ANSWERS TO THE ACS

COMMERCIAL PILOT

AIRPLANE SINGLE AND MULTIENGINE ENGINE LAND

VOLUME II: FLIGHT PORTION

REVISION 0

ADDRESSES FAA-S-ACS-7A (CHANGE 1)

PATRICK MOJSAK

MOJSAK AERO LLC, VENUS, TEXAS

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Dedication

To all those who have lost their lives in general aviation, that we may learn from their mistakes, and others, to forge a safer air transportation system.

ABOUT THE AUTHOR

Patrick Mojsak began learning to fly from his father at the age of 12. He proceeded to then earn his private, instrument, commercial, and flight instructor certificates by the age of 18, which is when he began instructing.

Patrick graduated from the University of Texas at Arlington in 2012 with a Bachelor of Science in Electrical Engineering. He then moved to Wichita, Kansas to pursue a position with Cessna Aircraft Company as an electrical engineer. Patrick began working on Cessna's single engine piston airplanes such as the Cessna TTx (formerly the Columbia 400) by performing avionics testing, supporting production flight test regarding customer training, and drafting certification documentation.

During his time there, in early 2014, the companies of Cessna and Beechcraft merged to form what is now known as Textron Aviation. Patrick was then moved to begin working on the Citation Longitude - the company's first super mid-sized business jet. Duties included FADEC integration of the Honeywell HTF 7000 engine, wire diagram development, and assisting experimental shop with assembling a functional prototype. First flight was achieved on October 8, 2016.

During his time at Textron Aviation, Patrick continued to fly by instructing at the employee's flying club and earning additional certificates and ratings such as airline transport pilot (ATP), commercial airplane single engine sea (ASES), commercial glider, and flight instructor glider.

In late 2016, Patrick left Textron Aviation to return to his home state of Texas and pursue a career with the airlines. Patrick began working for Envoy Air Inc. (formerly known as American Eagle) in 2017 as a first officer on the Embraer 145 regional jet. In 2019, Patrick upgraded to captain on the Embraer 175. In 2022, Patrick began working as an instructor in Envoy's Advanced Qualification Program (AQP) on the Embraer 175. In 2023, Patrick began working for American Airlines as a first officer on the Airbus 320.

Patrick's love for teaching is his inspiration behind this book. With new, more challenging standards being imposed by the FAA, Patrick wishes to reach a wider audience by providing detailed and tangible guidance.

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Photographic Contributions: I would like to thank the many individuals who contributed photographs to this work, each of whom are accredited below their respective photograph.

DISCLAIMER

This book is intended to be a learning tool for applicants preparing for the practical test towards a pilot certificate and/or rating. The information presented herein is as accurate, complete, and authoritative as possible. However, there may be errors and omissions, both typographical and in content.

This book should not be used as the ultimate source of aeronautical information. It is designed to complement other aviation texts and formal flight instruction. For additional reading materials, refer to the extensive references at the end of each section.

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REVISIONS

Revision	0	Date	February 1, 2024	ACS Addressed	FAA-S-ACS-7A (Change 1)
Reason(s) for Revision	NA				

Section	Sub-Section	Change Description
All	All	None - initial issue.

AREA OF OPERATION V

PERFORMANCE AND GROUND REFERENCE MANEUVERS

V. Performance and Ground Reference Maneuvers

A. Steep Turns

B. Steep Spiral (ASEL, ASES)

C. Chandelles (ASEL, ASES)

D. Lazy Eights (ASEL, ASES)

E. Eights on Pylons (ASEL, ASES)

For this area of operation, performance maneuvers include steep turns, chandelles, and lazy eights while ground reference maneuvers include steep spirals and eights on pylons. Performance maneuvers will be performed at altitude, the steep spiral used to transition to low altitude, and eights of pylons accomplished at low altitude. Additionally, tasks B through E are only evaluated if the practical test is being taken in a single engine airplane.

Note: *The at the time of this writing, the Airplane Flying Handbook considers the steep spiral to be a performance maneuver. However, a constant radius about a point must be maintained in this maneuver.*

AREA OF OPERATION V

TASK B

STEEP SPIRAL

B. STEEP SPIRAL
OVERVIEW

A steep spiral is a maneuver used to lose altitude while remaining over a selected point. This will typically be performed once the maneuvers at altitude have been completed as a way to transition to a lower altitude.[1]

Task	***B. Steep Spiral (ASEL, ASES)***
References	FAA-H-8083-2, FAA-H-8083-3; POH/AFM
Objective	To determine that the applicant exhibits satisfactory knowledge, risk management, and skills associated with steep spirals. ***Note:*** *See Appendix 7: Aircraft, Equipment, and Operational Requirements & Limitations.*
Knowledge	The applicant demonstrates understanding of:
CA.V.B.K1	Purpose of steep spirals.
CA.V.B.K2	Maintaining a constant radius about a point.
CA.V.B.K3	Effects of wind on ground track and relation to a ground reference point.
Risk Management	The applicant demonstrates the ability to identify, assess and mitigate risks, encompassing:
CA.V.B.R1	Failure to divide attention between airplane control and orientation.
CA.V.B.R2	Collision hazards, to include aircraft, terrain, obstacles, and wires.
CA.V.B.R3	Low altitude maneuvering including, stall, spin, or CFIT.
CA.V.B.R4	Distractions, loss of situational awareness, and/or improper task management.
CA.V.B.R5	Failure to maintain coordinated flight.
CA.V.B.R6	Effects of wind. (see ***CA.IX.B.R1***)
CA.V.B.R7	Airframe and/or airspeed limitations.
Skills	The applicant demonstrates the ability to:
CA.V.B.S1	Clear the area.
CA.V.B.S2	Select an altitude sufficient to continue through a series of at least three 360° turns.
CA.V.B.S3	Establish and maintain a steep spiral, not to exceed 60° angle of bank, to maintain a constant radius about a suitable ground reference point.
CA.V.B.S4	Apply wind-drift correction to track a constant radius circle around selected reference point with bank not to exceed 60° at steepest point in turn.
CA.V.B.S5	Divide attention between airplane control, traffic avoidance, and the ground track, while maintaining coordinated flight.
CA.V.B.S6	Maintain the specified airspeed, ±10 knots and roll out toward an object or specified heading, ±10°, and complete the maneuver no lower than 1,500' AGL.

Knowledge	The applicant demonstrates understanding of:
CA.V.B.K1	Purpose of steep spirals.

Examiner: *"What is the purpose of steep spirals?"*

You: *"To rapidly dissipate substantial amounts of altitude while remaining over a selected spot. This can be used during an engine failure to circle and descend over a landing area."*

From a training and evaluation standpoint, the steep spiral serves to rapidly dissipate substantial amounts of altitude while remaining over a selected spot. From a practical standpoint, the steep spiral can be used during an engine failure in a single engine airplane to circle and descend over a landing area.

