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EGH AVIATION

CFI Airplane — ACS-25 Lesson Plan Binder

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LESSON I–A

HUMAN BEHAVIOR & COMMUNICATION

Effects on the Learning Process

Duration: 60–90 min	**References:** FAA-H-8083-9B Ch. 2 & 4 | FAA-H-8083-25C Ch. 2 | FAA-S-ACS-25 Area I	**Audience:** CFI Applicant

ACS Reference: Area of Operation I (Fundamentals of Instructing), Task A — Effects of Human Behavior and Communication on the Learning Process — FAA-S-ACS-25 pp. 2–3

LESSON OBJECTIVES

By the end of this lesson the applicant will be able to:

- Define human behavior and describe the instructor–learner relationship and its effect on motivation.
- Explain Maslow's hierarchy of human needs and connect each level to the flight training environment.
- Identify and describe the defense mechanisms students use and explain how an instructor should respond to each.
- Recognize the five emotional reactions (anxiety, impatience, worry, physical discomfort, apathy) and select appropriate instructor interventions.
- Apply andragogy principles to adapt instruction for the adult learner.
- Identify the three basic elements of communication and describe how each affects the transfer of knowledge.
- Describe the four barriers to effective communication and demonstrate strategies to overcome them in ground and flight instruction.

MOTIVATION

Every flight lesson is, at its core, an exercise in human interaction. An instructor who understands *why* a student behaves the way they do — and who can communicate that understanding clearly and effectively — will consistently produce safer, more capable pilots. NTSB accident data repeatedly identifies breakdowns in the instructor–student relationship, unaddressed student anxiety, and poor communication as contributing factors in training accidents. This lesson provides the behavioral and communicative foundation upon which all subsequent CFI instruction is built.

KEY CONCEPTS

1. Elements of Human Behavior

Human behavior is the product of innate human nature and individual experience. For flight instructors, understanding *why* students act the way they do is foundational to creating an effective learning environment. *(FAA-H-8083-9B, Ch. 2)*

Element	Definition	Instructor Application
Definition of human behavior	Actions and reactions shaped by biological, psychological, and social factors	Recognize that student behavior is predictable and manageable, not random
Instructor–Learner Relationship	A professional bond built on trust, empathy, and consistent feedback	Establish rapport early; negative instructor habits (sarcasm, impatience) directly suppress motivation
Motivation	Positive (achievement), Negative (fear), Tangible (certificate), Intangible (adventure)	Link each lesson to the student's personal reasons for learning to fly
Human Needs — Maslow's Hierarchy	Physiological → Safety → Social → Esteem → Self-Actualization	A student who is fatigued, fearful, or hungry cannot learn at higher levels; address lower needs first
Defense Mechanisms	Rationalization, flight/withdrawal, aggression, resignation, fantasy	Recognize each; redirect rather than confront; avoid actions that reinforce the mechanism

Maslow's Hierarchy of Needs — Applied to Flight Training

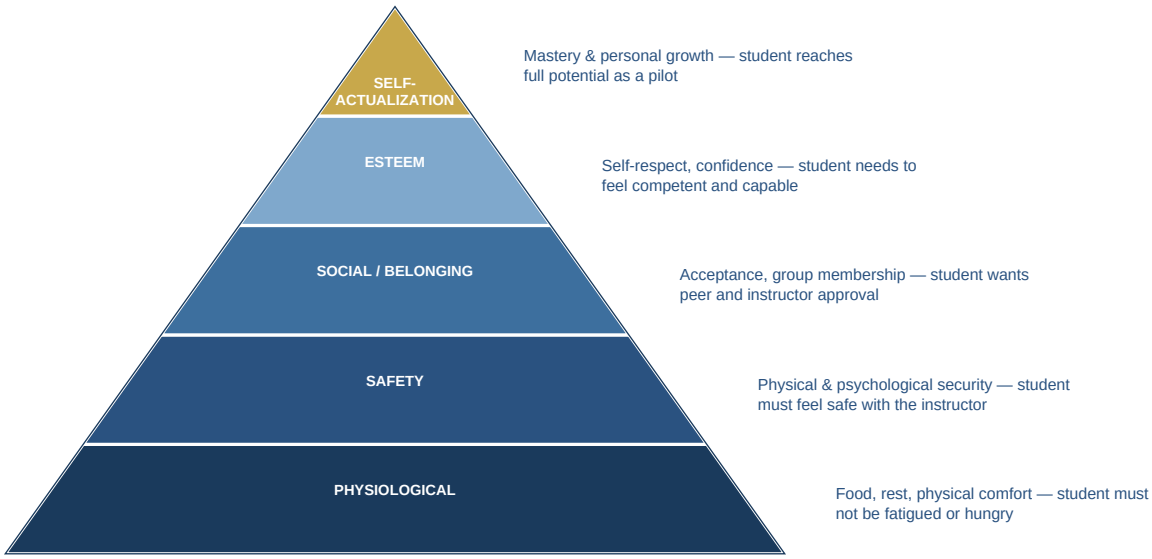


Figure: Maslow's Hierarchy of Needs — Aviation Instructor's Handbook, Ch. 2

Instructor Note: Before beginning any lesson, assess which level of the hierarchy your student is currently operating at. A student distracted by personal stress (Safety level) or fatigued (Physiological) cannot engage at the Esteem or Self-Actualization levels where meaningful skill acquisition occurs. Address the lower need first — even if that means shortening or rescheduling the lesson.

2. Learner Emotional Reactions

A student's emotional state directly determines their readiness to absorb instruction. The following five reactions are the most common encountered in aviation training. *(FAA-H-8083-9B, Ch. 2)*

Reaction	How It Presents	Instructor Response
Anxiety and Stress	Elevated heart rate, muscular tension, distraction, or abnormal laughter/paralysis in extreme cases	Reinforce enjoyment; use graduated exposure; explain clearly before each new task; never ridicule errors
Impatience	Student rushes through tasks; focuses only on solo or checkride; dismisses foundational skills	Put each task in context of the full training program; adjust pacing; celebrate incremental progress
Worry or Lack of Interest	Student appears preoccupied, disengaged, or provides monosyllabic responses	Acknowledge concerns openly; re-establish relevance; defer high-cognition tasks if needed
Physical Discomfort, Illness, Fatigue, Dehydration	Degraded attention span, coordination errors, slow decision-making	Include self-assessment in preflight brief; do not hesitate to postpone lessons
Apathy Due to Inadequate Instruction	Student appears unmotivated, detached, stops asking questions	First examine instruction quality — repetitive lessons, unclear standards, or no positive reinforcement all produce apparent apathy

3. Teaching the Adult Learner (Andragogy)

Aviation students are almost exclusively adults. Adult learning (andragogy) differs fundamentally from childhood pedagogy. Knowles' model provides five guiding principles every CFI applicant must be able to articulate and apply. *(FAA-H-8083-9B, Ch. 2)*

Self-Concept	Adults are self-directed. Involve students in planning and evaluating their own progress; avoid lecturing at them.
Experience	Adults bring a reservoir of prior knowledge. Build on it through analogy and comparison rather than ignoring it.
Readiness to Learn	Adults learn best when content is immediately applicable. Link every lesson to near-term, real-world flying situations.
Orientation	Adults are problem-centered, not subject-centered. Frame lessons around scenarios and decisions, not abstract theory alone.
Motivation	Internal motivation (pride, safety, personal achievement) is more powerful and lasting than external pressure in adult learners.

4. Effective Communication

An instructor with expert technical knowledge but poor communication skills cannot effectively transfer that knowledge. Communication is a dynamic, two-way process — its effectiveness is measured by the similarity between the idea transmitted and the idea received. *(FAA-H-8083-9B, Ch. 4)*

Basic Elements of Communication

Element	Description	Key Instructor Action

Source (Instructor)	Selects language, reveals credibility and confidence, uses accurate and current material	Speak from up-to-date knowledge; project confidence; make the message feel relevant
Symbols (Message)	Words, gestures, diagrams, models. Perceived through visual, auditory, and kinesthetic channels	Use all three channels — draw it, say it, and have the student do it
Receiver (Student)	Interprets based on prior experience, attitude, and ability. Communication succeeds only when the receiver understands	Tailor language to the student's background; check for understanding constantly with open-ended questions

Four Barriers to Effective Communication

Barrier	What It Looks Like	How to Overcome It
Lack of Common Experience	Student cannot relate to a term or concept because they have no experiential reference for it	Use concrete examples from the student's own life; never assume shared background
Confusion Between Symbol and Symbolized Object	Student interprets 'stall' as engine-related; 'tractor propeller' as farm equipment	Define every critical term explicitly before using it; draw the concept if needed
Overuse of Abstractions	'Fly a stable approach' produces a different mental image for every student	Replace abstract language with specific, action-oriented instructions: 'Maintain 75 knots to the 1,000-ft markers'
External Factors	Noise, cockpit distractions, fatigue, student anxiety, or hearing impairment	Mitigate environmental factors; acknowledge physiological/psychological factors; adapt the lesson plan accordingly

Developing Communication Skills

- **Listen actively** — monitor student feedback continuously; a nod is not confirmation of understanding.
- **Check for understanding** — use open-ended questions: 'Walk me through what you'd do if…'
- **Use analogies** — bridge the known and unknown. Trim as a 'hands-free' throttle analogy is more intuitive than a technical description.
- **Adjust vocabulary** — reduce jargon with new students; increase precision as proficiency develops.
- **Demonstrate confidence and enthusiasm** — both are contagious and significantly affect student engagement.
- **Use all sensory channels** — visual learners benefit from diagrams; kinesthetic learners need hands-on manipulation before concepts solidify.

COMMON ERRORS

Common Error	Recognition	Correction
Shallow defense mechanism descriptions	Applicant can name mechanisms but cannot describe how to respond as an instructor	Role-play each mechanism; instructor models a calm, non-confrontational response

Oversimplifying adult learning	Applicant states 'adults learn differently' without articulating the five andragogy principles	Require a specific principle + aviation example for each; re-read AIH Ch. 2
Confusing normal vs. abnormal stress reactions	Applicant cannot identify when to continue vs. when to terminate the lesson	Discuss threshold indicators; review AIH section on actions with seriously abnormal learners
Reciting barriers without application	Applicant memorizes four barriers but cannot apply them to a flight instruction scenario	Use the communication exercise: deliver a jargon-filled explanation, then rebuild it with concrete language
Weak communication demonstration (S3)	Applicant uses excessive abstraction or jargon when demonstrating instruction	Record a 2-minute demonstration; play back and identify specific barriers; repeat with corrections
Conflating motivation types	Applicant cannot give aviation-specific examples that distinguish intrinsic from extrinsic motivation	Ask applicant to describe a real or imagined student and identify the dominant motivation type at work

COMPLETION STANDARDS

COMPLETION STANDARDS (from FAA-S-ACS-25)
✓ Applicant accurately explains all knowledge elements (FI.I.A.K1–K4) using correct terminology and aviation-relevant examples without significant prompting.
✓ Applicant identifies and describes at least one risk mitigation strategy for each risk management element (FI.I.A.R1 and R2) in the context of flight instruction.
✓ Applicant demonstrates FI.I.A.S1 by giving specific, concrete examples of how human behavior affects student motivation and learning.
✓ Applicant describes appropriate instructor actions for abnormal emotional behavior (S2a) and specific defense mechanisms (S2b) without prompting.
✓ Applicant delivers a brief instructional explanation (S3) that is free of significant communication barriers — appropriate vocabulary, concrete language, and active feedback-checking throughout.

REVIEW QUESTIONS

REVIEW QUESTIONS & ANSWERS

Q1. Name and define the five defense mechanisms. For each one, describe what it looks like in a student pilot and what you, as the instructor, should do in response.

■ *Rationalization — student makes excuses for poor performance ('the turbulence threw me off'); redirect by acknowledging the factor then focusing on what the student can control. Flight/Withdrawal — student mentally or physically checks out; re-engage with a simpler task and positive reinforcement. Aggression — student becomes hostile after critique; remain calm, lower your voice, and give the student time to self-regulate before continuing. Resignation — student stops trying ('I'll never get this'); break the task into smaller, achievable steps to rebuild confidence. Fantasy — student daydreams or seems elsewhere; use a direct question to re-focus attention.*

Q2. A student arrives to the lesson visibly distracted, mentions a difficult week at work, and is sluggish on the controls. Which emotional reaction(s) might be at play, and how do you handle the lesson?

■ *Worry/lack of interest and physical fatigue/stress are both likely present. The student is operating below the Safety level on Maslow's hierarchy. Options: (1) conduct a purely ground-based review lesson rather than flight — remove the physiological/safety risk; (2) shorten the flight lesson to a single, familiar maneuver to rebuild confidence; (3) reschedule entirely if the student is clearly unfit to fly. Never introduce new material when a student is significantly stressed.*

Q3. Explain Maslow's hierarchy. At which level is a student operating when they are overly anxious about an upcoming solo? What can you do to move them up the hierarchy?

■ *Maslow's hierarchy (bottom to top): Physiological → Safety → Social/Belonging → Esteem → Self-Actualization. A student anxious about solo is stuck at the Safety level — they do not feel psychologically secure. To move them up: address the anxiety directly (explain what to expect, discuss go-around procedures); conduct additional dual circuits until the student verbalises readiness; use positive reinforcement to build esteem. Do not push a student to solo until they have demonstrated both technical competency and emotional readiness.*

Q4. You are briefing a new student on the traffic pattern. They nod along but cannot repeat back the key points. Which communication barrier is most likely at work, and how do you correct it?

■ *Lack of common experience — the student has no experiential frame of reference for 'downwind,' 'base leg,' or 'VASI.' Their nods reflect social compliance, not comprehension. Correction: draw a top-down diagram of the pattern with landmarks; use concrete, visual language ('turn left when the runway is off your left shoulder at 45 degrees'); ask the student to narrate each leg back to you using the diagram rather than just nodding.*

Q5. List the three basic elements of communication. Give a specific flight instruction example where a breakdown in the *receiver* element caused a misunderstanding.

■ *Source (instructor), Symbols (message/words/gestures), Receiver (student). Example: An instructor says 'reduce power and fly a stabilised approach.' The student, with a background in motorboating, reduces power to idle and holds altitude — 'stabilised' to them means level. The receiver interpreted the symbol differently than the source intended because their experience base differs. Fix: use specific, unambiguous language — '15 inches manifold pressure, 80 knots, 500 fpm descent.'*

Q6. What are the five core principles of andragogy? How does each require you to teach a 45-year-old career-changer differently?

■ *Self-Concept: involve them in setting lesson goals — don't dictate a schedule without input. Experience: they have decades of transferable skills (e.g., vehicle operation, spatial reasoning from another field) — reference these explicitly. Readiness: link every lesson to an immediate real-world need ('this cross-wind technique is what you'll use your first solo'). Orientation: use scenario-based problems ('you're on final and the winds shift — what do you do?') rather than abstract drills. Motivation: tap internal drivers (self-sufficiency, lifelong goal) rather than external pressure; they are not learning to please a parent or pass a class.*

Instructor: _____ Date: _____ Applicant: _____

LESSON I–B

THE LEARNING PROCESS

Theories, Domains, Memory, Transfer, Perception & Critique

Duration: 90–120 min	**References:** FAA-H-8083-9B Ch. 3 | FAA-H-8083-25C Ch. 2 | FAA-S-ACS-25 Area I	**Audience:** CFI Applicant

ACS Reference: Area of Operation I (Fundamentals of Instructing), Task B — Learning Process — FAA-S-ACS-25 p. 3 | Knowledge: FI.I.B.K1–K16 | Risk: FI.I.B.R1–R3 | Skills: FI.I.B.S1–S3

LESSON OBJECTIVES

By the end of this lesson the applicant will be able to:

- Define learning and distinguish it from mere exposure or rote memorization.
- Compare behaviorism and cognitive theory and explain how each applies to flight instruction.
- Explain how perception works and identify the five factors that shape what a student perceives.
- Describe the nature of insight, how it differs from rote knowledge, and how an instructor facilitates it.
- Identify the three domains of learning (cognitive, affective, psychomotor) and Bloom's six cognitive levels.
- State and apply the laws of learning to the design and delivery of a ground or flight lesson.
- Describe the stages of skill acquisition and the role of learning plateaus.
- Distinguish deliberate, blocked, and random practice and explain which produces the best long-term retention.
- Distinguish evaluation from critique, and describe the seven characteristics of an effective critique.
- Define scenario-based training (SBT) and describe how it develops higher-order thinking skills (HOTS).
- Identify and manage the effects of distractions, interruptions, fixation, and inattention in training.
- Explain the three-component memory model (sensory, STM, LTM) and strategies to move information to LTM.
- Describe the factors that affect retention and forgetting, and design instruction to maximize long-term recall.
- Explain positive and negative transfer of learning and how lesson sequencing exploits positive transfer.

MOTIVATION

A flight instructor who does not understand how people learn will inevitably repeat the same lesson in the same way, wondering why the student is not improving. Every instructional decision — how to sequence a maneuver, when to introduce distractions, why a student has plateaued, how to structure a debrief — is rooted in learning theory. This lesson gives the CFI applicant the scientific and pedagogical foundation to make those decisions deliberately rather than by intuition alone. Research cited in the AIH consistently shows that instructors who understand learning theory produce students who retain knowledge longer, transfer skills more effectively, and develop safer aeronautical decision-making.

KEY CONCEPTS

1. Definitions of Learning and Learning Theory

Learning is defined as a change in behavior as a result of experience — not simply exposure to information. The AIH distinguishes three levels of learning outcome: rote (repetition without understanding), understanding (grasping meaning), application (using knowledge in new situations), and correlation (relating to other knowledge). *(FAA-H-8083-9B, Ch. 3)*

Theory	Core Premise	Aviation Application
Behaviorism	Behavior is shaped by rewards and punishments (stimulus–response). Passive learner.	Useful for reinforcing correct procedures. Limited — does not explain complex ADM. Positive reinforcement (praise for correct rudder use) is behaviorist in origin.
Cognitive Theory	Learning is an internal mental process: thinking, perceiving, problem-solving. Active learner.	Underlies scenario-based training, Bloom's Taxonomy, and HOTS instruction. The dominant framework in modern aviation education.
Constructivism	Learners actively build knowledge by connecting new information to existing schemas.	Explains why building on a student's prior experience (car driving, sailing) accelerates aviation learning. Instructor acts as guide, not lecturer.
Social Learning (Bandura)	Learning through observation, imitation, and modeling in four stages: Attention, Retention, Reproduction, Motivation.	Students model instructor behavior unconsciously. Instructor professionalism and airmanship are teaching tools in themselves.

2. Laws of Learning

Thorndike's original laws — Readiness, Exercise, and Effect — were later expanded to include Primacy, Recency, Intensity, and Freedom. Every flight lesson implicitly operates under all seven laws simultaneously. *(FAA-H-8083-9B, Ch. 3)*

Readiness	Learning occurs best when the student is mentally and physically prepared. A fatigued or anxious student is not ready. Establish readiness before beginning.
Exercise	Skills and knowledge improve with practice and weaken with disuse. Recency and frequency both matter. Regular practice prevents skill decay.
Effect	Positive experiences strengthen learning; negative experiences inhibit it. Constructive critique builds; humiliation destroys. Always end on a success.
Primacy	What is learned first is learned most strongly and is hardest to unlearn. Teach correct technique from the very first lesson — bad habits are hard to break.
Recency	The most recent experience is remembered best. End every lesson with a clear summary of the key points; leave the student with the correct mental image.

Intensity	Vivid, dramatic, or memorable instruction is retained longer. Scenario-based training, actual emergencies (simulated), and real ATC experience all exploit the law of intensity.
Freedom	Students learn best when free from excessive pressure, threat, or punishment. An environment of psychological safety maximizes learning.

3. Perceptions and Insights

All learning begins with perception. Understanding how students perceive and process experience—and how insights emerge from that process—is fundamental to designing instruction that produces genuine understanding rather than surface-level recall. *(FAA-H-8083-9B, Ch. 3)*

Perception

Perception is the process by which a person gives meaning to sensory input. Students do not passively receive information—they actively construct meaning based on what they already know, what they believe, and the emotional context of the learning situation. The same demonstration can be perceived completely differently by two students.

Physical Organism	Sensory capability limits perception. A student with color deficiency may not perceive colored chart symbology the same way. An anxious student under high stress literally perceives less—attention narrows. Instructors must check for and accommodate sensory limitations.
Time and Opportunity	Perception requires time. A student overwhelmed with information on the first dual lesson perceives almost none of it with depth. Sequence instruction so each concept has adequate dwell time before the next is introduced. Never rush through material to cover the syllabus.
Self-Concept	A student who believes 'I'm not good at math' will perceive weight-and-balance problems as threats, triggering defensive reactions that impair perception and encoding. Positive self-concept is a prerequisite for open, receptive learning.
Goals and Values	Perception is selective. Students filter incoming information through what they believe is important. A student who does not yet value crosswind technique will not perceive the instructor's crosswind correction as significant. Make the relevance explicit before presenting the information.
Element of Threat	When a student perceives a physical or psychological threat, perception narrows dramatically (the 'threat tunnel'). Criticism perceived as personal attack, fear of failure, or an instructor who takes the controls aggressively can all activate this response. The learning environment must feel safe for full-bandwidth perception to occur.

Insight

Insight is the sudden, integrative understanding of how previously learned elements relate to each other—the 'aha moment.' It is qualitatively different from rote knowledge: it cannot be forced by repetition alone and cannot be taken away once genuinely achieved. Insight appears suddenly, usually after a period of incubation, and produces durable learning.

- **Insight is built on a foundation of component knowledge.** A student cannot have an insight about crosswind correction until they understand wind, lift, and aircraft axes separately. Ensure component knowledge is solid before expecting synthesis.

• **Insight is inhibited by excessive pressure and anxiety.** The insight mechanism requires a degree of mental relaxation. Instructors who relentlessly drill without allowing reflection and consolidation time suppress the conditions necessary for insight to occur.

• **Insight produces generalization.** Once a student truly understands why a soft-field takeoff technique works, they can extrapolate it to a grass strip they have never seen. Generalizations from insight are the building blocks of aeronautical decision-making.

• **Facilitate insight through questions, not lectures.** Socratic questioning — 'What do you think happened there?' — activates the student's own synthesizing process. Telling a student the answer prevents the insight from occurring.

Instructor Note: The goal of every debrief is to engineer insight, not just deliver corrections. A student who understands why the nose pitched at the wrong moment has achieved something permanent. A student who was told 'push forward' has only received a command. Design your debrief questions to guide the student to the explanation themselves—this is the difference between a lesson and a correction.

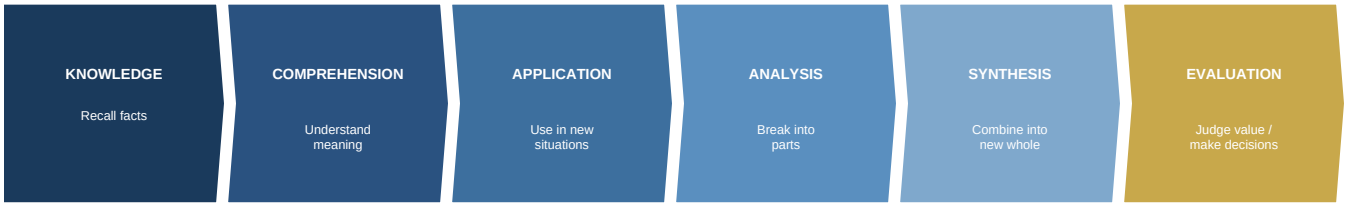
4. Domains of Learning

Bloom identified three domains of learning. Effective flight instruction addresses all three in every lesson — knowledge alone is insufficient. *(FAA-H-8083-9B, Ch. 3)*

Domain	Definition	Aviation Examples	Instructor Role
Cognitive (Thinking)	Intellectual skills from recall of facts through evaluation and judgment	Weather theory, regulations, systems knowledge, ADM, risk assessment	Teach from lowest level (recall) upward toward evaluation (HOTS). Do not stop at rote — require application and correlation.
Affective (Feeling)	Attitudes, values, emotions, and motivation toward the subject	Safety mindset, willingness to go-around, respect for regulations, situational awareness as a value, not just a skill	Model the attitudes you want to develop. Recognize and address hazardous attitudes as they emerge.
Psychomotor (Doing)	Physical skills and coordination developed through practice	Control inputs, checklist execution, radio communication, instrument scanning, crosswind landing technique	Demonstrate, then supervise deliberate practice with immediate feedback. Allow enough repetitions for skills to become automatic.

