS.

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

Flaps set 10° and checked, as appropriate.
Maximize Runway Distance.
Maintain backpressure on the yoke to keep weight off the nosewheel.
AVERAGE 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.
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, 62 KIAS (or as appropriate)
- 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 approach speed of 62 KIAS.
4. Select the appropriate final flap setting based on the wind conditions (refer to Traffic Pattern Operations)

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<tbody>
<tr>
<td>If reduced flap setting is used due to crosswind conditions, take into account the increased landing distance requirements and ensure adequate runway distance exists.</td>
</tr>
</tbody>
</table>

5. Ensure that the aircraft is on a stabilized approach with a final flap setting prior to reaching 300’ AGL.
6. 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.
7. 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.
   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.
8. Immediately after touchdown, continue “flying the airplane” by applying backpressure to the yoke, and adjusting the rudder pressures as the airplane slows down.

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

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

11. 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.

12. Slow the aircraft to a safe taxi speed and taxi off the runway.

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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:
- **C**ram – Full power, level the pitch, flaps (if full) from 30° to 20° immediately
- **C**limb – Ease into a climb, check for positive rate on ALT/VSI, then flaps 20° to 10°
- **C**lean – Clear of obstacles and above 60 KIAS, flaps from 10° to 0° and pitch for \( V_y \), then climb at \( V_y = 79 \) KIAS
- **C**all – announce go-around on radio
- **C**hecklist – verify the appropriate checklist flows (Airspeed? Flaps?)

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 (throttle – full forward) and level the wings.
2. Immediately set flaps from 30° to 20° (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 climb as indicated by needle reversal, retract flaps from 20° to 10°.

**NOTE**
During a go-around, flight crews should use \( V_x \) climb airspeed and flaps at 10° if obstacle clearance is required and until all obstacles have been cleared.

5. When clear of obstacles, and above 60 KIAS, retract flaps 10° to 0° (full up) and establish \( V_y \) pitch attitude.
6. After the aircraft accelerates to \( V_y \) airspeed, continue climbing at \( V_y \) (79 KIAS).
7. 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.
8. 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.
9. If an aircraft is on the runway or taking off, alter course to the right, or as directed by the control tower, while keeping 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.*
10. 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 past the runway departure end.

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

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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 checklist flows complete
- Position on downwind, 1000’ AGL, abeam landing point (“key position”)
- Power to idle, flaps 10°, Best Glide airspeed, evaluate wind strength and direction
- When appropriate, turn base, evaluate ground track and glidepath
- Flaps and slips to control descent rate, while remaining at Best Glide airspeed
- Touchdown no more than 200 ft beyond landing point (Commercial Pilot) or safely on runway (Private Pilot)

Description:
1. Ensure that all necessary checklists and arrival procedures 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 1/3rd 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, set flaps 10°, and establish best glide airspeed.
   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 rate of descent.
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.

NOTE
This procedure will only be conducted to a full-stop taxi-back landing. Stop-and-go or touch-and-go operations are PROHIBITED when conducting this maneuver in this aircraft.
SLOW FLIGHT AND STALLS

MANEUVERING DURING SLOW FLIGHT
(Clean Configuration: Flaps 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 90 KIAS, select and maintain ALT and HDG
- Throttle ≈ 1200 RPM
- Monitor AS, maintain ALT and HDG
- Approaching MCA – throttle ≈ 1900 RPM
- Maintain MCA just above Vs1 (44 KIAS)
- 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 **1200 RPM**. During the power reduction, maintain altitude by smoothly increasing pitch as airspeed decreases. Trim the aircraft if and as necessary.
4. Approaching slow flight airspeed Vs1 (44 KIAS), increase the power to ≈ **1900 RPM** (this setting will vary).
5. 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.

6. 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.
7. 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.
8. Resume cruising at PX area power setting (≈ **2000 RPM**) or as specified.
NOTE: Coordinated flight means the airplane is at the desired pitch and bank, while aligned with relative wind (ail is centered). Use whatever control inputs necessary to achieve coordinated flight during the Slow Flight maneuver.

Level power setting (approx. 1900 RPM, on average) 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 1200 RPM
- As airspeed decreases, adjust pitch attitude to maintain altitude.
- Reaching just above \( V_{s1} = 44 \text{ KIAS} \):
  - Adjust power to maintain level flight (approx. 1900 RPM)
  - 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.
  - Throughout the maneuver, maintain 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)

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 90 KIAS, select and maintain ALT and HDG
- Throttle ≈ 1500 RPM
- Monitor A/S, maintain ALT and HDG
- 110 KIAS and below – Flaps from 0° to 10°
- Vfe (85 KIAS) and below – flaps down in increments, until 30° (full)
- Approaching MCA – throttle ≈ 2100 RPM
- Maintain MCA just above Vs0 (33 KIAS)
- When prompted, recover:
  - Full power, flaps from full to 20° immediately
  - Maintain HDG and ALT
  - Passing into green arc (44 KIAS) – flaps from 20° to 10°
  - Passing 60 KIAS – 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 1500 RPM. During the power reduction, maintain altitude by smoothly increasing pitch as airspeed decreases. Trim the aircraft if and as necessary.
4. Below 110 KIAS, set flaps from 0° to 10°.
5. Below Vfe (85 KIAS), smoothly add flaps, in increments, until 30° (full).
6. Approaching slow flight airspeed Vs0 (33 KIAS), increase the power to ≈ 2100 RPM (this setting will vary).
7. 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.
8. 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.

