STANDARDIZATION MANUAL
and
AMPLIFIED PROCEDURES

CESSNA 172M/N
KNOTS

Revised April 2025

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GENERAL INFORMATION

This standardization manual is published to serve as a master reference document for expanded aircraft procedures during training. It does not replace the Pilot's Operating Handbook or any other document published by the manufacturer, nor does it replace the Airplane Flying Handbook or any other document published by the FAA.

This manual is intended as a reference for training at all levels. As such, some maneuvers differentiate between requirements for Private and Commercial training. Ensure that you are studying, training and performing maneuvers to the applicable standards and procedures.

References to "POH" indicate the aircraft Pilot's Operating Handbook for the 1976 Cessna 172M or 1977 172N as appropriate.

References to "AFH" indicate the Airplane Flying Handbook, FAA-H-8083-3C.

References to "IPH" indicate the Instrument Procedures Handbook, FAA-H-8083-16B.

With regards to emergencies, "Land as Soon as Practical" means that a return to the home base airport (21D) is recommended. "Land as Soon as Possible" means a landing at the nearest suitable airport or landing site is recommended, and return to the base airport should not be prioritized.

This manual's reference airspeeds are in NAUTICAL MILES PER HOUR (KTS/KIAS). For airspeeds indicated in STATUTE MILES PER HOUR (MPH), see other manual.

Revision History

- 5/12/2021 Initial version published.
- 10/31/2021 Added Traffic Pattern Quick Reference. Minor corrections. No major procedural changes.
- 9/12/2022 Added electrical system breakdown and GPS information.
- 6/2/2023 Updated AFH citations to FAA-8083-3C chapter and page numbers.
- 8/22/2023 Modified pattern speeds to provide margin from V_{FE} speed.
- 6/2/2024 Corrected errors in pattern speeds missed in previous revision.
- 12/29/2024 Added N737ME information.
- 2/9/2025 Added Autopilot/Flight Director guidance.
- 4/8/2025 Added Magneto STC and winterization kit information.

QUICK REFERENCE GUIDE

V-Speeds

V_{S0}	41 KIAS	Stall speed – Full landing configuration
V_{S1}	47 KIAS	Stall speed – Full clean configuration
V_X	59 KIAS	Best angle-of-climb speed
V_Y	73 KIAS	Best rate-of-climb speed
V_G	65 KIAS	Best glide speed
V_{FE}	85 KIAS	Maximum flap extension speed
V_A	97 KIAS	Maneuvering speed
V_{NO}	128 KIAS	Maximum structural cruising speed
V_{NE}	160 KIAS	Never-exceed speed

Takeoff Data

*(Assumes **C172M**, no wind/ISA/max weight)*	Sea Level	2500’ MSL	5000’ MSL
Ground Roll	865 feet	1040 feet	1255 feet
Total to Clear 50’ Obstacle	1525 feet	1910 feet	2490 feet

Cruise Data

*(Assumes **C172M**, leaned mixture)*	RPM	%PWR	KTAS	GPH
2500’ MSL	2500	70	111	7.7
	2400	63	106	7.1
	2300	57	101	6.6
5000’ MSL	2500	66	111	7.4
	2400	60	105	6.8
	2300	54	99	6.4
7500’ MSL	2600	69	116	7.6
	2500	63	109	7.1
	2400	57	103	6.6

Landing Data

(Assumes no wind/ISA/max weight)	Sea Level	2500’ MSL	5000’ MSL
Ground Roll	520 feet	560 feet	605 feet
Total to Clear 50’ Obstacle	1250 feet	1310 feet	1385 feet

Weight and Balance Information

	N70143(C172M)	N737YU (C172N)	N737ME (C172N)
Basic Empty Weight	1447 lb	1492 lb	1505 lb
Maximum Takeoff Weight	2300 lb	2300 lb	2300 lb
Baggage Area 1 Load Limit	120 lb	120 lb	120 lb
Baggage Area 2 Load Limit	50 lb	50 lb	50 lb
Useful Load	853 lb	808 lb	795 lb

SYSTEMS INFORMATION

Engine

The Cessna 172M engine is a Lycoming O-320-E2D. It produces 150HP at full power, under sea level standard conditions (ISA). It burns 100LL Avgas and is serviced with Phillips XC 20W-50 oil.
The Cessna 172N engine is a Lycoming O-320-H2AD, which produces 160HP at full power, and is otherwise similar to the O-320-E2D.

The O-320-E2D and O-320-H2AD are reciprocating (non-turbine), carbureted (not fuel injected), four-stroke, normally-aspirated (no forced induction system, such as a turbocharger), four-cylinder engines, with 320 cubic inches of displacement.

The engine's ignition is supplied by a dual-redundant magneto system. On the C172M, one unit is a fully independent magneto, which does not require electrical power to operate. The other (typically the left magneto) is a SureFly Electronic Ignition unit, which does require electrical power to function, but is more efficient and reliable and requires less maintenance. For more information, see STC SA04378CH.
On the C172N, both magnetos are fully independent and do not operate electronically.

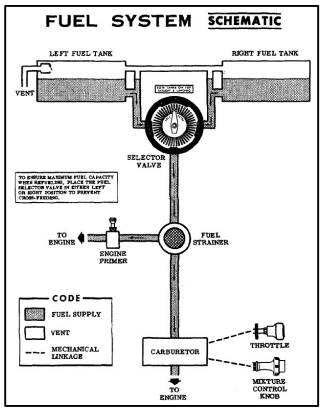
During cold-weather months, engine cowl air inlets may be equipped with a winterization kit. This kit is recommended to be installed when outside temperatures are consistently below 20 F, but does not have any exact temperature limitations.

Fuel System

Ref: POH 2-1
The Cessna 172M has two fuel tanks, one in each wing. Each tank holds 19 gallons of usable 100LL fuel, for a total of 38 gallons. The Cessna 172N has a similar fuel system, but is equipped with long-range tanks that hold 25 gallons per side for a total of 50 gallons of usable fuel.

Fuel from each wing tank flows by gravity to a selector valve, then through the fuel strainer and into the carburetor. There are no auxiliary or electric fuel pumps installed in this system.

The manufacturer recommends the Fuel Selector valve remain in the Both position for takeoff, landing, and maneuvers.



Electrical System

Ref: POH 2-3

The Cessna 172M/N is powered by a one-battery, one-alternator electrical system.

The 12-volt battery (172M) or 24V battery (172N) is located on the firewall, on the pilot's side of the aircraft.

The 14-volt alternator (172M) or 28-volt alternator (172N) is located on the front of the engine, and is belt-driven by the crankshaft just aft of the spinner. This alternator is voltage-protected, and will stop functioning if output exceeds 16 volts (172M) or 32 volts (172N).

The electrical system is protected by circuit breakers, eliminating the need for spare fuses to be carried on board at night in accordance with FAR 91.205(c)(6).

The electrical system is split into two buses: A Main Bus for general electrical components required for flight, and an Avionics Bus for radios, navigational equipment, and other accessories that draw high amounts of power. This bus distribution is as follows:

MAIN BUS	**172M**	**172N**
	Engine gauges	Garmin G3X Touch PFD
	Aircraft lights	Aircraft lights
	Electric flaps	Electric flaps
	Primary Garmin G5 (ADI)*	Garmin G5 (ADI)*
AVIONICS BUS	**172M**	**172N**
	Garmin GTN650 GPS	Garmin GTN650 GPS
	Com and Nav radios	Com and Nav radios
	Transponder	Transponder
	Secondary Garmin G5 (HSI)*	

* Garmin G5 units have a self-contained backup battery, capable of powering the unit for several hours even in the event of a power loss from the associated bus.

GPS Navigation

Ref: Garmin GTN650 Pilot Supplement

The Cessna 172M/N uses a Garmin GTN650 as a primary navigation source. This GPS conforms to TSO C164c and is capable of WAAS navigation, allowing GPS approaches to LP or LPV minima when available.

This GPS does *NOT* contain any baro-compensated VNAV capability; as such, LNAV/VNAV minima *cannot* be used for approaches. If LPV or LP is unavailable, users must apply standard LNAV minima.

In the Cessna 172N, the GTN650 provides its precise GPS data to the G3X Touch PFD when both units are powered on. The G3X Touch is not certified for IFR operations as a standalone unit.

The Pilot Supplement for the Garmin GTN650 is available in the aircraft.

External Lights

Navigation (Position) Lights

Navigation Lights consist of one rear-facing white light on the rudder, one red light on the left wingtip, and one green light on the right wingtip. These should always be on any time the aircraft is electrically powered. Lake Elmo Aero checklists dictate that this switch should be left in the On position.

Multiple aircraft in the Lake Elmo Aero fleet are equipped with a uAvionix SkyBeacon, which is a 1090MHz ADS-B transmitter attached to one of the navigation lights. For this reason, navigation lights must remain powered on whenever the aircraft is in operation; failure could result in noncompliance with FAR 91.225(b) regarding ADS-B in required airspace.

Beacon Light

The Beacon Light is a red flashing light located on top of the vertical stabilizer. It should be turned on prior to engine start, and remain on until the engine is shut down.

It is a commonly accepted practice in aviation that a flashing beacon indicates an aircraft with intent to start an engine, if it has not already. When operating or walking around a ramp or parking area, use appropriate vigilance and judgement.

Strobe (Anticollision) Light

Not installed on all aircraft.

Strobe Lights consist of two white flashbulbs, one on each wingtip. They should be used in conjunction with the Beacon light, except when taxiing at night. During these conditions, turn strobe lights off to avoid blinding others.

While operating in IMC after dark, consider turning off strobe lights to prevent blinding induced by reflection.

Taxi Light

Not installed on all aircraft.

The Taxi Light is a forward-facing white light, typically angled down at the taxiway to provide optimal visibility while taxiing. It should be turned on before taxi and landing, but can be turned off in flight at the pilot's discretion.

Landing Light

The Landing Light is a forward-facing white light, angled to provide optimal visibility during a takeoff or an approach to landing. It should be turned on before to takeoff and landing, but can be turned off in flight at the pilot's discretion.

In the absence of a taxi light being installed, the landing light can be turned on before taxi. Use caution when taxiing parallel to an active runway, and consider turning the landing light off if it could cause a hazard to arriving aircraft.

NOTE: When operating in Lake Elmo Aero practice areas, leaving all external lights on during flight is recommended.

Audio Control Panel

Not installed on all aircraft

The aircraft's intercom and ATC audio are controlled through a Garmin GMA340 audio panel. Understanding this panel's functionality is crucial to situational awareness and safety.

The double knobs on each side of the audio panel, titled PILOT and COPILOT, control the intercom volume and squelch.

The inner (smaller) knob controls the intercom volume for the respective occupant; turn clockwise to increase intercom volume. Pulling the COPILOT volume knob out (away from the panel) will allow control of the rear seat intercom volume.

The outer (larger) knob control controls the intercom squelch (microphone sensitivity) for the respective occupant. Turn this knob clockwise to increase the threshold of volume required to speak over the intercom; turn it counterclockwise to make the microphone more sensitive. If one pilot cannot be heard over the intercom, twist the respective squelch knob all the way counterclockwise to completely open the squelch (known as a "hot mic").

The receive select buttons, labeled COM1, COM2, and COM3, control which Com radios are able to be heard through the headsets. Multiple radios can be selected to receive simultaneously.

The transmit select buttons, labeled COM1 MIC, COM2 MIC AND COM3 MIC, control which Com radio is being used to transmit. Only one of these can be selected to transmit at any given time.

The Com Split button on the lower right, labeled COM 1/2, will allow the left seat pilot to transmit and receive on Com 1 only and the right seat pilot to transmit and receive on Com 2 only. Neither pilot will be able to hear the opposite radio until this button is deselected. This can be useful, for example, when an instructor wants to call flight service and provide a PIREP but not interrupt a student's communications on the main radio.

The Speaker button on the lower right, labeled SPKR, sends all received audio from Com and Nav radios through the airplane's speaker. Not commonly used.

The Intercom Isolation buttons on the lower right, labeled PILOT and CREW, allow ATC and intercom audio to be isolated to certain seats of the aircraft. In this mode, passengers are on their own intercom channel and can communicate with each other, but cannot hear ATC radios or communicate with the selected occupants (PILOT = left seat pilot, CREW = both front seats). Useful when flying with passengers in busy airspace and/or critical phases.

Autopilot/Flight Director Management

Not installed on all aircraft

The aircraft's Flight Director and Autopilot are controlled by a Garmin GFC500 Digital Autopilot Control Panel. Flight Director modes and commands are displayed in pink V bars on the attitude indicators of both the Garmin G3X primary attitude indicator and the Garmin G5 backup attitude indicator, as well as with a Flight Mode Annunciator ("scoreboard") at the top of each display.

Autopilot Philosophies/Adages

Use it or lose it

If the Flight Director is not providing guidance to follow, it should immediately be turned off to avoid disorientation.

Up to go Up, Down to go Down

On the right side of the panel, the top (IAS) button is generally used to command climbs, while the bottom (VS) button is generally used to command descents.

Magic Words, Magic Button

When a pilot hears the words "cleared for the approach", they should arm approach mode on the autopilot by selecting the APR button.

Left, Right, Center

When engaging autopilot/flight director while in flight, the recommended order of operations is to first choose a lateral mode (HDG/NAV) from the left side of the panel, then choose a vertical mode (IAS/VS/ALT) from the right side of the panel, then engage the autopilot via the AP button in the center of the panel if desired. Do not engage an autopilot until it is programmed to do what you want.