Bloom's Taxonomy of the Cognitive Domain

The six levels of cognitive learning — from simple recall to complex evaluation — define the depth of understanding an instructor should aim for. The top three levels (Analysis, Synthesis, Evaluation) are the Higher-Order Thinking Skills (HOTS) essential to aeronautical decision-making. *(FAA-H-8083-9B, Ch. 3)*



Bloom's Taxonomy — Cognitive Domain (lowest to highest order) • Aviation Instructor's Handbook, Ch. 3

Instructor Note: Most checkride failures occur not at the Knowledge level but at the Application and Analysis levels — the student can recite the rule but cannot apply it to an unfamiliar scenario. Design every oral debrief question to target at least Application level. Reserve Evaluation-level questions for applicants approaching checkride readiness.

5. Characteristics of Learning

Regardless of theory, all learning shares common characteristics that instructors must recognize and work with, not against. *(FAA-H-8083-9B, Ch. 3)*

- **Learning is purposeful** — students learn what they perceive as relevant to their goals. Frame every lesson in terms of why it matters to the student's flying.
- **Learning is a result of experience** — it cannot be transferred directly; the instructor creates conditions for the student's own learning to occur.
- **Learning is multifaceted** — knowledge, attitudes, and skills develop together. Teaching rudder coordination also teaches respect for coordination as a value.
- **Learning is an active process** — passive listening produces ~5% 24-hour retention. Active engagement (doing, discussing, teaching back) produces dramatically higher retention.

6. Scenario-Based Training (SBT)

SBT is the primary vehicle for developing HOTS in aviation. It places the student in a realistic operational scenario that requires integrated use of knowledge, skills, and judgment — not just execution of an isolated maneuver. *(FAA-H-8083-9B, Ch. 3)*

SBT Characteristic	Description
Not a test	The scenario has multiple valid outcomes. There is no single correct answer.
Realistic and operational	Based on actual flight scenarios with real routing, weather, and ATC. The closer the scenario is to real-world conditions, the stronger the learning.
Engages all three domains	Requires knowledge (cognitive), attitude (affective), and hands-on skills (psychomotor) simultaneously.
Interactive	Instructor acts as mentor and facilitator — not a passive observer or evaluator.
Promotes decision-making	Student plans, executes, evaluates, and adapts — mirroring real PIC responsibilities.

Does not promote errors	Scenarios are structured to challenge without creating dangerous habits or unsafe decisions.

7. Acquiring Skill Knowledge

Skill development follows a predictable pattern. Understanding this pattern prevents instructors from misinterpreting normal developmental struggles as student failure. *(FAA-H-8083-9B, Ch. 3)*

Stages of Skill Acquisition	1. Cognitive stage: student consciously thinks through each step (slow, error-prone). 2. Associative stage: steps begin to link together; fewer errors. 3. Autonomous stage: skill becomes automatic; student can redirect attention to other tasks.
Knowledge of Results	Immediate, specific feedback is essential in early stages. Without knowing what went wrong and why, a student practices errors. Delayed or vague feedback reduces the value of every repetition.
How to Develop Skills	Demonstrate → student attempts with guidance → supervised practice → independent practice with feedback → proficiency check. Never skip the demonstration step.
Learning Plateaus	A period of apparently no progress despite continued practice. Often occurs between the associative and autonomous stages. Causes: practice of incorrect technique, fatigue, boredom, or readiness for a new approach. Response: acknowledge it openly, vary the method, take a break, or revisit the cognitive foundation.

8. Types of Practice

How practice is structured determines how well skills are retained — not just how well they perform *during* the lesson. *(FAA-H-8083-9B, Ch. 3)*

Type	Description	Effect on Retention	When to Use
Deliberate	Goal-directed practice targeting specific areas of weakness, with immediate focused feedback	Best long-term improvement per unit of practice time	Whenever a specific error pattern is identified; early skill acquisition
Blocked	Repeating the same skill continuously until it feels automatic (e.g., ten touch-and-goes in a row)	Good short-term performance but poorer long-term retention — can fool both instructor and student	Initial familiarization only; not a primary long-term strategy
Random	Mixing different skills across a single session without a predictable sequence	Better long-term retention; student builds pattern recognition and distinguishes similar skills	Once individual skills are reasonably established; preferred for pre-checkride preparation

9. Evaluations and Critiques

Evaluation and critique are not add-ons to instruction—they are essential feedback loops that close the learning cycle. Without effective critique, a student may practice errors indefinitely. Without meaningful evaluation, neither the instructor nor the student knows where instruction should go next. *(FAA-H-8083-9B, Ch. 3 & Ch. 7)*

Evaluation vs. Critique

Concept	Definition	Purpose in Aviation Instruction
Evaluation	A systematic, objective measurement of a student's performance against a defined standard	Determines whether a student meets ACS standards; informs go/no-go decisions for solo endorsements, stage checks, and checkride recommendation. Must be based on observable, measurable performance.
Critique	Instructor analysis of a student's performance delivered verbally or in writing as instructional feedback—not a grade	Accelerates skill development by identifying specific errors, explaining the cause, and prescribing correction. The primary tool for improving performance between evaluations.

Characteristics of an Effective Critique (AIH Ch. 7)

Objective	Based on observed performance, not personality. 'Your crosswind correction was initiated 50 feet too late' is objective. 'You were nervous again' is not. Separate the behavior from the person at all times.
Flexible	Calibrate depth and tone to the student's experience level and emotional state. A student in the early cognitive stage needs more guidance and encouragement; an advanced student near checkride readiness needs more precision and candor.
Acceptable	The student must be psychologically ready to receive the critique. A critique delivered while a student is still shaking from a rough approach will not be heard. Wait for composure before debriefing critical errors.
Comprehensive	Cover all significant errors—but do not itemize every minor flaw. Prioritize: what are the one or two most important things to change before the next flight? Overwhelming a student with 12 critiques is as ineffective as giving none.
Constructive	Every error should be paired with a path forward. Not just 'that was wrong,' but 'here is what to do instead and why it will work.' The student should leave every debrief knowing exactly how to improve.
Well-Organized	Use a consistent debrief structure: acknowledge what went well → identify the primary error → explain the cause → demonstrate or describe the correction → confirm understanding → close with a positive forward-looking statement.
Thoughtful	Pause before speaking. The instructor's first impulse may not be the most useful response. Consider: what is the root cause of this error? Is it knowledge, technique, attitude, or environmental? The most effective critique addresses the root cause, not the symptom.

Types of Critique Delivery

Method	Description	Best Use
Instructor/Student	Direct one-on-one verbal debrief immediately after the lesson	Standard delivery; most common; allows immediate clarification

Student-Led (Self-Critique)	Instructor asks the student to evaluate their own performance first	Develops metacognition and self-assessment skills; essential for solo preparation. Ask: 'What do you think went well? What would you do differently?'
Student Critique of Student	In a ground school setting, students evaluate each other's presentations	Builds analytical skills and reinforces standards from multiple perspectives. Requires careful structure to remain constructive.
Written Critique	Instructor provides written feedback after reviewing a student product (navigation log, written test, oral response)	Creates a reference the student can review between lessons; useful for complex cognitive errors requiring extended explanation.
Video / Recording Review	Student reviews their own performance via cockpit video or audio recording	Highly effective—the student 'sees themselves' without the stress of the flight. Removes the instructor's perception as a filter.

Common Critique Failure Modes to Avoid: The 'sandwich' method (praise–criticize–praise) is overused and students quickly learn to ignore the praise layers. Instead, lead with the overall assessment, then provide specific actionable feedback, then close with a genuine forward-looking statement. Also avoid the 'I'll get to that later' trap — if a safety-related error occurred, it must be addressed first, regardless of the debrief structure.

10. Distractions, Interruptions, Fixation, and Inattention

The ability to manage competing demands on attention is a core pilot skill — and one that must be taught deliberately, not assumed. *(FAA-H-8083-9B, Ch. 3)*

Distraction	Unexpected event that briefly diverts attention. Student must decide: act on it or return to task. Teach students to mentally 'bookmark' their position before responding.
Interruption	Student voluntarily suspends one task to complete another. High-risk for checklist errors (student resumes at wrong point). Habit pattern: always return to the item before the interruption.
Fixation	Student becomes absorbed in one task while others deteriorate. Classic example: beginning instrument student fixates on attitude indicator while altitude drifts uncorrected. Usually indicates the fixated task has not been sufficiently automated.
Inattention	Student fails to attend to an important task — either from fixation on something else, boredom, or passive monitoring of an automated system. Alert the student explicitly; develop scan habits; use realistic distractions during training (AIM Ch. 8 reference).

Instructor Note (FI.I.B.S3): The ACS requires applicants to plan for and use realistic distractions during flight instruction — not as tricks, but as deliberate training tools. A student who can correctly handle a simulated ATC call-up during their crosswind leg has developed a genuine, transferable skill.

11. Memory

Memory determines whether instruction produces durable knowledge or ephemeral performance. Understanding the memory model helps instructors design lessons that move information into long-term memory where it is available

when it matters most — in the aircraft. *(FAA-H-8083-9B, Ch. 3)*

Memory Stage	Capacity / Duration	Key Characteristics	Instructor Implication
Sensory Memory	Unlimited input; retains for only 1–3 seconds	Receives all stimuli; discards most; passes relevant items to STM via precoding	Make instruction vivid and multi-sensory — engage sight, sound, and touch to increase what is precoded as 'relevant'
Short-Term Memory (STM / Working Memory)	~7 chunks; ~30 seconds without rehearsal	Active processing stage; information fades rapidly unless rehearsed or chunked; coding takes 5–10 sec and is disrupted by interruption	Do not present new information during a task; limit lecture chunks to ~7 items; use mnemonics (GUMPS, IMSAFE) to compress items into single chunks
Long-Term Memory (LTM)	Effectively unlimited; potentially lifelong	Organized in schemas; retrieval depends on frequency and recency of use; subject to reconstruction errors and forgetting over time	Connect new knowledge to existing schemas; use spaced repetition; revisit previous lessons at the start of each new lesson

How Usage Affects Memory: Frequency and Recency

- **Frequency + Recency** (ideal): Knowledge used often and recently — easy to retrieve quickly. Example: a student who flies three times a week retains traffic pattern procedures effortlessly.
- **Frequency only** (vulnerable): Used often in the past but not recently — retrieves slowly or not at all. Example: a student returning from a three-month break. Needs a review flight to refresh procedural memory.
- **Recency only** (fragile): Recently learned but not yet practiced repeatedly. Example: a student who just read about emergency procedures but has not yet practiced them. Regular rehearsal needed to build frequency before the knowledge is stable.

Forgetting: Principal Causes

Cause	Mechanism	Prevention
Retrieval Failure	Information encoded poorly or never reached LTM	Ensure thorough encoding at time of learning; use elaboration techniques
Fading / Decay	Unused memory traces weaken over time	Spaced repetition; recurrent training; regular currency
Interference	Similar new information overwrites or blocks older information	Clearly differentiate similar procedures (e.g., soft-field vs. short-field); use distinct mnemonics
Repression	Emotionally unpleasant memories are suppressed unconsciously	Create a positive, safe learning environment; avoid instruction that creates strong negative associations

12. Retention of Learning and Transfer of Learning

Retention and transfer are the ultimate measures of effective instruction — not lesson performance scores. *(FAA-H-8083-9B, Ch. 3)*

Five Principles of Retention

Principle	Application to Flight Instruction
Praise stimulates remembering	Positive reinforcement at the moment of correct performance strengthens the memory of that performance. Never end a lesson without recognizing something the student did well.
Recall is promoted by association	Link new information to what the student already knows. 'The carburetor heat is like a defroster — it trades performance for warmth' creates a lasting schema.
Favorable attitudes aid retention	Students who are motivated and feel respected remember more. Investing in the relationship is investing in retention.
Learning with all senses is most effective	Show, tell, and have the student do. Use models, diagrams, actual aircraft systems, and simulation together.
Meaningful repetition aids recall	Three to four spaced repetitions are more effective than one marathon session. Revisit key concepts at the start of the next lesson to reinforce recency.

Transfer of Learning

• **Positive transfer**: Learning skill A helps learning skill B. Example: slow flight (skill A) improves short-field landing technique (skill B). Design lesson sequences to maximize positive transfer chains.

• **Negative transfer**: Learning skill A hinders learning skill B. Example: landing habit patterns from airplanes can interfere with helicopter landings. Identify likely negative transfer points in advance and address them explicitly.

• **Near transfer**: Applying learning to a closely related context. Example: using VOR tracking skills for an ILS approach.

• **Far / Generative transfer**: Applying knowledge to a novel problem using underlying principles. This is the goal of HOTS instruction — the student who truly understands aerodynamics can reason through an unfamiliar aircraft's behavior.

COMMON ERRORS

Common Error	Recognition	Correction
Confusing rote and understanding	Applicant defines terms correctly but cannot apply them (e.g., states the laws of learning but cannot identify which law is violated in a given scenario)	Require scenario application for every concept: 'A student keeps making the same error despite multiple corrections — which law of learning is most relevant?'
Confusing blocked and random practice	Applicant recommends blocked practice as the primary training strategy	Review AIH Ch. 3 research on long-term retention; have applicant design a random-practice lesson for a specific maneuver
Describing SBT as a test	Applicant characterizes SBT as an evaluation tool rather than a training method	Re-read AIH SBT characteristics; role-play developing a scenario with multiple valid outcomes

Inability to identify domain for a given objective	Applicant cannot categorize a lesson objective as cognitive, affective, or psychomotor	Practice with 10 example objectives; require the applicant to write one objective for each domain for the same maneuver (e.g., soft-field takeoff)
Vague understanding of memory model	Applicant knows 'there are three kinds of memory' but cannot explain instructor implications	Ask: 'What does STM's 7-chunk limit mean for how you structure a ground briefing?' Require a concrete instructional change in response to each memory limitation
Underestimating forgetting rate	Applicant does not build review into lesson plans; assumes previous material is retained	Discuss the retention drop after 10–15 min of passive listening; show AIH Figure on retention curves; require the applicant to add a 3-minute review opener to every lesson plan

COMPLETION STANDARDS

COMPLETION STANDARDS (from FAA-S-ACS-25)

✓ Applicant explains all knowledge elements (FI.I.B.K1–K16) accurately using aviation-specific examples without significant prompting.

✓ Applicant identifies and mitigates risks for FI.I.B.R1 (inadequate instruction), R2 (lack of motivation), and R3 (learner errors) with concrete, actionable strategies.

✓ Applicant demonstrates FI.I.B.S1 by correctly applying an educational theory (cognitive, behaviorist, or constructivist) to a specific ground or flight instruction example.

✓ Applicant demonstrates FI.I.B.S2 by identifying at least three conditions that undermine the learning process and describing how they would recognize and correct each.

✓ Applicant demonstrates FI.I.B.S3 by designing a lesson element that uses a realistic, safe distraction to teach workload management in a flight context.

REVIEW QUESTIONS

REVIEW QUESTIONS & ANSWERS

Q1. A student correctly recites the steps for a soft-field takeoff from memory but cannot explain why each step is performed or adapt the procedure when the runway is contaminated. At which level of Bloom's Taxonomy is the student operating? What should the instructor do?

■ *The student is at the Knowledge (rote) level — they can recall but not apply. The instructor should move the student to the Application level by presenting scenarios: 'The runway has standing water near the threshold — how does that change your technique?' Only after the student can reason through novel situations have they reached meaningful understanding consistent with the ACS standard.*

Q2. You have taught the traffic pattern five times. The student performs it well in every lesson but then calls you two weeks later struggling to remember the altitudes. Which memory and forgetting concepts explain this? What would you do differently?

■ *The student has recency only — knowledge recently acquired but not yet frequently rehearsed. After two weeks without practice, recency fades and the knowledge has no frequency base to sustain it. Fix: build spaced repetition into the course — begin each lesson with a 3-minute review of the previous session's key points; recommend daily self-quizzing between lessons; use mnemonics to chunk pattern altitudes into STM-friendly units.*

Q3. You are teaching touch-and-goes. The student improves rapidly over eight consecutive landings but performs poorly on the same maneuver in the next lesson. Which type of practice is this and why does it produce this result?

■ *Blocked practice. Repeating the same task in an unbroken sequence improves short-term performance but produces poor long-term retention because the learner never truly retrieves the skill from memory — it remains active in working memory throughout. Switch to random practice: mix short-field, soft-field, and normal landings across a session so the student must retrieve each procedure independently, which builds lasting memory.*

Q4. Which law of learning is violated when an instructor ends every lesson immediately after the student makes an error? How would you correct this?

■ *The Law of Effect — negative final experiences weaken the learning association with the task, and the Law of Recency — the most recent experience is remembered best, so ending on a failure embeds failure as the final memory. Correction: always follow a failed attempt with a successful one before closing the lesson. If time is limited, at minimum debrief the error constructively and end with a positive, forward-looking statement: 'You know what to do differently — next time, you will get it.'*

Q5. A student is on short final, and you ask a question about a regulation. The student blows through the VASI and lands long. What happened cognitively, and how do you debrief this — and use it as a training tool?

■ *The student experienced task saturation: working memory was already near capacity with the approach, and the regulation question pushed it into overload — demonstrating fixation on the verbal task and inattention to the approach path. Debrief: explain the multitasking limit and working memory capacity; this is a predictable human response, not a character flaw. Training tool: this is precisely the kind of realistic distraction the ACS expects instructors to plan for (FI.I.B.S3). Debrief what happened, explain the cognitive mechanism, then repeat with a lighter distraction until the student can correctly prioritize.*

Q6. You notice a student who was progressing steadily has suddenly stopped improving on stalls over the last three sessions. What is this phenomenon, what are the possible causes, and what are your options as an instructor?

■ *This is a learning plateau — a period of apparent no progress during continued practice. Possible causes: (1) practicing an incorrect technique (the plateau is actually a ceiling imposed by the error); (2) fatigue or reduced motivation; (3) readiness for a cognitive reorganization that the current approach cannot produce. Options: (1) carefully observe and diagnose whether an error is being practiced; (2) vary the teaching approach — try a different entry technique, a different altitude, or add an instrument component; (3) take a break and return to stalls after working on other skills; (4) have an open conversation with the student about what they are experiencing.*

Q7. A student thoroughly understands each individual element of a soft-field takeoff but still cannot execute the maneuver fluently as a whole. They ask: 'I know all the steps — why can't I put it together?' What concept explains this gap, and how do you facilitate the transition?

■ *The student has component knowledge but has not yet achieved insight — the integrative understanding of how the elements relate to each other as a unified procedure. Insight cannot be delivered directly; it must emerge from the student's own processing. Facilitate it by stepping back from drills and asking Socratic questions: 'What is the purpose of back pressure before rotation? How does that change if the surface is soft vs. firm?' Allow consolidation time between attempts. Often the insight arrives between lessons, not during them. Avoid the trap of more repetition—additional blocked practice rarely produces insight and can deepen frustration.*

Q8. After a cross-country flight you debrief a student and list eleven errors in ten minutes. The student nods at each one but seems overwhelmed and disengaged by the end. What went wrong with your critique, and how should you restructure the debrief?

■ *The critique violated the principles of comprehensiveness and acceptability. Listing eleven errors violates comprehensiveness (too many corrections at once) and acceptability (the student's capacity to receive feedback was exceeded). Research on working memory supports limiting actionable feedback to 2–3 priority items per debrief. Restructure: (1) Begin with a self-critique — ask the student what they noticed. (2) Select the 1–2 most important errors (prioritizing safety). (3) For each, explain the cause and prescribe a specific correction. (4) Log the remaining items for future lessons — they are not lost, just deferred. (5) Close with a genuine forward-looking statement about what to work on next flight.*

Instructor: _____ Date: _____ Applicant: _____

LESSON I–C

COURSE DEVELOPMENT, LESSON PLANS

& Classroom Training Techniques

Duration: 90–120 min	**References:** FAA-H-8083-9B Ch. 5, 7 | FAA-H-8083-25C | FAA-S-ACS-25 Area I	**Audience:** CFI Applicant

ACS Reference: Area of Operation I (Fundamentals of Instructing), Task C — Course Development, Lesson Plans, and Classroom Training Techniques — FAA-S-ACS-25 p. 4 | Knowledge: FI.I.C.K1–K10 | Risk: FI.I.C.R1 | Skills: FI.I.C.S1a–b

LESSON OBJECTIVES

By the end of this lesson the applicant will be able to:

- Describe the teaching process and identify the essential skills every aviation instructor must possess.
- Explain the structure of a course of training and how it relates to regulatory requirements.
- Write clear training objectives using performance-based and decision-based formats, and explain the role of the ACS in aviation curricula.
- Organize lesson material using the four-step sequence and apply it to a ground or flight lesson.
- Select the most appropriate training delivery method for a given lesson and learner, and explain the strengths and limitations of each.
- Describe e-learning principles and identify when technology-based instruction enhances (or cannot replace) traditional instruction.
- Identify the characteristics of effective instructional aids and apply guidelines for their design and use.
- Explain integrated flight instruction and problem-based instruction, and describe how each develops higher-order thinking.
- Construct a complete, ACS-compliant lesson plan for both a ground knowledge lesson and a maneuver introduction.
- Define blocks of learning and describe how to assemble them into a training syllabus that meets 14 CFR Part 61 requirements.

MOTIVATION

Every lesson an instructor delivers — whether a ground briefing, an in-cockpit demonstration, or a debrief — is an act of course design. The quality of that design determines not just what the student does during the lesson, but what they remember and can apply weeks later. The FAA's shift from task-based to performance- and decision-based training is codified in the ACS, and it demands that instructors be deliberate designers of learning experiences, not merely experienced pilots who can also talk. This lesson gives the CFI applicant the framework to design instruction that is organized, objective-driven, appropriately delivered, and evaluated against a clear standard — every time, for every student.

KEY CONCEPTS

1. The Teaching Process and Essential Instructor Skills

Teaching is more than conveying information — it is a deliberate, structured process of facilitating a change in the learner's knowledge, skills, or attitudes. *(FAA-H-8083-9B, Ch. 5)*

The Teaching Process	A series of steps: (1) determine objectives and standards, (2) prepare the lesson, (3) present the material, (4) apply (have the student practice), (5) evaluate. Each step depends on the previous one—objectives drive preparation; preparation drives delivery; delivery drives application; application drives evaluation.
Essential Instructor Skills	The AIH identifies seven essential instructor skills: (1) Ability to communicate — clarity, accuracy, and empathy in spoken and written language. (2) Instructor personality and attitude — patience, enthusiasm, and genuine interest in the student. (3) Honesty — realistic assessment of student progress without false praise. (4) Student confidence — the ability to challenge without demoralizing. (5) Sincerity — students detect and respond negatively to instructors who are going through the motions. (6) Accuracy and currency — technically proficient and up-to-date on regulations and procedures. (7) Proper personal appearance and habits — the instructor is a role model, not just a teacher.
Student-Centered Focus	Effective teaching is organized around what the student needs to learn, not around what the instructor wants to cover. Every decision — method, aid, sequence, pace — must be made with the specific student in mind. A lesson perfectly designed for one student may be inappropriate for another at a different stage of training.