9. Recover the maneuver by smoothly applying full power and immediately bringing flaps from 30° to 20°. Adjust pitch to maintain the altitude as the airspeed increases, and trim the aircraft as necessary.
   a. Maintain HDG and ALT throughout the recovery.

10. As the airplane accelerates through 44 KIAS (green arc), retract flaps from 20° to 10°.

11. Passing through 60 KIAS retract flaps from 10° to 0° (up).

12. Resume cruising at PX area power setting (≈ 2000 RPM) or as specified.

This space is intentionally left blank
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. 2100 RPM, on average) 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.

1500 RPM
110 KIAS or below:
Flaps 10°

As airspeed decreases, adjust pitch attitude to maintain altitude.

85 KIAS or below:
Flaps 30°

Reaching just above Vs0 = 31 KIAS:

Adjust power to maintain level flight (Approx. 2100 RPM)
This is your level power setting, and it will vary.

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.

Maintain:
Attitude; Heading;
Airspeed; Coordination

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. Immediately raise flaps from 30° to 20°.

As airspeed reaches green arc; raise flaps from 20° to 10°.

Maintain heading, altitude and airspeed, as specified.

Above 60 KIAS, raise flaps from 10° to 0°.

Return to heading, altitude and airspeed, as specified.
POWER-ON STALL
(Take-off and departure stall in clean configuration: Flaps 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 ≈1200 RPM
  - Maintain altitude and heading on entry
  - Wait for Vr+10 KIAS (65 KIAS)
- **Rotation and climb** – simulate rotation and climb
  - At 65 KIAS, add full power 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 over-rotation / excessive climb pitch (≈10° 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 ≈ 1200 RPM. 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. Approaching Vr + 5-10 KIAS (≈60-65 KIAS), increase the power to full takeoff and climb power. Simultaneously, pitch up slightly excessively to simulate over-rotation and excessive climb pitch attitude (≈ 10° 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.

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

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<tr>
<th>NOTE</th>
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<tbody>
<tr>
<td>Turning stalls to the left/ right are accomplished with a maximum bank angle of <strong>20°</strong></td>
</tr>
</tbody>
</table>

6. 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.

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

<table>
<thead>
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<tbody>
<tr>
<td>➢ <strong>IMMINENT STALL</strong>: Buffeting, stall warning horn, or rapid decay of control effectiveness (whichever occurs first); The aircraft is <strong>ABOUT</strong> to stall.</td>
</tr>
<tr>
<td>➢ <strong>FULL STALL</strong>: A sudden loss of control effectiveness, excessive sink rate, or sudden decrease in pitch attitude; The aircraft <strong>HAS</strong> stalled.</td>
</tr>
</tbody>
</table>

8. Initiate a recovery by promptly decreasing the angle of attack. If appropriate, level the wings.

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

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

11. Return to the specified altitude, airspeed and heading. Resume cruising at PX area power setting (**≈2000 RPM**) or as specified.
NOTE: A Power-ON Stall simulates a stall that may occur after rotation and during climb

1200 RPM
Maintain altitude and heading

As airspeed decreases, adjust pitch attitude to maintain altitude.

69 KIAS (V+5 knot)
Simulate rotation and establish excessive pitch attitude.
Apply full power. Apply rudder as needed to maintain coordination.

Maintain:
Full power;
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 Vy (best rate of climb) pitch attitude. Minimize altitude loss.

Recovery:
Reduce Angle of Attack. Maintain coordinated flight.

Maintain Vy pitch attitude as the airplane accelerates to the Vy speed of 79 KIAS. Then, maintain Vy 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)

Objective
Flight crews 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
  - Power ≈1500 RPM
  - Maintain altitude and heading on entry
  - Below 110 KIAS – flaps 10°
  - In white arc (85 KIAS or below) flaps 20°
  - 70 KIAS – flaps 30° (full down)
- **Approach** – simulate a landing approach
  - 65 KIAS - 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, full power, then level the wings
  - Flaps from 30° to 20°
  - Establish \(V_X\) or \(V_Y\) pitch attitude to climb away from simulated terrain
  - Positive rate of climb – flaps from 20° to 10°
  - Passing 60 KIAS – 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 ≈1500 RPM. During the airspeed reduction, maintain altitude by smoothly increasing pitch as airspeed decreases. Trim the aircraft as necessary.
5. At 65 KIAS, 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.

6. 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.

   **NOTE**
   Turning stalls to the left/ right are accomplished with a maximum bank angle of 20°

7. 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.

8. Recover from IMMINENT STALL or from FULL STALL, as specified.

   **NOTE**
   - **IMMINENT STALL**: Buffeting, stall warning horn, 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.

9. Initiate a recovery by promptly decreasing the angle of attack. Simultaneously, apply full power to minimize altitude loss. If appropriate, level the wings. Immediately, retract flaps to from 30° to 20°.