You are the PIC

If an autopilot is doing something you don't like or understand, disconnect it and maintain positive control of the aircraft.

Phase/Location of Flight	Description	Roll Mode	Pitch Mode
Before Takeoff	Press Go Around button to place flight director in Takeoff mode (wings level, nose ~7deg up). Set Heading and Altitude bugs to initially cleared heading/altitude.	**TO**	**TO ALTS**
Initial turn (above 400' AGL)	Press HDG or NAV button as required to begin lateral navigation.	**HDG** **GPS**	**TO ALTS**
Transitioning to climb speed (above 500' AGL)	Press IAS button to transition to climb by reference to speed. Use scroll wheel to select V_Y (or desired climb speed).	**HDG** **GPS**	**IAS ALTS**
Cruise Climb	Use altitude knob to select new destination altitude, then use IAS button to select climb by reference to speed. Use scroll wheel to select desired climb speed. NOTE: Decelerating from cruise speed directly to V_Y for purposes of a cruise climb is not recommended, as this can result in a sudden high pitch angle. Consider higher indicated airspeeds for enroute climbs.	**HDG** **GPS**	**IAS ALTS**

Cruise Descent	Use altitude knob to select new destination altitude, then use VS button to select climb by reference to vertical speed. Use scroll wheel to select desired vertical speed for descent. NOTE: Vertical speed mode does not protect against high or low airspeed restrictions. Throttle input will be required to maintain stable airspeed during descent and after level-off.	HDG GPS	VS ALTS
Approach Clearance	Use APR button to arm Approach capture mode, which will follow lateral and vertical guidance and bypass selected altitude. **Recommended:** When glide slope is captured for final descent, use altitude knob to set initial missed approach altitude. Use heading knob if required to set initial heading for amended missed approach instructions.	HDG LOC HDG GPS GPS	ALT GP ALT GS
Missed Approach/Go-Around	Upon application of climb power, use Go-Around button to place flight director in Go-Around mode (wings level, nose ~7deg up).	GA	GA ALTS
Initial turn on Missed Approach/Go-Around (above 400’ AGL)	Press HDG or NAV button as required to begin lateral navigation. NAV will join published/programmed missed approach procedure.	HDG GPS	GA ALTS
Transitioning to climb speed (above 500’ AGL)	Press IAS button to transition to climb by reference to speed. Use scroll wheel to select V_Y (or desired climb speed).	HDG GPS	IAS ALTS
NEVER	The aircraft should not be left in Roll or Pitch mode at any time without a specific lateral or vertical mode selected.	ROL	PIT

COMMON TASKS

Traffic Pattern Arrival

Ref: AFH Ch. 7, AC 90-66B
Objective: To safely and efficiently arrive at an airport and perform traffic pattern operations.

1. Complete the Descent Checklist.
2. At least 10nm from the airport, attempt to determine the runway in use*.
3. At least 2nm from the runway, enter the traffic pattern at the published Traffic Pattern Altitude on a 45-degree entry to the downwind leg, maintaining a ½-mile distance from the runway once established.
    a. If approaching from the opposite side of the airport, overfly the airport at least 500' above Traffic Pattern Altitude.
4. Complete the Before Landing Checklist.

The above procedure assumes an ideal traffic pattern situation. Other traffic, ATC, local traffic pattern restrictions, obstacles, etc may require a modification of these procedures. In all cases, the pilot shall exercise good judgement and maintain positive airplane control.

* If the runway in use cannot be determined, overfly the airport at least 500' above Traffic Pattern Altitude to observe traffic and/or wind direction indicators to determine a runway for use.

Standards
Maintain proper spacing from other aircraft.
Maintain orientation with landing runway.
Maintain traffic pattern altitude +/- 100' (Private) or 50' (Commercial) and +/- 10 KIAS.

Traffic Pattern Departure

Ref: AFH Ch. 7, AC 90-66B

Objective: To safely depart an airport after takeoff or integrate into the flow of traffic when remaining in the traffic pattern.

If departing the traffic pattern…

1. Climb straight out on runway heading until above traffic pattern altitude, or…
2. Exit with a 45-degree turn to the left (assuming left-hand traffic) beyond the departure end of the runway, OR exit on the downwind leg once above traffic pattern altitude.
3. Complete the Climb Checklist.

If remaining in the traffic pattern…

1. Begin a turn to the crosswind leg when beyond the departure end of the runway and within 300 feet of Traffic Pattern Altitude.

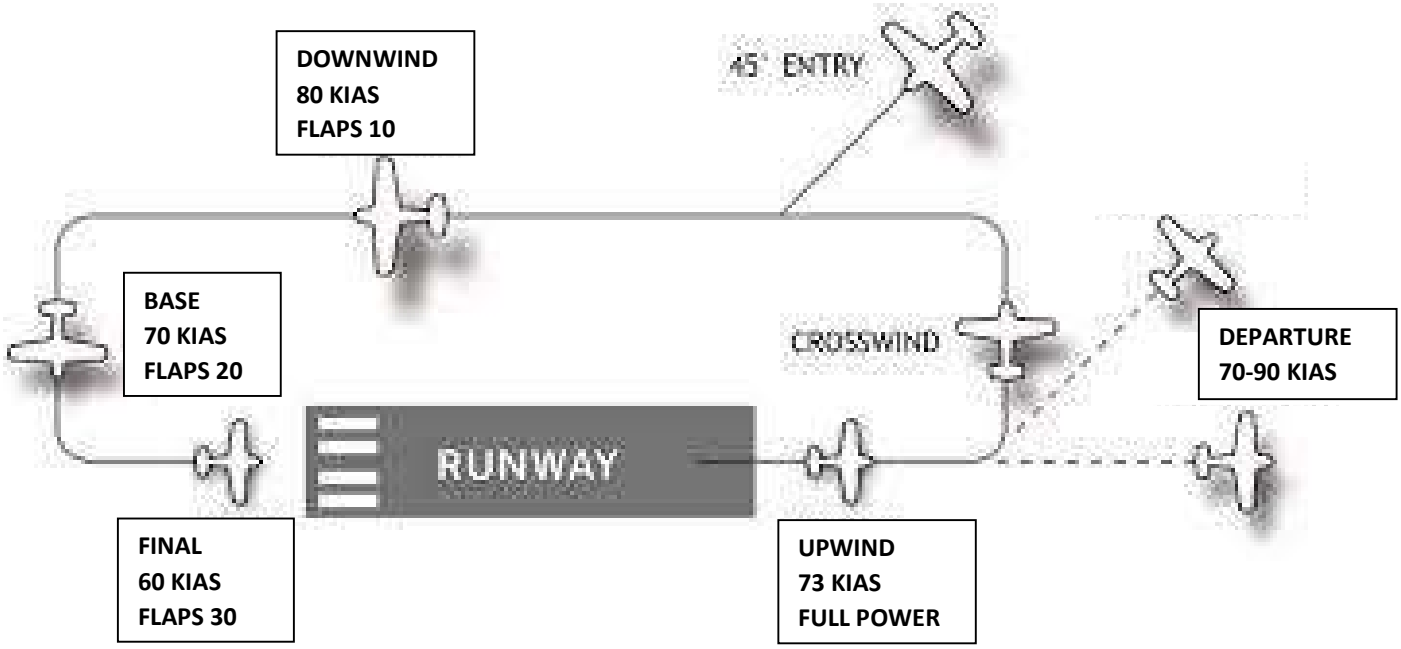
The above procedure assumes an ideal traffic pattern situation. Other traffic, ATC, local traffic pattern restrictions, obstacles, etc may require a modification of these procedures. In all cases, the pilot shall exercise good judgement and maintain positive airplane control.

Standards

Maintain proper spacing from other aircraft.
Maintain orientation with runway.
Maintain traffic pattern altitude +/- 100’ (Private) or 50’ (Commercial) and +/- 10 KIAS.

Traffic Pattern Quick Reference

Pattern Departure	**70-90 KIAS**
Upwind	**73 KIAS [V_Y]**
Downwind	**80 KIAS**
Base	**70 KIAS**
Final	**60 KIAS**



Clearing Turns

Ref: AIM Sec. 4

Objective: To observe any local threats or hazards, including obstacles or other traffic, prior to commencing any training maneuver.

1. Visually scan the area to the left and right of the aircraft.
2. Select a visual landmark off the wingtip in the direction of the turn to be executed as a 90-degree reference point.
3. Enter a 30-degree bank in the direction of the visual landmark.
4. Continuously scan the area above, below, and ahead of the flight path. Use the aircraft's wing position to your advantage; in a Cessna, the best visibility will be on the side from which you are turning away.
5. After completing a 90-degree turn, roll wings level on the selected landmark.
6. Select another visual landmark off the opposite wingtip in the direction of the next 90-degree turn.
7. Enter a 30-degree bank in the direction of the visual landmark.
8. Continuously scan the area above, below, and ahead of the flight path.
9. After completing the second 90-degree turn, roll wings level on the selected landmark. The aircraft should now be on its original heading.

Note: Clearing turns do not absolve a pilot of his/her responsibility to see and avoid traffic while performing training maneuvers.

Configuring the Aircraft for Maneuvers

Prior to commencing any maneuvers, the following configuration settings should be considered. Recommendations are offered below for individual maneuvers.

BOOST/FUEL PUMP

No auxiliary fuel pumps are installed on the Cessna 172; this step can be disregarded for this aircraft.

CARBURETOR HEAT

Carburetor heat should be used any time the engine will experience continuous RPM settings below 2200 RPM (the green arc of the tachometer).

GAS/FUEL TANKS

The fuel selector should always be in the "Both" position for maneuvers.

UNDERCARRIAGE/LANDING GEAR

Brakes should never be set in flight. Brake pressure can be checked before ground reference or landing maneuvers by briefly pressing on both toe pedals and feeling for feedback/pressure.
If operating an aircraft equipped with retractable landing gear, the down-and-locked position should be ensured if required by the maneuver. The Cessna 172 is not equipped as such.

MIXTURE

Mixture should always be set to full rich for maneuvers.

POWER/PROPELLER

Engine power and/or propeller RPM should be set as needed for the maneuver to be performed.

SEAT BELTS

All occupants' seat belts should be fastened at all times, and any baggage that may shift during maneuvers should be secured with seat belts if possible.

SWITCHES

All aircraft lights should be on for maneuvers. Additionally, pitot heat should be used if entering instrument conditions or in any form of visible moisture.

The preceding configuration can be accomplished by following the acronym: **BCGUMPSS**

Boost Pump
Carburetor Heat
Gas
Undercarriage
Mixture
Power
Seat belts
Switches

TAKEOFFS AND LANDINGS

Normal Takeoff and Climb

Ref: POH 1-5 and 2-13, AFH 6-3
Objective: To safely execute a takeoff under normal conditions.

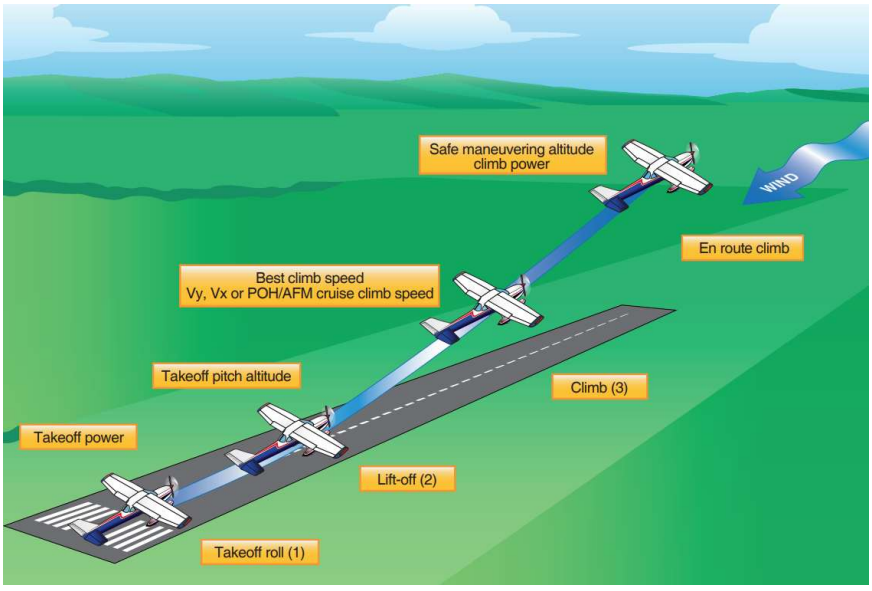
1. Complete the Before Takeoff Checklist.
2. Center the aircraft on the runway centerline with the nose wheel straight ahead.
3. Advance the throttle to full power.
4. Check engine instruments as power increases.
5. When airspeed indicator begins moving, call out *"Airspeed Alive"*.
6. Accelerate aircraft to 50-55 KIAS.
7. Increase back pressure on the control yoke to pitch up until the glare shield meets the horizon (approximately 10 degrees nose-up).
8. When practical, accelerate to 73 KIAS [V_Y] and climb on centerline. Trim as necessary.

If departing the pattern…

9. Execute a Traffic Pattern Departure procedure as applicable.
10. Above 1000' AGL, complete the Climb Checklist.

If remaining in the pattern…

11. Begin a turn to the crosswind leg when beyond the departure end of the runway and within 300 feet of Traffic Pattern Altitude.