2. Course of Training

A course of training is a structured series of lessons designed to lead a student from their current level to a defined goal — typically a certificate or rating. The structure is not arbitrary: it derives directly from regulatory requirements and the ACS. *(FAA-H-8083-9B, Ch. 7)*

Component	Definition	Regulatory Basis	Instructor Role
Course of Training	The total sequence of ground and flight instruction required to meet a certificate or rating	14 CFR Part 61 specifies minimum aeronautical experience; ACS defines knowledge and skill standards	Design or adopt a course that satisfies all regulatory minimums and ACS task coverage
Blocks of Learning	Discrete, measurable units of instruction that build progressively toward the overall objective	Implied by Part 61 stage-check requirements and ACS task structure	Sequence blocks from simple to complex; identify which blocks are prerequisites for others
Training Syllabus	An organized, written summary of the course: lesson sequence, objectives, references, completion standards	Part 141 requires FAA-approved syllabi; Part 61 does not require a syllabus but best practice demands one	Use or create a syllabus that documents every lesson, its objective, and its completion standard

Lesson Plan	A detailed instructor guide for a single lesson: objective, content outline, method, completion standard	Not specifically required by 14 CFR but expected by the ACS and all best-practice frameworks	Write a lesson plan for every lesson; use it as a contract with the student about what will be learned

3. Preparation of a Lesson: Objectives and Completion Standards

The objective is the most important element of any lesson plan. It establishes what the student will be able to do, under what conditions, and to what standard — before instruction begins. Without a clear objective, neither the instructor nor the student knows when the lesson is complete. *(FAA-H-8083-9B, Ch. 5)*

Three Types of Training Objectives

Objective Type	Structure	Example	When to Use
Performance-Based (PBO)	Describes: (1) the desired behavior, (2) the conditions under which it will be performed, (3) the criteria (standard) for acceptable performance	'Given a sectional chart and flight computer, the student will plan a 100 nm cross-country with all required items within 10% of the correct values.'	Any lesson with a measurable outcome — the default format for all aviation training objectives
Decision-Based (DBO)	Describes an aeronautical decision-making scenario in which the student must select and justify a course of action from multiple options	'Given deteriorating weather during a cross-country, the student will identify go/no-go decision points and select an appropriate divert option with supporting justification.'	Scenario-based training; pre-solo risk management lessons; instrument training
ACS-Referenced	Directly links the lesson objective to an ACS knowledge, risk, or skill element by code	'FI.I.C.K3b: Student will write a performance-based objective for a normal landing lesson.'	Always — every lesson objective in Part 141 and best-practice Part 61 instruction should reference at least one ACS element

Instructor Note (FI.I.C.K3c): The ACS is not just a checkride guide — it is the curriculum framework. Every lesson plan should map to ACS elements. If a lesson cannot be mapped to the ACS, ask whether it belongs in the course at all. If it maps to multiple ACS elements, the lesson may be trying to accomplish too much at once.

4. Organization of Material

Well-organized material makes instruction more efficient, reduces student confusion, and builds the coherent mental models that support long-term retention. *(FAA-H-8083-9B, Ch. 5)*

Introduction	Opens the lesson: attention, motivation, and overview. The three-part opening: (1) attention — engage the student immediately with a scenario, question, or visual; (2) motivation — answer 'why does this matter to my flying?' before the lesson begins; (3) overview — briefly describe what will be covered and in what sequence. Without all three elements the lesson is already off to a poor start.
Development	The main body of the lesson. Organize content using one of three proven methods: • Simple-to-complex: begin with the easiest concept; build progressively. • Known-to-unknown: start from what the student already knows and extend outward. • Whole-part-whole: overview the complete maneuver, then drill each sub-component, then reassemble into the whole. Especially effective for psychomotor skill instruction.
Conclusion	Restates the key points without introducing new material. The conclusion should: (1) summarize the lesson in 3–4 sentences, (2) tie the lesson back to the ACS standard, (3) preview the next lesson to create a forward connection. Law of Recency: the last thing the student hears is the best-remembered. Never let the lesson fade out — end with a clear, positive, forward-looking statement.

5. Training Delivery Methods

The selection of a teaching method is one of the most consequential instructional decisions an instructor makes. No single method is universally superior — the best choice depends on the objective, the student's level, and the content. *(FAA-H-8083-9B, Ch. 5)*

Method	Description	Best For	Limitation
Lecture	Instructor presents material verbally with minimal learner interaction	Introducing new topics to large groups; providing background knowledge before active methods	Passive for the learner; retention drops rapidly after 15–20 min; no feedback loop
Discussion	Two-way exchange between instructor and learner(s); instructor guides but learner contributes	Building on prior knowledge; developing critical thinking; smaller groups	Can drift off-topic; requires careful facilitation; less efficient for new content delivery
Guided Discussion	Instructor uses carefully prepared questions (not statements) to lead the learner to discover concepts themselves; Socratic in structure	Deepening understanding of concepts already partially known; pre-solo decision-making; debrief of flight maneuvers	Requires thorough instructor preparation; fails if student lacks prerequisite knowledge
Cooperative / Group Learning	Small groups of students work together to solve a problem or analyze a scenario	Ground school; scenario analysis; regulatory interpretation exercises	Less applicable to one-on-one flight training; group dynamics can suppress individual input

Demonstration-Performance	Instructor demonstrates the skill; student practices under supervision with immediate feedback. Four steps: explanation, demonstration, student practice, evaluation	All flight maneuvers; pre-solo skills; any psychomotor task	Requires airworthy aircraft and appropriate conditions; expensive in flight time
Drill and Practice	Repetition of a task until the desired level of automaticity is achieved	Checklist execution; radio phraseology; emergency procedures; instrument scan development	Risk of practicing errors if not closely supervised; blocked practice concerns (see Task B)

6. Electronic Learning (E-Learning)

E-learning encompasses any instruction delivered via electronic media — computer-based training (CBT), online courses, video, simulation, and interactive apps. Its use in aviation training has expanded dramatically, but it has specific capabilities and limitations that instructors must understand. *(FAA-H-8083-9B, Ch. 5)*

- **Advantages:** Self-paced; available 24/7; consistent delivery; can include interactive simulations and embedded quizzes; reduces cost of ground instruction when used appropriately.
- **Limitations:** Cannot provide real-time instructor feedback; cannot assess attitude or psychomotor performance; risk of passive completion (clicking through without engagement); technology access varies among students.
- **Best use — blended learning:** E-learning is most powerful as a supplement to, not a replacement for, instructor-led instruction. Use CBT or video to pre-teach concepts before the ground lesson, so face-to-face time can focus on questions, scenarios, and higher-order thinking.
- **Instructor role with e-learning students:** Verify comprehension — never assume a student who completed an online course has achieved understanding. Use the ground lesson to probe at the Application and Analysis levels of Bloom's Taxonomy.

7. Instructional Aids and Training Technologies

An instructional aid is any device used by the instructor to assist the learning process. The selection and design of aids should be driven by the learning objective, not by what is available or visually impressive. *(FAA-H-8083-9B, Ch. 5)*

Characteristics of an Effective Instructional Aid

- **Accurate and current** — outdated charts, superseded regulations, or incorrect procedures embedded in aids cause more harm than no aid at all.
- **Simple** — uncluttered; each aid communicates one primary idea. If an aid requires extensive explanation before the lesson, it is too complex.
- **Appropriate to the objective** — choose the medium that best communicates the concept: a 3D model for engine internals; a whiteboard diagram for traffic pattern geometry; a simulator for IFR approaches.
- **Visible and legible** — text is large enough to read from the back of the room; color contrast is sufficient; audio is clear without distortion.
- **Purposeful** — every aid used should have a specific instructional reason. If its removal would not affect learning, it should not be there.

Types of Training Aids

Aid Type	Examples	Best Use	Key Consideration
Visual	Whiteboard, charts, diagrams, posters, sectional maps, aircraft systems diagrams	Spatial relationships; procedures; geographic references	Keep diagrams clean; use color purposefully; ensure visibility for all students
Audio/Visual	Video, recorded ATC communications, cockpit audio	ATC phraseology; accident sequences; weather phenomena	Preview content before using in class; pause for discussion rather than passive viewing
Models and Cutaways	Engine cutaways, airfoil models, control surface demonstrations	Three-dimensional spatial concepts; mechanical principles	Ensure model accuracy; do not use a model for a different aircraft type
Flight Simulation	FTD, ATD, BATD — approved flight training devices	IFR procedures; emergency training; instrument scan; night operations	Understand FAA credit limits (14 CFR 61.65); brief and debrief rigorously
Digital / Interactive	Foreflight, Garmin Pilot, ForeFlight FPL generator, weight-and-balance apps	Flight planning; weather analysis; avionics familiarization	Verify information sources within the app are current; teach the skill, not just the app

Guidelines for Aid Use: Introduce the aid after explaining the learning objective, not before. Keep aids out of sight until needed — visual distractions compete with the lesson. After using an aid, remove it from sight when moving to the next topic. Never read directly from a projected slide — the slide supports the instruction; the instruction does not accompany the slide.

8. Integrated Flight Instruction

Integrated flight instruction introduces instrument references from the very first lesson, teaching the student to use both outside visual references and flight instruments simultaneously rather than sequentially. *(FAA-H-8083-9B, Ch. 5)*

Definition	The consistent use of both outside (visual) and inside (instrument) reference throughout training — beginning with the first dual lesson, not deferred to the instrument rating. The student develops the habit of cross-checking instruments as a natural part of flight, not as a separate emergency skill.
Rationale	Studies show that pilots trained with integrated flight instruction develop superior instrument scan habits, are less likely to lose control in IMC, and transition to instrument training more easily. The FAA strongly encourages this approach in the AIH.
Implementation	From lesson one: after demonstrating a maneuver visually, point out the instrument indications. ‘Notice the VSI reads +200 fpm during this climb attitude.’ Gradually shift the student to using instruments to verify their visual perceptions. By the time the student solos, they should be checking instruments automatically.
Limitation	Integrated instruction does not replace the instrument rating or produce a qualified instrument pilot. Its purpose is to build habit patterns that reduce the likelihood of spatial disorientation and CFIT accidents, not to develop full IMC capability.

9. Problem-Based Instruction

Problem-based instruction (PBI) places the student in the role of problem-solver from the outset of the lesson. Rather than providing information and then testing recall, the instructor presents a realistic problem and guides the student to discover the knowledge needed to solve it. *(FAA-H-8083-9B, Ch. 5)*

- **Core principle:** The student's motivation to learn is highest when they see a real problem that requires the new knowledge. PBI exploits this by presenting the problem before the lesson content, not after.
- **Structure:** (1) Present the problem or scenario. (2) Ask the student what they know and what they need to know. (3) Provide or guide discovery of the required knowledge. (4) Return to the problem and solve it using the new knowledge. (5) Generalize — what other situations would this apply to?
- **Aviation example:** Before teaching density altitude, present: 'You are planning a departure from an airport at 7,500 ft MSL on a 95°F summer afternoon. Your aircraft's POH shows a 1,200 ft ground roll at standard conditions. What do you actually expect, and why?' The student's inability to answer this question creates the motivation to learn density altitude concepts.
- **Relationship to SBT and HOTS:** PBI is the ground-school equivalent of scenario-based flight training. Both require the student to operate at the Application, Analysis, and Evaluation levels of Bloom's Taxonomy, producing the higher-order thinking skills essential to safe aeronautical decision-making.

10. Planning Instructional Activity: Blocks of Learning, Training Syllabus, and Lesson Plans

Effective instruction requires planning at three levels: the course (syllabus), the unit (block of learning), and the individual session (lesson plan). Each level of planning supports the others. *(FAA-H-8083-9B, Ch. 7)*

Blocks of Learning

A block of learning is a discrete, measurable unit of instruction. Blocks are sequenced so that each one builds on its predecessors — similar to the layers of a pyramid. For private pilot training, the major blocks might be: presolo skills, solo proficiency, cross-country operations, and checkride readiness. Each major block contains smaller sub-blocks (e.g., traffic pattern technique is a sub-block of presolo skills). The instructor should not advance a student to the next block until the current block is completed to ACS standard.

Training Syllabus

A training syllabus is a written document summarizing the entire course of training. It specifies the sequence of lessons, the objective of each, the references used, and the completion standard. It functions as both a planning tool for the instructor and a communication document for the student — the student knows from day one what will be required of them and in what order.

- **Part 141 syllabi** must be FAA-approved and structured to meet specific training hour requirements.
- **Part 61 syllabi** are not required by regulation but are strongly recommended as evidence of structured training in the event of an enforcement action or accident investigation.
- **Commercial syllabi** (Jeppesen, King Schools, Sporty's, etc.) may be used as-is or adapted. Instructors who modify a commercial syllabus should document the modifications.

Lesson Plan Structure and Requirements

Lesson Plan Element	Content	Why It Matters

Objective	A clear, measurable statement of what the student will be able to do at the end of the lesson. Tied to ACS element codes.	Without an objective, neither instructor nor student knows when the lesson is done.
Content Outline	The key topics, concepts, and skills to be covered, in logical sequence.	Keeps the instructor on track and ensures no critical elements are omitted.
Completion Standards	The specific, observable criteria the student must meet for the lesson to be marked complete. Drawn directly from the ACS.	Provides a pass/no-pass threshold; prevents advancement before readiness.
Schedule / Timeline	Approximate time allocation for each lesson segment.	Prevents over-spending time on the introduction and running short on practice.
References	Specific FAA publications, POH sections, and ACS tasks referenced by the lesson.	Documents the source of content for regulatory and legal purposes.
Instructor Actions	What the instructor will do: demonstrate, ask, evaluate, brief.	Forces the instructor to plan the teaching method, not just the content.
Student Actions	What the student will do: read, practice, solve, decide.	Ensures the lesson is active, not passive.

ACS Skill Requirement (FI.I.C.S1): The CFI applicant must be able to produce a complete lesson plan on demand during the practical test. The plan must include all required elements above, be appropriate for the identified learner, and use a method suitable for the task. Examiners will evaluate both the content and the instructor's ability to explain their design decisions.

COMMON ERRORS

Common Error	Recognition	Correction
Objectives that describe instructor actions, not student outcomes	Applicant writes: 'Cover weight and balance calculation' instead of 'Student will calculate weight and balance for a C172 within 2% of the correct value.'	Rewrite the objective in the format: 'Given [conditions], the student will [behavior] to [standard].' The subject of the sentence must be the student, not the instructor.
Selecting a method based on habit rather than the objective	Applicant defaults to lecture for every lesson regardless of content type	Map the objective to a method: psychomotor objectives demand demonstration-performance; decision objectives demand guided discussion or scenario; new knowledge may begin with lecture but must transition to active engagement.
Lesson plan that only lists topics without completion standards	Applicant's lesson plan contains a content outline but no measurable completion standard	Add an explicit ACS-referenced completion standard to every lesson plan. The standard answers: 'How will I know when the student is done?'

Treating the syllabus as a schedule rather than a standard	Applicant advances the student to the next lesson because the scheduled date has arrived, not because the completion standards for the current lesson were met	Review: the syllabus defines what must be accomplished, not how many sessions to take. A student who needs two sessions to master slow flight is not behind schedule — they are learning at their own rate.
Overloading lesson plans with too many objectives	Applicant designs a single lesson covering five or more new concepts	Apply the 14 CFR 61 principle that instruction should be organized into logical blocks. One primary objective per lesson; supporting sub-objectives should be limited to 2–3.
Failing to connect instructional aids to the objective	Applicant uses slides or models without explaining their purpose or removing them when done	Every aid should be introduced with: 'This diagram illustrates [concept] because [reason]. Notice [specific element].' Remove aids when their purpose is complete.

COMPLETION STANDARDS

COMPLETION STANDARDS (from FAA-S-ACS-25)
✓ Applicant accurately explains all knowledge elements (FI.I.C.K1–K10) using aviation-specific examples, including the full range of training delivery methods and their appropriate use cases.
✓ Applicant identifies and mitigates the risk associated with FI.I.C.R1 (selection of teaching method) by correctly matching method to objective and learner characteristics in at least two example scenarios.
✓ Applicant demonstrates FI.I.C.S1a by producing a complete, ACS-referenced lesson plan for an aeronautical knowledge ground lesson with all required elements: objective, content outline, method, completion standard, references, instructor actions, and student actions.
✓ Applicant demonstrates FI.I.C.S1b by producing a complete lesson plan for a maneuver introduction, using the demonstration-performance method with an explicit performance-based objective and ACS-compliant completion standard.
✓ Applicant can explain their design decisions for both lesson plans without reference to notes, and can adapt each plan on the spot for a learner with different experience or characteristics.

REVIEW QUESTIONS

REVIEW QUESTIONS & ANSWERS

Q1. An applicant writes the following lesson objective: 'Teach the student about weight and balance.' What is wrong with this objective, and how would you rewrite it as a proper performance-based objective?

■ *The objective describes an instructor action ('teach'), not a student outcome, and provides no conditions or standard. Rewrite: 'Given a Cessna 172 POH, a loaded weight-and-balance problem with four occupants and full fuel, the student will calculate gross weight, center of gravity, and determine whether the aircraft is within limits, with all computed values within 2% of the correct answer.' The revised objective specifies: behavior (calculate, determine), conditions (given the POH and problem), and standard (within 2%).*

Q2. You are about to teach traffic pattern procedures to a first-lesson student. Which training delivery method would you select and why? Which would be least appropriate, and why?

■ *Best method: Demonstration-performance. Traffic pattern execution is a psychomotor task requiring instructor demonstration followed by supervised student practice with immediate feedback. The four-step sequence (explain → demonstrate → practice → evaluate) is designed precisely for this. Least appropriate: Pure lecture. A verbal-only description of the traffic pattern provides no kinesthetic experience, no visual reference calibration, and no feedback loop. Lecture may be used briefly in the ground briefing to introduce the pattern, but cannot be the primary method for a motor skill.*

Q3. What is integrated flight instruction, and why does the FAA recommend it from the very first lesson rather than waiting until instrument training?

■ *Integrated flight instruction is the simultaneous use of both outside visual references and cockpit flight instruments throughout all training — beginning at lesson one. The FAA recommends it because: (1) pilots who develop instrument-checking habits early are less likely to experience spatial disorientation when inadvertently entering IMC; (2) the habit pattern is far easier to establish early than to add later; (3) it reduces the instrument training learning curve by eliminating the need to teach instrument scan as a new, unfamiliar skill. It does not produce an instrument-rated pilot, but it makes all pilots safer by building an automatic cross-check reflex.*

Q4. A student has completed a 5-hour online CBT course on weather theory and arrives for the ground lesson telling you they already know the material. How do you approach this lesson?

■ *Do not skip the ground lesson or accept CBT completion as evidence of understanding. E-learning provides knowledge exposure, not demonstrated understanding. Immediately probe at the Application level: 'You said you know weather theory — walk me through how you would evaluate this METAR/TAF for a cross-country to [airport].' If the student can apply the knowledge to a real scenario with appropriate decision-making, the lesson can be shortened and focused on gaps. If they cannot, the ground lesson should proceed normally, using the CBT content as a foundation rather than a substitute. The CBT is most valuable as a pre-study tool, not as instruction.*

Q5. Describe the structure of a complete lesson plan and explain what would happen if the completion standard element were omitted.

■ *A complete lesson plan includes: (1) objective (what the student will do, under what conditions, to what standard); (2) content outline (topics in logical sequence); (3) method (how the instructor will teach); (4) completion standard (ACS-referenced pass/no-pass threshold); (5) schedule; (6) references; (7) instructor actions; (8) student actions. Without the completion standard: the instructor has no defined endpoint; the student cannot gauge their own progress; advancement decisions become subjective; the lesson cannot be documented as complete for regulatory purposes; and the student may be advanced before they are ready, compounding errors in future lessons.*

Q6. Explain the difference between blocks of learning and a training syllabus. How do they relate to each other and to the individual lesson plan?

■ *Blocks of learning are the discrete, measurable units of knowledge and skill that must be assembled in sequence to produce a certificated pilot. They are the 'bricks' of the pyramid — each one complete in itself and a necessary foundation for the next. The training syllabus is the blueprint that specifies which blocks are needed, in what order, with what completion standards — it is the architect's plan for the whole structure. The lesson plan is the contractor's instruction for laying a single brick: it defines exactly what will be done in one session to complete one block (or part of a block). The three levels form a hierarchy: syllabus → blocks → lesson plans. A lesson plan that does not advance a block, and a block that does not advance the syllabus, are both wasted instruction time.*

Q7. What is problem-based instruction and how does it differ from a traditional lecture? Give an aviation example.

■ *Problem-based instruction begins with a realistic problem or scenario the student cannot yet solve, creating the motivation to acquire the knowledge needed. Traditional lecture begins with the content and ends with an application exercise. PBI reverses this sequence: problem first, discovery second, solution third. Aviation example: instead of lecturing on density altitude and then giving a problem, the instructor presents: 'You are departing Leadville, CO (elevation 9,928 ft) in August at noon. Temperature is 95°F. Your Cessna 172 POH says 900 ft ground roll at sea level standard. Your runway is 6,500 ft long. Will you make it?' The student's inability to answer immediately creates authentic motivation to understand density altitude, pressure altitude, and temperature correction — not as abstract concepts, but as tools needed to solve an urgent real-world problem.*

Instructor: _____ Date: _____ Applicant: _____

EXAMPLE A
Lesson Plan

Steep Turns

Maneuver Introduction — Demonstration-Performance Method

Duration: 60 min (30 pre-flight + 30 flight)	**Method:** Demonstration-Performance	**ACS Ref:** ACS PA.V.A / CA.V.A | FAA-S-ACS-6B	**Audience:** Student Pilot

OBJECTIVE	**Performance-Based:** Given a properly equipped training aircraft at cruise altitude, the student will enter, maintain, and roll out of a 45° banked steep turn in both directions, maintaining altitude ±100 ft, airspeed ±10 kts, and rolling out within ±10° of the entry heading, while verbally identifying overbanking tendency and the increased load factor relationship.
MATERIALS	Airplane (C172 or equivalent) • POH/AFM • Pre-flight briefing card • FAA-H-8083-3C (PHAK) Ch. 4 (load factors) • Whiteboard / load-factor diagram
SCHEDULE	**0–5 min** Motivation / why steep turns matter (emergencies, airspace avoidance) • **5–15 min** Ground brief: physics, entry procedure, sight picture, common errors • **15–20 min** Pre-flight and taxi • **20–45 min** Flight: instructor demo both directions, student practice 2–3 turns each • **45–60 min** Debrief: student self-assessment against ACS standard
INST. ACTIONS	Brief maneuver using load-factor diagram. • Demonstrate one full steep turn in each direction narrating sight picture and control inputs. • Observe student; intervene only for safety. • Debrief using student's own assessment first, then instructor critique.
STUDENT ACTIONS	Review PHAK Ch. 4 before lesson. • Perform clearing turns. • Enter and maintain 45° bank turns independently. • Verbalize overbanking tendency and back-pressure relationship. • Self-assess performance against ACS standard after each turn.
COMMON ERRORS	• Fixating on instruments instead of outside reference — *Correction: cover instruments for one turn.* • Losing altitude in the turn (insufficient back-pressure) — *Correction: emphasize trim use and sight picture.* • Rolling out late — *Correction: lead the rollout by half the bank angle (22½° early).*
COMPLETION STANDARD	Student demonstrates steep turns that meet ACS PA.V.A standards: bank angle ±5° of 45°, altitude ±100 ft, airspeed ±10 kts, rollout within ±10° of entry heading. Student correctly explains overbanking tendency and load factor without prompting.

Instructor Design Note: This plan uses demonstration-performance because steep turns are a psychomotor skill — the student must develop muscle memory and a visual sight picture that cannot be acquired through lecture alone. The debrief uses the student's self-assessment first (guided discovery) to develop the habit of self-critique essential for solo flight.