Knowledge	The applicant demonstrates understanding of:
CA.V.B.K2	Maintaining a constant radius about a point.
CA.V.B.K3	Effects of wind on ground track and relation to a ground reference point.

Examiner: *"What are the effects of wind on ground track and in relation to a ground reference point?"*

You: *"A crosswind will cause an airplane flying in a straight line to drift, thus requiring the pilot to point the nose into the wind, known as 'crabbing.' In a turn around a ground reference point the bank angle must be modified to maintain a constant radius."*

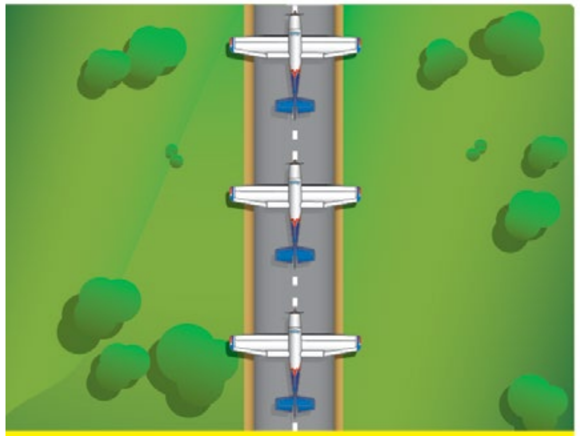
This knowledge element refers to the effect of wind on a straight flight path as well as a continuous turn.

Straight Flight Path

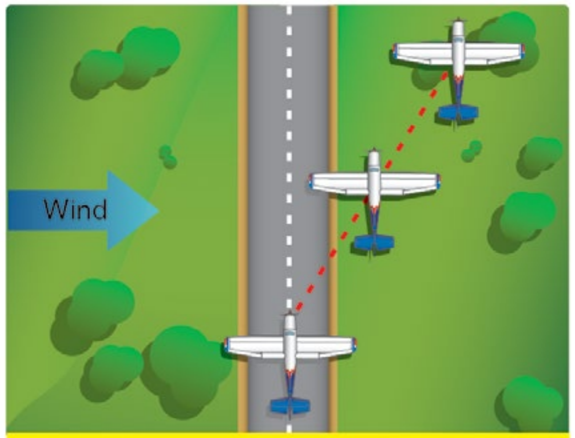
Continuous Turn

Straight Flight Path

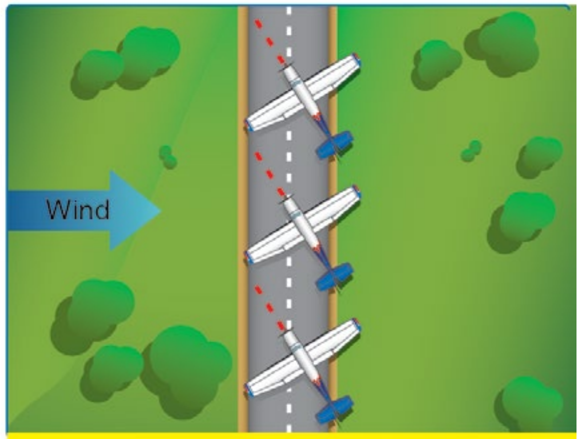
For a straight flight path, only a crosswind affects the ground track and thus requires correction. A headwind only reduces groundspeed while a tailwind increases it. With no correction, a crosswind will cause the airplane to drift at an angle based on the airplane's airspeed and the wind speed (known as the drift angle). To correct for drift, the pilot must point the airplane's nose into the wind at an equivalent angle, which is known as the wind correction angle. This is also known as "crabbing" since the apparent sideways movement of the airplane is similar to a crab walking sideways.



No wind, no drift.



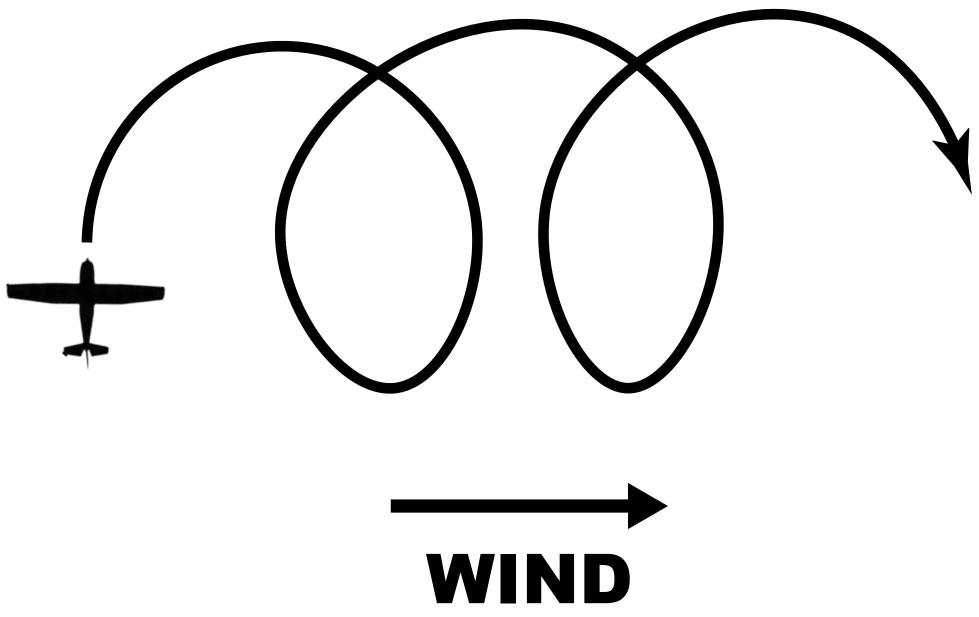
With any wind, the airplane drifts downwind unless corrected.



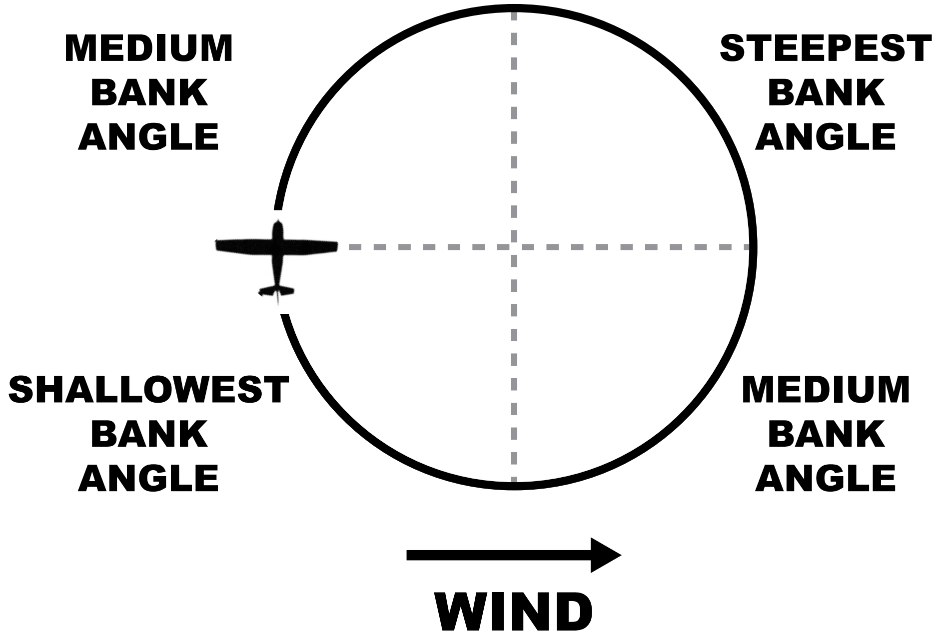
With proper correction, the airplane stays on intended course.