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

11. 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
   c. Bring flaps from 20° to 10°

12. As the airplane accelerates in the climb and past 60 KIAS, retract flaps to 0° (full up).

13. Maintain Vy pitch attitude and accelerate to Vy (79 KIAS). Continue climbing at Vy away from simulated terrain.

14. Return to the specified altitude, airspeed and heading. Resume cruising at PX area power setting (=2000 RPM) or as specified.
Note: A Power-OFF stall simulates a stall that may occur during approach and landing

1500 RPM
110 KIAS or below:
Flaps 10°
As airspeed decreases, adjust pitch attitude to maintain altitude.
85 KIAS or below:
Flaps 30°
Reaching 65 KIAS
(final approach speed):
Establish normal approach angle to an imaginary runway.
Reduce power to idle.
Simulate landing flare by establishing flare pitch attitude. If turning stall, set the specified angle of bank.

Maintain:
Flare pitch attitude;
Coordination;
Heading or angle of bank, as appropriate.

Announce “Imminent Stall”, as appropriate.

Imminent stalls:
Recover immediately as specified.
Full stalls:
Induce full stall and recover as specified.

Recovery:
Reduce Angle of Attack. Immediately add full power. Immediately raise flaps from 30° to 20°. Maintain coordinated flight.

As flying speed returns, transition smoothly into Vy (best rate of climb) pitch attitude.

When positive rate of climb is established, raise flaps from 20° to 10°.
Minimize altitude loss

Maintain Vy pitch attitude as the airplane accelerates to Vy speed of 79 KIAS.

Above 60 KIAS, raise flaps from 10° to 0°.
Then, maintain Vy climb, as specified, to simulate climbing away from approaching terrain.

Return to heading, altitude and airspeed, as specified.

Power - OFF stall
DEMONSTRATION STALLS  (Specialty stalls)

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 stall speed with increasing aircraft bank angle.

WARNING

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

Quick reference

- Accelerated Stall – simulate banking excessively while maintaining altitude
  - Power ≈ 1500 RPM
  - Maintain altitude and heading on entry
  - 85 KIAS – 45° of bank and maintain altitude
  - Induce an imminent stall within 90° of heading change
  - Note the (high) airspeed at which the first stall indication occurs
  - Recover from imminent stall at the first indication of a stall
  - Point out the airspeed 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 1500 RPM, and trim the aircraft as necessary.
4. During the power reduction maintain altitude by smoothly increasing pitch as the airspeed decreases.
5. As the airspeed approaches 85 KIAS, 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.
6. 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.

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

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

9. 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.
10. Establish a climb speed of 60 KIAS (V_X) or 79 KIAS (V_Y) as specified.
11. Resume normal cruise or transition cruise flight.
12. 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 PUls 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

Quick reference
- Elevator Trim Stall – simulate improper go-around while trimmed for final approach speed
  - Set up for a normal power-off stall
  - 65 KIAS – power to IDLE and TRIM for hands-off 65 KIAS descent
  - Once stabilized, FULL power
  - Note pitch attitude at which the first stall indication occurs
  - Recover from imminent stall at the first indication of a stall
  - 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 1500 RPM.
4. Extend flaps as specified to arrive at full flaps down, landing configuration by 65 KIAS.
5. Establish a stabilized descent at 65 KIAS to simulate approach to a landing.
6. Set the throttle to IDLE and re-trim the aircraft in a stabilized descent at 65 KIAS at minimum (idle) power setting.
7. 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.
8. Announce “Stall Warning” and initiate the recovery at the first indication of a stall.

WARNING
This maneuver may be flown to IMMINENT STALL ONLY.

9. Initiate a 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.
10. Retract flaps to 20°.
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. Once positive rate of climb has been confirmed, retract flaps to 10°.

13. Establish a climb speed of 60 KIAS ($V_X$) or 79 KIAS ($V_Y$) as specified.

14. Passing through 60 KIAS, retract flaps to 0°.

15. Once the recovery has been completed, establish a normal cruise climb speed of 85 KIAS.

16. Resume normal cruise or transition cruise flight.

17. 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 an incorrect trim setting and not letting it fly an 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.

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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 that demonstrates 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

Quick reference
- Crossed Control Stall – simulate cross-controlled turn from base to final
  - Power ≈1500 RPM
  - Maintain altitude and heading on entry
  - 75 KIAS - no flaps; establish stabilized descent, power IDLE
  - 30° bank turn – use excessive rudder and opposite aileron
  - Add backpressure
  - Note improper control inputs and crossed control indications (ball)
  - Recover from imminent stall at the first indication of a stall
  - 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 1500 RPM and trim the aircraft as necessary.
4. Establish a stabilized descent at 75 KIAS, simulating decent on the base leg of a traffic pattern. Do not use flaps for this demonstration.
5. Smoothly set throttle to IDLE and re-trim the aircraft in the stabilized descent at 75 KIAS.
6. Initiate a 30° bank in either direction. 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.
7. Point out the improper crossed control inputs, and the indications of crossed controls reflected on the inclinometer (the ball) not being centered.
8. Announce, “Stall Warning” and initiate the recovery at the first indication of a stall.

WARNING
This maneuver may be flown to IMMINENT STALL ONLY.

9. Recover by promptly and simultaneously decreasing the angle of attack, applying full power and, if appropriate, leveling the wings.
10. Pitch for an attitude that will ensure a minimal loss of altitude and a positive rate of climb.
11. Establish a climb speed of 60 KIAS ($V_X$) or 79 KIAS ($V_Y$) as specified. Once the recovery has been completed establish normal cruise climb speed of 85 KIAS.