Standards
Maintain airspeed +10/-5 KIAS (Private) or +5/-5 KIAS (Commercial) from V_Y.

Crosswind Takeoff and Climb

Ref: POH 1-5 and 2-14, AFH 6-6
Objective: To safely execute a takeoff in crosswind conditions.

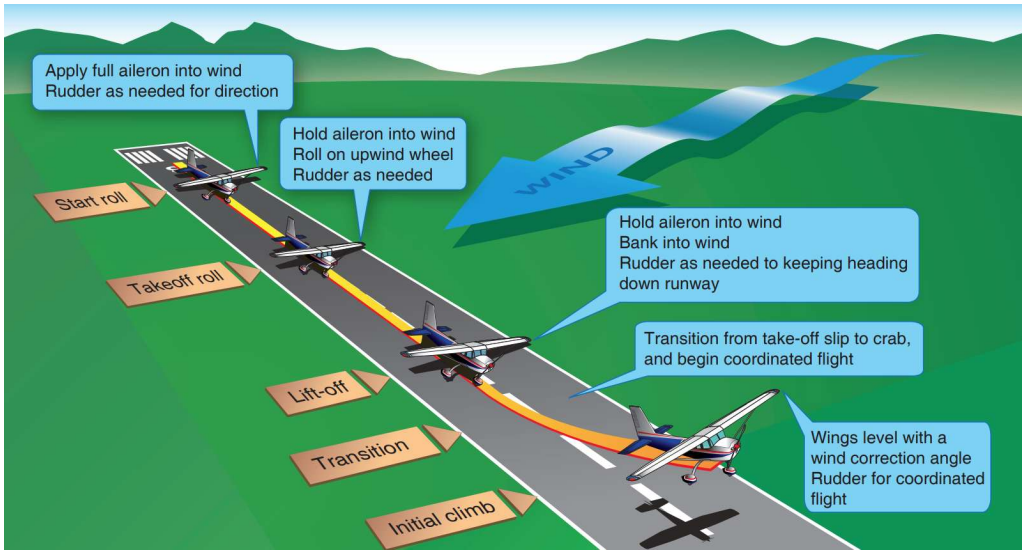
1. Complete the Before Takeoff Checklist.
2. Note the wind direction and velocity relative to the takeoff runway.
3. Center the aircraft on the runway centerline with the nose wheel straight ahead.
4. Position flight controls for the takeoff wind conditions (full aileron into the wind).
5. Advance the throttle to full power.
6. Check engine instruments as power increases.
7. When airspeed indicator begins moving, call out *"Airspeed Alive"*.
8. Slowly reduce aileron input as necessary during the takeoff roll to keep wings level.
9. Accelerate aircraft to 50 KIAS.
10. Increase back pressure on the control yoke to pitch up until the glare shield meets the horizon (approximately 10 degrees nose-up).
11. When practical, accelerate to 73 KIAS [V_Y] and climb on centerline. Trim as necessary.

If departing the pattern…

12. Execute a Traffic Pattern Departure procedure as applicable.
13. Above 1000' AGL, complete the Climb Checklist.

If remaining in the pattern…

14. Begin a turn to the crosswind leg when beyond the departure end of the runway and within 300 feet of Traffic Pattern Altitude.



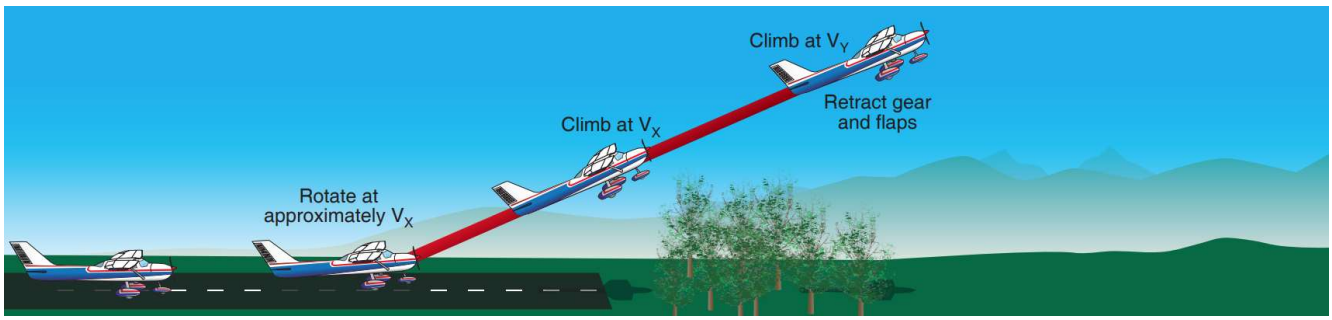
Standards
Maintain airspeed +10/-5 KIAS (Private) or +5/-5 KIAS (Commercial) from V_Y.

Short Field Takeoff

Ref: POH 1-5 and 2-14, AFH 6-11
Objective: To obtain maximum performance during takeoff and minimize runway length required.

1. Complete the Before Takeoff Checklist, with the Flaps set to 10 degrees.
2. Center the aircraft on the runway centerline with the nose wheel straight ahead. Use all available runway for maximum performance.
3. Firmly press and hold brake pedals to keep airplane in position while power is added.
4. Advance the throttle to full power.
5. Check engine instruments as power increases.
6. When engine RPM reaches maximum, release brakes.
7. When airspeed indicator begins moving, call out *"Airspeed Alive"*.
8. Accelerate aircraft to 45-50 KIAS.
9. Increase back pressure on the control yoke to pitch up until the glare shield meets the horizon (approximately 10 degrees nose-up). Pitch for an initial climb speed of 59 KIAS [VX].
10. When [simulated] obstacles are clear and aircraft is >200' AGL, accelerate to 73 KIAS [VY], retract flaps, and climb on centerline. Trim as necessary.

NOTE: Flap settings greater than 10 degrees are not recommended at any time for takeoff. If 10 degrees of flaps are used on takeoff, it is preferred to leave them extended through the climb over the obstacle, rather than retract them early.



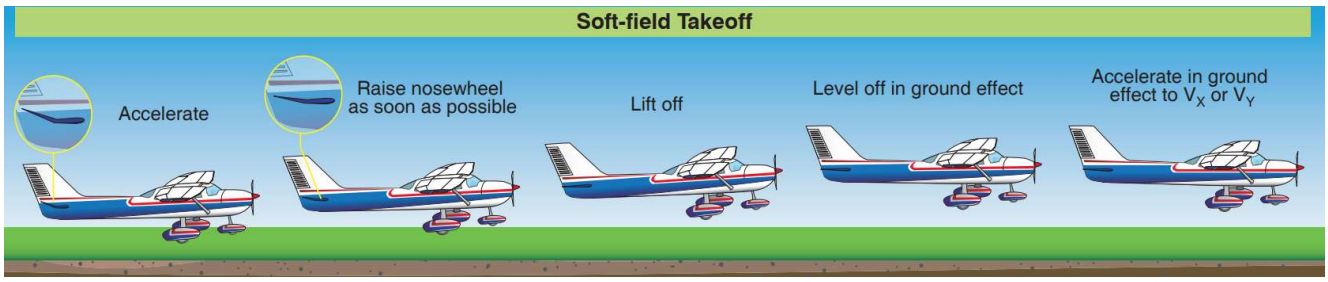
Standards
Maintain airspeed +10/-5 KIAS (Private) or +5/-5 KIAS (Commercial) from VX/VY.

Soft Field Takeoff

Ref: POH 2-14, AFH 6-13
Objective: To safely depart from a runway with a soft or rough surface.

1. Complete the Before Takeoff Checklist, with the Flaps set to 10 degrees.
2. Upon entering the runway, maintain full back pressure on the yoke and utilize as little braking as possible to avoid lowering the nose of the aircraft.
3. Center the aircraft on the runway centerline with the nose wheel straight ahead, without stopping the aircraft.
4. Advance the throttle to full power.
5. Check engine instruments as power increases.
6. When airspeed indicator begins moving, call out *"Airspeed Alive"*.
7. As the aircraft accelerates, slightly reduce back pressure to maintain minimal weight on the nose wheel. The aircraft will lift off around 50 KIAS.
8. When clear of the ground, reduce back pressure on the yoke and lower the nose to keep the aircraft in ground effect over the runway.
9. Upon reaching 73 KIAS [V_Y], apply back pressure to begin a standard climb on centerline. Trim as necessary.
10. When clear of obstacles (if applicable), retract flaps.

Note: Flap settings greater than 10 degrees are not recommended at any time for takeoff.



Standards
Maintain airspeed within +10/-5 KIAS (Private) or +5/-5 KIAS (Commercial) from V_Y.

Normal Approach and Landing

Ref: POH 1-6 and 2-18, AFH 9-15
Objective: To safely and accurately establish and maintain a stabilized approach to a landing.

1. Complete the Before Landing checklist.
2. Enter the traffic pattern as described in this manual – see Traffic Pattern Arrival.
3. Abeam the point of intended landing on downwind, reduce throttle to 1500 RPM and allow the airplane to begin descending at 80 KIAS.
4. Apply carburetor heat and set flaps to 10 degrees.
5. When the touchdown point is 45 degrees to the rear of the wing root (or as appropriate for wind conditions), turn to the base leg.
6. Slow the aircraft to 70 KIAS and extend flaps to 20 degrees. Continue to maintain appropriate descent rate (500-700 fpm) and adjust power if necessary.
7. Visually verify that the final approach (including the extended centerline and the opposite base) is clear of traffic, then turn to final.
8. Extend the flaps to 30 degrees. Maintain 60 KIAS on final approach (+ ½ gust factor, if applicable). Trim for minimum control input on a stable descent to the runway.
9. When landing on runway is assured, reduce power to idle. Keep the nose of the airplane at or below level until within 10 feet of the ground.
10. When in close proximity to the runway, pitch the nose up so that the main wheels will touch down prior to the nose wheel. Allow the aircraft to settle gently.
11. Maintain directional control on centerline with rudders throughout flare, landing and rollout.
12. Apply brakes as necessary. Ensure that the airplane is slower than 10 KIAS before turning onto a taxiway.

NOTE: If the approach is unstable at or below 200’ AGL, execute a go-around.

NOTE: A flap setting of 30 degrees is recommended for Normal Landings. However, the POH allows any desired flap setting to be used for landing.

Standards
Maintain airspeed +10/-5 KIAS (Private) or +5/-5 KIAS (Commercial).
Touch down within 400 feet (Private) or 200 feet (Commercial) of landing point.

Crosswind Approach and Landing

Ref: POH 1-6 and 2-18, AFH 9-15
Objective: To safely and land the aircraft during crosswind conditions.

1. Complete the Before Landing checklist.
2. Enter the traffic pattern as described in this manual – see Traffic Pattern Arrival.
3. Abeam the point of intended landing on downwind, reduce throttle to 1500 RPM and allow the airplane to begin descending at 80 KIAS.
4. Apply carburetor heat and set flaps to 10 degrees.
5. When the touchdown point is 45 degrees to the rear of the wing root (or as appropriate for wind conditions), turn to the base leg.
6. Slow the aircraft to 70 KIAS and extend flaps to 20 degrees. Continue to maintain appropriate descent rate (500-700 fpm) and adjust power if necessary.
7. Visually verify that the final approach (including the extended centerline and the opposite base) is clear of traffic, then turn to final.
8. Extend the flaps to 30 degrees. Maintain 60 KIAS on final approach (+ ½ gust factor, if applicable). Trim for minimum control input on a stable descent to the runway.
9. Use aileron to lower the upwind wing on final, and use rudder to keep airplane on extended centerline. This will result in a slightly cross-controlled “slip” style input.
10. When landing on runway is assured, reduce power to idle. Keep the nose of the airplane at or below level until within 10 feet of the ground. Keep upwind wing slightly low and maintain centerline with rudder input.
11. When in close proximity to the runway, pitch the nose up so that the main wheels will touch down prior to the nose wheel. Allow the aircraft to settle gently on the upwind main wheel first, then the downwind main wheel, then the nosewheel.
12. Maintain directional control on centerline with rudders throughout flare, landing and rollout. Use aileron input to maintain wings level through rollout.
13. Apply brakes as necessary. Ensure that the airplane is slower than 10 KIAS before turning onto a taxiway.

NOTE: In heavy crosswind conditions, landing with less than 30 degrees of flaps should be considered.

Standards
Maintain airspeed +10/-5 KIAS (Private) or +5/-5 KIAS (Commercial).
Touch down within 400 feet (Private) or 200 feet (Commercial) of landing point.

Short Field Approach and Landing

Ref: POH 1-6 and 2-18, AFH 9-20
Objective: To safely land the aircraft in the shortest distance possible.