Continuous Turn

In a continuous turn around a ground reference point the effect of wind on ground track is constant and thus requires constant correction. With no correction, the ground track of a continuous turn will have the appearance of a spiral. Correction must be accomplished by modifying the bank angle throughout the turn. This can be done by dividing a circular ground track into four quadrants and identifying the relative bank angle required in each. The quadrant on the tailwind side of the circle with a quartering tailwind requires the steepest bank, while the quadrant on the headwind side of the circle with a quartering headwind requires the shallowest bank.



Ground track of a continuous turn with no wind correction.



Ground track of a continuous turn with wind correction.

Risk Management	The applicant demonstrates the ability to identify, assess and mitigate risks, encompassing:
CA.V.B.R1	Failure to divide attention between airplane control and orientation.
CA.V.B.R2	Collision hazards, to include aircraft, terrain, obstacles, and wires.

Identifying Risks

Risks
Collision with obstacles during intentional low altitude maneuvering.

One of the risks of intentional low altitude maneuvering is collision with obstacles. Table V-B-1 summarizes select fatal low altitude maneuvering accidents resulting from collision with obstacles between 2016 and 2019.

Accident No.	Year	Make & Model	Operation	Obstacle Struck
CEN16LA326	2016	Ayres Thrush	Agricultural	Guy wire
CEN18FA011	2017	C172M	Personal	Power lines
ERA17FA279	2017	AT502	Agricultural	Trees
CEN19FA003	2018	AT502	Agricultural	Antenna tower
CEN18FA297	2018	7AC	Personal	Power lines
CEN18FA232	2018	AT502B	Agricultural	Guy wire
ERA19LA263	2019	Weatherly 620	Agricultural	Power lines
CEN19FA259	2019	AT502	Repositioning	Power lines

Table V-B-1: Summary of Low Altitude Obstacle Accidents From 2016 to 2019

It can be seen firstly that agricultural operations (crop dusting) are overrepresented in these accidents. Second, collision with either powerlines or guy wires is also overrepresented. This is because these obstacles are effectively invisible to pilots.

Assessing Risks

◇ **Severity (Catastrophic):** Collision with obstacles at low altitude frequently results in fatalities.

◇ **Likelihood:** Likelihood of colliding with obstacles is greatest during low altitude maneuvering.

◇ **Example:** For the proposed flight, the likelihood of colliding with obstacles is **remote** since the pilot will be performing some low altitude maneuvers as part of their checkride. Using the ***Risk Assessment Matrix***, this makes low altitude collision hazards a **serious**-risk item.

Mitigating Risks

The following are risk mitigation measures for low altitude collision hazards:

- If intending to perform low altitude maneuvering, whether due to employment (i.e., crop dusting, fire spotting) or other reasons, be thoroughly familiar with obstacle marking/lighting requirements per AC 70/7460-1:[2]
  - Generally, only obstacles that exceed 200 feet in height are marked and lighted. Below 200 feet, there is no such protection.
  - Marking comes in the form of orange and white stripes/patterns on structures and aerial marker balls on powerlines. Lighting is typically accomplished with a steady red light on top of the structure at night, but flashing red or white lights are also used.
  - Guy wires for towers are often not marked. This is why pilots must maintain at least 2,000 feet horizontally from obstacles in congested areas per 14 CFR §91.119(b), as this is also a requirement for the construction of towers with guy wires.

Risk Management	The applicant demonstrates the ability to identify, assess and mitigate risks, encompassing:
CA.V.B.R3	Low altitude maneuvering including stall, spin, or CFIT.
CA.V.B.R4	Distractions, loss of situational awareness, or improper task management.
CA.V.B.R5	Failure to maintain coordinated flight.

Identifying Risks

Risks
Inducing a stall/spin at an altitude too low to recover during intentional low altitude maneuvering.

In a study by AOPA in 2017 which analyzed over 2,000 stall accidents between the years of 2000 and 2014, it was found that 74% (1407) of non-commercial stall accidents occurred during personal flights and 13% (247) on instructional flights.[3] For stall accidents that occurred during personal flights, 18% (253) occurred during maneuvering. This was dominated by accelerated stalls caused by either sharp pull-ups (37% of both fatal and non-fatal) or steep turns (30%, including 32% of fatal accidents) attempted at low altitudes. The former is characterized by the so-called "airspeed pass" involving a steep climbout from a high-speed low-altitude run, while the latter is typified by the "moose stall," an attempt to make slow, tight circles around something on the ground.

For stall accidents that occurred during instructional flights, 25.1% (62) occurred during maneuvering. Fatalities were more common during intentional low-altitude maneuvering, including conventional ground reference maneuvers, but also attempts to outclimb rising terrain. More than three-fourths of these types of stalls were fatal, as were all six accidents during aerobatic instruction. Together these accounted for 38% of fatal accidents in the "maneuvering" category involving instructional flights.

Assessing Risks

◇ **Severity (Catastrophic):** Stalls/spins during low altitude maneuvering frequently result in fatalities.

◇ **Likelihood:** Likelihood of a low altitude stall is greatest during low altitude maneuvering when the pilot is distracted with another task besides flying the airplane, such as observing something on the ground.

◇ **Example:** For the proposed flight, the likelihood of a low altitude stall/spin is **remote** since the pilot will perform low altitude maneuvers as part of their checkride. Using the ***Risk Assessment Matrix***, this makes moose stalls a **serious**-risk item.

Mitigating Risks

The following are risk mitigation measures for low altitude stalls/spins:

- Avoid unnecessary low-altitude maneuvering. Circling one's house, doing a flyby, or buzzing boats on a river are unnecessary high-risk activities.
- If low-altitude maneuvering is necessary for the job or operation being performed, do the following:
  - » Have a second person in the airplane who can perform any required non-flying tasks (i.e. observation) while you focus on flying only.
  - » Use a maximum bank angle of 30 degrees.

Risk Management	The applicant demonstrates the ability to identify, assess and mitigate risks, encompassing:
CA.V.B.R7	Airframe and/or airspeed limitations.