EXAMPLE B
Lesson Plan

Airspace Classifications

Ground Knowledge Lesson — Lecture with Guided Discussion

Duration: 60–90 min	**Method:** Lecture / Guided Discussion	**ACS Ref:** ACS PA.I.B | FAA-S-ACS-6B | 14 CFR §91.119–.135	**Audience:** Student Pilot

OBJECTIVE	**Performance-Based:** Given a sectional aeronautical chart and a set of airspace scenario cards, the student will correctly identify the class of airspace, required equipment, minimum pilot certification, and entry requirements for each scenario with 100% accuracy before solo flight.
MATERIALS	Current sectional chart (local area) • AIM Ch. 3 • 14 CFR §91.119–.135 • Airspace summary card (EGH handout) • Scenario cards (10 pre-built scenarios) • Whiteboard / airspace diagram poster
SCHEDULE	**0–5 min** Motivation: SVFR incident case study • **5–25 min** Lecture: Class A–G overview, dimensions, requirements • **25–40 min** Chart exercise: identify airspace on sectional with instructor • **40–55 min** Student-led scenario card drill (pairs or solo) • **55–60 min** Q&A; and completion standard check
INST. ACTIONS	Open with incident case study to establish relevance. • Present overview using poster/whiteboard. • Work first two sectional scenarios together as models. • Circulate during student drill; use Socratic questions rather than giving answers. • Administer oral completion check.
STUDENT ACTIONS	Read AIM Ch. 3 §3-2 before lesson. • Follow along on personal sectional chart. • Answer instructor questions during guided discussion. • Complete scenario drill cards independently. • Verbalize entry requirements for each airspace class called out by instructor.
COMMON ERRORS	• Confusing Class D (surface to 2,500 AGL) with Class C lateral limits — *Correction: overlay circles exercise on sectional.* • Forgetting two-way radio contact ≠ clearance for Class C — *Correction: emphasize ATC does not have to say 'cleared to enter.'* • Mixing up Special Use Airspace types — *Correction: acronym card: P-R-W-A-MOA-A (Prohibited, Restricted, Warning, Alert, MOA, Controlled Firing).*
COMPLETION STANDARD	Student correctly identifies class, equipment, certification, and entry requirements for 10/10 scenario cards without reference to notes. Student locates and describes at least three different airspace classes on the local sectional chart. Meets ACS PA.I.B knowledge standard.

Instructor Design Note: Lecture is appropriate here for initial concept introduction, but the lesson transitions to active practice (chart exercise + scenario cards) because FAA research confirms students retain regulatory specifics far better through application than passive listening. The incident case study opening applies the Law of Effect — connecting the content to a real outcome the student wants to avoid.

LESSON I–D

STUDENT EVALUATION, ASSESSMENT & Testing

Duration: 90–120 min	**References:** FAA-H-8083-9B Ch. 6 | FAA-H-8083-25C | FAA-S-ACS-25 Area I	**Audience:** CFI Applicant

ACS Reference: Area of Operation I (Fundamentals of Instructing), Task D — Student Evaluation, Assessment, and Testing — FAA-S-ACS-25 p. 5 | Knowledge: FI.I.D.K1–K7 | Risk: FI.I.D.R1 | Skill: FI.I.D.S1

LESSON OBJECTIVES

By the end of this lesson the applicant will be able to:

- Explain the purpose of assessment in aviation training and identify the characteristics of an effective assessment.
- Distinguish between traditional and authentic assessment methods and select the appropriate method for a given instructional situation.
- Describe learner-centered assessment, maneuver/procedure grading, and assessment of risk management skills.
- Explain the purposes and types of critiques and deliver a structured, effective critique of student performance.
- Construct oral assessment questions that meet the characteristics of effective questions, and identify question types to avoid.
- Explain how to handle learner questions using the relay, redirect, and reverse techniques.
- Assess piloting ability using ACS standards and explain the factors that influence a valid evaluation of flight performance.

MOTIVATION

Assessment is the bridge between instruction and learning. An instructor who teaches well but assesses poorly will advance students who are not ready, miss students who are struggling, and ultimately send pilots into the system who lack the competence the ACS demands. Equally important, a poorly delivered critique can demoralize a student who is genuinely progressing, while a well-constructed critique accelerates growth and builds the habit of self-evaluation that will protect that pilot long after training ends. Every assessment a CFI makes — formal or informal, oral or written, flight or ground — is a professional judgment that carries regulatory and safety consequences. This lesson develops the knowledge and skill to make those judgments accurately, consistently, and in a way that serves the learner.

KEY CONCEPTS

1. Purpose and Characteristics of Effective Assessment

Assessment is the process of measuring a learner's knowledge, skill, or attitude against a defined standard. In aviation training, assessment serves three purposes: to diagnose gaps in learning, to motivate continued effort, and

to document readiness for advancement. *(FAA-H-8083-9B, Ch. 6)*

Characteristics of Effective Assessment

Characteristic	Definition	Example of Failure
Objective	Based on observable, measurable performance against the ACS standard; not colored by the instructor's personal feelings about the student	Passing a student on slow flight because they 'seem confident' rather than because they met the ±10 kt airspeed standard
Flexible	Adapted to the student's level, experience, and the conditions of the lesson; not rigidly identical for every student	Applying commercial pilot standards to a student pilot on their third flight
Acceptable	Understood and accepted by the student as fair, relevant, and connected to ACS standards; not surprising or arbitrary	Telling a student they failed without explaining which standard was not met
Comprehensive	Evaluates all relevant aspects of the task: knowledge, risk management, and skill	Grading only airspeed control on a cross-country without evaluating navigation or weather decisions
Constructive	Identifies what was done correctly as well as what needs improvement; provides a path forward, not just a verdict	Critique that lists only errors with no acknowledgment of progress or guidance for correction
Organized	Follows a logical sequence; covers the most critical items first	Jumping from topic to topic during a debrief with no structure
Thoughtful	Considers the impact of critique on the student's motivation and self-concept; delivered with empathy	Criticizing a student sharply in front of others; failing to acknowledge anxiety or fatigue
Specific	Names the exact behavior, the standard it failed to meet, and the correction required	'Your landings need work' instead of 'You were 200 ft high on final; use a consistent power reduction at the FAF to establish the correct glide path.'

2. Traditional Assessments

Traditional assessments measure knowledge using standardized written or oral instruments. They are efficient and objective, but limited in their ability to evaluate applied skill or aeronautical decision-making. *(FAA-H-8083-9B, Ch. 6)*

Type	Description	Aviation Use	Limitation
Written Test (Objective)	Multiple choice, true/false, matching, fill-in-the-blank; machine or hand-scorable; single correct answer	FAA Knowledge Test; stage-check written exams; regulatory knowledge review	Measures only recall and recognition; cannot assess judgment, skill, or risk management
Written Test (Subjective)	Short answer or essay; evaluator judges quality of response against criteria	Case study analysis; accident investigation summaries; weather briefing write-ups	Scoring variability between evaluators; time-intensive to grade; harder to standardize

Oral Examination	Evaluator poses questions; student responds verbally; evaluator probes for depth	FAA practical test oral portion; pre-solo knowledge check; stage-check oral component	Evaluator bias possible; student anxiety may suppress performance; not easily documented

Instructor Note: The FAA Knowledge Test is a traditional objective assessment. Passing it demonstrates minimum knowledge recall but does not indicate the student can apply that knowledge to real decisions. The practical test oral is a traditional subjective assessment. Both are necessary — neither alone is sufficient to certify a pilot.

3. Authentic Assessments

Authentic assessments measure a student's ability to apply knowledge and skill in realistic contexts. They are more representative of actual flying than traditional tests, but require more instructor skill to administer and score fairly. *(FAA-H-8083-9B, Ch. 6)*

Learner-Centered Assessment	The student evaluates their own performance against a defined standard before the instructor offers feedback. The instructor asks: 'How do you think that went? What standard were you trying to meet?' The student's self-assessment is then compared to the instructor's observation. Discrepancies (student over- or underestimates performance) reveal as much about learning as the performance itself. Develops the self-critique habit essential for solo flight and post-certification flying.
Maneuver or Procedure Grades	Each maneuver or procedure is graded against ACS standards on a defined scale. Common scales: Pass/No-Pass (binary, ACS-aligned); Satisfactory/Unsatisfactory; numerical (1–4 or 1–5). The grade documents not just the outcome but the trend over multiple attempts — a student improving from 3 to 4 to 5 over three lessons demonstrates mastery in progress. Grades should always reference the specific ACS element (e.g., PA.V.A ±5° bank, ±100 ft altitude).
Assessing Risk Management Skills	Evaluates whether the student correctly identifies hazards, assesses risk, and selects appropriate mitigations in scenario-based situations. Methods: scenario cards; PAVE checklist debrief; go/no-go decision exercises; post-flight risk discussion. Risk management cannot be assessed through written tests alone — the student must demonstrate the thought process in a realistic context. ACS risk elements (e.g., FI.I.D.R1) should be referenced explicitly in assessment records.

4. Choosing an Effective Assessment Method

No single assessment method is appropriate for all learning outcomes. The instructor must select the method that best matches the learning domain, the lesson objective, and the student's current stage of training. *(FAA-H-8083-9B, Ch. 6)*

Learning Domain	What Is Being Assessed	Best Assessment Method(s)
Cognitive (Knowledge)	Recall of regulations, procedures, weather concepts, systems	Written objective test; oral questioning; scenario-based discussion
Cognitive (Application)	Using knowledge to solve a problem: W&B; calculation, cross-country planning, weather go/no-go	Practical problem-solving exercise; scenario-based oral; preflight planning debrief

Cognitive (Analysis / Judgment)	Evaluating options, assessing risk, making ADM decisions	Scenario-based training (SBT); PAVE debrief; post-flight risk discussion; case study analysis
Psychomotor (Skill)	Flight maneuver performance: steep turns, landings, instrument approaches	In-flight observation against ACS standards; maneuver grade; debrief with learner self-assessment
Affective (Attitude)	Professionalism, hazardous attitude recognition, CRM behavior	Behavioral observation; guided discussion; scenario debrief; long-term pattern analysis

5. Purposes and Types of Critiques

A critique is a structured evaluation of student performance delivered after a lesson or maneuver. Its purpose is not to judge the student but to accelerate learning by providing specific, actionable feedback connected to a defined standard. *(FAA-H-8083-9B, Ch. 6)*

Purposes of a Critique

- Reinforce what was done correctly — confirming good habits before they become inconsistent.
- Identify what must change — naming the specific behavior that did not meet the standard.
- Provide a correction path — telling the student exactly what to do differently next time.
- Document the lesson — creating a record that supports progression decisions.
- Develop self-assessment habits — asking the student to evaluate their own performance first.

Types of Critiques

Type	Description	Best Use	Key Consideration
Instructor Critique	Instructor delivers structured feedback to the student. Common structure: positive opening → areas for improvement → positive closing (the 'sandwich'). Should be specific, organized, and time-limited.	Post-flight debrief; ground lesson review; stage check debrief	Student self-assessment should precede instructor critique whenever possible
Student-Led (Self-Critique)	Student evaluates their own performance first; instructor guides and corrects. Instructor asks: 'What did you do well? What would you do differently?'	All debriefs; promotes self-assessment habit for solo and post-certificate flying	Students may be overly harsh or overly generous; both reveal important information
Group Critique (Peer Review)	Group of students reviews a performance or scenario together; instructor facilitates without dominating	Ground school; scenario analysis; accident case study; simulator debrief	Prevent one student from dominating; ensure feedback remains constructive
Written Critique	Instructor provides written feedback on a performance or assignment; student can review and reference it later	Written assignments; online CBT follow-up; cross-country planning review	Must be legible, specific, and delivered promptly to have maximum impact

Recorded Critique	Audio or video of the performance is reviewed by student and/or instructor	Advanced training; unusual attitude recovery; checkride preparation	Student must consent; recordings should be used to identify patterns, not embarrass

The Sandwich Critique (Use with Caution): The positive-negative-positive structure is widely taught but easily misused. When the positives are generic ('Good flight!') and the negative is specific and lengthy, students learn to wait through the positives for the real feedback. The structure works only when all three elements are equally specific and genuine. A better approach: lead with the student's self-assessment, then provide instructor-specific feedback on the most critical items in order of safety significance.

6. Oral Assessment

Oral assessment is the primary evaluation tool during both ground instruction and the FAA practical test oral examination. Its effectiveness depends entirely on the quality of the questions asked and the instructor's skill in interpreting and responding to answers. *(FAA-H-8083-9B, Ch. 6)*

Characteristics of Effective Oral Questions

Characteristic	Description	Example
Clear	Unambiguous; the student knows exactly what is being asked	'What is the minimum fuel reserve required for a VFR day flight under 14 CFR §91.151?'
Concise	Brief enough to be remembered while thinking; not compound questions	Avoid: 'Tell me about weather and how you'd plan a cross-country and what equipment you'd need.'
Adapted	Matched to the student's level; does not require knowledge not yet covered	Do not ask a pre-solo student to explain ETOPS alternates
Purposeful	Each question targets a specific ACS knowledge or skill element; not filler	Every question should be traceable to an ACS code or a lesson objective
Thought-Provoking	Requires analysis or application, not just recall; moves beyond memorized answers	'You're 50 miles out and the METAR shows 3 SM visibility. What's your decision process?'

Question Types to Avoid

Type to Avoid	Why It Fails	Example / Fix
Leading Question	Signals the correct answer; student confirms rather than demonstrates knowledge	'You'd check the weather before a long cross-country, right?' → Fix: 'Walk me through your weather decision process for a 200 nm cross-country.'
Yes/No Question	Provides no information about depth of understanding; student can guess correctly 50% of the time	'Do you know what density altitude is?' → Fix: 'Explain density altitude and its effect on takeoff performance.'
Trick Question	Designed to confuse rather than evaluate; destroys student trust	Intentionally ambiguous questions with no clear correct answer

Compound Question	Multiple questions in one; student does not know which to answer; evaluator cannot identify gaps	'What are VFR weather minimums and how do METARs work and what's a SIGMET?' → Fix: Ask one question at a time.
Irrelevant Question	Not tied to the lesson objective or ACS standard; wastes limited ground time	Asking about multi-engine OEI procedures in a private pilot pre-solo oral

Handling Learner Questions

Relay	Redirect the learner's question to another student in the group. 'Good question — Sarah, what do you think the answer is?' Use: Group ground school settings; when another student may know the answer and benefit from explaining it.
Redirect	Return the question to the student who asked it, after a brief prompt. 'That's an important question. Based on what you know about density altitude, what would you expect?' Use: When the student likely has the knowledge and needs a nudge to access it; builds self-confidence.
Reverse	Answer a student's question with a question that builds toward the answer. 'Before I answer that, tell me what happens to lift when you increase angle of attack beyond C■.' Use: When Socratic discovery is more valuable than direct instruction; builds analytical thinking.
Direct Answer	Answer directly when the student genuinely cannot access the information and delay serves no purpose. Safety-critical questions always receive direct answers: 'If the engine quits at 500 ft AGL, do not attempt to return to the runway.' Use: Emergency procedures; time-sensitive safety information; knowledge not yet covered in training.

7. Assessment of Piloting Ability

Assessing piloting ability requires the evaluator to observe performance objectively, measure it against published standards, and account for the variables that can validly affect performance without lowering the standard. *(FAA-H-8083-9B, Ch. 6)*

The Standard	The ACS defines the standard for every maneuver: the tolerances are not targets but minimum acceptable performance. An instructor who accepts performance outside ACS tolerances is certifying below standard. The standard does not change based on the student's 'effort' or the instructor's assessment of their 'potential.'
Single vs. Pattern of Performance	One error does not define the student. Assess patterns across multiple attempts: a student who consistently loses 150 ft in steep turns despite correction has a deeper problem than one who lost 110 ft once on a turbulent day. Document both the individual performance and the trend. Progression decisions should be based on the pattern.
Factors Affecting Validity	Environmental factors (turbulence, crosswind, ATC workload) can affect performance without indicating a learning failure. A valid assessment accounts for these factors and repeats the evaluation under more controlled conditions when validity is in doubt. Stress, fatigue, illness, and personal issues can also suppress performance temporarily.
Detecting the Unsafe Pilot	The most important assessment skill is recognizing when a student is unsafe to solo or advance. Signs: consistently fails to clear before maneuvers; ignores traffic calls; shows poor judgment in go/no-go decisions; demonstrates hazardous attitudes (invulnerability, anti-authority). These are not technique errors — they are character and judgment issues that require immediate action and documentation.

Documentation	Every assessment that affects a training decision must be documented in the student's training record with: date, lesson, maneuvers evaluated, ACS standard referenced, performance observed, and the instructor's determination. Undocumented assessments create regulatory risk for the instructor and safety risk for the student.

COMMON ERRORS

Common Error	Recognition	Correction
Halo effect	Instructor rates all aspects of a student's performance high (or low) because of one outstanding (or poor) characteristic	Evaluate each ACS element independently. Ask: 'Did this specific maneuver meet this specific standard?' before forming a global judgment.
Central tendency	Instructor avoids giving very high or very low ratings; clusters all ratings near the middle of the scale	Use ACS standards as anchors: a student either met the standard or did not. Binary pass/no-pass eliminates the temptation to split the middle.
Unwarranted leniency	Instructor passes students who have not met ACS standards because of time pressure, student frustration, or a desire to avoid conflict	Remember: advancing an unprepared student harms them and endangers others. Schedule an additional lesson and document the reason for the extension.
Critique without specifics	Instructor delivers vague feedback: 'Your approach was a little off.'	Every critique point must name: (1) the specific behavior, (2) the standard it missed, (3) the correction. 'You were 200 ft high at the 50 ft key position. Reduce power by 200 RPM earlier, at the 90° position.'
Skipping self-assessment	Instructor launches immediately into critique without asking the student to evaluate first	Build student self-assessment into every debrief as a non-negotiable first step. The habit developed here will serve the student for their entire flying career.
Oral questions that only test recall	All oral questions are at the 'knowledge' level: 'What is Vso?' 'What does a METAR include?'	Mix question levels: recall (K), application (how would you use this?), and analysis (what would you do if…?). The ACS emphasizes application and decision-making, not memorization.

COMPLETION STANDARDS

COMPLETION STANDARDS (from FAA-S-ACS-25)

✓ Applicant accurately explains all knowledge elements (FI.I.D.K1–K7): purpose of assessment, traditional and authentic methods, characteristics of effective assessment, critique types, oral assessment techniques, and assessment of piloting ability.

✓ Applicant identifies and mitigates the risk associated with FI.I.D.R1 (delivering an assessment) by describing at least two assessment errors (e.g., halo effect, unwarranted leniency) and their corrections.

✓ Applicant demonstrates FI.I.D.S1 by constructing an oral assessment sequence for a given lesson objective that includes at least one recall, one application, and one analysis-level question, and by delivering a structured critique of a described student performance.

✓ Applicant correctly distinguishes between traditional and authentic assessment, explains when each is most appropriate, and explains how to assess risk management skills in flight training.

✓ Applicant explains the relay, redirect, and reverse techniques for handling learner questions and demonstrates appropriate use of each in a scenario presented by the evaluator.

REVIEW QUESTIONS

REVIEW QUESTIONS & ANSWERS

Q1. What are the eight characteristics of an effective assessment? Give an aviation example of a failure to meet any two of them.

■ *The eight characteristics are: objective, flexible, acceptable, comprehensive, constructive, organized, thoughtful, and specific. Example failures: (1) Failing to be specific — telling a student 'your approaches need work' without identifying which aspect, which standard was missed, or what correction is required. (2) Failing to be constructive — delivering a critique that lists only errors with no acknowledgment of what was done correctly and no path forward for improvement.*

Q2. A student has just completed their first solo cross-country. Describe how you would structure the post-flight debrief using learner-centered assessment.

■ *Begin by asking the student to assess their own flight: 'Walk me through the flight — what went well, and what would you do differently?' Listen without interrupting. Note where their self-assessment matches your observation (confirming accurate self-awareness) and where it diverges (revealing blind spots). Then provide your own structured critique: confirm what they identified correctly, add what they missed, and for each area needing improvement, name the specific behavior, the standard, and the correction. End with a forward-looking statement about the next lesson.*

Q3. Identify three types of questions to avoid in oral assessment and explain why each fails to produce valid assessment information.

■ *(1) Leading questions — signal the correct answer so the student confirms rather than demonstrates knowledge; the evaluator learns nothing. (2) Yes/no questions — give no information about the depth or accuracy of the student's understanding; the student has a 50% chance of being correct by guessing. (3) Compound questions — ask multiple things simultaneously; the student doesn't know which to answer and the evaluator cannot identify which element the student knows or doesn't.*

Q4. What is the difference between the relay, redirect, and reverse techniques for handling learner questions? When would you use each?

■ *Relay: Redirect the question to another student. Use in group settings when a peer may know the answer and benefit from explaining it. Redirect: Return the question to the asking student with a prompt. Use when the student likely has the knowledge and needs encouragement to access it — builds confidence. Reverse: Answer with a question that builds toward the answer. Use when Socratic discovery is more valuable than direct instruction — develops analytical thinking. Always use a direct answer for safety-critical information or knowledge not yet covered.*

Q5. Describe the halo effect and central tendency as assessment errors. How does an ACS-referenced pass/no-pass system reduce both?

■ *Halo effect: Allowing one outstanding or poor characteristic to color the rating of all other elements — e.g., giving a student high marks on all maneuvers because their radio work is excellent. Central tendency: Avoiding extreme ratings by clustering assessments near the middle — neither acknowledging truly excellent nor truly deficient performance. ACS-referenced pass/no-pass eliminates both by anchoring each element to a specific, objective standard: the student either maintained altitude ±100 ft or did not. There is no subjective scale on which to cluster or for impressions from one element to contaminate another.*

Q6. How should an instructor assess risk management skills, and why can't a traditional written test accomplish this alone?

■ *Risk management skills must be assessed in realistic, scenario-based contexts: PAVE checklist debrief; go/no-go decision exercises; post-flight risk discussion; scenario cards requiring the student to identify hazards and select mitigations. A traditional written test can assess recall of risk management concepts (e.g., 'Name the four PAVE elements') but cannot assess whether the student actually applies those concepts under realistic pressure, accounts for incomplete information, or recognizes risk factors that were not explicitly listed in a question stem. The ACS requires demonstration of risk management in context — not memorization of a framework.*

Instructor: _____ Date: _____ Applicant: _____

LESSON I–E

ELEMENTS OF EFFECTIVE TEACHING

in a Professional Environment

Duration: 90–120 min	**References:** FAA-H-8083-9B Ch. 8 | FAA-H-8083-25C | FAA-S-ACS-25 Area I	**Audience:** CFI Applicant

ACS Reference: Area of Operation I (Fundamentals of Instructing), Task E — Elements of Effective Teaching in a Professional Environment — FAA-S-ACS-25 p. 6 | Knowledge: FI.I.E.K1–K5 | Risk: FI.I.E.R1–R2 | Skill: FI.I.E.S1 | Note: Task E is one of two tasks (with Task F) that the evaluator MUST select for all initial CFI practical tests.

LESSON OBJECTIVES

By the end of this lesson the applicant will be able to:

- Describe all five aviation instructor responsibilities (FI.I.E.K1a–e) and explain how each directly affects student safety and learning outcomes.
- Explain the unique supervisory and surveillance responsibilities of a flight instructor during training, including when to intervene.
- Identify the qualifications required to hold a flight instructor certificate and explain the difference between certificate currency and genuine professionalism.
- Describe the pathways and importance of professional development, and articulate a personal plan for maintaining instructor competency.
- Define instructor ethics and conduct as applied to the instructor-student relationship, including boundaries and conflicts of interest.
- Recognize and mitigate the risks associated with failing to fulfill instructor responsibilities (R1) and failing to exhibit professionalism (R2).
- Deliver ground or flight instruction on an evaluator-assigned task in a manner fully consistent with the professional characteristics described in K1–K5.