1. Complete the Before Landing checklist.
2. Enter the traffic pattern as described in this manual – see Traffic Pattern Arrival.
3. Abeam the point of intended landing on downwind, reduce throttle to 1500 RPM and allow the airplane to begin descending at 80 KIAS.
4. Apply carburetor heat and set flaps to 10 degrees.
5. When the touchdown point is 45 degrees to the rear of the wing root (or as appropriate for wind conditions), turn to the base leg.
6. Slow the aircraft to 70 KIAS and extend flaps to 20 degrees. Continue to maintain appropriate descent rate (500-700 fpm) and adjust power if necessary.
7. Visually verify that the final approach (including the extended centerline and the opposite base) is clear of traffic, then turn to final.
8. Extend the flaps to 30 degrees. Maintain 60 KIAS on final approach (+ ½ gust factor, if applicable). Trim for minimum control input on a stable descent to the runway.
9. When stabilized on final approach, extend flaps to 40 degrees. Slow to 54-60 KIAS if wind conditions allow.
10. When landing on runway is assured, reduce power to idle. Keep the nose of the airplane at or below level until within 10 feet of the ground.
11. When in close proximity to the runway, pitch the nose up so that the main wheels will touch down prior to the nose wheel. Allow the aircraft to settle gently.
12. Maintain directional control on centerline with rudders throughout flare, landing and rollout.
13. Apply maximum possible toe braking without locking the main wheels. When the aircraft is on the ground, apply back pressure for aerodynamic braking. Ensure that the airplane is slower than 10 KIAS before turning onto a taxiway.

NOTE: If the approach is unstable at or below 200’ AGL, execute a go-around.
NOTE: The manufacturer allows retracting the flaps during landing roll for maximum short-field braking ability. This procedure shall not be performed for training purposes.
NOTE: 54 KIAS is equal to 1.3x V_{S0}, which is the recommended approach speed on a Short-Field landing (AFH 9-3).

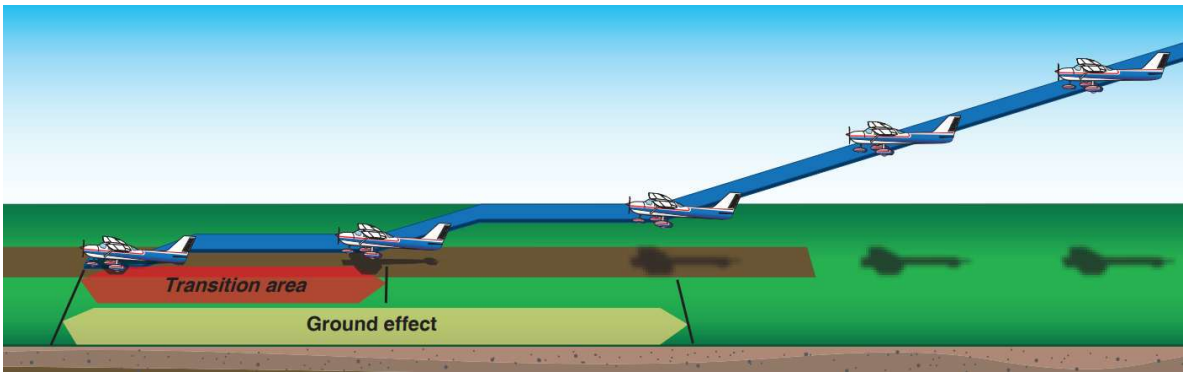
Standards
Maintain airspeed +10/-5 KIAS (Private) or +5/-5 KIAS (Commercial).
Touch down within 200 feet (Private) or 100 feet (Commercial) of landing point.

Soft Field Approach and Landing

Ref: POH 1-6, 2-18, AFH 9-23
Objective: To safely land the aircraft on a soft or rough surface.

1. Complete the Before Landing checklist.
2. Enter the traffic pattern as described in this manual – see Traffic Pattern Arrival.
3. Abeam the point of intended landing on downwind, reduce throttle to 1500 RPM and allow the airplane to begin descending at 80 KIAS.
4. Apply Carburetor heat and set flaps to 10 degrees.
5. When the touchdown point is 45 degrees to the rear of the wing root (or as appropriate for wind conditions), turn to the base leg.
6. Slow the aircraft to 70 KIAS and extend flaps to 20 degrees. Continue to maintain appropriate descent rate (500-700 fpm) and adjust power if necessary.
7. Visually verify that the final approach (including the extended centerline and the opposite base) is clear of traffic, then turn to final.
8. Extend the flaps to 30 degrees. Maintain 60 KIAS on final approach (+ ½ gust factor, if applicable). Trim for minimum control input on a stable descent to the runway.
9. When landing on runway is assured, reduce power to idle. Keep the nose of the airplane at or below level until within 10 feet of the ground.
10. When in close proximity to the runway, pitch the nose up so that the main wheels will touch down prior to the nose wheel. Allow the aircraft to settle gently. To ensure a soft touchdown, consider small power application in the flare, but ensure that the throttle is at idle when the aircraft settles down.
11. Throughout landing roll, maximize back pressure on the yoke to keep weight off nose as long as possible and utilize aerodynamic braking. Minimize toe braking to keep nose from dropping until aircraft is slowed to taxi speed.

NOTE: The manufacturer allows Flaps to be extended to 40 degrees for a soft-field landing if necessary due to field length.



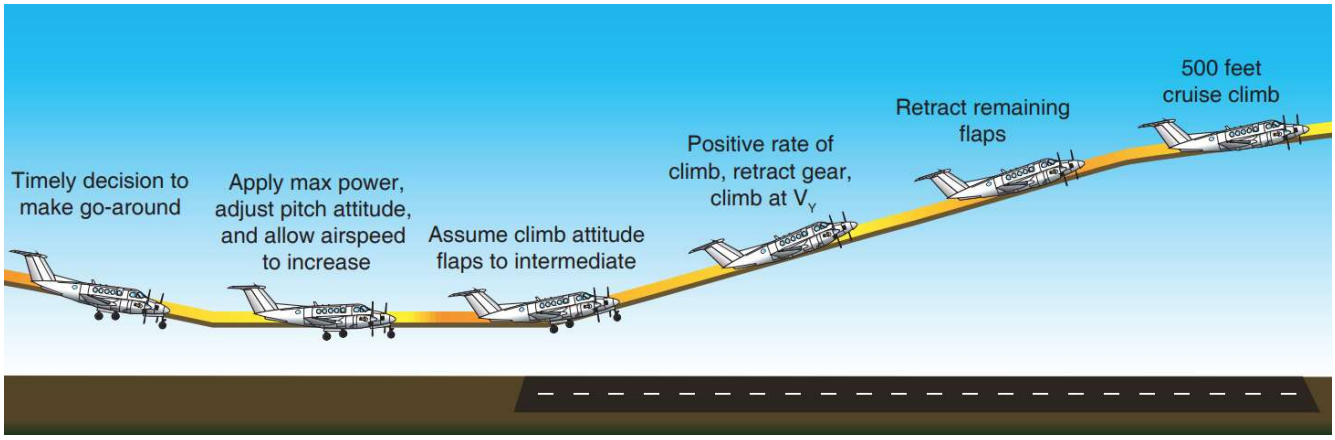
Standards
Maintain airspeed +10/-5 KIAS (Private) or +5/-5 KIAS (Commercial).
Make smooth, timely, and correct control inputs during the round out and touchdown to keep the nose wheel off the surface until loss of elevator effectiveness.

Go-Around/Balked Landing

Ref: POH 1-6, 2-19, AFH 9-10

Objective: To safely abandon a landing and climb away from the runway, to return to the traffic pattern.

1. Apply full throttle to initiate the go-around procedure. Close carburetor heat for maximum climb performance.
2. Pitch the aircraft's nose up to establish a positive rate of climb.
3. Retract flaps to 20 degrees.
4. Maintain a climb speed of at least 55 KIAS.
5. When clear of obstacles, accelerate to 73 KIAS [VY].
6. When airspeed is above 65 KIAS and obstacles are clear, retract remaining flaps slowly.
7. Follow departure procedures listed in this manual (see "Traffic Pattern Departure") as appropriate.



Standards

Apply takeoff power immediately and transition to climb pitch attitude for VX or VY as appropriate +10/-5 KIAS (Private) or +5/-5 KIAS (Commercial).

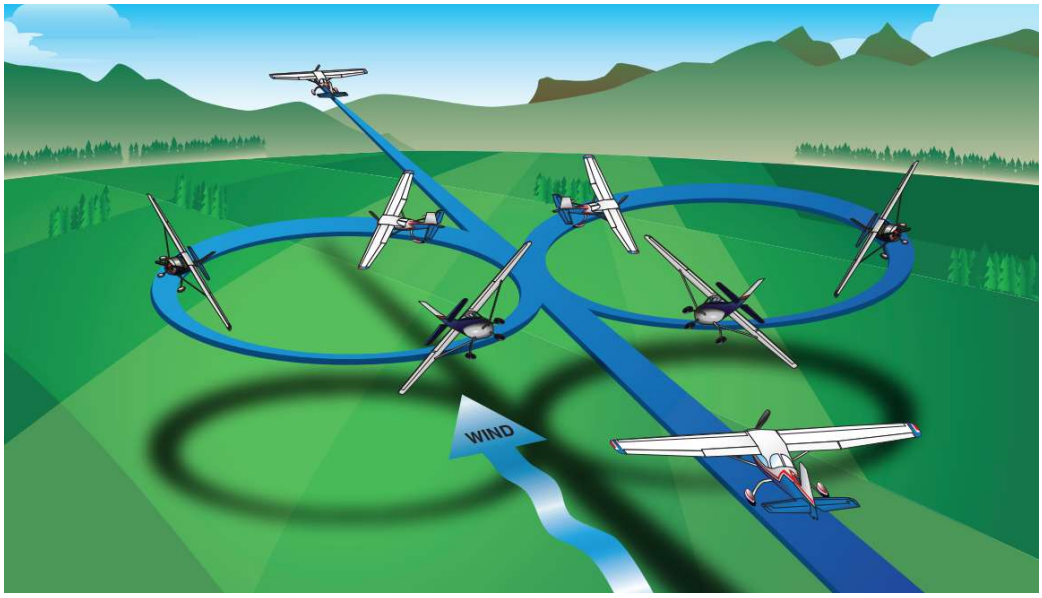
PERFORMANCE MANEUVERS

Steep Turns

Ref: AFH 10-1

Objective: To safely perform turns at 45 degrees of bank or greater while maintaining controlled flight.

1. Complete clearing turns and configure the airplane for maneuvering.
2. Establish airspeed of 95 KIAS and trim as necessary for level flight.
3. Choose a prominent landmark straight ahead and/or note current aircraft heading.
4. Roll into a 45-degree bank (Private) or 50-degree bank (Commercial) in your direction of choice and begin a 360-degree turn.
5. Add power as required to maintain altitude and airspeed. A typical power setting for this maneuver is 2300 RPM.
6. If necessary, use nose-up pitch input and/or trim to maintain altitude.
7. Begin rolling the wings level approximately 15-20 degrees prior to the original landmark or heading. They should be level upon reaching the original heading.
8. Immediately roll into a 45-degree bank (Private) or 50-degree bank (Commercial) to begin a 360-degree turn in the opposite direction. Be careful to maintain altitude while rolling through wings level by using nose-down input or trim as applicable.
9. Begin rolling the wings level approximately 15-20 degrees prior to the original landmark or heading. They should be level upon reaching the original heading.
10. Return to cruise power.



Standards

Maintain airspeed +/-10 KIAS.

Maintain altitude +/-100 feet.

Slow Flight

Ref: AFH 5-9

Objective: To maintain flight at the aircraft's minimum controllable airspeed.

1. Complete clearing turns and configure the airplane for maneuvering.
2. Reduce throttle to 1500-1700 RPM and apply Carburetor Heat to begin slowing the airplane.
3. As the airplane's speed decreases, use nose-up trim to maintain altitude.
4. When below 85 KIAS [V_{FE}], gradually extend flaps to 30 degrees. Use trim to maintain altitude.
5. Slow to a speed just above the first indication of a stall (about 45-50 KIAS).
6. Upon reaching the target speed, add power to maintain altitude.
7. Use pitch to make minor corrections in airspeed, while continuing to use throttle to make minor corrections in altitude.

To recover…

8. Add full throttle and close carburetor heat.
9. Use trim to maintain altitude.
10. Gradually retract flaps. Use caution not to exceed 85 KIAS [V_{FE}].
11. When flaps are fully retracted, return to cruise power.

Standards

Maintain airspeed +10/-0 KIAS (Private) or +5/-0 KIAS (Commercial) from V_{S0}.

Maintain altitude +/-100 feet (Private) or +/-50 feet (Commercial).

Maintain heading +/-10 degrees.

Power-On Stall

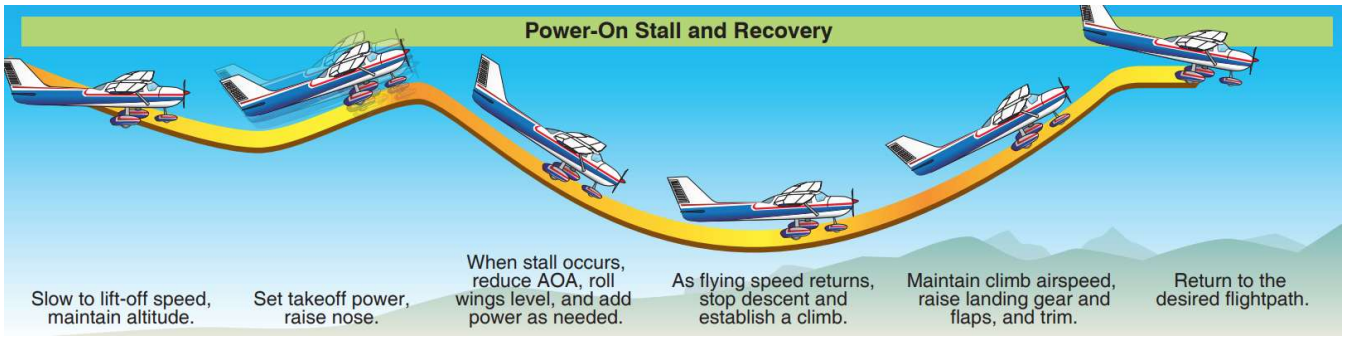
Ref: POH 2-17, AFH 5-18

Objective: To demonstrate and safely recover from the power-on stall characteristics of the aircraft.