The following are concerns regarding airframe and airspeed limitations related to steep spirals:

- **Airspeed Limitations:** It should be noted that since the steep spiral is not a level flight maneuver, concerns related to maneuvering speed and accelerated stalls do not necessarily apply. However, the airplane should still be flown below maneuvering speed but not too slow in case hard pull-ups occur.
- **Airframe Limitations:** Airplanes in the normal category are restricted to 60 degrees of bank.[4]

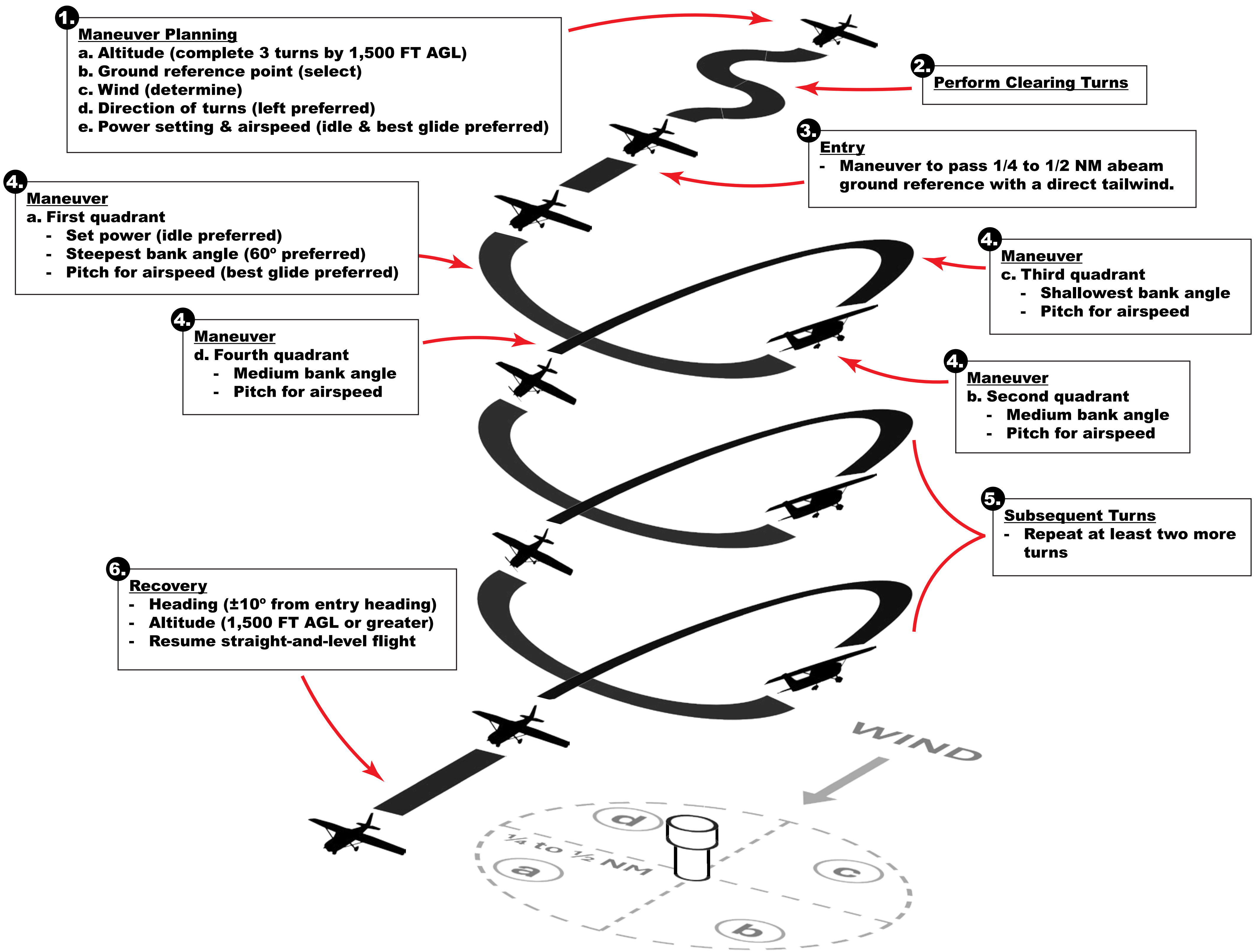
Skills	The applicant demonstrates the ability to:
CA.V.B.S1	Clear the area.
CA.V.B.S2	Select an altitude sufficient to continue through a series of at least three 360° turns.
CA.V.B.S3	Establish and maintain a steep spiral, not to exceed 60° angle of bank, to maintain a constant radius about a suitable ground reference point.
CA.V.B.S4	Apply wind-drift correction to track a constant radius circle around selected reference point with bank not to exceed 60° at steepest point in turn.
CA.V.B.S5	Divide attention between airplane control, traffic avoidance, and the ground track, while maintaining coordinated flight.
CA.V.B.S6	Maintain the specified airspeed, ±10 knots and roll out toward an object or specified heading, ±10°, and complete the maneuver no lower than 1,500' AGL.

The following are expanded procedures for performing a steep spiral compliant with the ACS. Refer to ***Profile V-B-1*** for a graphical depiction:

1. **Maneuver Planning (*CA.V.B.S2*):** Plan the maneuver by selecting the following:
   - **a. Altitude Selection:** Select an altitude sufficient to complete at least three 360-degree turns by 1,500 feet AGL. The amount of altitude loss per turn should be known from previous training. The starting altitude has the potential to be quite high in some airplanes, as much as 5,000 feet AGL.
   - **b. Ground Reference Selection:** Select a distinct ground reference that can be seen by the applicant at any phase of the maneuver, and, if possible, the examiner as well. This is especially challenging in low wing airplanes when bank is the shallowest, to the point where even the applicant may briefly lose sight of the ground reference. As a result, surrounding/supplementary references are often necessary. An ideal example is two straight roads crossing at 90 degrees.
   - **c. Wind:** Note the direction of the wind.
   - **d. Direction of Turns:** The ACS does not specify which direction of turns the steep spiral must be. However , left turns are preferred to allow the applicant to best see the ground reference.
   - **e. Power Setting and Airspeed:** Although the steep spiral is understood by many to be performed at an idle power setting and best glide speed, this is not required by the ACS. Airplanes that lose an excessive amount of altitude may require a power setting greater than idle (i.e. 1500 RPM or 15" manifold pressure) but can still perform the maneuver at best glide.
2. **Perform Clearing Turns (*CA.V.B.S1*):** Perform clearing turns with emphasis on clearing the area below.
3. **Entry:** Maneuver the airplane to pass abeam the reference point on the left side with a tailwind. Do so ¼ to ½ NM away which will be the radius of the maneuver. A radius greater than this will result in

B. STEEP SPIRAL
IN-FLIGHT TASK

S



Profile V-B-1: Steep Spiral

excessive altitude loss in each turn.