12. Resume normal cruise or transition cruise flight.

13. Explain what would happen if immediate recovery action was not taken and a stall was allowed to progress with controls crossed.
   a. Emphasize the importance of proper control inputs and simultaneous bank and inclinometer (the ball) indications in turns.
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 that demonstrates how rushed stall recovery can result in a second stall, delaying the overall recovery.

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

Quick reference
- Secondary stall – simulate improper recovery from first stall, leading to another stall
  - Set up for a normal power-off stall
  - Effect a normal power-off stall entry to full stall
  - On recovery, reduce the angle of attack but do not add power
  - Pitch up excessively to enter a secondary stall
  - Recover normally with pitch and power, retracting flaps as specified
  - 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 the throttle to 1500 RPM and trim the aircraft as necessary.
4. Extend flaps as specified to arrive at full flaps down, landing configuration by 65 KIAS.
5. Establish a stabilized descent at 65 KIAS.
6. Smoothly set the throttle to IDLE, while increasing pitch to an attitude that will result in a steady decrease in airspeed.
7. Announce, “Stall Warning” when stall is imminent, and “Full Stall” as full stall occurs, and initiate the recovery by reducing the pitch attitude, but, for this demonstration, do not add power during this step.

NOTE
- **IMMINENT STALL:** Buffeting, stall warning horn, 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.

8. Add excessive back pressure to induce another (secondary) full stall.
9. Announce, “Secondary Stall” as full stall occurs, and initiate the recovery by reducing the pitch attitude, promptly and simultaneously applying full power, decreasing the angle of attack and, if appropriate, leveling the wings once the stall has been broken.

10. Pitch for an attitude that ensures a minimal loss of altitude and a positive climb rate.

11. Retract flaps to 20°.

12. Once positive rate of climb has been confirmed, retract flaps to 10°.

13. Establish a climb speed of 60 KIAS ($V_X$) or 79 KIAS ($V_Y$) as specified.

14. Passing through 60 KIAS, retract flaps to 0°.

15. Resume normal cruise or transition cruise flight.

16. 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 Cessna C172R Skyhawk is certified for spins ONLY when loaded in Utility Category in accordance with the AFM.

Intentional spins outside of specifically authorized CFI training are PROHIBITED.

The following guidance is for general, unintentional spin recovery only. It is not to be practiced or demonstrated in the actual aircraft outside of specifically authorized CFI training.

**Objective**

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

**Quick reference:**

- Remember: PARE
  - 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 ailerons** 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 BRISKLY FORWARD FAR ENOUGH TO BREAK THE STALL**.
   - a. Full down elevator may be required at aft center of gravity loadings to assure optimum recoveries.
7. **HOLD ALL THESE CONTROL INPUTS** in their respective positions **UNTIL ROTATION STOPS**.
   - a. Premature relaxation of the control inputs may extend the recovery.
8. **AS ROTATION STOPS, neutralize rudder**.
9. **RECOVER from the resulting dive** with smooth backpressure on the yoke.
10. **Avoid abrupt control movement** during dive recovery, as to not exceed the positive limit load factor.
SPINS (CFI training only, with prior approval)

**WARNING**

The Cessna C172R Skyhawk is certified for spins ONLY when loaded in Utility Category in accordance with the AFM.

**Intentional spins outside of specifically authorized CFI training are PROHIBITED.**

The following guidance is for CFI training ONLY. It is not to be practiced or demonstrated in the actual aircraft outside of specifically authorized CFI training.

**WARNING**

The spin maneuver entry must be accomplished NO LOWER than 4,000 AGL for ONE (1) turn spins, with an additional **1,000’ AGL** for each additional turn in the spin.

The spin maneuver recovery, including the pullout from the resulting dive and return to straight and level flight, must be accomplished NO LOWER than 3,000 AGL.

**Objective**

CFI applicants will develop instructional knowledge regarding situations where unintentional spins may occur and procedures for demonstration spin entry and recovery.

**Quick reference:**

- **Setting up**
  - Flaps up
  - Confirm loose items secure

- **Entry**
  - Induce a power-off stall
  - Apply and hold rudder in the desired spin direction
  - Maintain opposite aileron pressure to maintain wings level as stall occurs
  - Maintain elevator full aft
  - A slight power addition during stall break may assist spin entry

- **Spin development**
  - When spin occurs, reduce power to idle and neutralize ailerons
  - Hold pro-spin elevator and rudder inputs for the desired number of spin turn