1. Complete clearing turns and configure the airplane for maneuvering. Plan to recover by 1500' AGL.
2. Reduce throttle to 1500-1700 RPM and apply Carburetor Heat to begin slowing the airplane.
3. As the airplane's speed decreases, use nose-up trim to maintain altitude.
4. When at or below 60 KIAS, increase throttle to 2300 RPM. Add bank if desired for training purposes.
5. Pitch aircraft up to approximately 10 degrees nose-up. Airspeed will decay and stall indication may sound.
6. While decelerating, use rudder input to maintain aircraft coordination at all times.

To recover…

7. When the airplane fully develops a stall (Private) or at the first indication of a stall (Commercial), immediately reduce the angle of attack by using forward pressure to lower the nose.
8. Apply full throttle (if not already full).
9. When the aircraft speed reaches 70 KIAS or above, return to cruise power.



Standards

Maintain heading +/-10 degrees.

Maintain angle of bank (if specified) +/-10 degrees.

Recover promptly after a full stall occurs (Private) or after the first indication of a stall (Commercial).

Power-Off Stall

Ref: POH 2-17, AFH 5-11

Objective: To demonstrate and safely recover from the power-off stall characteristics of the aircraft.

1. Complete clearing turns and configure the airplane for maneuvering.
2. Reduce throttle to 1500-1700 RPM and apply Carburetor Heat to begin slowing the airplane.
3. As the airplane's speed decreases, use nose-up trim to maintain altitude.
4. Below 85 KIAS [V_{FE}], gradually lower flaps to 30 degrees.
5. To simulate a final approach path, establish a descent at about 400 feet per minute at 60 KIAS.
6. When at or below 60 KIAS, decrease throttle to idle. Add bank if desired for training purposes.
7. Pitch up to simulate a landing flare. Allow airspeed to decay.
8. While decelerating, use rudders to maintain aircraft coordination at all times.

To recover…

9. When the airplane fully develops a stall (Private) or at the first indication of a stall (Commercial), immediately apply full power and reduce the angle of attack by using forward pressure to lower the nose slightly.
10. When airspeed exceeds 65 KIAS, gradually retract flaps fully. Ensure that minimum altitude is lost by maintaining a slight climb angle, but be careful not to induce a secondary stall by adding too much nose up pitch.
11. When the flaps are fully retracted and the aircraft speed reaches 70 KIAS or higher, return to cruise power.

Standards

Maintain heading +/-10 degrees.

Maintain angle of bank (if specified) +/-5 degrees.

Recover promptly after a full stall occurs (Private) or after the first indication of a stall (Commercial).

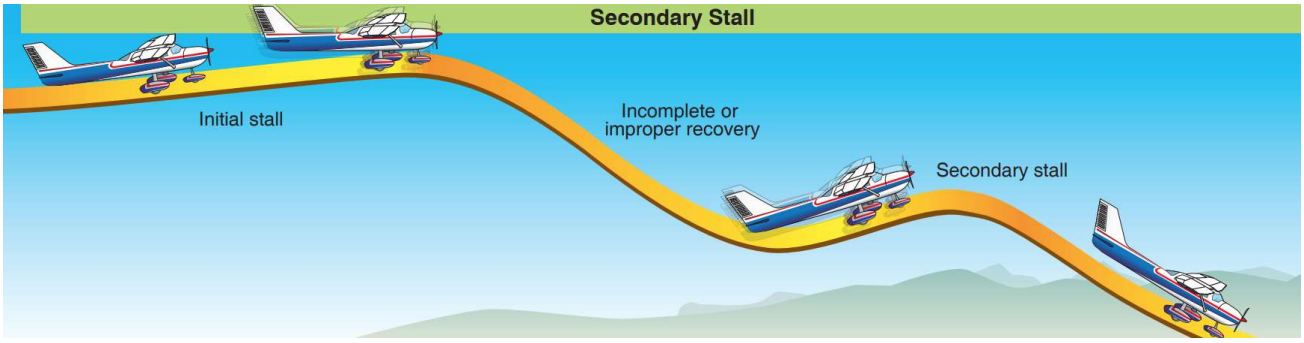
Secondary Stall

Ref: AFH 5-18

Objective: To recognize the effects of improper control usage, inducing another stall after initiating a recovery from the stall.

This maneuver will be for demonstration purposes only, except in the case of an Initial CFI candidate.

1. Complete clearing turns and configure the aircraft for maneuvering. Plan to recover by 1500' AGL.
2. Perform a Power-Off Stall or Power-On Stall as directed.
3. When the stall indication occurs, reduce angle of attack to regain control effectiveness and apply full power.
4. When the stall indication stops, immediately increase the pitch attitude to induce another (secondary) stall.
5. When the secondary stall indication occurs, reduce angle of attack to regain control effectiveness and ensure full power is set.
6. Maintain coordinated use of rudder and ailerons to level the wings and prevent a spin.
7. Accelerate to a safe airspeed (>65 KIAS) and retract flaps gradually.
8. Return to cruise power.



Standards

Student demonstrates an understanding of the maneuver and the risks associated.

Elevator Trim Stall

Ref: AFH 5-20

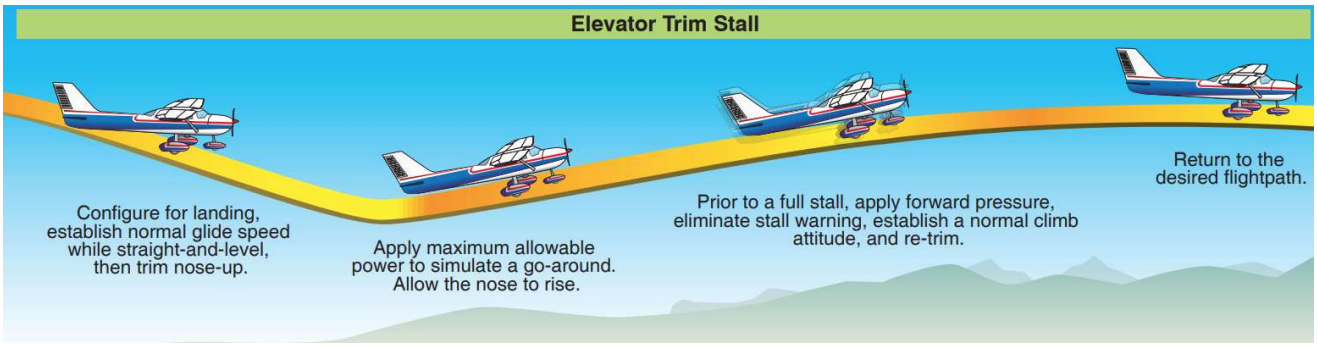
Objective: To recognize the effects of not maintaining positive airplane control during a go-around or balked landing.

This maneuver will be for demonstration purposes only, except in the case of an Initial CFI candidate.

1. Complete clearing turns and configure the airplane for maneuvering.
2. Reduce throttle to 1500 RPM and apply Carburetor Heat to begin slowing the airplane.
3. As the airplane's speed decreases, use nose-up trim to maintain altitude.
4. Below 85 KIAS [V_{FE}], gradually lower flaps to 30 degrees.
5. When at or below 60 KIAS, decrease throttle to idle.
6. Add full nose-up trim as airspeed decays.
7. Apply full power and allow pitch to increase until stall indication.

To recover…

8. Immediately reduce the angle of attack by using forward pressure to lower the nose.
9. When airspeed exceeds 65 KIAS, gradually retract flaps fully.
10. When the flaps are fully retracted and the aircraft speed reaches 70 KIAS or higher, return to cruise power.



Standards

Student demonstrates an understanding of the maneuver and the risks associated.

Cross-Controlled Stall

Ref: AFH 5-20

Objective: To recognize the dangerous effects of improper flight control application at low speed.

This maneuver will be for demonstration purposes only, except in the case of an Initial CFI candidate.

1. Complete clearing turns and configure the airplane for maneuvering.
2. Reduce throttle to 1500 RPM and apply Carburetor Heat to begin slowing the airplane.
3. As the airplane's speed decreases, use nose-up trim to maintain altitude.
4. Upon reaching 65 KIAS, establish a simulated descent to a landing (with flaps retracted).
5. Once established in descent, pick a reference point off the left or right wing tip.
6. Turn towards the reference point at a 25-30 degree bank.
7. Apply excessive rudder pressure in the direction of the turn, and use opposite aileron to prevent over-banking while maintaining 25-30 degrees of bank.
8. Increase elevator back pressure to maintain altitude.

To recover…

9. At stall or loss-of-control indication, reduce pitch to regain control effectiveness and apply full power.
10. Return flight controls to coordinated input and return to cruise power.

Standards

Student demonstrates an understanding of the maneuver and the risks associated.

Accelerated Stall

Ref: AFH 5-19

Objective: To recognize the relationship between bank, angle of attack, and stall speed.

1. Complete clearing turns and configure the airplane for maneuvering.
2. Reduce throttle to 1500 RPM and apply Carburetor Heat to begin slowing the airplane.
3. As the airplane's speed decreases, use nose-up trim to maintain altitude.
4. Upon reaching 80 KIAS, add 45 degrees of bank in either direction.
5. Abruptly add back pressure to induce a stall indication. *Always recover at the first indication of an accelerated stall.*

To recover…

6. Immediately release back pressure to decrease angle of attack.
7. Roll the wings level.
8. Return to cruise power.

Standards

Recover promptly at the first indication of a stall (Commercial).

Forward Slips

Ref: AFH 9-12
Objective: To increase rate of descent without increasing airspeed.

1. Select an intended point of touchdown on the runway, or a fixed reference point directly ahead.
2. Bank the airplane into the direction from which the wind is blowing, if applicable. If not, pick a direction and add approximately 15 degrees of bank.
3. Simultaneously (and *gradually*) add opposite rudder until it is fully applied.
4. Use bank to keep the airplane on the extended centerline or tracking towards the reference point.
5. Prior to round-out, simultaneously decrease aileron and rudder deflections in time to enter a landing flare or recover to cruise flight.

NOTE: Forward slips should not be conducted with the flaps extended more than 20 degrees due to potential tail airflow interruption and/or control surface oscillation (POH 2-18).

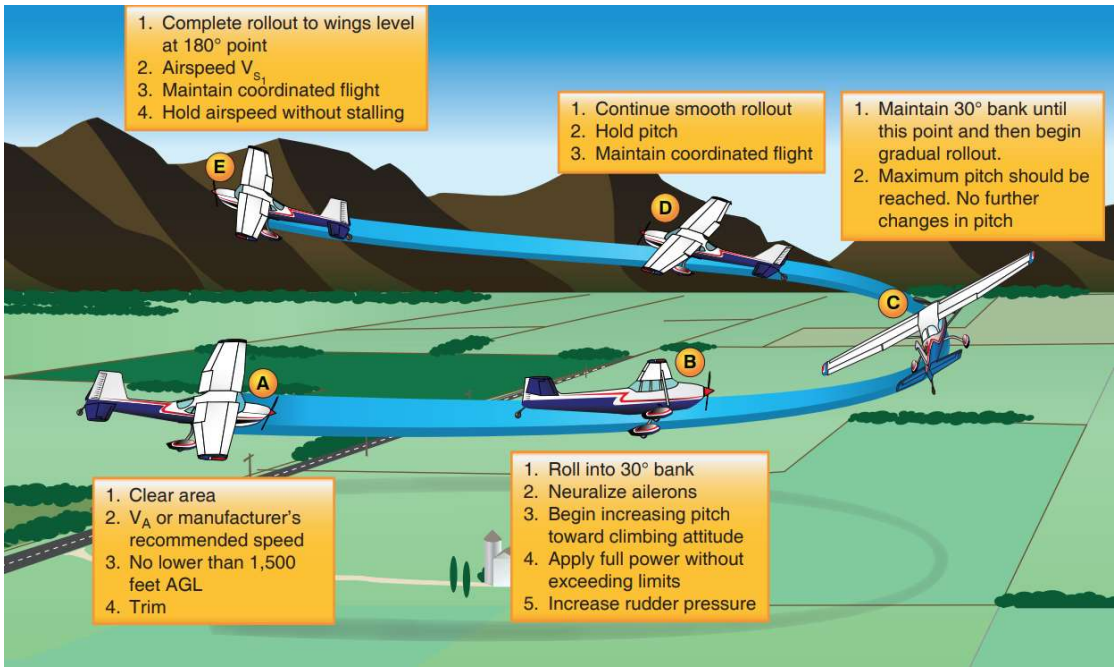
Standards
Correlate crosswind with direction of forward slip and transition to sideslip before touchdown.
Touch down +400/-0 feet from the specified point.

Chandelles

Ref: AFH 10-4

Objective: To demonstrate a maximum-performance climbing turn, which can also be used as a terrain escape maneuver.