4. **First 360-Degree Turn (*CA.V.B.S3*, *CA.V.B.S4*, *CA.V.B.S5*, and *CA.V.B.S6*):** Once abeam the reference point, note the heading and perform the following. An airspeed tolerance of ±10 knots is required throughout the maneuver:

    a. **First Quadrant:** Once abeam the reference point, immediately begin a turn to the left and reduce the power to the planned setting (typically idle). Apply carburetor heat if the engine is carbureted and turn on the fuel pump if it is required for landing. Pitch up and trim for the planned airspeed (typically best glide). The bank angle initially established will be the steepest of the maneuver and should be near, but not exceed, 60 degrees. Scanning focus should primarily be between the ground reference (for bank corrections) and airspeed (for pitch corrections). In addition to this, periodically scan for traffic and monitor turn coordination. When nearing the second quadrant, bank angle should be reduced to maintain a constant radius.

    b. **Second Quadrant:** The second quadrant, which is down wind of the reference point with a quartering tailwind, will require a medium bank angle which will be less than the first quadrant but greater than the third quadrant. Modulate bank angle as necessary to maintain a constant radius. Slowly reduce the bank angle while approaching the third quadrant. As bank angle changes, pitch will have to be changed to maintain a constant airspeed. When reducing bank angle, pitch must be increased. After completion of the second quadrant (while experiencing a direct headwind) it is recommended to clear the engine by advancing it to cruise or full for a few seconds. Doing so with a direct headwind minimizes the change in groundspeed.

    c. **Third Quadrant:** The third quadrant, which is up wind of the reference point with a quartering headwind, will require the shallowest bank of the maneuver. Modulate bank angle as necessary to maintain a constant radius. Slowly increase the bank angle while approaching the fourth quadrant.

    d. **Fourth Quadrant:** The fourth quadrant, which is up wind of the reference point with a quartering tailwind, will require a medium bank angle similar to the second quadrant. Modulate bank angle as necessary to maintain a constant radius. Slowly increase the bank angle while approaching the first quadrant. While bank angle is increased pitch must be decreased to maintain a constant airspeed.

5. **Subsequent Turns:** Repeat at least two more turns.

6. Recovery: When overflying the entry point after the third turn at a heading of ±10 degrees from the starting heading and above 1,500 feet AGL, resume straight-and-level flight. Advance the power to cruise, re-trim the airplane, and turn off carburetor heat and/or the fuel pump as necessary.

B. STEEP SPIRAL
REFERENCES

1 FAA. *Airplane Flying Handbook*. FAA-H-8083-3C. (Oklahoma City, OK: FAA Airman Testing Standards Branch, 2021), 10-3 through 10-4.

2 FAA. "Obstruction Marking and Lighting." AC 70/7460-1M. (Washington, DC: AJV-P, Mission Support Services).

3 McSpadden Jr, Richard, Kenny, David Jack, Collins, John, Sable, Andy, and Urban, Claire. "Stall and Spin Accidents: Keep the Wings Flying." (Frederick, MD: AOPA Air Safety Institute, 2017).

4 FAA. *Airplane Categories*. 14 CFR §23.3(a)(3). (Washington, DC: U.S. Government Publishing Office, 1 January 2017).

AREA OF OPERATION IX

EMERGENCY OPERATIONS

IX. EMERGENCY OPERATIONS

IX. Emergency Operations

This area of operation consists of a set of tasks relating to emergency procedures. Task D is normally evaluated during the preflight inspection while all other tasks are evaluated in flight. Additionally, task B will only be evaluated if the practical test is being taken in a single engine airplane. Tasks E, F, and G will only be evaluated if the practical test is being taken in a multiengine airplane.

AREA OF OPERATION IX

TASK F

ENGINE FAILURE AFTER LIFTOFF (SIMULATED)

F. ENGINE FAILURE AFTER LIFTOFF (SIMULATED)

OVERVIEW

Task	*F. Engine Failure After Liftoff (Simulated) (AMEL, AMES)*
References	FAA-H-8083-2, FAA-H-8083-3; FAA-P-8740-66; POH/AFM
Objective	To determine that the applicant exhibits satisfactory knowledge, risk management, and skills associated with an engine failure after liftoff. ***Note:*** *See Appendix 6: Safety of Flight and Appendix 7: Aircraft, Equipment, and Operational Requirements & Limitations.*
Knowledge	The applicant demonstrates understanding of:
CA.IX.F.K1	Factors affecting V_{MC} (see ***CA.X.B.K1***).
CA.IX.F.K2	V_{MC} (red line), V_{YSE} (blue line), and V_{SSE} (safe single-engine speed) (see ***CA.X.B.K2***).
CA.IX.F.K3	Accelerate/stop and accelerate/go distances.
CA.IX.F.K4	How to identify, verify, feather, and secure an inoperative engine (see ***CA.IX.A.K3***).
CA.IX.F.K5	Importance of drag reduction, to include propeller feathering, gear and flap retraction, the manufacturer's recommended control input and its relation to zero sideslip (see ***CA.X.A.K4***).
CA.IX.F.K6	Simulated propeller feathering and the evaluator's zero-thrust procedures and responsibilities.
Risk Management	The applicant demonstrates the ability to identify, assess and mitigate risks, encompassing:
CA.IX.F.R1	Failure to plan for engine failure after liftoff.
CA.IX.F.R2	Collision hazards, to include aircraft, terrain, obstacles, and wires.
CA.IX.F.R3	Improper airplane configuration.
CA.IX.F.R4	Low altitude maneuvering including, stall, spin, or CFIT.
CA.IX.F.R5	Distractions, loss of situational awareness, or improper task management.

Skills	The applicant demonstrates the ability to:
CA.IX.F.S1	Promptly recognize an engine failure, maintain control, and utilize appropriate emergency procedures.
CA.IX.F.S2	Establish V_{YSE}; if obstructions are present, establish V_{XSE} or V_{MC} +5 knots, whichever is greater, until obstructions are cleared. Then transition to V_{YSE}.
CA.IX.F.S3	Reduce drag by retracting landing gear and flaps in accordance with the manufacturer's guidance.
CA.IX.F.S4	Simulate feathering the propeller on the inoperative engine (evaluator should then establish zero thrust on the inoperative engine).
CA.IX.F.S5	Use flight controls in the proper combination as recommended by the manufacturer, or as required to maintain best performance, and trim as required.
CA.IX.F.S6	Monitor the operating engine and make adjustments as necessary.
CA.IX.F.S7	Recognize the airplane's performance capabilities. If a climb is not possible at V_{YSE}, maintain V_{YSE} and return to the departure airport for landing, or initiate an approach to the most suitable landing area available.
CA.IX.F.S8	Simulate securing the inoperative engine.
CA.IX.F.S9	Maintain heading ±10° and airspeed ±5 knots.
CA.IX.F.S10	Complete the appropriate checklist.

This task consists of the examiner simulating a failure of one of the engines shortly after takeoff. This is normally accomplished while in the traffic pattern performing stop and go takeoffs and landings.