- **Recovery: Remember PARE**
  - P – power to idle
  - A – ailerons neutral
  - R – rudder opposite rotation
  - E – elevator forward
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. Ensure flaps are up and all maneuver requirements and aircraft limitations have been met.
4. Enter the spin by inducing a power-off stall with flaps up:
   a. Steadily add backpressure to slow down toward the stall by increasing the angle of attack
   b. As the aircraft approaches stall speed, set up an intentional cross controlled situation by applying and holding full rudder in the direction of the desired spin, and opposite aileron to maintain wings level.
   c. Continue adding elevator backpressure until full aft elevator is reached.
   d. An optional small power addition at the stall break will ensure a positive spin entry.
   e. Due to the aircraft design a left spin entry will be much easier to achieve than the right spin entry.
5. As the aircraft enters the spin:
   a. Retard the power to idle and neutralize ailerons, but continue holding full aft elevator and full rudder in the direction of the spin as long as a spin is desired.
   b. Any relaxation of pro-spin controls will most likely result in premature recovery and a spiral dive developing instead.
   c. Monitor airspeed indicator for increasing airspeed to guard against a spiral dive and resultant potential high pullout airspeed and load factor.
6. When the desired number of spin turns has been accomplished, initiate recovery.
7. Retard throttle to IDLE.
8. Place and maintain ailerons in NEUTRAL position.
9. 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.
10. Just after the rudder reaches the stop, MOVE THE CONTROL WHEEL BRISKLY FORWARD FAR ENOUGH TO BREAK THE STALL.
    a. Full down elevator may be required at aft center of gravity loadings to assure optimum recoveries.
11. HOLD ALL THESE CONTROL INPUTS in their respective positions UNTIL ROTATION STOPS.
    a. Premature relaxation of the control inputs may extend the recovery.
12. AS ROTATION STOPS, neutralize rudder.
13. RECOVER from the resulting dive with smooth backpressure on the yoke.
14. Avoid abrupt control movement during dive recovery, as to not exceed the positive limit load factor.
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
- Power $\approx 2000$ RPM
- Maintain $V_A$ or 90 KIAS, whichever is less, as well as the entry ALT, throughout the maneuver
- Add power ($\approx 2200$ RPM), yoke backpressure and rudder rolling into the left turn
  - Complete 360° level left turn at 45° (Private Pilot) or 50° (Commercial Pilot) of bank
- Reduce power and pitch rolling out of the left turn, as to not 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 bank angles of 45° (Private Pilot) or 50° (Commercial Pilot)
- Reduce power and pitch rolling out of the right turn, as to not climb or accelerate
- Maintain original altitude, heading and airspeed on recovery

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 90 KIAS, whichever airspeed is less ($\approx 2000$ 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 $\approx 2200$ RPM in order to maintain entry airspeed
   b. Apply back pressure on the yoke as necessary to maintain constant altitude
   c. Add sufficient rudder to maintain coordination (ball centered)
   d. Trim if necessary.
7. Maintain a 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 elevator 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**.

11. Repeat the procedures from Steps 6 through 8 to complete 360 degrees 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 (≈2000 RPM), or as specified.

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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 ≈ 100 KIAS and ≈ 2200 RPM
- Pick a 90° point (right or left as appropriate) and note corresponding heading
- Simultaneously:
  - Roll into 30° bank
  - Add full power
- 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 ≈ 100 KIAS using ≈ 2200 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.
5. Select a prominent reference point, or appropriate straight-line reference (such as a road) off the wing tip.
   a. Note the 90° heading indicator reference as a secondary backup.
6. Enter a coordinated turn in the direction of the 90° reference point by simultaneously
   a. Increasing the bank to 30°
   b. Increasing the power to full
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 so 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 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 ≈ 100 KIAS and ≈ 2200 RPM
- Pick a 90° point and/or line reference
  - 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. Ensure that all pre-maneuver checklist items, clearing turns and a radio call are complete, as specified.
2. Establish the aircraft in level cruise flight at ≈ 100 KIAS (≈2200 RPM).
3. Plan to initiate this maneuver into the wind, inasmuch as practical, to avoid drifting away from the reference points and/or practice area.
4. Select prominent references on or near the horizon at the 45°, 90°, and 135° points.
   a. Selecting an appropriate straight reference line, such as a road, powerline, etc. off of the wing tip 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
5. Initiate a coordinated, gradual climbing turn in the direction of the 90° reference point.
6. From original heading to 45° point
   a. Pitch increases toward max.
   b. Bank increases toward ≈15°
   c. Pitch increases at a rate approximately three times more rapidly than the bank
6. Arriving at $45^\circ$ point
   a. Maximum pitch up attitude
   b. Bank angle $\approx 15^\circ$, which is $\frac{1}{2}$ of the maximum bank angle

7. From $45^\circ$ point to $90^\circ$ point
   a. Bank angle continues to increase toward max. $\approx 30^\circ$
   b. Pitch starts to decrease toward level

8. Arriving at $90^\circ$ point
   a. Level pitch attitude
   b. Airspeed just above (within 5-10 KIAS) stall speed
   c. Maximum bank angle of $\approx 30^\circ$

9. From $90^\circ$ point to $135^\circ$ point
   a. Pitch decreases below level
   b. Bank decreases toward $\approx 15^\circ$
   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 $30^\circ$, and to decrease the required bank below $30^\circ$

10. Arriving at $135^\circ$ point
    a. Lowest pitch down attitude
    b. Bank angle $\approx 15^\circ$, which is $\frac{1}{2}$ of the maximum bank angle

11. From $135^\circ$ point to $180^\circ$ point
    a. Pitch increases toward level
    b. Bank decreases toward $0^\circ$

12. Arriving at $180^\circ$ point
    a. Straight and level flight at the original entry altitude and airspeed

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

14. On completion of the second symmetrical loop resume normal cruise or transition cruise flight, as specified.

---

*This space is intentionally left blank*
180 degree point
Maximum bank angle
Level pitch attitude