1. Complete clearing turns and configure the airplane for maneuvering. Begin no lower than 1500' AGL.
2. Establish cruise flight at approximately 95 KIAS.
3. Select a reference point directly off the left or right wing tip.
4. Roll into a coordinated 180-degree turn at 30 degrees of bank, while simultaneously applying full power.
5. For the first 90 degrees of the turn, add back pressure to continuously and gradually increase the aircraft's pitch angle. It should be roughly 13-15 degrees nose up by the 90-degree point. Throughout this portion, the bank should remain at 30 degrees.
6. For the remaining 90 degrees of the turn, use aileron and rudder to continuously and gradually reduce the bank angle until the wings are level. This should be timed to occur when the airplane reaches the end of the 180-degree turn. Throughout this portion, the pitch should remain at the same nose-up angle that was previously established.
7. Upon reaching the 180-degree point of the turn, the aircraft should be wings level, with the airspeed just high enough not to cause a stall indication.
8. Carefully lower the nose to return to level flight. Minimize altitude loss as airspeed increases.
9. Return to cruise power.



Standards

Maintain constant bank with increasing pitch in first half.

Maintain constant pitch with decreasing bank in second half.

Roll out at 180-degree point +/-10 degrees.

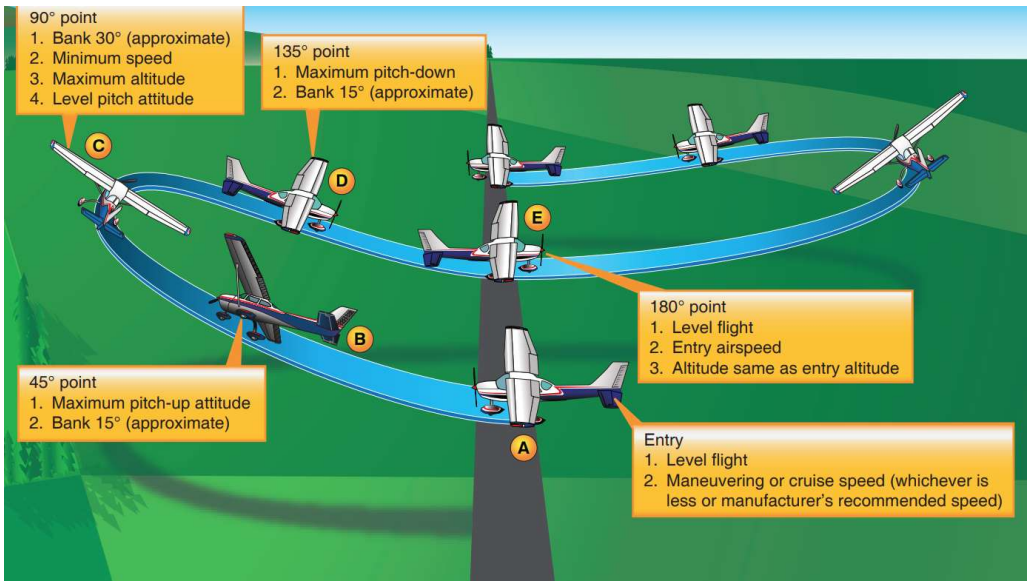
Lazy Eights

Ref: AFH 10-6

Objective: To demonstrate flight control coordination across a variety of airspeeds and altitudes.

1. Complete clearing turns and configure the airplane for maneuvering. Begin no lower than 1500' AGL.
2. Establish cruise flight at approximately 95 KIAS.
3. Begin a gradual 180-degree turn in either direction, which will begin with a shallow climb. Each 45-degree point of this turn will serve as a reference for a specific bank and pitch angle, as follows:
4. For the first 45 degrees of the turn, the airplane's pitch and bank should both increase, until the airplane is banked 15 degrees at its maximum pitch-up attitude (about 13-15 degrees nose-up).
5. For the next 45 degrees of the turn, the bank should continue increasing, but the pitch should decrease, until the airplane is banked 30 degrees with the nose pitched level to the horizon.
6. For the next 45 degrees of the turn, the bank should begin decreasing and the pitch should continue decreasing, until the airplane is banked 15 degrees at its maximum pitch-down attitude (about 7-10 degrees nose-down).
7. For the final 45 degrees of the turn, the bank should continue decreasing, but the pitch should begin increasing, until the airplane returns to the horizon with the wings level after completing the 180-degree turn.

NOTE: This maneuver should be accomplished in one gradual, fluid motion; there should be no "snapping" the airplane's roll or pitch.



Standards

Arrive at 180-degree point +/-100 feet from starting altitude.
Arrive at 180-degree point +/-10 KIAS from starting airspeed.
Roll out at 180-degree point +/-10 degrees.
Maintain coordinated flight throughout maneuver.

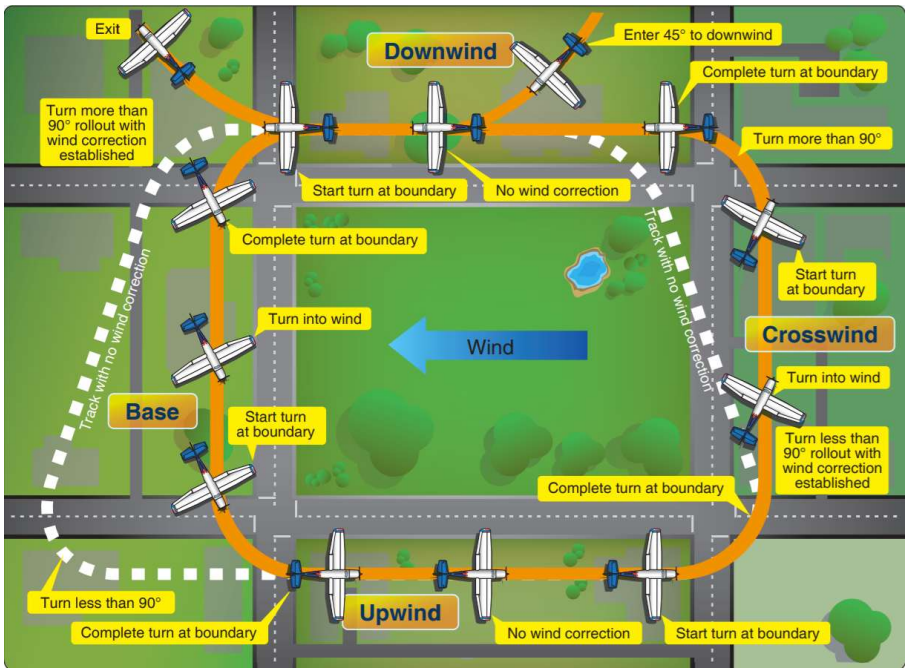
GROUND REFERENCE MANEUVERS

Rectangular Course

Ref: AFH 7-5

Objective: To maneuver the airplane over a predetermined ground path, similar to a traffic pattern, while dividing attention inside and outside the airplane.

1. Complete clearing turns and configure the airplane for maneuvering.
2. Establish cruise flight at 85 KIAS and 1000’ AGL in a downwind direction.
3. Locate a square or rectangular field, or an area with multiple ground references on all four sides. If possible, this area should be at least 1nm x 1nm. Each side of the rectangle will serve as a “leg” of the maneuver.
4. Enter on the downwind leg as you would a traffic pattern, and fly parallel to (but outside of) the reference point or line.
5. Fly one full lap around the reference area in this manner, using reference points and wind correction to maintain a rectangular path. Do not exceed 30 degrees of bank during turns, and attempt to maintain a constant radius around points when turning.
6. When one lap has been completed, depart the downwind leg at a 45-degree angle. Return to cruise flight when able.



Standards

Maintain altitude +/-100 feet.

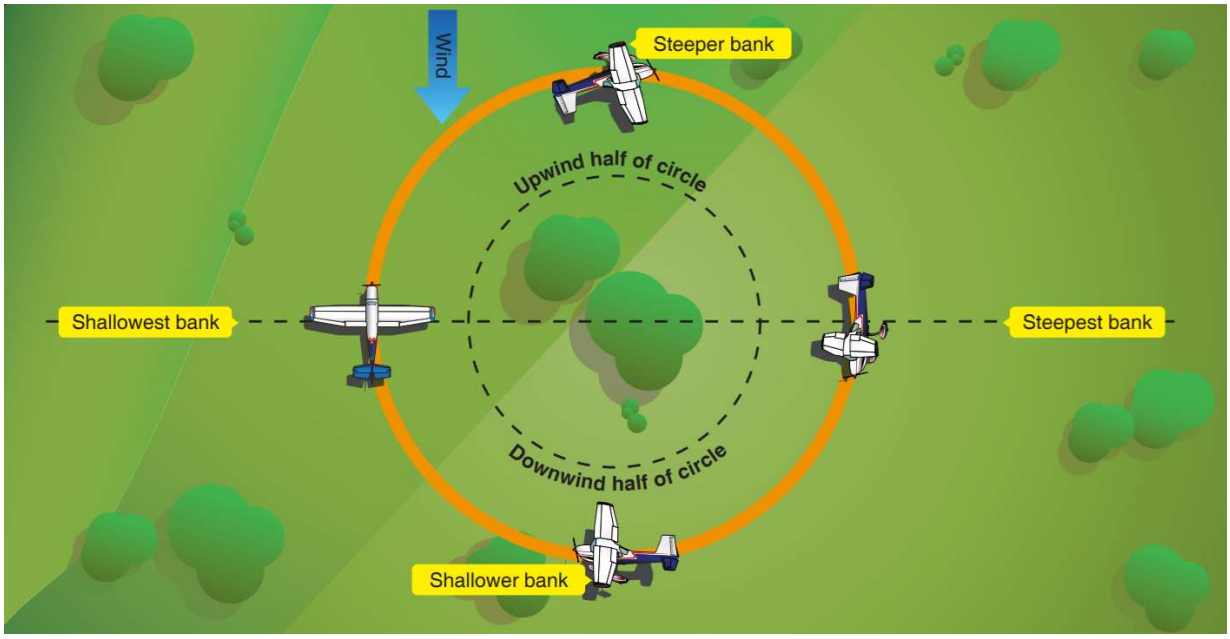
Maintain airspeed +/-10 KIAS.

Turns Around a Point

Ref: AFH 7-7

Objective: To maneuver the airplane over a predetermined ground path, similar to a traffic pattern, while dividing attention inside and outside the airplane.

1. Complete clearing turns and configure the airplane for maneuvering.
2. Establish cruise flight at 85 KIAS and 1000’ AGL in a downwind direction.
3. Select a prominent point ahead, and plan to pass the point about ½ mile to the left or right.
4. When the wing is directly abeam the reference point, begin a 360-degree turn around it. Make note of the airplane’s current distance from the point, and attempt to keep this distance consistent throughout the turn.
5. In the first half of the turn, as the aircraft proceeds downwind of the reference point, bank should steadily decrease to avoid overflying the point. The shallowest bank should occur at the 180-degree point, when the airplane is directly into the wind.
6. In the second half of the turn, as the aircraft transitions to the upwind side of the reference point, bank should steadily increase to avoid overflying the point. The steepest bank should occur just as the airplane is returning to its original downwind heading.
7. When one full lap has been completed, level the wings and return to cruise flight.



Standards

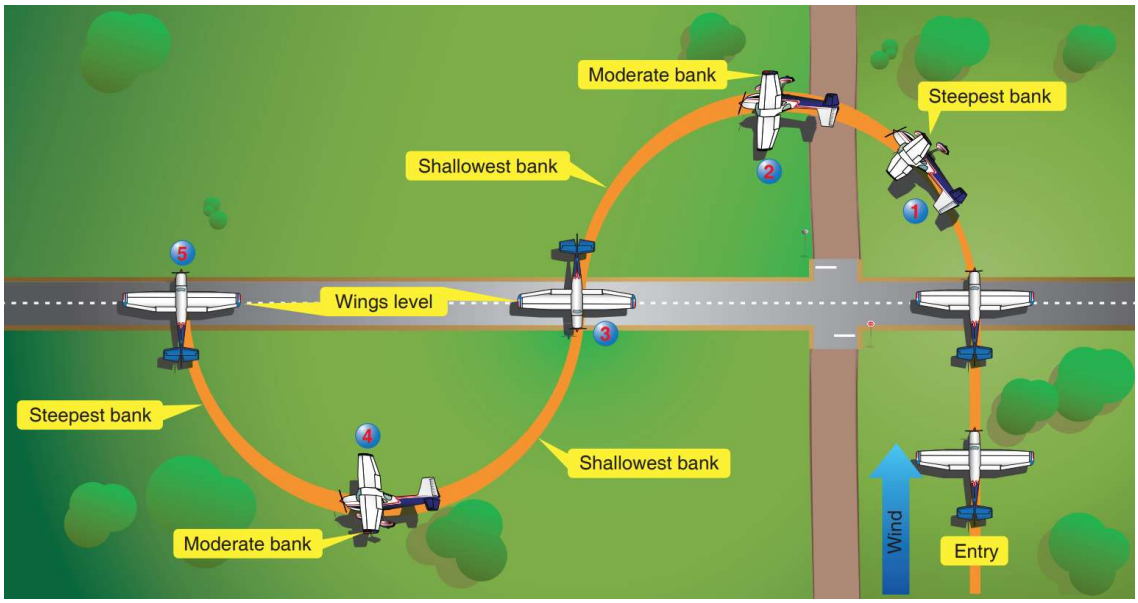
Maintain altitude +/-100 feet.
Maintain airspeed +/-10 KIAS.
Maintain constant radius.