F. ENGINE FAILURE AFTER LIFTOFF (SIMULATED)
ACCELERATE/STOP AND ACCELERATE/GO DISTANCES

Knowledge	The applicant demonstrates understanding of:
CA.IX.F.K3	Accelerate/stop and accelerate/go distances.

Examiner: *"Discuss accelerate/stop and accelerate/go distances."*

You: *"Accelerate/stop distance is the runway length required to accelerate to rotation speed, experience an engine failure, and bring the airplane to a complete stop. Accelerate/go distance is the horizontal distance required to continue the takeoff and climb to 50 feet, assuming an engine failure at V_R or V_{LOF}. Only accelerate/stop performance data is provided for my airplane."*

-PA-44-180 Seminole

Accelerate/Stop Distance

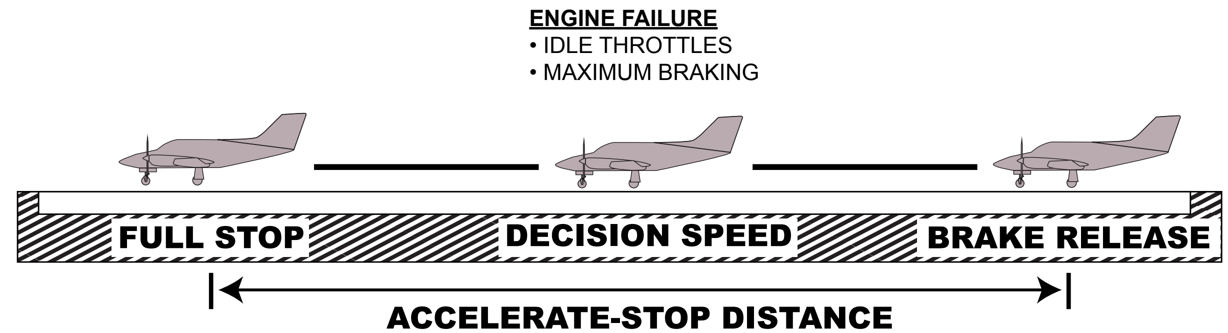
Accelerate/Go Distance

F. ENGINE FAILURE AFTER LIFTOFF (SIMULATED)
ACCELERATE/STOP AND ACCELERATE/GO DISTANCES

K

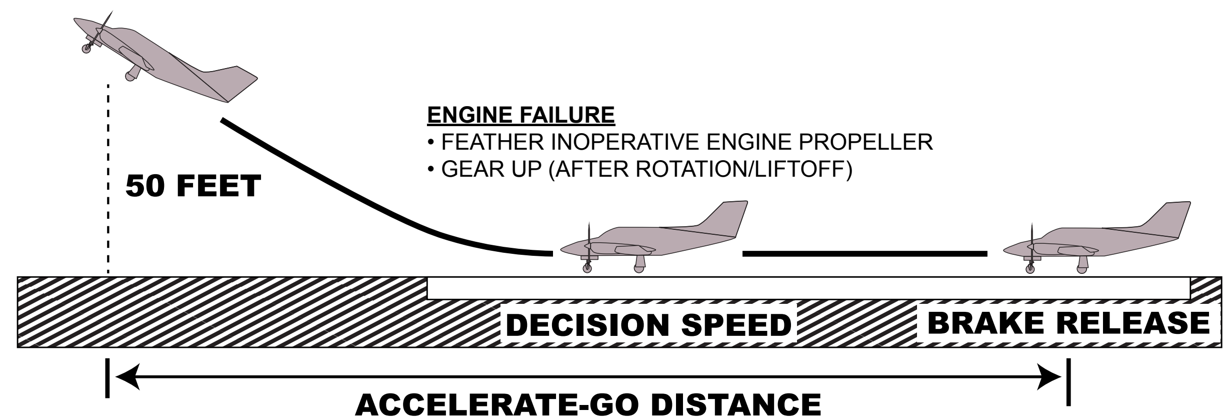
Accelerate/Stop Distance

Accelerate-stop distance is the runway length required to accelerate to a specified speed (either V_R or V_{LOF}, as specified by the manufacturer), experience an engine failure, and bring the airplane to a complete stop.[1] This can be determined by a dedicated performance graph or table as discussed in CA.I.F.K1 in Volume I.



Accelerate/Go Distance

Accelerate-go distance is the horizontal distance required to continue the takeoff and climb to 50 feet, assuming an engine failure at V_R or V_{LOF}, as specified by the manufacturer.[2] Note that although practically all multiengine airplanes will be provided accelerate/stop performance data, not all multiengine airplanes will be provided accelerate/go performance data. This is also discussed in CA.I.F.K1 in Volume I.



F. ENGINE FAILURE AFTER LIFTOFF (SIMULATED)

SIMULATED PROPELLER FEATHERING PROCEDURES

Knowledge	The applicant demonstrates understanding of:
CA.IX.F.K6	Simulated propeller feathering and the evaluator's zero-thrust procedures and responsibilities.

Examiner: *"Discuss simulated propeller feathering in your airplane and my zero-thrust procedures and responsibilities."*

You: *"To simulate feathering I will touch the appropriate propeller control without moving it and announce 'feather.' You will then set the appropriate throttle for zero-thrust which is 2180 RPM at V_{YSE}."*

-PA-44-180 Seminole

During multiengine training, simulated propeller feathering is used in lieu of actual feathering for certain maneuvers due to increased risk in case the second engine is needed. These are typically low-altitude maneuvers such as engine failure after liftoff and approach and landing with one engine inoperative.

Simulated feathering is accomplished by first placing the propeller control for the simulated inoperative engine to the full/max RPM position, which is done as part of engine failure immediate action items. The throttle for the simulated inoperative engine is then advanced from idle to a setting determined by the manufacturer, either in RPM or manifold pressure. The ensuing thrust produced by the propeller serves to cancel out its drag.

During training and evaluation, both the applicant and evaluator or instructor have responsibilities concerning simulated feathering. The following are common practices:

- **Applicant:** Touch the appropriate propeller control (normally with the index finger) so that the evaluator/instructor can verify that the applicant intended to feather the correct engine. The applicant should then state "feather" or similar announcing their intent to feather that engine.
- **Evaluator/Instructor:** The evaluator/instructor should then advance the throttle of the simulated inoperative engine from idle to the zero-thrust setting recommended by the manufacturer and state "zero thrust is set" or similar.

Risk Management	The applicant demonstrates the ability to identify, assess and mitigate risks, encompassing:
CA.IX.F.R1	Failure to plan for engine failure after liftoff.
CA.IX.F.R2	Collision hazards, to include aircraft, terrain, obstacles, and wires.
CA.IX.F.R3	Improper airplane configuration.
CA.IX.F.R4	Low altitude maneuvering including, stall, spin, or CFIT.
CA.IX.F.R5	Distractions, loss of situational awareness, or improper task management.