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

Complete a symmetrical loop in the opposite direction

180 degree point
Arrive at level flight, on entry attitude and airspeed

Decrease pitch increase bank

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

Increase pitch increase bank

Entry:
From straight and level flight
Turn into the wind
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 rectangle
  - Closely aligned with the wind
  - Near an emergency landing field
- Enter 45° to downwind
  - Maintain 90 KIAS (≈2000 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 as to roll out ≈ ½ mile from the boundary
- Crab into the wind to maintain a constant ground track ≈ ½ mile from field boundaries
- Exit on the downwind

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
   - Consider the winds reported at the departure airport
   - Consider the winds reported at an airport nearest to the area where the maneuver is conducted
   - Observe wind indications on the surrounding terrain, such as ripples on the water, etc.
3. Select a prominent rectangular area 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 90 KIAS (≈2000 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 and rollout heading according to the strength of the wind to maintain a constant radius during the turns and constant distance and track along the field boundaries.

11. The maneuver is complete after one complete circuit has been completed, with the aircraft departing on the downwind

12. Initiating a climb to an appropriate altitude, as instructed.

13. Resume normal cruise or transition cruise flight.
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 a reachable emergency landing field
- Enter on downwind, perpendicular to the road
  - Maintain 90 KIAS (≈2000 RPM) and 1,000’ AGL
- Vary the bank angle to achieve a constant ground track
  - Project a ≈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
   d. Consider the winds reported at the departure airport
   e. Consider the winds reported at an airport nearest to the area where the maneuver is conducted
   f. Observe wind indications on the surrounding terrain, such as ripples on the water, etc.

3. Select a road or other straight-line reference, running approximately perpendicular to the wind.
   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 90 KIAS (≈2000 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:
   a. Initiate a 180° constant radius turn to the left
   b. Project a ≈ ½ mile radius half-circle to follow over the ground on the current (downwind) side of the road in order to keep positional awareness.
   c. Maintain this constant ground track by modifying the bank angle in relation to groundspeed.
   d. During entry on the downwind, the groundspeed will be the highest and consequently the angle of bank will be the steepest.
   e. The higher the groundspeed, the steeper the angle of bank required to maintain a constant ground track, but do NOT exceed 45° of bank.
   f. Throughout this first turn, the wind will change from tailwind to left crosswind, and then to headwind.
   g. As the groundspeed decreases, the angle of bank has to decrease to maintain a constant ground track.
   h. Completing the turn into the headwind (upwind), the groundspeed will be the lowest and consequently the angle of bank will be the shallowest.
   i. 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:
   a. Initiate a 180° constant radius turn to the right
   b. Project a ≈ ½ mile radius half-circle to follow over the ground on the current (upwind) side of the road in order to keep positional awareness.
   c. Maintain this constant ground track by modifying the bank angle in relation to groundspeed.
   d. Making this turn on the upwind, the groundspeed will be the lowest and consequently the angle of bank will be the shallowest.
   e. 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.
   f. The lower the groundspeed, the shallower the angle of bank required to maintain a constant ground track.
   g. Throughout this second turn, the wind will be changing from headwind to left crosswind, and then to tailwind.
   h. As the groundspeed increases, the angle of bank has to increase to maintain a constant ground track.
   i. Completing the turn with the tailwind (downwind), the groundspeed will be the highest and consequently the angle of bank will be the steepest.
   j. 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 two turns.
11. Initiate a climb to an appropriate altitude, as instructed.
12. Resume normal cruise or transition cruise flight.
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 90 KIAS (≈2000 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
  - 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. Consider the winds reported at the departure airport
   b. Consider the winds reported at an airport nearest to the area where the maneuver is conducted
   c. Observe wind indications on the surrounding terrain, such as ripples on the water, etc.
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 90 KIAS (≈2000 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.
   c. During entry on the downwind, the groundspeed will be the highest and consequently the angle of bank will be the steepest.
   d. The higher the groundspeed, the steeper the angle of bank required to maintain a constant ground track, **but do NOT exceed 45° of bank.**
   e. Throughout this first half of the turn, the wind will change from tailwind to left crosswind, and then to headwind.
   f. As the groundspeed decreases, the angle of bank has to decrease to maintain a constant ground track.
   g. 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.
    c. 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.
    d. The lower the groundspeed, the shallower the angle of bank required to maintain a constant ground track.
    e. Throughout this second half of the turn, the wind will be changing from headwind to right crosswind, and then to tailwind.
    f. As the groundspeed increases, the angle of bank has to increase to maintain a constant ground track.
    g. 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 instructed.

13. Resume normal cruise or transition cruise flight.
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 90 KIAS (≈ 2000 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 formula

The formula:
PIVOTAL ALTITUDE = GROUNDSPEED (KNOTS) SQUARED, then divide by 11.3

Using the formula will result in the following table.

<table>
<thead>
<tr>
<th>AIRSPEED</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>
<td>96</td>
<td>110</td>
</tr>
<tr>
<td>100</td>
<td>115</td>
</tr>
<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 by 11” --- 110 kts Groundspeed implies 1,100’ pivotal altitude, or
“100 gets 900” --- 100 kts Groundspeed implies 900 feet 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. Compare the values in the simplified table below derived from memory using this rule of thumb to the table above derived using the formula.