MOTIVATION

A flight instructor is the final human filter between a student and a certificate. When that filter fails — when an instructor advances an unprepared student, allows a hazardous attitude to go uncorrected, or signs off a logbook because it is easier than saying no — the consequences can be fatal, and they can arrive weeks or years after the training ended. The FAA's data consistently identifies instructional failure as a contributing factor in general aviation accidents: not just skill deficiency in the student, but deficiency in the professional behavior of the instructor who trained them. This lesson defines what it means to be a professional aviation instructor — not in the abstract, but in specific, observable, enforceable behaviors that can be demonstrated on a practical test and practiced throughout a career.

KEY CONCEPTS

1. Aviation Instructor Responsibilities (FI.I.E.K1a–e)

The FAA identifies five core responsibilities that define effective and professional aviation instruction. These are not aspirational goals — they are baseline professional obligations. *(FAA-H-8083-9B, Ch. 8)*

Responsibility	Definition	What Failure Looks Like	ACS Code
Helping Learners (K1a)	Actively supporting the student's growth: diagnosing barriers, adapting methods, and prioritizing the student's development over the instructor's convenience or schedule. The instructor's job is to make the student successful — not to demonstrate the instructor's own skill.	Instructor blames the student for slow progress without adapting methods. Instructor skips extra explanation because the lesson is running long.	FI.I.E.K1a
Providing Adequate Instruction (K1b)	Delivering instruction that is thorough, accurate, and appropriate to the student's current level. 'Adequate' means sufficient to produce competence — not minimum required time, but minimum required learning. The instructor must teach until the student can perform, not until the Hobbs meter reads a target number.	Instructor meets the minimum flight hour requirement and endorses the student regardless of demonstrated competence. Ground briefings are rushed or skipped.	FI.I.E.K1b
Training to Established Standards (K1c)	Holding students to the published ACS standards consistently, without exception. Standards are not negotiable based on student frustration, time pressure, or the instructor's desire to be liked. Every endorsement is a legal certification that the student met the standard.	Instructor passes a student on steep turns with a 200 ft altitude deviation because the student 'usually does better.' Standard is adjusted downward for a student who is paying for lessons.	FI.I.E.K1c
Emphasizing the Positive (K1d)	Building the student's confidence by acknowledging genuine progress, framing corrections constructively, and ensuring that positive feedback is specific and earned. Emphasizing the positive is not false praise — it is accurate recognition of what is working, delivered in proportion to its significance.	Instructor only comments on errors; never acknowledges improvement. Alternatively, instructor praises everything regardless of quality, rendering positive feedback meaningless.	FI.I.E.K1d
Minimizing Learner Frustrations (K1e)	Recognizing the signs of student frustration (impatience, apathy, fixation, regression) and intervening before frustration becomes a barrier to learning. Methods: change the environment, shorten the lesson, acknowledge the difficulty, return to a lesson the student can succeed at before re-attempting the difficult one.	Instructor continues drilling a maneuver the student has failed repeatedly in the same lesson without changing the approach. Instructor attributes frustration to lack of effort rather than instructional failure.	FI.I.E.K1e

Key Insight: These five responsibilities are not independent — they form a system. An instructor who trains to standards (K1c) without emphasizing the positive (K1d) will produce frustrated students who meet minimums but lack confidence. An instructor who minimizes frustrations (K1e) without holding standards (K1c) will produce confident students who are not competent. All five must be present simultaneously.

2. Flight Instructor Responsibilities: Supervision and Surveillance (FI.I.E.K2)

Beyond the general teaching responsibilities that apply to all instructors, the flight instructor carries a specific set of legal and safety obligations that arise from the unique environment of flight training. *(FAA-H-8083-9B, Ch. 8; 14 CFR Part 61)*

Supervision During Dual Instruction	During all dual flight instruction, the CFI is the pilot in command (PIC) regardless of who has the controls. The instructor's right to maintain control is absolute and must be exercised immediately whenever safety requires it. 'Passive supervision' — watching a student make a dangerous error without intervening — is not an instructional technique; it is a safety failure. The threshold for intervention is: *any situation that a reasonable instructor would not allow to continue.*
Positive Exchange of Controls	The FAA's three-step control transfer procedure eliminates ambiguity about who is flying the aircraft. It is required for all control transfers in dual instruction: (1) Transferring pilot says 'You have the controls.' (2) Receiving pilot says 'I have the controls.' (3) Transferring pilot confirms 'You have the controls.' Failure to use this procedure has been a contributing factor in accidents where both pilots assumed the other was flying.
Solo Flight Endorsements	Before any student solo flight, the instructor must have verified that the student has met all requirements under 14 CFR 61.87 (first solo) and issued the appropriate logbook endorsement. The endorsement is a legal certification. Signing an endorsement without documented proficiency evaluation is a regulatory violation that can result in suspension or revocation of the instructor certificate.
Surveillance During Solo	The CFI retains responsibility for a solo student throughout the authorized flight. The instructor should be available by radio or phone, aware of the weather conditions for the authorized area, and prepared to deny a solo if conditions deteriorate. Authorizing a solo and walking away is insufficient supervision.
Record-Keeping	The instructor must maintain records of endorsements given, including: student name, the specific endorsement language from AC 61-65, date, and instructor certificate number and expiration. 14 CFR 61.189 requires these records be maintained for three years. Records protect both the student and the instructor in the event of an accident investigation or enforcement action.

3. Flight Instructor Qualifications and Professionalism (FI.I.E.K3)

Holding a flight instructor certificate establishes minimum legal qualifications. Professionalism requires substantially more — it is a standard of conduct, not a credential. *(FAA-H-8083-9B, Ch. 8)*

Minimum Qualifications (14 CFR 61.183)

- Hold the certificate and rating applicable to the instruction being given (e.g., CFI ASEL to teach in single-engine land airplanes).
- Meet the flight time and aeronautical experience requirements of 14 CFR 61.183.
- Pass the required knowledge tests: Fundamentals of Instructing (FOI) and the appropriate aircraft knowledge test.

- Pass the CFI practical test with an FAA-designated pilot examiner.
- Hold a valid medical certificate (or BasicMed for privileges that allow it).
- Maintain a current flight review (14 CFR 61.56) and comply with any recent flight experience requirements.

Professionalism Beyond Minimum Qualifications

Professional Attribute	Description	Contrast with Minimum Qualification
Technical Currency	Staying current on regulations, procedures, avionics, and aircraft systems beyond what is strictly required for certificate maintenance. Reading NOTAMs, attending safety seminars, flying regularly in the types being taught.	Minimum: hold a current CFI certificate. Professional: actually know what changed in the last AIM revision and how it affects your students.
Instructional Competency	Continuously improving teaching skills: understanding learning theory, adapting to different student types, seeking feedback on instructional performance.	Minimum: passed the FOI knowledge test. Professional: can actually apply adult learning principles to a student who is struggling.
Honesty About Limitations	Referring a student to a more experienced or specialized instructor when the task exceeds the instructor's genuine competency. 'I can teach you instrument approaches, but for multi-engine instruction, I'd recommend working with an instructor with more multi time.'	Minimum: only teach within your certificate privileges. Professional: only teach within your genuine competency, which may be narrower.
Reliability	Keeping scheduled lesson times, arriving prepared, returning student communications promptly, and being ready to teach the lesson — not improvising in the preflight.	Minimum: show up. Professional: show up prepared, on time, with a plan, and student records reviewed.
Appearance and Conduct	Presenting a professional appearance and demeanor that models the standards expected of certificated pilots. The instructor is always a role model — the student notices everything: how the preflight is conducted, how ATC is addressed, how checklists are used.	Minimum: no specific appearance requirement. Professional: conduct yourself as the pilot you want your student to become.

4. Professional Development (FI.I.E.K4)

Professional development is the ongoing process of improving as an instructor throughout a career. It is not a checkbox or a renewal requirement — it is the commitment to being better at teaching aviation than you were last year. *(FAA-H-8083-9B, Ch. 8)*

FAA WINGS Program	The FAA Safety Team's voluntary proficiency program. Pilots complete knowledge and flight activities to earn 'wings' at various phases. For instructors, participation also satisfies the flight review requirement (14 CFR 61.56) and demonstrates commitment to safety culture. Instructors who participate in WINGS are statistically less likely to be involved in accidents.

FAA Safety Seminars & Webinars	Free FAASTeam events covering current safety topics, accident trends, regulatory updates, and best practices. Attendance demonstrates initiative and exposes the instructor to current accident data that should directly inform what they teach about risk management. Available at faasafety.gov.
Industry Organizations	NAFI (National Association of Flight Instructors): professional organization for flight instructors; offers the Master CFI designation, mentoring, and industry resources. SAFE (Society of Aviation and Flight Educators): focuses on instructor professionalism and standardization. AOPA Air Safety Institute: accident analysis resources, online courses, and CFI renewal programs.
Formal Education & Mentoring	Advanced certificates and ratings (CFII, MEI, ATP) directly expand instructional capability and technical currency. Mentoring relationships with more experienced instructors accelerate professional growth faster than solo experience alone. The CFI applicant should identify a mentor before the ink is dry on their certificate.
Self-Assessment & Peer Review	Regularly reviewing your own instructional performance: recording and critiquing ground lessons; asking students for feedback; observing other instructors; benchmarking against ACS standards rather than personal habits. The CFI who stops growing stops being effective — often without realizing it.

5. Instructor Ethics and Conduct (FI.I.E.K5)

Instructor ethics govern the professional conduct of the instructor-student relationship. Aviation instruction creates a significant power differential: the student depends on the instructor for knowledge, endorsements, and ultimately a certificate. Ethics define how that power is exercised. *(FAA-H-8083-9B, Ch. 8)*

Ethical Obligation	Standard	Violation Example
Honesty in Assessment	The instructor must assess and report student performance accurately, regardless of the student's response or the financial relationship. Providing a false or misleading endorsement is both unethical and illegal.	Signing a solo endorsement for a student who has not demonstrated ACS competency because the student is frustrated and threatening to go to another school.
Avoidance of Conflicts of Interest	The instructor should not allow financial, personal, or competitive interests to affect instructional decisions. The student's safety and progress are the only legitimate criteria for advancement.	Delaying a student's checkride recommendation to accumulate additional lesson revenue. Rushing a student to checkride to impress a chief instructor.
Appropriate Boundaries	The instructor-student relationship is a professional relationship. Personal friendships and romantic relationships with current students create conflicts of interest that compromise the instructor's ability to assess and correct honestly.	Giving a passing assessment to a student who is a close personal friend despite documented performance deficiencies.
Accurate Record-Keeping	Logbook entries must be accurate and honest. The instructor must not enter hours, maneuvers, or endorsements that were not completed to standard. Falsification of logbook records is a federal violation.	Logging a flight as 'simulated instrument' when the student did not wear a view-limiting device and conditions were VMC.

Obligation to Report Unsafe Conditions	If an instructor becomes aware of a student who poses a safety risk to themselves or others, the instructor has a professional and potentially legal obligation to take action: document the concern, consult with a chief instructor or FSDO, and withhold endorsement until the issue is resolved.	Allowing a student with documented spatial disorientation tendencies to continue training without a documented plan to address the deficiency.
Currency vs. Competency	The instructor must not exercise instructional privileges beyond their genuine competency, even if their certificate allows it. Being legal is a necessary but not sufficient condition for professional instruction.	Teaching aerobatics because the certificate does not restrict it, without having received formal aerobatic instruction or currency.

The Bottom Line on Ethics: Every endorsement a CFI signs is a legal statement that the student meets a federal standard. Every logbook entry is a legal document. Every instructional decision is a professional judgment that can be reviewed by the FAA in an accident investigation. The question 'What would I do if this ended up in front of an NTSB report?' is not paranoia — it is the professional standard of care.

RISK MANAGEMENT

The ACS identifies two specific risk elements for Task E that the applicant must be able to identify, assess, and mitigate. *(FAA-S-ACS-25, FI.I.E.R1–R2)*

Risk Element	Description	Assessment Questions	Mitigation
FI.I.E.R1 Fulfilling Instructor Responsibilities	The risk that an instructor fails to meet one or more of the K1 responsibilities, leading to an undertrained student who advances in the system. This is one of the highest-risk failure modes in general aviation training because its consequences may not appear until long after the training relationship ends.	Am I holding this student to the published ACS standard? Am I adapting my method when the student is not progressing? Am I documenting all assessments accurately?	Use a written training record for every lesson. Reference ACS standards explicitly in every debrief. Apply a self-check before any endorsement: 'Would I be comfortable defending this decision to an FAA inspector?'
FI.I.E.R2 Exhibiting Professionalism	The risk that an instructor's unprofessional behavior — inaccurate record-keeping, ethical violations, failure to maintain currency, or poor conduct — harms a student or compromises the integrity of the certification system. Unlike skill-based risks, professionalism failures are often invisible until something goes wrong.	Is my currency genuinely current or just minimally compliant? Am I allowing any personal or financial interest to affect my instructional decisions? Am I modeling the cockpit behavior I want my students to have?	Maintain a personal professional development plan. Seek peer review of instructional performance. Establish and maintain clear professional boundaries with all students. Consult FAA resources (AC 61-65, AIH) regularly.

COMMON ERRORS

Common Error	Recognition	Correction
Confusing minimum qualifications with professionalism	Applicant describes the CFI certificate requirements when asked about 'what it means to be a professional instructor'	Professionalism is a standard of conduct, not a credential. Reframe: 'The certificate is the legal minimum. Professionalism is the personal commitment to exceed that minimum in every lesson.'
Failing to distinguish supervision from instruction	Applicant describes the CFI's role during dual instruction as purely instructional, without acknowledging the PIC safety responsibility	Emphasize: during dual flight, the CFI is always PIC regardless of who holds the controls. Safety intervention is not optional — it is the primary obligation.
Generic positive feedback	During a demo lesson, applicant says 'Good job!' or 'Nice work!' after every student action regardless of quality	Positive feedback must be specific and earned: 'Your rollout was exactly on heading — that's exactly what we're looking for.' Vague praise loses all value within a few lessons.
Ignoring frustration signals	Applicant continues drilling a maneuver after student shows clear signs of frustration (silence, terse responses, declining performance trend)	Recognize the signals: silence, short answers, sighing, erratic performance. Intervene: change the lesson structure, acknowledge the difficulty, or return to a lesson the student can succeed at before re-attempting.
Treating ethics abstractly	Applicant discusses instructor ethics in theoretical terms without connecting them to specific professional scenarios or regulatory consequences	Ethics must be grounded in specific behaviors: endorsements, logbook entries, assessment integrity. Use concrete examples: 'Would I sign this endorsement if I knew the FAA would review it tomorrow?'
Confusing professional development with mandatory recurrency	Applicant equates professional development with the biennial flight review or CFI renewal requirements	Recurrency is the minimum. Professional development is voluntary, proactive, and ongoing: WINGS, safety seminars, NAFI/SAFE membership, advanced certificates, peer mentoring — none of which are required but all of which make better instructors.

COMPLETION STANDARDS

COMPLETION STANDARDS (from FAA-S-ACS-25)
✓ Applicant accurately explains all five aviation instructor responsibilities (FI.I.E.K1a–e) with specific aviation examples of both proper execution and failure for each.
✓ Applicant explains the flight instructor's supervisory and surveillance responsibilities (FI.I.E.K2), including the positive exchange of controls procedure, solo endorsement requirements, and record-keeping obligations.
✓ Applicant clearly distinguishes between minimum legal qualifications (FI.I.E.K3) and professional conduct, and identifies at least three attributes of professional behavior that exceed the regulatory minimum.

✓ Applicant describes at least four specific professional development pathways (FI.I.E.K4) and articulates a personal plan for maintaining and improving instructional competency after certificate issuance.

✓ Applicant explains instructor ethics and conduct (FI.I.E.K5) using specific behavioral examples, including endorsement integrity, conflict of interest avoidance, and the professional obligation to report unsafe student behavior.

✓ Applicant correctly identifies and mitigates both risk elements: FI.I.E.R1 (fulfilling instructor responsibilities) and FI.I.E.R2 (exhibiting professionalism) in at least one realistic scenario presented by the evaluator.

✓ Applicant demonstrates FI.I.E.S1 by delivering a ground or flight lesson segment on an evaluator-assigned task in a manner that visibly incorporates all five instructor responsibilities, consistent professional conduct, and appropriate supervision behavior.

REVIEW QUESTIONS

REVIEW QUESTIONS & ANSWERS

Q1. A student has failed their fifth attempt at a short-field landing. They are silent and their performance has deteriorated. Which of the five instructor responsibilities are most at risk of being violated right now, and what should you do?

■ *The responsibilities most at risk are minimizing learner frustrations (K1e) and emphasizing the positive (K1d). Continuing to drill the maneuver will compound frustration and may cause the student to associate flying with failure. Actions: (1) Acknowledge the difficulty honestly: 'Short-field landings are genuinely challenging — you're not alone in finding this hard.' (2) Change the lesson: return to a normal landing or pattern entry the student can succeed at — reestablish confidence before attempting short-field again. (3) Find something specific and genuine to reinforce: even a failed landing usually has one element that was correct. (4) Brief a fresh approach for the next lesson — different entry speed, different reference point, possibly a different runway.*

Q2. During a dual flight, your student sets up for a landing that is clearly going to result in a long, fast touchdown on a short runway. The student has not corrected despite your verbal prompt. What do you do, and what principle governs this decision?

■ *Take control immediately using the positive exchange of controls: 'I have the controls,' initiate a go-around, then debrief on the ground. The governing principle: during dual instruction, the CFI is PIC regardless of who holds the controls. The threshold for intervention is any situation a reasonable instructor would not allow to continue. A long, fast landing on a short runway meets that threshold. Allowing a dangerous situation to develop as an 'instructional exercise' is not a teaching technique — it is a safety failure and a PIC responsibility violation. The debrief should be specific: what the cue was, what the correct response would have been, and how the student should recognize and correct the situation independently next time.*

Q3. What is the difference between a CFI's minimum legal qualifications and genuine professional competency? Give two examples where the gap matters.

■ *Minimum legal qualifications: hold the appropriate CFI certificate and rating, meet experience requirements of 14 CFR 61.183, pass required knowledge tests and practical test, hold valid medical, and maintain current flight review. Professional competency is the actual ability to teach effectively within those privileges. Example 1: An instructor who holds a CFII but has not flown an instrument approach in six months is legally qualified to give instrument instruction, but lacks the genuine currency to demonstrate proficient approaches to a student — the student models what they see. Example 2: An instructor who passed the FOI test years ago but has never studied adult learning theory in practice is legally qualified to teach, but lacks the instructional competency to adapt when a student with a different learning style does not respond to standard methods.*

Q4. You discover that a colleague has been signing solo endorsements for students who have not completed all the required pre-solo maneuvers to ACS standard, citing time pressure and student frustration. What are the ethical issues, and what should you do?

■ *Ethical issues: (1) Dishonesty in assessment — a solo endorsement is a legal certification that the student meets 14 CFR 61.87 requirements; signing without demonstrated competency is both unethical and potentially illegal. (2) Conflict of interest — allowing time pressure or student frustration to override safety standards is a violation of the instructor's obligation to train to established standards (K1c). (3) Risk to the student — an undertrained solo student is a safety hazard to themselves and others. Actions: (1) Do not endorse students yourself unless they have genuinely met the standard. (2) Raise the concern with the chief flight instructor or school management. (3) If the behavior continues, the FAA has a Safety Hotline (1-800-255-1111) for reporting unsafe instructional practices. Your professional obligation to the safety of the NAS supersedes collegial loyalty.*

Q5. Describe the FAA WINGS program and explain why it matters for professional development beyond its benefit as a flight review substitute.

■ *The WINGS program is the FAASTeam's voluntary pilot proficiency initiative. Pilots complete knowledge activities (online courses, seminars) and flight activities (specific maneuver categories with a CFI) to earn proficiency — and each completed phase satisfies the 14 CFR 61.56 flight review requirement. Beyond the flight review benefit: (1) WINGS activities are designed around current accident cause data — participating instructors stay current on what is actually killing pilots. (2) The program creates a structured professional development habit: regular, documented, goal-directed training rather than the minimum required. (3) CFIs who actively participate in WINGS are statistically less likely to be involved in accidents. (4) It models the safety culture the instructor should be instilling in students.*

Q6. Explain the concept of 'training to established standards' (K1c). How should an instructor respond when a student consistently performs at the margin of the ACS standard but never clearly fails it?

■ *Training to established standards means the ACS defines the pass threshold, not the instructor's subjective sense of readiness. The standard is not negotiable based on student frustration, time in training, or tuition paid. A student who consistently performs at the margin requires a different instructional response than one who clearly fails: (1) Document the trend precisely — 'marginal performance over four consecutive lessons' is a pattern, not a passing record. (2) Diagnose the root cause — is the student stuck due to a knowledge gap, a technique flaw, or an external factor like stress or fatigue? (3) Change the instructional approach before changing the standard. (4) Set a clear intermediate benchmark: 'Before we schedule the stage check, I need to see three consecutive maneuvers that clearly pass — not three that barely pass.' The marginal student is the most professionally challenging to handle correctly — they are neither clearly passing nor clearly failing, and the temptation to advance them is strongest precisely when the risk is highest.*

Instructor: _____ Date: _____ Applicant: _____

LESSON I–F

RISK MANAGEMENT & ACCIDENT PREVENTION

in Flight Instruction

Duration: 90–120 min	**References:** FAA-H-8083-9B Ch. 9 | FAA-H-8083-2 | FAA-S-ACS-25 Area I	**Audience:** CFI Applicant

ACS Reference: Area of Operation I (Fundamentals of Instructing), Task F — Elements of Effective Teaching that Include Risk Management and Accident Prevention — FAA-S-ACS-25 p. 7 \| Knowledge: FI.I.F.K1–K6 \| Risk: FI.I.F.R1–R3 \| Skills: FI.I.F.S1–S2 \| Note: Task F is REQUIRED on all initial CFI practical tests.

LESSON OBJECTIVES

By the end of this lesson the applicant will be able to:

- Explain the three-step risk management process (identify, assess, mitigate) and apply it to flight instruction scenarios.
- Use the PAVE checklist and a Flight Risk Assessment Tool (FRAT) to conduct a structured preflight risk assessment.
- Explain when and how to introduce risk management concepts at each phase of student training.
- Describe risk management teaching techniques appropriate for preflight, flight, and post-flight instruction.
- Identify common risks specific to flight instruction and apply best practices for managing them, including special considerations for takeoff and landing instruction.
- Explain Aeronautical Decision-Making (ADM), Crew Resource Management (CRM), and Single-Pilot Resource Management (SRM) and describe how to teach each concept in a training environment.
- Recognize and manage the five hazardous attitudes, explain their antidotes, and demonstrate how to use scenario-based training to develop sound ADM in students.
- Identify, assess, and mitigate risks to situational awareness during dual flight instruction (R1–R3) and demonstrate S2a–S2c in a flight or scenario context.

MOTIVATION

The NTSB has identified pilot error — specifically poor aeronautical decision-making and inadequate risk management — as the leading cause of general aviation accidents for decades. Many of those pilots were certified. Many had adequate stick-and-rudder skills. What they lacked was the ability to recognize, assess, and respond to risk in real time. That ability is not developed automatically through flight experience — it must be deliberately taught, and taught early. A CFI who teaches only maneuvers and procedures but ignores risk management is producing pilots who can execute a perfect steep turn and still kill themselves on a VFR-into-IMC cross-country. This lesson equips the CFI applicant with the tools, techniques, and habits to make risk management a core element of every lesson they ever teach.