Identifying Risks

In April of 2020, the pilot of a Cessna 402 experienced a substantial loss of engine power after gear retraction during takeoff.[3] The pilot then retarded the throttles to idle and landed the airplane on the remaining runway without lowering the landing gear, resulting in substantial damage. Fortunately, the pilot was not injured.

In June of 2020, the pilot and two passengers of a Piper PA-23 experienced an engine failure during the takeoff roll.[4] The airplane yawed abruptly to the left due to the left engine not producing full power. The pilot elected to continue the takeoff and applied right rudder, right aileron and back pressure, similar to a crosswind soft field takeoff. The airplane climbed about 100 feet-per-minute at a slow airspeed. When the pilot reached to retract the hydraulically controlled landing gear, it failed to retract. The airplane eventually rolled left and impacted the water adjacent to the airport in an inverted nose-low attitude. The pilot and one of the passengers were fatally injured.

Assessing Risks

- **Severity (Catastrophic):** Accidents due to an engine failure in multiengine airplanes have the potential to be catastrophic.
- **Likelihood:** Likelihood of an accident due to an engine failure is largely dependent on pilot proficiency in engine failure procedures as well as familiarity with engine failure procedures during takeoff.
- **Example:** For the proposed flight, the likelihood of an accident due to an engine failure is **improbable** since the pilot has just completed multiengine training and is well-versed in engine failure procedures during takeoff. Using the ***Risk Assessment Matrix***, this makes an accident due to an engine failure in flight a **low**-risk item.

Mitigating Risks

The following are risk mitigation measures for engine failures during takeoff:

- Be thoroughly familiar with engine failure procedures during takeoff to include aborting the takeoff if an engine failure is experienced prior to liftoff, landing on the available runway if an engine failure is experienced after liftoff but prior to gear retraction, and continuing with engine failure procedures if an engine failure is experienced after gear retraction.
- Ensure proficiency in engine failure procedures prior to flying multiengine airplanes. This should include a review of memory items and procedures at a minimum, and if necessary, training with a multiengine instructor.

F. ENGINE FAILURE AFTER LIFTOFF (SIMULATED)

IN-FLIGHT TASK

S

Skills	The applicant demonstrates the ability to:
CA.IX.F.S1	Promptly recognize an engine failure, maintain control, and utilize appropriate emergency procedures.
CA.IX.F.S2	Establish V_{YSE}; if obstructions are present, establish V_{XSE} or V_{MC} +5 knots, whichever is greater, until obstructions are cleared. Then transition to V_{YSE}.
CA.IX.F.S3	Reduce drag by retracting landing gear and flaps in accordance with the manufacturer's guidance.
CA.IX.F.S4	Simulate feathering the propeller on the inoperative engine (evaluator should then establish zero thrust on the inoperative engine).
CA.IX.F.S5	Use flight controls in the proper combination as recommended by the manufacturer, or as required to maintain best performance, and trim as required.
CA.IX.F.S6	Monitor the operating engine and make adjustments as necessary.
CA.IX.F.S7	Recognize the airplane's performance capabilities. If a climb is not possible at V_{YSE}, maintain V_{YSE} and return to the departure airport for landing, or initiate an approach to the most suitable landing area available.
CA.IX.F.S8	Simulate securing the inoperative engine.
CA.IX.F.S9	Maintain heading ±10° and airspeed ±5 knots.
CA.IX.F.S10	Complete the appropriate checklist.

The following are expanded procedures for how to perform an engine failure after liftoff compliant with the ACS. Refer to ***Profile IX-F-1*** for a graphical depiction:

Note

As referenced in the task's objective, an important note for the examiner is discussed in Appendix 6 of the ACS:

> ***Appendix 6: Safety of Flight***
>
> ***Multiengine Considerations***
>
> *On multiengine practical tests, where the failure of the most critical engine after liftoff is required, the evaluator must consider local atmospheric conditions, terrain, and type of aircraft used. The evaluator must not simulate failure of an engine until attaining at least V_{SSE}/V_{XSE}/V_{YSE} and an altitude not lower than 400 feet AGL.*

1. **Perform Takeoff:** The task will begin by performing a normal or short-field takeoff.
2. **Simulate Engine Failure:** Failure of one of the engines is normally simulated by reducing one of the throttles to idle. The examiner will do this unexpectedly and announce that a simulated engine failure has occurred.

F. ENGINE FAILURE AFTER LIFTOFF (SIMULATED)

IN-FLIGHT TASK

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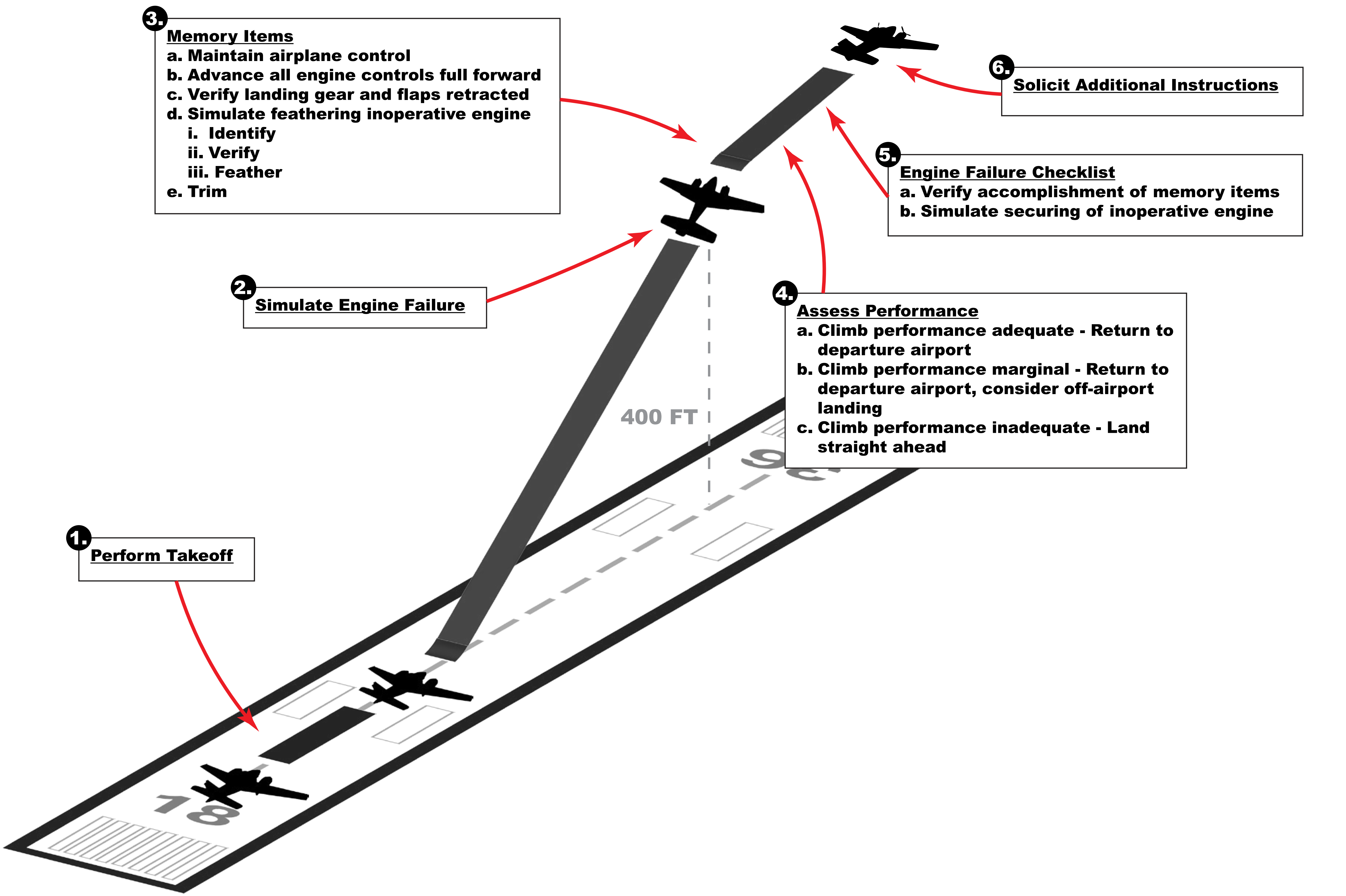