<table>
<thead>
<tr>
<th>KNOTS GROUNDSPEED</th>
<th>PIVOTAL ALTITUDE FEET AGL</th>
</tr>
</thead>
<tbody>
<tr>
<td>85</td>
<td>600</td>
</tr>
<tr>
<td>90</td>
<td>700</td>
</tr>
<tr>
<td>95</td>
<td>800</td>
</tr>
<tr>
<td>100</td>
<td>900</td>
</tr>
<tr>
<td>105</td>
<td>1000</td>
</tr>
<tr>
<td>110</td>
<td>1100</td>
</tr>
<tr>
<td>115</td>
<td>1200</td>
</tr>
</tbody>
</table>
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. Consider the winds reported at the departure airport
   b. Consider the winds reported at an airport nearest to the area where the maneuver is conducted
   c. Observe wind indications on the surrounding terrain, such as ripples on the water, etc.

3. Select two appropriate ground reference points (pylons)
   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 90 KIAS (≈2000 RPM)
   a. The power setting required to maintain 90 KIAS 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 90 KIAS 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 ground speed)
   c. A higher altitude will be required in the downwind portion of the maneuver (increased ground speed).
   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. Roll out of the turn a heading 45° to the downwind and approximately 90° from the entry heading
   a. The aircraft will again bisect the two ground reference pylons.
   b. The next turn around the second pylon will be right and into the wind.
   c. Crab into the wind as necessary to maintain proper ground track.
   d. Return to the appropriate pivotal altitude.

10. Maintain level flight at **90 KIAS** 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 entry pivotal altitude, heading, and airspeed and exiting the maneuver.

13. Climb to an appropriate altitude, as instructed.

14. Resume normal cruise or transition cruise flight.

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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
- Enter the maneuver
  - Downwind
  - Over the point on the ground
  - 75 KIAS and idle power
- Bank ≈45° to ≈60° maximum
  - Maintain 75 KIAS throughout
  - Vary bank angle for constant ground track
  - Clear the engine each turn upwind
- After three turns
  - Rollout on the original horizon reference and heading
  - Recover by 1,000’ AGL

Maneuver description:

1. Select an altitude that allows for performing a series of at least (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.
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.
2. Enter the maneuver on downwind and nearly over the reference point
   a. Set the power to idle
   b. Maintain altitude and reduce the airspeed to 75 KIAS
3. Once established at 75 KIAS, initiate a descending spiral
   a. Set initial bank to ≈50°
   b. Maintain 75 KIAS throughout the maneuver
4. During the turns, adjust bank angle as necessary to maintain a constant radius from the selected point
   a. Vary the bank between ≈45° to ≈60° 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.
   c. Do NOT exceed 60° during this maneuver at its steepest point
5. Ensure that during each 360° turn the engine is warmed by smoothly advancing the throttle while heading into the wind.
6. After completing (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:
   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.
11. Maintain course by the use of pilotage, dead reckoning and radio navigation.
12. Follow a pre-planned course by reference to landmarks and be able to demonstrate the ability to use an airborne electronic navigation system.
13. Identify landmarks by relating surface features to chart symbols and be able to locate the aircraft’s position using the navigation system.
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 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.
4. Establish on the precise heading if different from the original estimated heading.
5. Using the distance calculated, a groundspeed estimate, and airborne electronic navigation systems, calculate an ETA and required fuel.
6. 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.
7. On arrival and landing at the appropriate alternate, contact the FSS and close the active flight plan, if applicable.
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 altitudes, 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 full power
  - Conserve fuel by pulling back on power while circling
  - Maintain 85-90 KIAS
- **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 becomes unsure of their position, aircraft control must be maintained at all times as first priority
2. Climb to a higher altitude, if able, to attain a better “birds eye” view.
   a. 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.
   a. Use a shallow to medium bank to minimize the workload
   b. It is the equivalent of “pulling over” on the side of the road in the airplane
   c. 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
   d. If position was known sometime in the past, by remaining over the same landmark you will not get any further away from last known position
4. Conserve the fuel by utilizing appropriate power and mixture setting
   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 **85-90 KIAS** 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 APPROACH**

**Objective**

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

**Quick reference:**

- **3 min Prior to IAF / PT Turn inbound / Interception final approach course (if vectored):**
  - Approach brief complete
  - Descent checklist flows complete
  - 100 KIAS (≈ 2200 RPM)
- **3 min prior to FAF (Glideslope intercept):**
  - 90 KIAS (≈ 2000 RPM)
- **Glideslope intercept (1 dot low):**
  - Flaps 10°
  - Before landing checklist flows complete
- **Descent at 90 KIAS (≈ 1700 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 100 KIAS by establishing ≈ 2200 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 90 KIAS by establishing ≈ 2000 RPM by 3 min prior to FAF (Glideslope / Glidpath intercept)**

6. **Approaching glideslope / glidpath intercept (one dot below GS needle and established on final approach course):**
   
   a. Flaps 10°
   
   b. Perform before landing checklist flows
7. On glideslope / glidepath, maintain 90 KIAS (≈ 1700 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 glidepath
   b. Headwind will require more power and tailwind will require less power to remain on the glidepath
   c. You may estimate the necessary descent rate using the following formula: 
      \[\text{groundspeed} \times 5.3 = \text{descent rate (FPM)}\] 
      to remain on 3 degree glideslope
   d. Example for GS of 90 Kts: \((90 \times 5.3) \approx 500 \text{ FPM}\)

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, in accordance with FAR 91.175 requirements.