KEY CONCEPTS

1. Teaching Risk Identification, Assessment, and Mitigation (FI.I.F.K1)

Risk management is a three-step process that pilots must learn to apply before, during, and after every flight. The instructor's job is to make this process automatic — a habit of thought that activates before the engine starts. *(FAA-H-8083-9B, Ch. 9; FAA-H-8083-2)*

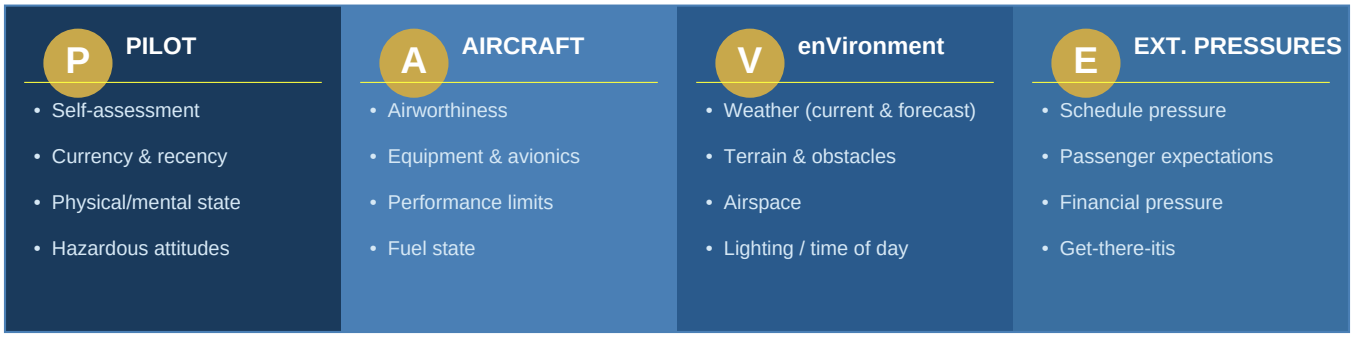
Step	Definition	Teaching Approach	Student Failure Mode
1. Identify	Recognize all potential hazards present in the planned flight: pilot condition, aircraft status, weather, terrain, airspace, time pressure, fatigue.	Use PAVE and FRAT as structured checklists. Ask students: 'What could go wrong on this flight? What are you not sure about?' before every lesson.	Tunnel vision on a single known hazard; missing hazards outside their current knowledge base; assuming that 'it looks fine' means risk has been assessed.
2. Assess	Evaluate the severity and probability of each identified hazard. Ask: How likely is this to happen? If it does, how bad could it be? Is this risk within my personal minimums?	Use a FRAT scoring matrix. Teach students to separate 'unlikely but catastrophic' from 'likely but manageable.' Use past accident examples to calibrate probability estimates.	Underestimating severity ('it's probably fine'); overweighting recent experience ('I flew in worse weather last week'); failing to combine multiple low-risk factors into a high-risk picture.
3. Mitigate	Select and implement actions that reduce risk to an acceptable level. Mitigation options: avoid the hazard entirely (go/no-go), reduce exposure (fly at a lower altitude, shorter route), add redundancy (carry extra fuel, file IFR).	Present the mitigation decision as a professional obligation, not a sign of weakness. Model go/no-go decisions explicitly: 'I'm canceling this lesson because the ceiling is below our training minimums.'	Choosing the mitigation that requires the least change to the plan (get-there-itis); failing to cancel when mitigation is insufficient; not communicating the mitigation decision to passengers or dispatch.

2. Risk Management Tools: PAVE and FRATs (FI.I.F.K2)

Two structured tools give pilots a systematic framework for risk identification and assessment: the PAVE checklist and Flight Risk Assessment Tools (FRATs). Both should be introduced early and used on every flight throughout training. *(FAA-H-8083-9B, Ch. 9)*

The PAVE Checklist

PAVE is a memory aid that directs the pilot's attention to the four primary risk categories before every flight. It is not a pass/fail checklist — it is a structured thought process that ensures no major risk category is overlooked.



Teaching PAVE: Introduce PAVE before the first solo cross-country and reinforce it on every subsequent preflight briefing. Ask students to complete a written PAVE assessment for each cross-country lesson. The goal is to make the four-category scan automatic — the student should be able to verbalize PAVE risk factors for any flight without prompting by the time they reach the checkride.

Flight Risk Assessment Tools (FRATs)

A FRAT is a quantitative risk scoring system that assigns numerical values to risk factors and produces a total score that recommends a go, go with mitigation, or no-go decision. FRATs operationalize the PAVE categories into measurable items. *(FAA-H-8083-9B, Ch. 9)*

Structure	Typically a checklist of 10–20 risk factors (weather minimums, pilot currency, aircraft squawks, schedule pressure, etc.), each assigned a point value based on severity. Total score falls into color-coded zones: green (proceed), yellow (proceed with mitigation plan), red (no-go or consult supervisor).
Teaching Application	Have students complete a FRAT for every cross-country lesson during training. Debrief the score: 'Your total was 14 — yellow zone. What was the highest-scoring single item? What would you do to bring that score into the green?' The FRAT debrief is more valuable than the score itself.
FAA Resources	The FAA offers free FRATs at faasafety.gov. The AOPA Air Safety Institute also publishes a Personal Minimums Worksheet that functions as a customized FRAT. Instructors should direct students to these tools and use them in lessons — not just describe them.
Limitation	FRATs score known risk factors. They cannot score hazards the pilot fails to identify in step one. A perfect FRAT score on an incomplete risk picture is not safety — it is a false sense of security. FRAT use is never a substitute for judgment.

3. When and How to Introduce Risk Management (FI.I.F.K3)

Risk management must not be treated as an advanced topic reserved for cross-country or instrument training. FAA research and accident data both demonstrate that attitudes and decision-making habits are established early in training and are very difficult to change later. *(FAA-H-8083-9B, Ch. 9)*

■ ***If risk management is introduced only after the student has developed habits of ignoring weather, skipping preflight planning, or yielding to schedule pressure, the instruction is almost certainly too late. The FAA's accident data shows that fatal decision-making patterns are present from early training — the CFI is the only mechanism that can interrupt them before they become fixed.***

Lesson 1	Introduce PAVE verbally during the first preflight briefing: 'Before every flight, we'll check four things: the pilot, the aircraft, the environment, and external pressures. Today, let's walk through each one.' Do not wait for a dedicated 'risk management lesson' — integrate it immediately.
Pre-Solo (Lessons 2–10)	Introduce go/no-go decision-making by example: when you cancel or modify a lesson due to weather, explain why using PAVE language. 'I'm reducing today's flight to the practice area because the ceiling is 1,500 ft — the environment element of PAVE is marginal for pattern work.' Begin discussing personal minimums.

Post-Solo Cross-Countries	Introduce FRATs. Require a completed written FRAT for every solo cross-country authorization. Debrief go/no-go decisions: did the student's risk assessment match reality? Introduce scenario-based decision-making using real weather scenarios.
Pre-Checkride	Review hazardous attitudes by name (see K6). Run at least one full SBT scenario requiring a real-time go/no-go decision with incomplete information. Discuss personal minimums explicitly: the student should be able to articulate their own minimums before the practical test.

4. Risk Management Teaching Techniques by Phase of Instruction (FI.I.F.K4)

The technique for teaching risk management adapts to the phase of the lesson: preflight, flight, and post-flight. Each phase offers unique teaching opportunities that cannot be replicated in another phase. *(FAA-H-8083-9B, Ch. 9)*

Phase	Risk Management Teaching Technique	Key Questions to Ask
Preflight Briefing	Walk through PAVE verbally before every flight. Have student complete FRAT independently, then debrief. Present a 'what if' scenario relevant to the planned flight: 'What's your plan if the ceiling drops to 1,200 ft during our cross-country?' Model the go/no-go decision process explicitly — do not just announce the decision.	'What is your biggest concern about today's flight?' 'What would make you cancel?' 'What are your personal minimums for this type of flight?'
In-Flight	Use real-time developing situations as teaching moments: 'The winds have shifted to 090 at 18 kts since we departed. Walk me through your options.' Introduce distractions and interruptions to teach workload management (SRM). Point out traffic, airspace, weather, and terrain as risk factors as they appear — build the scanning habit.	'What's the current weather at our destination?' 'If we had an engine problem right now, where would you go?' 'How much fuel do we have? Is that acceptable?'
Debrief (Post-Flight)	Debrief risk decisions as well as maneuver performance. 'Was there any point during the flight where you felt uncertain about continuing?' Review any external pressure the student felt. Connect the flight's risk profile back to the pre-flight PAVE assessment: was the assessment accurate?	'Was there any decision point where you could have made a safer choice?' 'Did any pressure (schedule, passenger, weather) affect your decisions?' 'What would you do differently?'

5. Managing Risk During Flight Instruction (FI.I.F.K5)

Flight instruction creates a unique risk environment. The instructor must simultaneously teach, observe, evaluate, and maintain safety — while managing the heightened risks created by student error, distraction, and the instructor's own tendency to focus on instruction rather than situational awareness. *(FAA-H-8083-9B, Ch. 9)*

Common Flight Instruction Risks (K5a)

Risk	Description	Why It Is Elevated During Instruction
Distraction	The instructor's attention is divided between teaching, observing the student, and maintaining SA of the aircraft's state and environment	Normal flight requires 100% pilot attention. Instruction demands 150% — the gap is filled by degraded SA. Instructors involved in accidents commonly report 'I was focused on the student.'

Student Unexpected Inputs	A student may make sudden, incorrect control inputs that require immediate instructor intervention to prevent loss of control or collision	Student inputs are unpredictable — even experienced instructors cannot always anticipate them. Instructors must maintain a hand position that allows immediate control override at all times.
Low Altitude Exposure	Teaching traffic pattern, takeoff and landing, and low-altitude maneuvering exposes both occupants to the highest-risk phase of flight	75% of all general aviation accidents occur in the traffic pattern or during takeoff and landing — exactly where instructors spend a disproportionate amount of training time.
Repeated Operations Complacency	Instructors who perform the same maneuvers hundreds of times develop habituation — reduced alertness and vigilance due to familiarity	The 200th traffic pattern is as dangerous as the first. Complacency has been identified in CFI accident reports where experienced instructors failed to intervene in deteriorating situations.
Dual SA Degradation	When a student becomes task-saturated, their SA degrades. The instructor, focused on the student, may not notice the aircraft's energy state, position, or traffic environment	The student's degraded SA does not protect the aircraft. The instructor must maintain independent SA at all times, not rely on the student to manage the aircraft environment.

Best Practices (K5b)

- **Maintain control-ready posture at all times** — hands near (but not on) controls; feet lightly on rudder pedals during all student-flown segments, especially at low altitude.
- **Brief intervention criteria before each lesson** — tell the student explicitly: 'If I say "I have the controls," immediately release everything. I will take over if I see a safety issue.'
- **Use visual scan as an independent task** — regularly scan outside the aircraft independent of what the student is focusing on. The instructor's scan cannot depend on the student's scan.
- **Monitor energy state continuously** — airspeed, altitude, bank angle, and descent rate are safety-critical at all times. Verbalize energy awareness: 'We're 10 kts slow on final — note the sight picture.'
- **Recognize own fatigue and proficiency limits** — instructors flying multiple back-to-back lessons are subject to fatigue-induced attentional narrowing. Know your own limits and honor them.

Special Considerations: Teaching Takeoffs and Landings (K5c)

Takeoffs and landings represent the highest-risk segment of every training flight. The combination of low altitude, high workload, rapidly changing aircraft state, and student unpredictability creates a compounded risk environment that demands heightened instructor readiness. *(FAA-H-8083-9B, Ch. 9)*

■ ***More CFI accidents occur during takeoff and landing instruction than in any other flight phase. The most common scenario: the instructor allows the aircraft to reach an energy state (too slow, too low, too fast, too long on the runway) from which recovery is impossible before intervention occurs. The margin for error is measured in feet and seconds — not the minutes available at cruise altitude.***

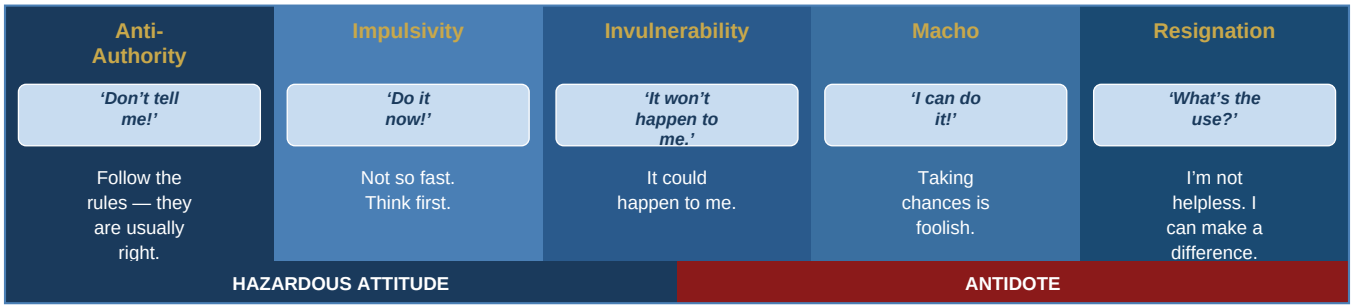
Takeoff Instruction Risks	Runway incursion due to student distraction during taxi. Incorrect rotation speed or technique leading to tail strike or runway overrun. Engine failure on climbout — student may not have a pre-briefed emergency plan. **Mitigation:** Brief the abort criteria before every takeoff: 'If we are not at [airspeed] by [landmark], I will close the throttle and stop.' Always brief engine failure procedure before departure.
Landing Instruction Risks	Student-induced balloon, bounce, porpoise, or hard landing — each of which can cause structural damage or loss of directional control. Instructor delay in recognizing and executing a go-around. **Mitigation:** Establish a clear go-around trigger: 'Any landing that does not look correct by [altitude] gets a go-around.' Initiate the go-around — do not wait for the student to initiate it.
Go-Around Decision	The most common instructor error in landing instruction is allowing a marginal approach to continue past the point where a safe landing is possible. **Rule:** A stabilized approach is required at or before 500 ft AGL in VMC. Any unstabilized approach below 500 ft should result in a go-around — instructor-initiated if the student does not respond immediately.

6. Aeronautical Decision-Making, CRM, and SRM (FI.I.F.K6)

Aeronautical Decision-Making (ADM) is a systematic approach to the mental process used by pilots to consistently determine the best course of action in response to a given set of circumstances. It is the cognitive framework within which risk management operates. *(FAA-H-8083-9B, Ch. 9; FAA-H-8083-2)*

ADM	ADM is the complete decision-making process: situation assessment → option generation → option evaluation → decision → action → outcome review. The FAA's ADM model recognizes that most accidents result not from lack of skill but from failure at one of these cognitive steps — usually option evaluation (choosing the wrong option despite having identified it) or outcome review (failing to monitor whether the decision is working). Teaching ADM means teaching the complete decision loop, not just the 'right answers' to specific scenarios.
Crew Resource Management (CRM)	CRM is the effective use of all available resources — people, information, and equipment — to achieve safe, efficient flight. Developed in airline operations after accidents revealed that technically competent crews were crashing due to communication and authority failures. In multi-crew environments (MEI instruction, flight with a safety pilot): CRM includes cross-checking, assertive communication, and shared situation awareness. Brief CRM expectations before multi-crew flights: who has the radio, who monitors traffic, how disagreements about decisions will be resolved.
Single-Pilot Resource Management (SRM)	SRM applies CRM principles to single-pilot operations: the pilot uses all available resources — instruments, automation, weather products, ATC, passengers, checklists — as a crew would. SRM is especially important for GA pilots because there is no co-pilot to catch errors or break fixation. Teaching SRM: demonstrate automation use (GPS, autopilot) as cognitive tools, not substitutes for thinking. Teach ATC as a safety resource, not an obstacle. Teach passengers as potential hazards (distraction) and potential assets (second set of eyes).
Hazardous Attitudes & Antidotes	The FAA identifies five hazardous attitudes that impair ADM by distorting the pilot's risk assessment and option evaluation. Each has a specific verbal antidote that pilots can use to interrupt the attitude in real time. Teach by name, recognize by behavior, correct with the antidote.

The Five Hazardous Attitudes and Their Antidotes



Teaching Hazardous Attitudes: Do not just list the five attitudes and their antidotes — students will memorize and forget them. Instead, present a scenario and ask: 'Which hazardous attitude is present here, and what is the antidote?' Then ask: 'Have you ever felt this attitude in your own flying?' Self-recognition is the only mechanism that makes the antidote work in real flight.

The Five Hazardous Attitudes — In Depth

1. Anti-Authority "Don't tell me!" Antidote: Follow the rules — they are usually right.	Anti-authority is a rejection of rules, regulations, and guidance from any external source. The anti-authority pilot views regulations as arbitrary obstacles rather than risk-mitigating tools developed from decades of accident investigation. In training, this attitude appears as a student who skips checklist items ('I know this airplane'), dismisses weather briefings ('the app says it's fine'), or argues with ATC rather than clarifying instructions. Left uncorrected, anti-authority leads directly to regulatory violations — VFR into IMC, airspace incursions, and operation of unairworthy aircraft. The antidote — *'Follow the rules — they are usually right'* — works because it reframes regulations as the accumulated wisdom of people who investigated fatal accidents and wrote those rules in response. Teach students to ask: 'Why does this regulation exist? What accident produced it?' Understanding the history of a rule replaces resentment with respect.
2. Impulsivity "Do it now!" Antidote: Not so fast. Think first.	Impulsivity is the tendency to act immediately without taking time to think through the options. The impulsive pilot selects the first solution that comes to mind rather than evaluating available alternatives. In the cockpit, impulsivity manifests as immediate, uncoordinated reactions to emergencies (pulling back on the yoke at the first sign of low airspeed rather than applying power and recovering systematically), rushing checklists, or making snap go/no-go decisions without using PAVE. Impulsivity is especially dangerous in abnormal and emergency situations where the incorrect first response (cutting the wrong engine, shutting off the wrong fuel valve) can be fatal. The antidote — *'Not so fast. Think first'* — interrupts the automatic response loop and forces a moment of cognitive evaluation. Train students to verbalize their planned action before executing it: 'I see low oil pressure — my plan is to check the gauge, scan for a landing area, and declare an emergency. Executing now.' Vocalization slows impulsivity and catches errors before they become irreversible.
3. Invulnerability "It won't happen to me." Antidote: It could happen to me.	Invulnerability is the belief that accidents happen to other pilots — less experienced, less skilled, or less careful — but not to oneself. It is arguably the most statistically dangerous hazardous attitude because it causes pilots to systematically underestimate personal risk. NTSB accident reports frequently describe experienced, certificated pilots who flew into known IMC, pressed below personal minimums, or launched into marginal conditions despite forecasts because their skill and experience felt protective. In training, invulnerability appears as a student who is comfortable skipping preflight items on familiar aircraft ('I've flown this plane fifty times'), who dismisses weather risk ('we'll be fine'), or who recovers poorly from close calls because they don't register as genuine near-misses. The antidote — *'It could happen to me'* — must be made personally real, not abstract. Use accident case studies of pilots with identical experience profiles as the student. Show the NTSB data: statistical immunity does not exist. Skill does not eliminate risk — it only changes which risks you face.

4. Macho "I can do it!" Antidote: Taking chances is foolish.	The macho attitude is a need to prove one's skill and courage by taking risks. Unlike invulnerability (which is passive — simply not believing danger exists), macho is active: the pilot seeks out challenging situations to demonstrate capability. Macho can present in either sex and at any experience level. In training it appears as a student who wants to fly in stronger crosswinds than their demonstrated skill supports, who views a go-around as an admission of failure, who rushes back into the pattern after a poor approach rather than extending to regroup, or who minimizes equipment deficiencies ('the radio static isn't that bad'). The macho pilot frequently reframes poor judgment as professionalism: 'A good pilot can handle this' is a classic macho rationalization. The antidote — *'Taking chances is foolish'* — reframes professionalism itself: the hallmark of a skilled pilot is not the ability to get out of bad situations, but the judgment to never enter them. Model this explicitly: 'The professional move is the go-around. Continuing a bad approach is not courage — it is a gamble.'
5. Resignation "What's the use?" Antidote: I'm not helpless. I can make a difference.	Resignation is a sense of powerlessness — the belief that the pilot's actions cannot affect the outcome, so there is no point in trying. It appears in two distinct forms in aviation. The first is passive acceptance of developing emergencies: a student who, faced with a deteriorating situation (lowering ceilings, increasing crosswind, degrading fuel state), stops actively problem-solving and defaults to continuing the current plan because changing it feels too complicated. The second is learned helplessness: a student who, after repeated difficult lessons or instructor corrections, begins to disengage and simply accept whatever outcome occurs without effort to improve. Both forms are dangerous, but in different ways: the first causes accidents, the second causes training stagnation. The antidote — *'I'm not helpless. I can make a difference'* — activates agency. In training, reinforce student decision authority: 'What are your options right now?' is a more powerful question than 'What should you do?' because it forces recognition that options exist. Every scenario debrief should end with: 'What could you have done differently?' Resignation disappears when pilots discover they have more control than they believed.

RISK MANAGEMENT — INSTRUCTOR-SPECIFIC (FI.I.F.R1–R3)

These three risk elements are specific to the flight instructor's role and are evaluated on the practical test. The applicant must be able to identify, assess, and mitigate each. *(FAA-S-ACS-25, FI.I.F.R1–R3)*

ACS Code	Risk Element	How It Manifests	Mitigation
FI.I.F.R1	Hazards associated with providing flight instruction	Student unexpected inputs; low-altitude exposure; distraction from instruction competing with SA; complacency from repeated maneuver exposure	Maintain control-ready posture; brief intervention criteria; scan independently of student; establish personal limits on back-to-back instructing hours
FI.I.F.R2	Obstacles to maintaining situational awareness during flight instruction	Focusing on the student's technique to the exclusion of traffic, weather, airspace, terrain, and aircraft energy state; task fixation during complex maneuvers	Develop a deliberate SA scan pattern separate from student monitoring; verbalize SA items continuously; use checklists to prevent fixation; establish altitude floors below which you do not instruct without independent monitoring

FI.I.F.R3	Recognizing and managing hazards arising from human behavior, including hazardous attitudes	Student (or instructor) exhibiting anti-authority, impulsivity, invulnerability, macho, or resignation during training flights; schedule pressure overriding risk assessment; student anxiety leading to poor decision-making	Brief hazardous attitudes by name before advanced lessons; debrief attitude-influenced decisions post-flight; use the antidotes explicitly; model healthy decision-making by explaining your own go/no-go decisions using PAVE language

COMMON ERRORS

Common Error	Recognition	Correction
Treating risk management as a separate lesson	Applicant describes risk management as a specific ground school topic to be covered before cross-country training	Risk management must be woven into every lesson from day one. Use PAVE on every preflight briefing; discuss go/no-go on every flight; debrief decisions on every post-flight. It is not a topic — it is a practice.
Describing PAVE without demonstrating use	Applicant recites the PAVE acronym correctly but cannot demonstrate how to apply it to a specific flight scenario	Always follow acronym identification with application: ‘Walk me through PAVE for a VFR cross-country tomorrow with a 2,500 ft ceiling.’ PAVE knowledge is only useful if it produces structured preflight thinking.
Missing the dual SA management requirement	Applicant describes risk management for the student but does not address the instructor’s own SA obligation during dual flight	The CFI must maintain independent situational awareness — the student’s SA is not a substitute. Verbalize this clearly: ‘While you fly, I am monitoring traffic, terrain, and our energy state independently.’
Generic hazardous attitude descriptions	Applicant lists the five attitudes and antidotes but cannot identify which attitude is present in a specific scenario	Practice scenario-based identification: ‘A pilot departs despite a 50% chance of IFR conditions because the trip is important for business.’ ‘Which attitude? What’s the antidote?’ Identification must be specific and real-time, not abstract.
Failing to initiate a go-around during landing instruction	During a demonstration lesson, applicant allows an unstabilized approach to continue below 500 ft without initiating a go-around	Establish the go-around trigger before the lesson: ‘Any approach that is not stabilized by 500 ft AGL gets a go-around — I will initiate it if you do not.’ Honor this standard every time, regardless of traffic, time pressure, or the student’s frustration level.
Confusing CRM with multi-crew operations only	Applicant describes CRM as applicable only to multi-engine or airline operations	SRM brings CRM principles to single-pilot GA: all available resources (ATC, GPS, weather products, passengers, checklists, autopilot) are the ‘crew.’ A private pilot flying VFR with a current METAR, a sectional, and a GPS has exactly the same resource management obligation as an airline crew.