Profile IX-F-1: Engine Failure After Liftoff (Simulated)

3. **Memory Items (*CA.IX.F.S1*):** Perform the appropriate immediate action/memory items as follows:

   a. **Maintain Airplane Control (*CA.IX.F.S2*):** Apply rudder pressure to oppose the asymmetric thrust and center the inclinometer or nearly so, bank 2 to 5 degrees in the same direction as the rudder, and pitch to maintain V_{YSE}. If obstructions are present, establish V_{XSE} or V_{MC} +5 knots, whichever is greater, until obstructions are cleared. Then transition to V_{YSE}.

   b. **Advance All Engine Controls Full Forward**

   c. **Verify Landing Gear and Flaps Retracted (*CA.IX.F.S3*):** Retract or verify that the landing gear and flaps are retracted. The landing gear should already be retracted, but flaps may be partially extended if used for takeoff. Touch the landing gear and flap handles to indicate verification that they are retracted.

   d. **Simulate Feathering of the Inoperative Engine(*CA.IX.F.S4*):** Simulate a feathering of the inoperative engine as follows:

      i. **Identify:** Identify the inoperative engine by observing which foot is not applying rudder pressure ("dead foot, dead engine").

      ii. **Verify:** Verify the inoperative engine by retarding the appropriate throttle and verifying no change in power on the operating engine. Note that if the examiner simulated the engine failure by retarding the throttle, it will already be at idle. If this is the case, touch the appropriate throttle and state "verify."

      iii. **Feather:** Simulate feathering of the inoperative engine by touching the appropriate propeller control and stating "feather." The examiner will then set zero thrust on the inoperative engine and state something to that effect as discussed in ***Knowledge Element 6***.

   e. **Trim (*CA.IX.F.S5*):** Trim the elevator/stabilator to maintain V_{YSE}, trim the rudder for zero sideslip (½ ball towards the operating engine), and trim the aileron for 2 to 5 degrees of bank towards the operating engine.

4. **Assess Performance (*CA.IX.F.S7*):** Assess the airplane's single engine climb performance as follows:

   a. **Climb Performance Adequate:** If maintaining V_{YSE} results in a climb, climb to a safe altitude (at least traffic pattern altitude) and complete the appropriate Engine Failure Checklist to include securing the inoperative engine, and then return to the departure airport for landing.

b. Climb Performance Marginal: If maintaining V_{YSE} results in straight-and-level flight or barely so, maintain V_{YSE} and immediately return to the departure airport. Depending on a number of factors to include the current altitude, obstacles, distance from the airport, and wind, this may involve a landing on the departure runway in the correct direction, opposite direction, or landing off-airport. Inform the examiner of your intentions with consideration of these factors if this is the case.

c. Climb Performance Inadequate: If maintaining V_{YSE} results in a descent, perform a controlled descent maintaining V_{YSE} and land straight ahead or nearly so. Inform the examiner of the selected landing area and your intentions if this is the case.

5. Engine Failure Checklist (*CA.IX.F.S10*): If climb performance was deemed adequate, once the memory items are complete, reference the appropriate Engine Failure Checklist. This may be accomplished in the traffic pattern or just outside of it at the discretion of the examiner and applicant as well as considering external factors (i.e. amount of traffic, controlled versus uncontrolled airport):

a. Verify Accomplishment of Memory Items: First verify that all memory items have been accomplished per the checklist.

b. Simulate Securing the Inoperative Engine (*CA.IX.F.S8*): Simulate securing the inoperative engine by verbally stating how you would accomplish the various checklist items. Note that this may be located on a separate Engine Securing Checklist.

> ***Example***
>
> ***You:*** *"I would secure the engine by bringing the mixture to idle cutoff, turning the fuel selector off, fuel pump off, magnetos off, alternator off, closing the cowl flaps, and then reducing the electrical load."*
>
> ***PA-44-180 Seminole***

6. Solicit Additional Instructions: If climb performance was deemed adequate, and once the Engine Failure Checklist is complete and the engine secured, solicit additional instructions from the examiner. This may include a single engine landing per ***Task G, Approach and Landing with an Inoperative Engine (Simulated)***, or the inoperative engine may be restored to perform some other task.

F. ENGINE FAILURE AFTER LIFTOFF (SIMULATED)

REFERENCES

1 FAA. *Airplane Flying Handbook*. FAA-H-8083-3C. (Oklahoma City, OK: FAA Airman Testing Standards Branch, 2021), 13-10.
2 FAA. *Airplane Flying Handbook*. FAA-H-8083-3C. 13-10.
3 NTSB. "Aviation Investigation Final Report." Accident No. CEN20LA149. 5 May 2021.
4 NTSB. "Aviation Investigation Final Report." Accident No. ERA20LA202. 28 June 2022.

APPENDICES AND ADDENDA

APPENDICES AND ADDENDA

Appendices expand on pertinent information referenced throughout this book. Addenda contain information that has recently changed, which permits for rapid deployment of revisions. Over time addenda will be integrated back into the main body of the book in the appropriate location.

APPENDIX 1

RISK ASSESSMENT MATRIX

1. RISK ASSESSMENT MATRIX

The following risk assessment matrix is referenced in all risk elements throughout this book:

Likelihood	Severity			
	Catastrophic	Critical	Marginal	Negligible
Probable	High	High	Serious	Medium
Likely	High	Serious	Medium	Low
Remote	Serious	Medium	Low	Low
Improbable	Low	Low	Low	Low