S-Turns Across a Road

Ref: AFH 7-8

Objective: To practice application of wind correction during turns.

1. Complete clearing turns and configure the airplane for maneuvering.
2. Establish cruise flight at 85 KIAS and 1000’ AGL in a downwind direction.
3. Select a prominent road or section line ahead that runs perpendicular to the aircraft’s current direction (e.g. if flying south or north, pick an east-west road).
4. Upon crossing the reference road, roll into a 30-degree bank to begin a 180-degree turn back towards the road. The bank in this half of the turn should remain relatively steep, to avoid being pushed too far away from the road on the downwind side.
5. Near the end of the first 180-degree turn, use appropriate bank such that the airplane’s wings will return to level at the same time it flies over the reference road.
6. Upon crossing back over the reference road, roll into a shallower bank than the first turn to begin a 180-degree turn back towards the road. The bank should remain relatively shallow in this half, to avoid being pushed too close to the road on the upwind side.
7. Near the end of this 180-degree turn, use appropriate bank such that the airplane’s wings will return to level at the same time it flies over the reference road.
8. Upon crossing the reference road, return to cruise flight.



Standards

Maintain altitude +/-100 feet.

Maintain airspeed +/-10 KIAS.

Eights on Pylons

Ref: AFH 7-14

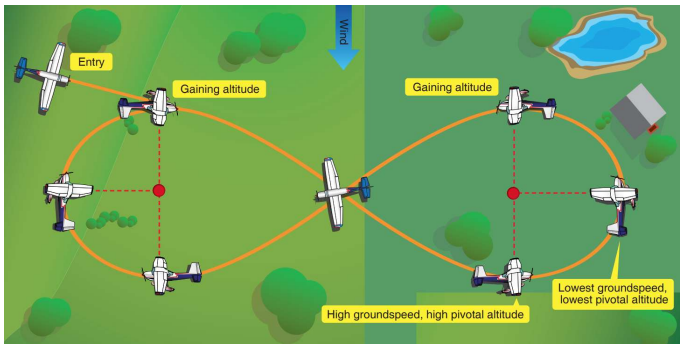
Objective: To demonstrate precision control of the airplane by flying fixed-radius turns around two points.

1. Complete clearing turns and configure the airplane for maneuvering.
2. Establish cruise flight at 85 KIAS and in a downwind direction.
3. Note or calculate the aircraft's groundspeed and calculate a pivotal altitude. This altitude can be calculated with the following formula:

   Pivotal altitude (AGL) = [Ground speed in KNOTS]^2 / 11.3
4. Climb or descend to the calculated pivotal altitude and stabilize at 85 KIAS.
5. Pick two reference points ahead, located on a reference line perpendicular to the aircraft's heading (e.g. if heading north or south, the two points should be located east/west of each other).
6. Enter the first turn at a 45-degree angle.
7. When abeam the first point, bank the aircraft such that the wingtip is just above the point.
8. Continually adjust bank and pitch to keep the reference point just under the lowered wingtip. If the point moves forward of the wing, pitch the airplane down. If it moves aft of the wing, pitch the airplane up.
9. When the airplane is nearing completion of the first turn and reaches a 45-degree angle to the second point, roll the wings level.
10. When abeam the second point, bank the aircraft such that the wingtip is just above the new point.
11. Continually adjust bank and pitch to keep the reference point just under the lowered wingtip.
12. When the airplane is nearing completion of the second turn and reaches its initial 45-degree entry heading, roll the wings level and exit the area.
13. Return to cruise flight.

NOTE: Pivotal Altitudes are in relation to GROUND LEVEL, not sea level. Ground level in the Lake Elmo practice areas can be assumed as 1000 feet MSL.

NOTE: Do not exceed 40 degrees of bank in this maneuver.



Standards

Apply smooth and continuous corrections so that the line-of-sight reference remains on the pylon.

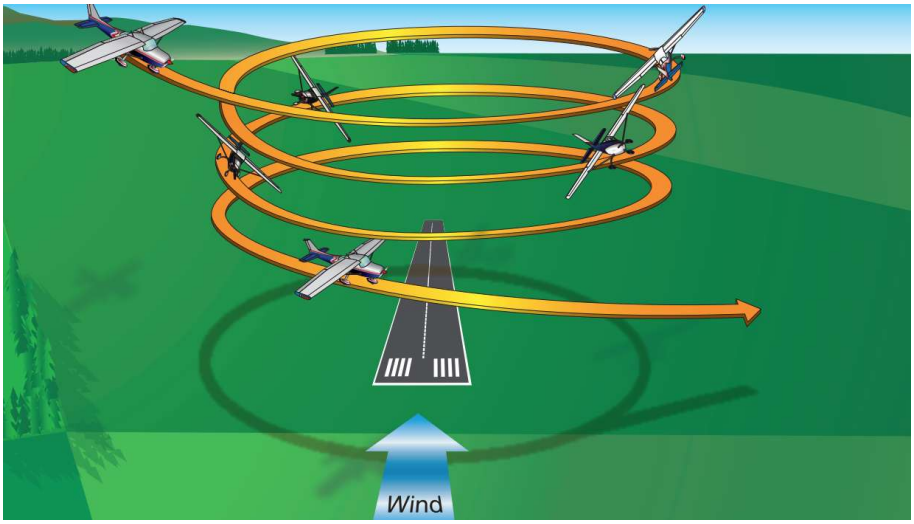
Steep Spirals

Ref: AFH 10-3

Objective: To safely descend the airplane to a landing site or reference point directly below.

1. Complete clearing turns and configure the airplane for maneuvering. Plan to recover by 1500' AGL.
2. Establish cruise flight at 85 KIAS in a downwind direction.
3. Select a prominent point almost directly underneath the airplane (within ½ mile).
4. When abeam the point, reduce throttle to idle power and pitch for 65 KIAS [VG].
5. Immediately begin a 30-degree banking turn to maintain a close, consistent turn radius to the reference point.
6. Use bank to correct for wind as appropriate (see Turns Around a Point) to maintain a constant radius. Bank should be at least 30 degrees, but should not exceed 60.
7. Upon completion of each lap in the turn, apply a short (1-2 sec) throttle application to ensure engine is still functioning properly.
8. Complete three 360-degree turns around the reference point. Maintain 65 KIAS [VG] to minimize altitude loss throughout each turn. If a stall is indicated, lower the nose slightly to stop the indication.
9. Upon returning to the aircraft's starting heading at the end of the third turn, level the wings.
10. Return to cruise flight.

NOTE: This maneuver requires a high starting altitude, and involves a rapid descent. Ensure that the aircraft will remain clear of any conflicting airspace, and be vigilant for any conflicting traffic throughout the maneuver.
NOTE: This maneuver involves extended periods of time at high indicated airspeeds with the engine at idle throttle. Caution should be exercised in cold temperatures to avoid excessive engine wear.



Standards

Maintain a steep spiral, not to exceed 60 degrees of bank.
Maintain a constant radius around the reference point.
Maintain airspeed +/-10 KIAS.
Roll out on starting heading +/-10 degrees.

INSTRUMENT FLIGHT

Recovery From Unusual Attitudes

Ref: AFH 5-1, POH 3-6

Objective: To safely recover the aircraft from an unusual flight attitude induced by spatial disorientation.

1. Scan primary flight instruments (Attitude indicator, Airspeed indicator, Altimeter) to assess the situation.

If the aircraft is in a nose-low unusual attitude:

2. Reduce power to idle.
3. Roll the wings to level with aileron input.
4. Pitch the aircraft to level with elevator input.
5. When aircraft is flying straight and level, return to cruise power. Carefully monitor primary flight instruments.

If the aircraft is in a nose-high unusual attitude:

2. Immediately add power to full and pitch the aircraft's nose to level with aileron input.
3. Roll the wings to level with aileron input.
4. When aircraft is flying straight and level, return to cruise power. Carefully monitor primary flight instruments.

NOTE: Remember the phrase "slow is smooth, and smooth is fast". Do not rush unusual attitude recoveries, or you may make incorrect inputs that worsen the situation.

NOTE: The manufacturer does describe a recommended procedure for "Emergency Let-Downs Through Clouds" in the event of inadvertent IMC entry (POH 3-5). While this can be practiced for training purposes, it is not accepted as an unusual attitude recovery technique for the purposes of a flight exam.

Standards

Recognize unusual flight attitude.

Perform correct, coordinated and smooth flight control application to resolve unusual attitude.

Instrument Approach

Ref: IPH Ch 4
Objective: To safely conduct an instrument approach to a landing.

Upon crossing the Initial Approach Fix or intercepting a vector to the final approach course:

1. Start a timer if the approach or procedure calls for it.
2. Begin a turn at standard rate to the applicable course, heading, or track.
3. Set the throttle for 95 KIAS.
4. Ensure that the appropriate course or track is tuned, and that the correct navigation source is selected and displayed.
5. Communicate as required with radios.

Upon crossing the Final Approach Fix or starting final descent to land..,.

1. Start a timer.
2. Check brake functionality by pressing both toe pedals and feeling for pressure/feedback.
3. Set the throttle for descent at 80 KIAS.
4. Extend the flaps to 10 degrees.
5. On a non-precision approach, trim for a descent rate of 500 feet per minute or greater. Do not exceed 1000 feet per minute of descent under any circumstances while in instrument flight conditions on final descent.
6. Communicate as required with radios.

NOTE: In all phases of instrument flight, remember to Aviate, *then* Navigate, *then* Communicate.
NOTE: See Lake Elmo Aero Instrument Syllabus for more specific IFH/IPH references.

Standards

Maintain altitude +/-100 feet.
*Beyond FAF, maintain all published altitudes and MDA +100/-0 feet.
Maintain airspeed +/-10 KIAS.
Maintain heading +/-10 degrees.
Maintain course +/- ¾ scale deflection.

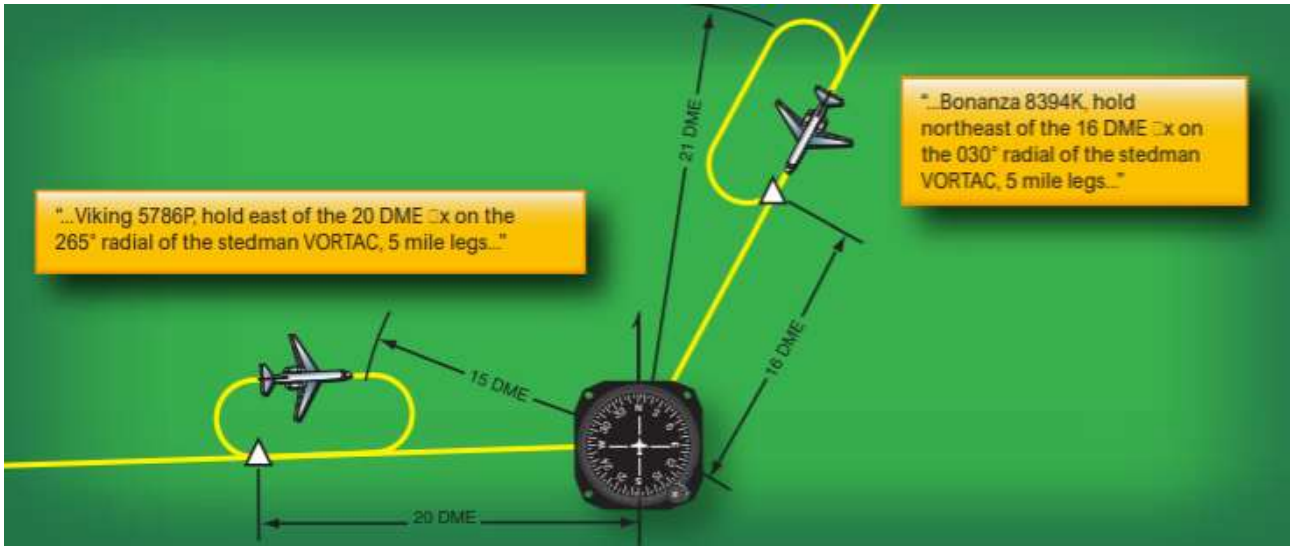
Holding

Ref: IPH 3-21

Objective: To safely execute published or requested holding procedures in instrument conditions.

Upon crossing the holding fix for entry…

1. Start a timer.
2. Turn to the applicable heading, course or track for your chosen hold entry.
3. Set the throttle for 95 KIAS.
4. Ensure that the appropriate course or track is selected, and that the correct navigation source is selected and displayed.
5. Communicate as required with radios.
6. Repeat steps 1-5 each time the holding fix is crossed for a new lap.



Standards

Maintain airspeed +/-10 KIAS.
Maintain altitude +/-100 feet.
Maintain heading +/-10 degrees.
Maintain course +/- ¾ scale deflection.

EMERGENCIES

Engine Failure in Flight

Ref: AFH 18-2, POH 3-2

Objective: To safely configure the aircraft in the event of a complete loss of engine power.

1. Level the wings and pitch to establish flight at 65 KIAS [V_G].
2. Locate the nearest suitable landing field and immediately begin flying towards it. Take the following into consideration:
    a. Wind
    b. Obstructions
    c. Field Length
3. Apply Carburetor Heat.
4. Confirm the Fuel Selector is set to Both.
5. Set the mixture to Full Rich.
6. Confirm the Ignition Switch is in the Both position.
    a. If the propeller is stopped, briefly move the Ignition Switch to Start. DO NOT attempt this if the propeller is still spinning to prevent additional engine damage.
7. Confirm the Primer is in the Locked position.
8. Go to the Engine Failure in Flight Checklist.
9. If engine power is not restored, proceed to the Power-Off Landing procedure.