COMPLETION STANDARDS

COMPLETION STANDARDS (from FAA-S-ACS-25)
✓ Applicant explains the three-step risk management process (identify, assess, mitigate) and applies all three steps to at least one realistic flight scenario presented by the evaluator (FI.I.F.K1).
✓ Applicant correctly uses the PAVE checklist to conduct a structured preflight risk assessment for a described flight, and explains the structure and scoring logic of a FRAT (FI.I.F.K2).
✓ Applicant explains when and how risk management is introduced at each phase of training — from lesson one through pre-checkride — and describes at least two specific integration techniques (FI.I.F.K3–K4).
✓ Applicant identifies at least four common flight instruction risks (FI.I.F.K5a), explains best practices for managing them (K5b), and describes the special risk considerations and mitigation strategies for teaching takeoffs and landings (K5c).
✓ Applicant explains ADM, CRM, and SRM (FI.I.F.K6), correctly identifies all five hazardous attitudes and their antidotes, and describes how to use scenario-based training to develop ADM in students.
✓ Applicant correctly identifies and mitigates all three risk elements (FI.I.F.R1–R3) in scenarios presented by the evaluator, demonstrating understanding of instructor-specific risk during dual flight.
✓ Applicant demonstrates FI.I.F.S1 by describing or conducting a scenario-based training segment that integrates risk management and ADM into an evaluator-assigned task.
✓ Applicant demonstrates FI.I.F.S2a–S2c by describing specific behaviors that maintain (a) oversight of learner actions, (b) awareness of learner cognitive/physiological state, and (c) overall aircraft situational awareness during dual instruction.

REVIEW QUESTIONS

REVIEW QUESTIONS & ANSWERS

Q1. Walk through the PAVE checklist for the following scenario: You plan a 150 nm VFR cross-country tomorrow. You have 48 hours of recent flight time in the past 30 days. The weather shows a 3,000 ft broken layer at the destination, scattered along the route. You have a business meeting at the destination that cannot be rescheduled.

■ ***Pilot:*** *Recent and current; assess physical/mental state on the day of the flight. The business meeting is an external pressure flag.* ***Aircraft:*** *Airworthiness status, fuel for destination plus reserve, equipment for planned route.* ***enVironment:*** *3,000 ft broken at destination is marginal VFR; scattered enroute is workable but requires divert planning; check forecast trend — is the ceiling forecast to lower?* ***External Pressures:*** *The business meeting is a significant get-there-itis risk factor. This is a yellow-zone FRAT scenario — proceed only with a solid divert plan, identified alternates, and an explicit personal minimum: 'If the destination drops below 2,500 ft ceiling by [time], I divert to [alternate].' The external pressure is the highest-risk single factor.*

Q2. A student is on a solo cross-country you authorized. Three hours after departure, you get a call from a nearby airport FBO: your student has landed there because of weather. The student says they felt embarrassed but didn't know what else to do. How do you handle this debrief, and what does it reveal about their training to this point?

■ *First response: affirm the decision emphatically — 'You made exactly the right call. Landing at an unfamiliar airport because of weather is not a failure — it is the correct application of everything we've worked on.' The student's embarrassment reveals the invulnerability and macho attitudes may be influencing their self-assessment: they feel continuing into weather was the 'tougher' choice. This is a perfect teachable moment: 'Which hazardous attitude is at work when a pilot feels embarrassed to divert?' In terms of training to this point: the student has correctly internalized the go/no-go skill; the work remaining is on eliminating the shame associated with exercising it. Use this event in future lessons as a positive example.*

Q3. During a landing lesson, your student balloons 8 feet on a normal landing approach and begins to slowly descend back toward the runway. What do you do, and at what point?

■ *Immediately initiate a go-around. Do not wait to see if the student recovers. An 8-foot balloon on a normal landing creates an energy state where: the aircraft is decelerating, the sink rate is increasing, and the remaining runway may be insufficient for a landing from the new touchdown point. The go-around trigger is this: any landing that does not look correct by 500 ft AGL (or at any point below 500 ft) gets a go-around, instructor-initiated if the student does not respond immediately. Post-flight debrief: explain what happened aerodynamically, why the go-around was initiated rather than allowed to continue, and what the student should recognize as the cue for a self-initiated go-around.*

Q4. Describe the difference between ADM, CRM, and SRM. How would you teach SRM to a student pilot on a solo cross-country flight?

■ *ADM is the cognitive decision-making process itself: the loop of situation assessment → options → evaluation → decision → action → review. CRM is the framework for using all available resources in a multi-crew environment: communication, authority, cross-checking. SRM applies CRM principles to single-pilot operations: the pilot manages all available resources (ATC, weather products, GPS, autopilot, checklists, passengers) as a solo 'crew.' Teaching SRM for a solo cross-country: before the flight, brief which resources the student should use and when: 'If your GPS fails, what's your resource?' 'If you're unsure about the weather at the destination, who do you call?' 'If you feel task-saturated, what do you do first?' Post-flight, debrief which resources were used and which were available but not used.*

Q5. A student consistently makes overconfident go/no-go decisions, wanting to fly in conditions that push their personal minimums. Which hazardous attitude best describes this behavior, what is the antidote, and how do you address it instructionally?

■ *The primary attitude is invulnerability ('It won't happen to me') potentially combined with macho ('I can do it'). Antidote for invulnerability: 'It could happen to me.' Antidote for macho: 'Taking chances is foolish.' Instructional approach: (1) Use accident case studies where the pilot had similar experience and similar confidence — make the statistical risk concrete and personal. (2) Require the student to complete a written PAVE and FRAT for each proposed flight; the written process slows down impulsive decisions. (3) Model conservative decision-making explicitly: 'I am canceling today because my personal minimum is 2,000 ft ceiling for this route — not because it's impossible to fly, but because the margin is not there.' (4) Have a direct conversation naming the attitude: 'What I'm seeing is invulnerability — the feeling that your skill protects you from the statistics. It doesn't.'*

Q6. What are the three skill requirements (S2a, S2b, S2c) for managing risk during flight instruction, and give a concrete example of how each would appear during a traffic pattern lesson?

■ ***S2a — Awareness and oversight of learner actions:*** *Monitoring the student's control inputs, scanning, and procedure execution; intervening when the aircraft deviates beyond safe limits. Traffic pattern example: noticing the student has allowed airspeed to decay to 5 kts below target airspeed on final and providing a verbal cue before the deviation becomes dangerous.* ***S2b — Awareness of learner cognitive/physiological state:*** *Recognizing signs of task saturation, anxiety, fatigue, or fixation and adjusting instruction accordingly. Traffic pattern example: noticing the student has stopped scanning for traffic because they are focused entirely on the VASI — recognizing task saturation and reducing the information load ('I have the radio for this pattern — you fly').* ***S2c — Overall situational awareness of the aircraft's dynamic state:*** *Maintaining independent awareness of the aircraft's position, energy state, and environment regardless of the student's focus. Traffic pattern example: independently monitoring the runway length remaining during a long landing and initiating a go-around before the student recognizes the runway is insufficient.*

Instructor: _____ Date: _____ Applicant: _____

AREA II, TASK A — HUMAN FACTORS

Aeromedical Physiology • Fitness for Flight • Spatial Disorientation • ADM & Hazardous Attitudes

Duration: 90–120 min	Audience: CFI Applicant	ACS: AI.II.A.K1–K4 / R1–R4 / S1–S2	Refs: PHAK Ch.17 | AIH Ch.9 | RMH Ch.2 | AIM 8-1

SECTION 1 — LESSON OBJECTIVES

- Identify symptoms, causes, effects, and corrective actions for each aeromedical condition in K1a–K1l. *(Knowledge)*
- Differentiate hypoxia from hyperventilation when symptoms overlap, and prescribe the correct treatment for each. *(Analysis)*
- Explain all five spatial disorientation illusions, describe their vestibular mechanism, and prescribe recovery procedures. *(Application)*
- Apply the IMSAFE checklist to self-assess fitness for flight and teach students to do the same before every flight. *(Application)*
- Explain the physiological effects of fatigue, dehydration, hypothermia, and inadequate nutrition on pilot performance. *(Knowledge)*
- Identify OTC medication categories that impair flight safety and counsel students on medication use. *(Application)*
- Recite the complete 14 CFR 91.17 alcohol standard (all three components) and distinguish it from DUI limits. *(Knowledge)*
- Apply the DECIDE model to a multi-factor in-flight scenario and evaluate decision quality at each step. *(Evaluation)*
- Identify all four R-element risks (R1–R4) and teach a student to mitigate each using RMH tools. *(Application)*
- Explain confirmation bias and expectation bias, and describe specific techniques to build cognitive immunity in students. *(Synthesis)*
- Conduct a fitness-for-flight self-assessment for a given scenario and explain the decision to a student as a teaching moment. *(Evaluation)*
- Demonstrate how to brief optical illusions before every approach to an unfamiliar runway. *(Application)*

SECTION 2 — MOTIVATION

The NTSB's database consistently shows human factors — not mechanical failure — as the dominant cause of fatal general aviation accidents. Fatigue, spatial disorientation, subtle physiological impairment, and flawed decision-making are the real killers. A CFI who cannot teach human factors with clinical precision is producing pilots who can execute a perfect steep turn and still fly into a cloud.

This lesson prepares you to understand, explain, and teach every aeromedical and ADM topic in Area II, Task A. The DPE will test scenario application — not rote recall. More importantly, the skills here are what keep your students alive.

SECTION 3 — KEY CONCEPTS

1. IMSAFE Self-Assessment Checklist (AI.II.A.K1 / R1)

A WHAT TO TEACH

Purpose: Structured preflight fitness-for-flight assessment. Bidirectional — the CFI evaluates themselves AND the student before every flight.

Six elements:

- **I**llness — Any symptom that could impair judgment?
- **M**edication — Any drug with impairing side effects?
- **S**tress — Psychological load dividing attention?
- **A**lcohol — Within 8 hrs? BAC < 0.04%?
- **F**atigue — Rested? Adequate sleep?
- **E**ating — Hydrated and nourished?

Go / No-Go Logic: IMSAFE is not a pass/fail list. It is a structured prompt for an honest self-assessment. A 'yes' to any item triggers a decision process, not just awareness.

Bidirectional use:

- CFI evaluates **themselves** before every lesson
- CFI prompts **student** through the same check
- Model it out loud — students internalize what they observe, not what they're told

KEY RULE ■ A positive answer to ANY IMSAFE item is a go/no-go factor, not a footnote. One 'yes' requires a decision, not just awareness.



Figure 1 — IMSAFE Checklist | PHAK Ch. 17 | FAA-H-8083-2, Ch. 2

B HOW TO TEACH IT

- **Introduce on Day 1** — before the student ever sits in the cockpit.
- Walk through IMSAFE verbally before every preflight briefing.
- **Model it out loud:** 'Before I brief you today, let me do my own IMSAFE check.'
- Follow up: 'If your Stress item is positive today, what would you do about this flight?'
- Goal: automatic, behavioral — not memorized recitation.

Instructor Note: *How to recognize genuine understanding vs. surface recall: Ask the student to apply IMSAFE to a specific scenario (e.g., 'You took NyQuil last night, slept 5 hours, and have a job interview this afternoon'). Can they produce a go/no-go decision with reasoning? If they recite the letters but can't make the call, they haven't internalized it.*

2. Hypoxia: Types, Symptoms, and Corrective Actions (AI.II.A.K1a)

A WHAT TO TEACH

Definition: Deficiency of oxygen reaching body tissues. The most dangerous feature: **mild hypoxia produces euphoria, not distress.**

Four Types:

- **Hypoxic (altitude)** — Low O_2 partial pressure. Most common above 10,000 ft.
- **Hypemic (anemic)** — Blood can't carry O_2 (CO poisoning, anemia, donation).
- **Stagnant** — Poor blood flow (high-G, extreme cold).
- **Histotoxic** — Cells can't use O_2 (alcohol, narcotics, CN poisoning).

Symptoms (hypoxic type):

- Euphoria, false sense of well-being *(earliest, most dangerous)*
- Impaired judgment and decision-making
- Headache, dizziness, blurred vision
- Cyanosis of lips/fingertips *(late sign)*
- Loss of consciousness if uncorrected

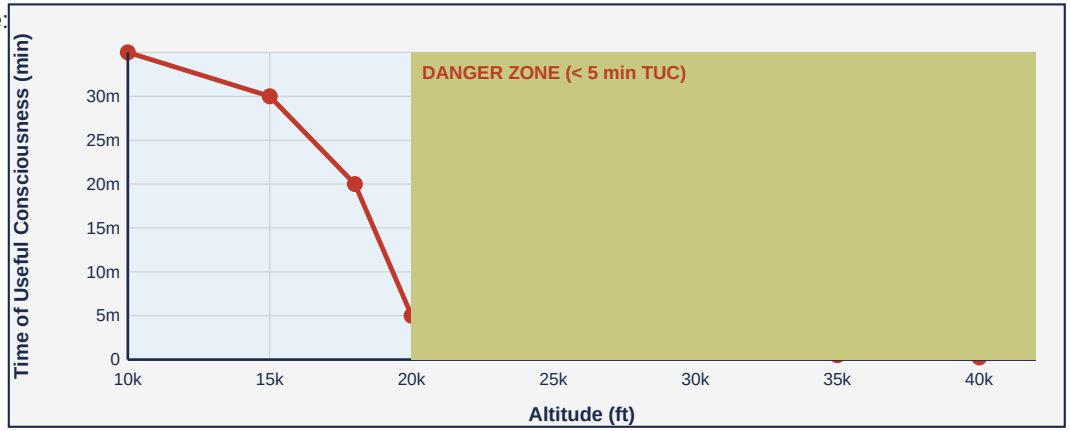


Figure 2 — Time of Useful Consciousness vs. Altitude | PHAK Ch. 17 | AIM 8-1-2

KEY RULE ■ 14 CFR 91.211: O_2 required above 12,500 ft after 30 min | ALL times above 14,000 ft | Passengers above 15,000 ft

CRITICAL ■ CORRECTION: 100% O_2 immediately + descend below 10,000 ft. Declare emergency if disoriented. Recovery is rapid but cognitive impairment may persist several minutes after O_2 restoration.

C REAL-WORLD EXAMPLES

Example 1: *A VFR pilot climbs to 14,500 ft without supplemental O_2 during a mountain crossing. Feels great, then misses a frequency change from ATC. Continues flying for 12 minutes in a gradual 10-degree off-track deviation before the controller calls on guard. The pilot had no memory of the deviation when interviewed. Classic hypoxic judgment impairment preceding physical symptoms.*

Example 2: *An instructor and student complete pattern work at a field at 8,500 ft MSL on a hot afternoon. The student's night vision is already degraded. Neither uses supplemental O_2. The instructor notices the student's landings are degrading after 45 minutes but attributes it to fatigue. Combined IMSAFE factors: altitude + fatigue + heat-induced dehydration.*

D ANALOGY

> *"Hypoxia is like carbon monoxide in a house — it doesn't warn you. People who die from CO poisoning don't feel unwell. They feel sleepy, then they fall asleep, then they don't wake up. Hypoxia works the same way: the euphoria IS the symptom, not a sign that you're okay. Feeling great at 16,000 ft without oxygen is a medical emergency masquerading as a good afternoon."*

E INSTRUCTOR NOTE

Instructor Note: *Probe question: 'You're at 15,000 ft without oxygen and you feel great. Is that normal or should you be concerned?' A student who understands hypoxia knows that feeling great at 15,000 ft IS the warning sign. If they say 'I'd be fine,' they need more work on the euphoria mechanism.*

3. Hyperventilation: Recognition and Treatment (AI.II.A.K1b)

A WHAT TO TEACH

Mechanism: Excessive breathing expels CO_2 faster than the body produces it → respiratory alkalosis → cerebral vasoconstriction → paradoxical reduction in brain O_2 despite breathing rapidly.

Common triggers:

- Anxiety, fear, or stress *(student's first emergency, first hood flight)*
- Turbulence or unexpected aircraft behavior
- Consciously 'helping' breathing during a tense moment

Symptoms:

- Tingling/numbness in lips, hands, feet
- Lightheadedness, dizziness
- Carpopedal spasm (involuntary hand/foot cramping)
- Visual disturbances; possible unconsciousness if sustained

Differentiating from Hypoxia:

Feature	Hypoxia	Hyperventilation
Feeling	Euphoric, well-being	Anxious, panicked
Key symptom	Judgment impaired first	Tingling/spasm first
Cyanosis	Present (late)	Absent
Treatment	O_2 + descend	Slow breathing

CRITICAL ■ TREATMENT: Consciously slow breathing to 12–16 breaths/min. Breathe into a bag if available (rebreathes CO_2). CFI verbal reassurance is highly effective — a calm voice interrupts the anxiety-breathing feedback loop.

Instructor Note: *Teaching tip: Have students voluntarily hyperventilate for 30 seconds in a ground setting. They experience the tingling firsthand. That visceral memory is more powerful than any list of symptoms on a page.*

B HOW TO TEACH

Ground demonstration (pre-flight):

- Have the student breathe rapidly and deeply for 20–30 seconds under supervision. They will feel the tingling, lightheadedness, or carpopedal spasm firsthand. **This sensory experience eliminates any doubt about symptom reality.**
- Debrief: 'What did you feel? How would you recognize this at 8,000 ft while hand-flying ILS?'

Scenario drill (flight or BATD):

- Introduce mild turbulence or an unexpected deviation while student is task-saturated.
- Prompt: 'You feel tingling in your hands — what do you do first?'
- Evaluate whether student distinguishes treatment (slow breathing vs. O_2 + descend).

Verbal coaching script (in-flight):

- **Step 1 — Identify:** 'Are you tingling/dizzy? Any anxiety triggers?' (not euphoria = not hypoxia)
- **Step 2 — Control aircraft:** AP on or maintain altitude first.
- **Step 3 — Slow breathing:** 'Match my count — in 2-3-4, out 2-3-4.'
- **Step 4 — Reassure:** 'This is hyperventilation — you are not in danger. Slowing breathing cures it.'
- **Step 5 — Rebreathe if needed:** Use airsick bag or cupped hands.

KEY RULE ■ CRITICAL DISTINCTION: Hypoxia = feel great, judgment gone. Hyperventilation = feel anxious, tingling present. O_2 cures hypoxia; slow breathing cures hyperventilation.

C EXAMPLES

Example 1 — Student's First IMC Encounter

A primary student is on their first actual IMC flight with a CFI. Shortly after entering the clouds, the student begins breathing rapidly. Within 60–90 seconds they report tingling in both hands, then lightheadedness. The student says *'I feel really weird — am I okay?'*

The CFI immediately checks: **no euphoria** (student is clearly anxious, not falsely content), **altitude unchanged** (no hypoxic altitude), **tingling present** (classic hyperventilation sign). The CFI takes the controls, reduces workload, and begins counted breathing aloud: *'Match my count — in, 2, 3, 4 — hold — out, 2, 3, 4.'* Symptoms fully resolve within 90 seconds. The student is visibly relieved.

CFI debrief questions:

- 'What did your body tell you vs. what were the instruments showing?'
- 'At what point did you realize breathing was the issue, not something mechanical?'
- 'How will you recognize this in yourself next time — before it becomes severe?'

Example 2 — BATD Scenario: Task Saturation as a Trigger

Setup: Student is hand-flying an ILS in a BATD. The instructor introduces moderate simulated turbulence, activates an annunciator alert, and simultaneously asks the student an unrelated question — intentionally saturating task load. After 2–3 minutes, the instructor prompts: *'How are you feeling right now?'*

Many students in this scenario begin rapid, shallow breathing without noticing. Some develop mild tingling during the debrief when they slow down and take stock. The instructor uses this as a real-time teaching moment: **task saturation is a known hyperventilation trigger**, not just acute fear. The student learns to actively monitor their own breathing rate during high-workload phases — treating it as a checklist item like any other physiological check.

CFI debrief questions:

- 'Were you aware of how fast you were breathing during that segment?'
- 'What workload management technique could prevent this on a real flight?'
- 'At what point would you have called for help if this were actual IMC?'

Symptom	Points to Hypoxia	Points to Hyperventilation
Emotional state	Euphoric, falsely content	Anxious, panicked
Tingling / spasm	Absent (early stages)	Hands, lips, feet — early sign
Breathing rate	Normal or slightly slow	Rapid, shallow
Altitude factor	Typically above 10,000 ft	Any altitude — triggered by anxiety
Cyanosis	Late sign — may be present	Absent
O_2 response	Rapid, dramatic improvement	No effect
Best treatment	100% O_2 + descend	Slow breathing to 12–16/min

KEY RULE ■ Teach students to ask two questions before treating: (1) **Do I feel great or anxious?** — Great = suspect hypoxia. Anxious = suspect hyperventilation. (2) **What is my breathing rate?** — Rapid/shallow = likely hyperventilation. Treat accordingly.

D ANALOGY

"Hyperventilation is like a car alarm going off in an empty parking lot. The alarm (rapid breathing) is triggered by a perceived threat (anxiety), but the response itself becomes the problem — draining the battery (CO■ level) until the system shuts down. Turning off the alarm (slowing the breath) is the fix, not addressing a real intruder."

E INSTRUCTOR NOTE

Instructor Note: *Students frequently confuse hyperventilation with hypoxia during written test prep. Use the mnemonic:* ***HYPO = Happy (euphoric)*** *→* ***Hypoxia; HYPER = Hurting (tingling)*** *→* ***Hyperventilation.*** *Emphasize that a calm, authoritative CFI voice is documented as one of the most effective treatments — simply hearing 'you are okay, slow your breathing' breaks the anxiety-breathing loop. This underscores the CFI's dual role as both instructor and crew resource during training flights.*

4. Spatial Disorientation: Vestibular Illusions and Recovery (AI.II.A.K1d)

A WHAT TO TEACH

Spatial disorientation occurs when a pilot's perception of attitude, altitude, or motion conflicts with actual instrument data. The **vestibular system** in the inner ear senses motion through three semicircular canals (roll, pitch, yaw) filled with fluid. These canals only detect **angular acceleration** — not sustained angular velocity. Once the fluid stops moving during a prolonged turn, the brain interprets level flight, even while still banking.

Once the illusion is established, it **does not self-correct**. Only visual cues (flight instruments or a confirmed natural horizon) resolve spatial disorientation. This is why **instrument trust** and **cross-check discipline** are non-negotiable skills, especially in IMC or night operations.

KEY RULE ■ Three systems provide orientation: Vestibular (inner ear), Somatosensory (body feel), Visual (eyes). In flight, ONLY the visual system is reliable — the other two must be overridden by instruments.