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NOTE: Each IAP (Instrument Approach Procedure) may have different IAFs (Initial Approach Fix). Not all IAPs require course reversal. For a particular IAP, course reversal may depend on IAF used.

By 3 minutes prior to IAF:
- Approach checklist complete
- 100 KIAS

At DA:
- If no visual reference, go missed!

At 500 Above DA:
- Begin altitude callouts

One dot below glideslope:
- Reduce power
- Flaps 10
- 90 KIAS

Before landing checklist complete:

Review each IAP chart carefully!
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
  - 100 KIAS (≈ 2200 RPM)
- 3 min prior to FAF
  - 90 KIAS (≈ 2000 RPM)
- Just prior to FAF
  - Flaps 10°
  - Before landing checklist flows complete
- Descent at 90 KIAS (≈ 1700 RPM) and 500 - 1000 FPM
- 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 100 KIAS by establishing ≈ 2200 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 90 KIAS by establishing ≈ 2000 RPM by 3 min prior to FAF
6. Approaching FAF (just prior to, < 1 min from FAF and established on final approach course):
   a. Flaps 10°
   b. Perform before landing checklist flows
7. Descending from FAF, maintain 90 KIAS (≈ 1700 RPM) and 500 – 1000 FPM, or as appropriate, planning to arrive at MDA prior to MAP.
   a. Consider the winds, the resulting ground speed, time and distance remaining when selecting your descent rate

8. Note the altitude and time/distance, when crossing waypoints / stepdown fixes (if any).
   a. Level off by maintaining 90 KIAS (≈ 2100 RPM) to comply with any stepdown fix altitude restrictions, if any.
   b. Re-establish descent after passing the stepdown fix at or above the minimum altitude.

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.

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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
- 100 KIAS

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

At 500 feet above MDA:
- Begin attitude callouts

JUST BEFORE FAF
- REDUCE POWER
- FLAP 10
- 90 KIAS

Before Landing Checklist Complete

Non-Precision Approach (off airport navaid)

3 minutes prior to FAF
- 90 KIAS

FIX / CROSSING CHECK

REV VI 12/11
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 five C’s:
- **Cram** – Full power, level the pitch, flaps (if full) from 30° to 20° immediately
- **Climb**
  - Ease into a Vy climb attitude (≈ 3° nose-up) and maintain Vy = 79 KIAS
  - Check for positive rate on ALT/VSI, then flaps 20° to 10° (if at 20°)
- **Clean** – Verify above 60 KIAS, flaps from 10° to 0°
- **Call** – announce Missed Approach on the appropriate radio frequency
- **Checklist**
  - 500’ AGL, establish cruise climb (500 FPM minimum)
  - Verify the appropriate checklist flows

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.
   
   b. Ensure that missed approach procedure is briefed prior to any IAP execution
   
   c. Remember that the first step of any missed approach is to **climb**

   d. 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 30° to 20° (if fully extended).
4. Establish a positive rate of climb by simultaneously easing into a Vy climb attitude (≈ 3 degree nose-up pitch on AI), and cross-checking VSI and altimeter for needle reversal.
5. Once established in a positive climb as indicated by needle reversal, retract flaps from 20° to 10° (if at 20°)
6. Confirm above 60 KIAS, then retract flaps 10° to 0° (full up)
7. Maintain Vy pitch attitude and confirm aircraft is climbing at Vy (79 KIAS). Make final pitch adjustments and trim.
8. 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.

9. At 500’ AGL, transition to Cruise Climb (≈ 90 KIAS), or as appropriate (attempt to maintain at least a 500 FPM climb)
10. While climbing, follow the published missed approach procedure path, or as otherwise instructed by ATC.
11. 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 a descent for the appropriate landing.
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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**
  - 90 KIAS (≈ 2000 RPM)
  - Holding entry determined
  - Holding procedure determined (turns, time or distance, wind correction)
  - 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 wind correction angle on outbound leg
  - Adjust outbound leg timing to achieve desired inbound leg timing
  - If EFC time is reached with no ATC contact, query ATC
- **Report leaving the hold to ATC**

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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.*

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Procedure description:

1. Reduce the speed to **90 KIAS (≈ 2000 RPM)** when 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**

   **NOTE**
   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.

   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 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 $30^\circ$ 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).
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.
NOTE
The maximum permissible intercept angle is 90°, which is a direct path to the desired radial and would be used only in special circumstances. A typical intercept angle would be in ≈ 30° to 60° range.

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.
   - NAV 2 may be used as a standby / backup source for the same VOR, another VOR or navigational / approach facility, as appropriate
   - Set OBS 2 to the approach course to be intercepted upon completion of the arc, or as required
   - 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.
   - Appropriately certified GPS may be used in lieu of DME for distance from the station information
   - 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.
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 a C172R, 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 ½ % of groundspeed for small airplanes
      i. To enter a 10 DME arc from outside with GS of 100 knots; ½% 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 ≈ 90 KIAS

- 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 ≈ 90 KIAS

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 at 90 KIAS (~2000 RPM), 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 at 90 KIAS (≈2000 RPM), or as required.