NOTE: Remember the following mnemonic in the event of a loss of engine power: **A, B, C, D.**

A. Airspeed. Immediately establish flight at V_G.

B. Best Landing Site. Find somewhere the airplane can be landed, and fly towards it. Keep in mind this may be behind or underneath you; take your time and find the safest option.

C. Checklist. Proceed with the appropriate memory items and checklists as described above.

D. Declare. If already in radio contact with a controller, *remain on the frequency* and declare your emergency to the controller. Otherwise, tune to VHF Guard (121.5 MHz) and broadcast your emergency, including your callsign and the word “Mayday”. DO NOT SWITCH TO 121.5 if you are already in radio contact with a controller; this will cause confusion and delay any emergency response, if required.

Engine Failure on Takeoff

Ref: AFH 18-7, POH 3-2

Objective: To safely glide, secure, and land the aircraft in the event of a complete loss of engine power shortly after takeoff.

For training purposes, this maneuver should NEVER be taken all the way to a landing. When the student makes a corrective action, recover immediately to avoid ground contact.

1. Immediately pitch the nose down to establish flight at 65 KIAS.
2. If necessary, make small direction changes to fly towards the least hazardous landing site available. Altitude and airspeed are seldom sufficient to execute a 180-degree gliding turn to the runway.
3. Extend flaps if time and altitude allow.
4. Prior to touchdown, unlatch both doors to avoid becoming trapped in the event of structural buckling.
5. Touch down at the slowest possible ground speed, and heavily apply brakes to stop in the shortest distance possible.
6. Upon stopping the aircraft, immediately evacuate all occupants and move upwind in case of a fire.
7. CALL 911 FIRST IF NECESSARY, then call Lake Elmo Aero at 651-777-1399 to activate Emergency Response procedures. Refer to Lake Elmo Aero Safety Policies and Procedures manual for emergency contact procedures when safely outside of the airplane.

Power-Off Landing

Ref: AFH 18-3, POH 3-2

Objective: To safely glide, secure, and land the aircraft in the event of a complete loss of engine power.

1. Pitch to establish flight at 65 KIAS for final approach.
2. Set the Mixture to Idle Cutoff, to secure the fuel system and prevent a fire.
3. Set the Fuel Selector to Off, to secure the fuel system and prevent a fire.
4. Set the Ignition Switch to Off, to secure the engine and prevent inadvertent engine firing during evacuation.
5. Extend flaps as required for a safe landing. When flaps are extended, slowing to 60 KIAS is permitted as required. Use of 40 degrees of flaps is recommended in order to land with the slowest possible ground speed.
6. When the airplane is fully configured for landing, turn the Master Switch Off, to secure the electrical system and prevent a fire.
7. Prior to touchdown, unlatch both doors to avoid becoming trapped in the event of structural buckling.
8. Touch down at the slowest possible ground speed, and heavily apply brakes to stop in the shortest distance possible.
9. Upon stopping the aircraft, immediately evacuate all occupants and move upwind in case of a fire.
10. CALL 911 FIRST IF NECESSARY, then call Lake Elmo Aero at 651-777-1399 to activate Emergency Response procedures. Refer to Lake Elmo Aero Safety Policies and Procedures manual for emergency contact procedures when safely outside of the airplane.

NOTE: Any control inputs that would cause an actual loss of engine power, such as Fuel Selector or Ignition Off, should only be simulated in a training scenario. Lake Elmo Aero does not permit actual engine-out training scenarios in single-engine aircraft, with no exceptions.

Engine Fire in Flight

Ref: AFH 18-9, POH 3-2
Objective: To safely extinguish an engine fire in cruise flight.

1. Set the Mixture to Idle Cutoff.
2. Set the Fuel Selector Valve to Off.
3. Turn the Master Switch Off (if no further configuration changes or radio communications are required).
4. Close Cabin Heat and Cabin Air Vents on panel to minimize smoke intake from engine compartment. Overhead vents can be opened for fresh air if needed.
5. Lower the nose and increase speed to 105 KIAS. If this does not extinguish the fire, continue increasing airspeed within airframe limitations.
6. Go to Engine Fire in Flight Checklist.

If fire extinguishes…

7. Proceed to Power-Off Landing procedure.

If fire does not extinguish…

8. Proceed to Emergency Descent procedure.

NOTE: Any control inputs that would cause an actual loss of engine power, such as Fuel Selector or Ignition Off, should only be simulated in a training scenario. Lake Elmo Aero does not permit actual engine-out training scenarios in single-engine aircraft, with no exceptions.

Engine Fire on Start

Ref: POH 3-2

Objective: To safely extinguish an engine fire during the starting process.

1. Continue cranking starter to attempt to suck flames and accumulated fuel back into the engine.

If engine starts…

2. Run engine at 1700 RPM for about one minute to ensure all flames have been extinguished.

If engine does not start…

3. Fully open Throttle and reduce Mixture to Idle Cutoff.
4. Continue cranking starter until fire is safely out. Obtain assistance from ground personnel with fire extinguishers if possible.

When fire is extinguished and engine is no longer running…

5. Discontinue cranking starter (if applicable) and turn off Master Switch, Ignition Switch, and Fuel Selector.
6. Evacuate aircraft as soon as practical.

Electrical Fire

Ref: AFH 18-10, POH 3-4
Objective: To safely extinguish an engine fire in cruise flight.

1. Turn the Master Switches Off.
2. Turn all individual radio and electrical switches Off.
3. Close Cabin Heat and Cabin Air Vents on panel to minimize smoke intake. Overhead vents or cabin windows can be opened for fresh air if needed.
4. If available, use a fire extinguisher on the afflicted area.
5. Proceed to Electrical Fire Checklist.

If fire does not extinguish…

6. Land as soon as possible. Consider off-airport landing if necessary for safety of occupants.

If fire extinguishes…

7. Land as soon as practical.
8. If electrical power is *absolutely* necessary for continuance of flight, turn Master Switch On.
9. Check circuit breakers for signs of a faulty circuit. Do not reset any breakers that have been tripped.
10. Turn on individual electrical components one at a time, and ensure that a fire does not restart.
11. Open Cabin Air and Cabin Heat Vents as applicable.

Emergency Descent

Ref: AFH 18-8

Objective: To safely and rapidly descend the aircraft.

1. Reduce the Throttle to Idle.
2. Enter a steep bank (30-45 degrees).
3. Lower the nose of the aircraft and pitch for 128 KIAS [V_{NO}].
4. Plan to recover by 1000’ AGL.

To recover…

5. Level the wings to the horizon and stop the descent.
6. Apply throttle when airspeed decreases safely below 97 KIAS [V_A].
7. Return to cruise flight or complete the Power-Off Landing procedure, as applicable.

NOTE: In a non-training scenario requiring this action, descent at up to 160 KIAS [V_{NE}] is permitted if necessary.

Engine Roughness

Ref: POH 3-7

Objective: To diagnose and rectify a rough-running engine.

1. Apply Carburetor Heat and a high throttle setting (about 2500 RPM). If carburetor ice exists, engine will momentarily run even worse while ice is melted and passes through the engine. Operation should return to normal after 30 seconds. If no change is observed after one minute, close Carburetor Heat.
2. Switch the Fuel Selector to each individual tank for about 30 seconds apiece. If one tank runs more smoothly, remain on that tank and carefully monitor fuel quantity. If no change is observed in the allotted time frame, return the Fuel Selector to Both.
3. Set the mixture to Full Rich. If already Full Rich, attempt to slowly lean the Mixture by about an inch and a half. This will cause the engine's combustion temperature to increase, which could burn away lead or carbon deposits causing roughness. If no change is observed after one minute, return the Mixture to Full Rich.
4. Switch the Ignition Switch to each individual magneto position (L and R) to test operation of each magneto. If one magneto runs more smoothly, remain on that magneto and land as soon as practical. If no change is immediately observed, return the Ignition Switch to Both.
5. Confirm the Primer is in the Locked position. If not, slowly push the Primer in and rotate it so that it remains locked.
6. If Engine Roughness continues, land as soon as possible and prepare for a loss of engine power.

NOTE: On airplanes with SureFly Electronic Ignition installed, the Left Magneto is the solid-state electronic ignition source.

Loss of Oil Pressure

Ref: POH 3-8, AFH 18-11
Objective: To safely manage a loss of oil pressure in flight.

If Low Oil Pressure is accompanied by **Normal or Low Oil Temperature…**

1. Land as soon as practical.

If Oil Pressure is completely lost, or if Low Oil Pressure is accompanied by **High Oil Temperature…**

1. Prepare for a loss of engine power.
2. If the airplane is climbing, stop the climb.
3. Reduce Throttle to 2200 RPM and maintain level flight.
4. Set Mixture to Full Rich.

If Oil Pressure and Oil Temperature do not return to normal range…

5. Land as soon as possible.

High Oil Temperature

Ref: AFH 18-11
Objective: To safely cool the engine in the event of an overheat.

If High Oil Temperature is accompanied by **Low Oil Pressure…**

1. See "Loss of Oil Pressure" procedure.

If High Oil Temperature is detected, and **Oil Pressure is normal…**

1. If the airplane is climbing, stop the climb.
2. Reduce throttle to 2200 RPM for a minute or so to allow the airplane to accelerate. This will force more air over the engine. If airplane is equipped with CHT gauge, monitor this as well (keep below 420F/215C if possible).

If Oil Temperature returns to normal…

3. Resume normal operations, but climb at a higher-than-normal speed (at least 73 KIAS [V_Y] to facilitate cooling) when required.

If Oil Temperature does not return to normal…

4. Land as soon as practical.

Alternator Failure

Ref: POH 3-9, AFH 18-13

Objective: To manage electrical load and return for a safe landing in the event of an alternator failure.

1. Prepare for the possibility of an electrical fire. Go to the Electrical Fire procedure if applicable.
2. Turn off all unnecessary electrical equipment to reduce system load, including…
    a. External lights (as safe/required).
    b. Secondary communication radio(s).
3. Unplug all devices from the airplane's 12-volt charging socket.
4. Check circuit breakers.
    a. If no circuit breakers are tripped, cycle the Alternator Master Switch.
        i. If Alternator power is not restored, land as soon as possible.
    b. If one or more circuit breaker(s) is tripped…
        i. If the equipment is unnecessary for the safety of flight, leave it tripped and cycle the Alternator Master Switch.
        ii. If the equipment *is necessary* for the safety of flight, the use of emergency authority to reset the breaker can be used. Land at the nearest suitable airport.
5. Minimize inputs that require heavy electrical load, including…
    a. Transmitting on Communication radios.
    b. Extending or retracting Flaps.
6. Land as soon as practical (if in IMC, land as soon as possible).

NOTE : Resets of circuit breakers protecting necessary equipment can be attempted, but prepare for the possibility of an Electrical Fire and do not attempt to reset the same breaker more than once.

NOTE: The Cessna 172's alternator is equipped with an overvolt-sensing alternator, which will shut off if output voltage exceeds preset parameters. This will trigger the red "Over Voltage" light, and will take the form of an Alternator failure. Recycling power to the alternator will reset this failsafe system, and can be attempted once to restore electrical power. Multiple resets should not be attempted.

NOTE: When cycling the Alternator Master Switch, use caution to avoid turning the Battery Master Switch off in flight.

Electrical System Failure

Ref: POH 3-9, AFH 18-13

Objective: To manage electrical load and return for a safe landing in the event of a loss of electrical power.

1. Turn off Battery and Alternator Master Switches.
2. Turn off all individual electrical switches (such as lights and Avionics Master switch).
3. Prepare for the possibility of an electrical fire. Go to the Electrical Fire procedure if applicable.
4. Turn the Battery Master Switch on.
    a. If electrical power is not restored, land as soon as practical and do not continue troubleshooting. Due to the electrical system being inoperative, plan to land without flaps.

If electrical power is restored…

5. Turn the Alternator Master Switch on.
    a. If Alternator Over-Voltage Light illuminates, turn Alternator Master Switch Off and land as soon as practical.
6. Individually, turn on each component to isolate the problem. Use caution and make sure each individual component does not cause an electrical abnormality.
7. Land as soon as practical.

Spin Recovery

Ref: AFH 5-22

Objective: To safely recover from an uncoordinated, aggravated stall.

1. Reduce the Throttle to Idle.
2. Return the Ailerons to the neutral position. Attempting to recover from a spin with aileron input can further aggravate the aspin.
3. Apply Rudder input in the direction opposite to the spin. The aircraft should stop spinning and become oriented in a steep dive.
4. Apply forward pressure on the Elevators to break the stall condition. Do not invert the aircraft or exceed 160 KIAS [V_{NE}].

When the stall is broken and the aircraft is controllable…

5. Gradually recover from the dive and return to level flight with elevator input. Do not recover abruptly in order to avoid overstressing the aircraft beyond its rated structural limits (+3.8G) or inducing a secondary stall.
6. When level flight has been achieved, apply throttle as necessary to return to cruise flight.

NOTE: Remember the following mnemonic in the event of a spin: **PARE**.

Power: Idle.
Ailerons: Neutral.
Rudder: Opposite, to break the spin.
Elevator: Forward, to break the stall. Then back to recover from the dive.