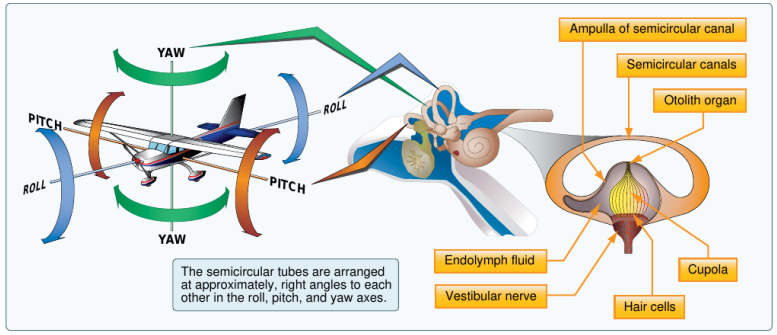


Figure 17-3. *The semicircular canals lie in three planes and sense motions of roll, pitch, and yaw.*

Figure 3a — Inner ear semicircular canals sense roll, pitch, and yaw. Source: PHAK Figure 17-3 (FAA-H-8083-25C, Ch. 17)

Leans Illusion	Graveyard Spiral	Somatogravic Illusion	False Horizon	The Leans (Continued)
After recovering from a banked turn, pilot perceives wings as level when aircraft actually is.	Sustained coordinated turn feels like straight flight. Pilot pulls back to 'level off', tightening spiral.	Rapid acceleration felt as nose-high pitch. Pilot pushes forward — possible CFIT.	Sloped cloud layer or terrain mistaken for horizon. Aircraft banked to align with false cue.	Vestibular system cannot detect slow rolls below 2°/sec sensation threshold.

Figure 3b — Five Vestibular Illusions | PHAK Ch. 17 | AIM 8-1-5

Graveyard Spiral Sequence:

- Pilot enters smooth, coordinated banked turn
- After ~20 seconds: semicircular canals **adapt** — turn feels like straight flight
- Pilot rolls wings level → canals signal **turn in opposite direction**
- Pilot rolls back into original bank to 'correct' the false sensation
- Aircraft descends, airspeed increases → pilot pulls back
- **Pulling back in a bank tightens the spiral** — G-load increases
- Without instrument trust: fatal

Other Key Illusions:

- **The Leans:** Slow roll (<2°/sec) undetected; pilot leans body to align with felt 'vertical'
- **Somatogravic:** Rapid acceleration felt as nose-high pitch → pilot pushes forward (CFIT risk)
- **False Horizon:** Sloped clouds/terrain mistaken for horizon → aircraft banked to match
- **Elevator Illusion:** Updraft creates pitch-up sensation; pilot pushes forward

Risk Factors:

- IMC or no natural horizon
- Night flight over dark terrain
- Stress or task saturation
- Inadequate instrument training

CRITICAL ■ RECOVERY: Wings level by AI only. Level pitch with elevator. Verbalize: 'My body says turning — AI says wings level. I believe the AI.'

D ANALOGY

"Your inner ear is like a gyroscope that only detects the START of movement, not the movement itself. Spin in an office chair for 30 seconds at a constant rate — you stop feeling the spin. When you stop, you feel like you're spinning the other way. The inner ear made the same mistake in the original bank: after 20 seconds, it decided you were flying straight. When you rolled out, it screamed 'turning!' — because relative to its new 'straight,' you were."

E INSTRUCTOR NOTE

Instructor Note: *Best demonstration: AATD or FTD in simulated IMC. Establish a 20-second constant coordinated turn. Ask the student: 'What attitude are you in right now?' Then show the instruments. The gap between felt attitude and actual attitude is visceral and unforgettable. Follow up: 'If your body said wings level but the AI said 30° bank, which would you believe?' The answer to that question is the entire lesson.*

5. Carbon Monoxide Poisoning (AI.II.A.K1f)

A WHAT TO TEACH

Source: Cracked heat exchanger allows exhaust gases into the cockpit. CO is odorless, colorless. Binds to hemoglobin **200+ times more effectively** than O_2 → hypemic hypoxia even at low concentrations.

Symptoms (in order):

- Headache, yawning *(earliest — often misattributed to fatigue)*
- Dizziness, nausea
- Loss of muscular control
- Unconsciousness

Highest-risk scenario in training:

- Cold weather, extended ground engine run
- Cabin heat ON, windows closed
- Student distracted by ATC or maneuvers

Prevention:

- CO detector in cockpit — **under $30, potentially life-saving**
- Annual inspection of heat exchanger for cracks
- Pre-flight check of all vents and heat ducts
- If any headache or drowsiness in cockpit: suspect CO first

Example: *An instructor and student reported severe headaches on a winter cross-country with cabin heat on full. Heat exchanger had a hairline crack invisible during pre-flight. Both landed safely, but the instructor estimated his decision-making was severely impaired for the final 30 minutes. A CO detector would have alarmed 45 minutes earlier.*

KEY RULE ■ CO poisoning is hypemic hypoxia. All hypoxia treatment rules apply: O_2 + descend + emergency declaration.

CRITICAL ■ IMMEDIATE ACTION: Cabin heat OFF. Open all fresh air vents. Land as soon as practical. 100% O_2 if available. Declare emergency.

6. Fatigue, Dehydration, Hypothermia, and Nutrition (K1g–K1j)

A WHAT TO TEACH

Four factors that degrade cognitive performance before the pilot notices impairment. All are common in training environments and are captured under the IMSAFE **F (Fatigue)** and **E (Eating)** items. Fatigue in particular has two distinct forms with very different presentations and recovery paths.

Fatigue — Acute vs. Chronic

	Acute Fatigue	Chronic Fatigue
Definition	Short-term exhaustion from a single episode of insufficient sleep, intense mental/physical effort, or an unusually long duty day.	Cumulative fatigue that accumulates over days or weeks of inadequate rest. The pilot never fully recovers between cycles.
Cause	• One night of <5–6 hrs sleep • Night shift before a morning lesson • Long cross-country, high-workload day	• Sustained training schedule with back-to-back instructing days • CFI building time while working a second job • Student working nights and flying mornings for weeks
Onset / Recognition	Usually identifiable: 'I didn't sleep well.' The pilot is aware of the cause, even if they underestimate the effect.	**Insidious — the pilot often feels 'normal'** because their baseline has shifted downward. They lose the ability to accurately self-assess.
Performance Effect	• Slower reaction time • Increased errors on complex tasks • Degraded peripheral scan • Impairs judgment BEFORE it impairs stick-and-rudder	• All acute effects, plus: • Emotional dysregulation (irritability, poor student relations) • Significantly impaired risk assessment • Burnout and motivation loss • Immune suppression (more illness)
Recovery	One full night of quality sleep (7–9 hrs) typically restores performance.	**Does NOT recover with one night of sleep.** Requires multiple consecutive recovery nights. Many chronically fatigued CFIs do not realize they are impaired.
IMSAFE Catch	Fatigue item: 'Am I rested?' — student/CFI likely to identify this.	Fatigue item: 'Am I rested?' — chronically fatigued pilot often says YES because their impaired baseline feels normal to them. **Peer or supervisor observation is the only reliable catch.**

KEY RULE ■ FAA personal minimum: Establish a non-negotiable sleep floor. A common standard: no flight instruction after fewer than 6 hours of sleep. No back-to-back instructing days exceeding 8 flight hours without an intervening full rest period.

Instructor Note: *Real-World Scenario: A CFI building time while holding a night-shift warehouse job instructs 6 days/week, averaging 5 hrs sleep. After 3 weeks they feel 'used to it.' During a complex crosswind solo endorsement decision, they approve conditions they would have questioned at full rest. This is chronic fatigue at its most dangerous — the impaired pilot no longer has an accurate reference for 'normal.'*

■ ***Risk Note:*** ■ *Risk Note: The IMSAFE checklist is less reliable for chronic fatigue than for acute fatigue, because the chronically fatigued pilot's self-assessment is itself impaired. Build external checks: a trusted colleague or chief instructor who monitors your schedule is a more reliable catch than IMSAFE alone.*

Other Impairing Factors:

Factor	Performance Effect	Action
Dehydration (1–2% fluid loss)	20–30% cognitive decline; early fatigue onset; headache	8 oz water/hr of flight. Hot ramp + closed cockpit = rapid loss.
Hypothermia (core <35°C)	Confusion; fine motor loss; arrhythmia risk below 33°C	Dress in layers; know cold-soak conditions. Unheated night flight is highest risk.
Poor Nutrition (skipped meals)	Hypoglycemia: irritability, poor concentration, tremor	Balanced meal within 2 hrs of flight. Never skip breakfast before early lessons.

D ANALOGY

"Acute fatigue is like a dirty windshield after a muddy drive — you know it's dirty, you can see the smears, and you know you need to wash it. Chronic fatigue is like a windshield that has been slowly fogging for three weeks — you've adapted to the reduced visibility, you've stopped noticing the fog, and you're driving at highway speed convinced you can see fine. The difference is self-awareness: acute fatigue is visible to the pilot; chronic fatigue is invisible to the pilot but visible to everyone else."

E INSTRUCTOR NOTE

Instructor Note: *Debrief question that reveals genuine understanding vs. surface recall: 'You've been instructing 6 days a week for a month, sleeping 5–6 hours a night. You feel okay — no different than last week. Should you fly today?' A student who understands chronic fatigue knows the answer is: the fact that you feel okay is not reliable evidence that you ARE okay. That's the whole point of chronic fatigue.*

7. Stress and Performance: The Yerkes-Dodson Curve (AI.II.A.K1g)

A WHAT TO TEACH

Stress has a dual character in aviation: a moderate level of arousal **improves** performance, while too little (complacency) or too much (panic) degrades it. Like fatigue, stress exists in two distinct clinical forms — acute and chronic — with fundamentally different causes, symptoms, and detection challenges.

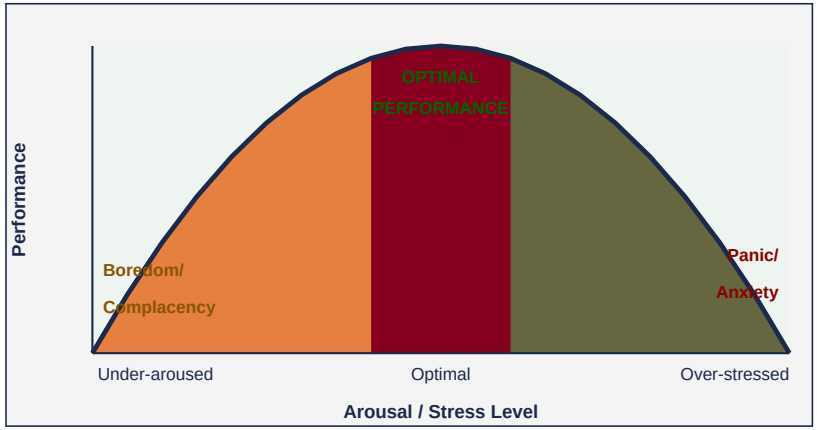


Figure 4 — Yerkes-Dodson Curve | PHAK Ch. 17 | AIH Ch. 9

How Stress Narrows Performance:

- Attention narrows — peripheral tasks drop first (traffic scan, fuel check)
- Working memory shrinks — complex multi-step problem-solving fails
- Impulsive responses increase — first solution replaces best solution
- Tunnel vision develops — pilot fixates on one variable

CFI Complacency — Under-Arousal:

A form of stress-related impairment on the opposite end of the curve. The 200th traffic pattern feels so routine that the CFI's arousal level drops below optimal. Alertness and intervention speed degrade. **Complacency has been cited in CFI accident reports where experienced instructors failed to intervene in deteriorating student-flown situations.**

> ■ ***Risk Note:*** ■ *Risk Note: Stress compounds with other IMSAFE factors. A fatigued + stressed + dehydrated student is not 3x impaired — the Swiss Cheese holes may be fully aligned. Stress + fatigue is a particularly dangerous combination because both degrade the self-assessment ability needed to catch the other.*

Acute vs. Chronic Stress — Key Distinctions

	Acute Stress	Chronic Stress
Definition	Sudden, identifiable stressor with rapid onset. The fight-or-flight response activates in seconds.	Persistent stress from ongoing life demands that never fully resolve. The body remains in a low-grade activated state continuously.
Aviation Examples	• Engine roughness during flight • ATC frequency change during a critical phase • Unexpected traffic call-out • Student's first simulated engine failure	• Financial pressure (student loan debt, flight costs) • Relationship or family problems • CFI with unsatisfactory student performance over weeks • Job uncertainty or workplace conflict

Symptoms	• Elevated heart rate, muscle tension • Narrowed attention (tunnel vision) • Impulsive decision-making • Short-term memory disruption	• Persistent fatigue and irritability • Difficulty concentrating even in calm situations • Decreased motivation and engagement • Impaired ADM quality — all risk assessments become optimistic
Self-Detection	Usually detectable — the pilot knows they are stressed and why.	**Often undetected.** The pilot has normalized an elevated baseline. They feel 'fine' but perform below their own standard without noticing.
IMSAFE Catch	Stress item catches this if the pilot is honest: 'Am I worried about something right now that's dividing my attention?'	IMSAFE Stress item is LESS reliable here. The chronically stressed pilot may honestly say no because they've normalized their elevated baseline. **External observation by CFI or peer is more reliable.**
Recovery / Mitigation	Removal of the stressor; controlled breathing; verbalization to slow the impulse loop; structured checklist use.	Requires sustained lifestyle change, not a single flight day off. Address root causes. Consider temporary reduction in flight schedule.

B HOW TO TEACH IT

• Have students **rate their stress level 1–10** before and after high-workload maneuvers.
• Ask: 'At what point did your attention narrow? What did you stop monitoring first?'
• Introduce acute stress deliberately in the AATD: engine failure during IMC approach, ATC frequency change during a complex task.
• For chronic stress: make it part of the IMSAFE debrief: 'Any ongoing situation at home or work that's been on your mind this week?'

Instructor Note: *Self-awareness of stress response is a teachable skill. Students who are prompted to rate their own stress during training develop a calibrated internal scale they can apply on solo flights. This is exactly what SRM requires: accurate self-monitoring under load. If the student never self-monitors in dual training, they have no reference for solo.*

D ANALOGY

"Acute stress is like a car alarm going off next to you — loud, disruptive, but you know what it is and it stops. Chronic stress is like living next to a freeway — after a week, you stop consciously hearing it, but your cortisol is still elevated, your sleep is shallower, and your patience is shorter. You've adapted to the noise, not recovered from it. A pilot in chronic stress has adapted to impairment and no longer recognizes it as impairment."

E INSTRUCTOR NOTE

Instructor Note: *Best debrief question for chronic stress recognition: 'You mentioned your landlord situation last week. Is that resolved, or is it still on your mind?' The fact that it takes 30 seconds to ask shows students that their CFI takes human factors seriously as a pre-flight item, not just a checkride topic. A student who sees their CFI genuinely curious about their mental state will self-report honestly.*

8. Alcohol, Drugs, and Medications (AI.II.A.K2, K3)

A WHAT TO TEACH

KEY RULE ■ 14 CFR 91.17 — Three-part standard (ALL three must be satisfied): (1) At least 8 hours since last alcoholic drink • (2) BAC below 0.04% • (3) Not under the influence of alcohol. Most students know #1. Few know that #2 and #3 can be violated even after 8 hours.

Category	The FAA Standard	Performance Reality	Teaching Point
Alcohol	8 hrs + BAC <0.04% + not 'under influence'	**Judgment impaired at 0.02% BAC.** Complex tasks impaired at 0.04%. Even after 8 hrs, a heavy night of drinking may leave BAC above 0.04%.	Bottle-to-throttle is a minimum, not a safe number. Hangover symptoms = still 'under the influence' per FAA interpretation.
OTC Medications	No specific regulation; pilot judgment required	Antihistamines (Benadryl): drowsiness + impaired psychomotor function that persists AFTER drowsiness resolves.	'I slept it off' is not a pharmacokinetic standard. 1st-gen antihistamines: AME guidance = 72 hrs from last dose before flying.
Prescription Drugs	Must hold valid medical; no impairing effects	Many common prescriptions are disqualifying. 'Legal to drive' does not equal safe or legal to fly.	Advise students to contact their AME before starting any new prescription.
Illicit Drugs	Prohibited under 91.17(a)(3)	Severe impairment of all flight skills; creates medical certificate compliance questions.	Any controlled substance use = self-report to FAA required. Not just a legal issue.

9. Aeronautical Decision-Making (ADM) and the DECIDE Model (AI.II.A.K4)

A WHAT TO TEACH

ADM is a systematic mental process for determining the best course of action in any circumstance. Most aviation accidents result not from lack of skill but from failure at one step in the decision chain. The DECIDE model (FAA-H-8083-2, Ch. 2) structures this process into 6 steps.

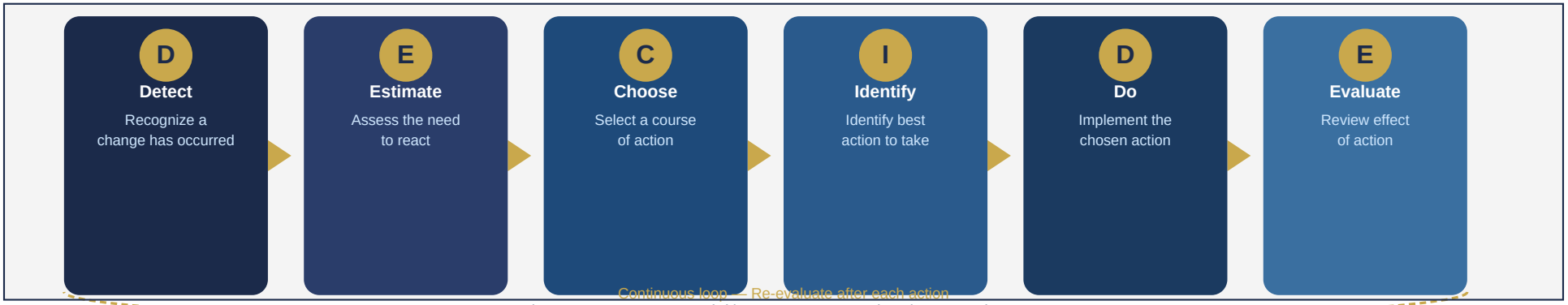


Figure 5 — DECIDE Model | FAA-H-8083-2, Ch. 2 | PHAK Ch. 17

The Most-Failed Steps:

- **Estimate:** Pilots underestimate urgency or severity of the situation.
- **Evaluate:** Pilots fail to re-assess whether the chosen action is working. The loop never completes.

Single-Pilot Resource Management (SRM):

SRM brings CRM principles to single-pilot operations. All available resources function as the pilot's 'crew.'

- ATC — always available, often underused
- GPS/autopilot — cognitive tools, not substitutes for thinking
- Passengers — second set of eyes for traffic
- Weather products — update your situational picture in real time
- Checklists — capture attention and free working memory

■ ***Risk Note:*** ■ *Confirmation Bias (R4): A pilot who has decided to go will interpret ambiguous weather as flyable and ambiguous fuel as adequate. Teach students to actively seek DISCONFIRMING information: 'What would make you NOT go on this flight?' (FAA-H-8083-2, Ch. 2)*

■ ***Risk Note:*** ■ *Expectation Bias (R4): Perceiving what is expected rather than what is present. Example: A pilot expecting a cleared approach visually acquires what they believe is the runway — but it is the parallel taxiway. Standard callouts and instrument cross-checks break expectation bias.*

Instructor Note: *Teaching DECIDE: Don't lecture from the model — present a scenario. 'You're 30 miles out, ceiling dropped to 2,000 ft, and your fuel is lower than planned. Walk me through DECIDE.' Probe each step explicitly.*

10. Optical Illusions During Landing (AI.II.A.K1k)

A WHAT TO TEACH

Unlike vestibular illusions, optical illusions create **visual misperceptions** — the pilot's eyes report incorrect altitude or approach angle. Most dangerous at unfamiliar airports or in low visibility/night conditions. Understanding the mechanism prevents the wrong corrective response.

Illusion	What Causes It	What You Perceive	Danger	Correction
Narrow runway	Runway narrower than calibrated	Higher than actual	Fly too low → undershoot	Trust PAPI/VASI; use altimeter
Wide runway	Runway wider than calibrated	Lower than actual	Fly too high → land long or overshoot	Research runway width pre-flight
Upsloping runway	Terrain/runway tilts upward	Higher than actual	Fly lower approach → CFIT risk	PAPI is mandatory; cross-check ALT
Downsloping runway	Terrain/runway tilts downward	Lower than actual	Fly high → land long, runway overrun	Runway gradient on approach plate
Black hole approach (night, dark terrain)	No terrain/light cues below	No altitude perception	CFIT — has killed many pilots	PAPI mandatory; instrument approach preferred
Haze/reduced vis	Visual perspective compressed	Closer + lower than actual	Fly high → land long	Plan for long TD; go-around brief

B HOW TO TEACH IT

- Brief relevant illusions before **every approach to an unfamiliar runway**.
- Example brief: 'This runway is 75 ft wide vs. our usual 100 ft. You may perceive yourself higher than you are. Trust the PAPI.'
- Make it routine — illusion briefing should be part of the approach briefing checklist.

Instructor Note: *Key question to test understanding: 'You're on a 4,000 ft runway instead of your usual 8,000 ft field. Same width. How might your sight picture differ, and how does that change your approach?' If the student says 'it looks the same,' they need more work on visual cue dependency.*

11. Human Factors Risk Management Summary (AI.II.A.R1–R4)

A WHAT TO TEACH

The four R-elements are not independent risks — they compound:

- **R1 — Aeromedical / physiological:** Hypoxia, hyperventilation, CO, motion sickness, fatigue, dehydration, medications, scuba intervals.
- **R2 — Hazardous attitudes:** Anti-authority, Impulsivity, Invulnerability, Macho, Resignation. Each has a named antidote.
- **R3 — Distractions / task saturation / SA loss:** In-cockpit distractions are the #1 contributor to LOC-I and runway incursions.
- **R4 — Confirmation and expectation bias:** Cognitive distortions that corrupt the risk-assessment process itself.

KEY RULE ■ The Swiss Cheese principle: no single factor kills. Multiple aligned holes in your defenses (fatigue + stress + poor wx + confirmation bias) open the accident trajectory.

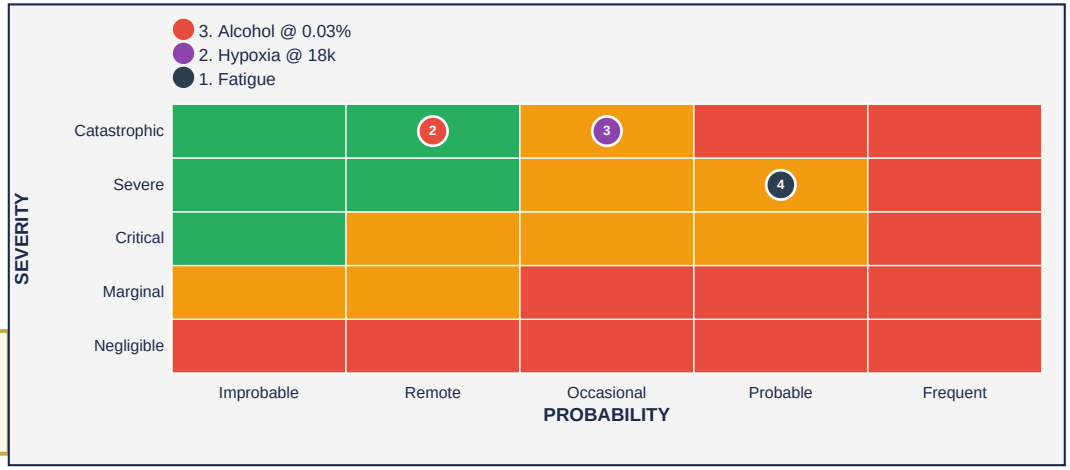


Figure 6 — Risk Assessment Matrix | FAA-H-8083-2, Ch. 2

12. Motion Sickness, Scuba Diving, and Other Aeromedical Factors (K1e, K1l)

A WHAT TO TEACH

Motion Sickness (K1e)

Conflict between vestibular and visual inputs. Most common in first 10–20 hrs of training. The CFI's response determines whether the student quits.

Onset indicators:

- Yawning, excessive salivation, pallor, sweating
- Reluctance to speak or look inside

CFI response:

- Smooth, coordinated flight; avoid abrupt maneuvers
- **Give the student the controls** — active input reduces motion sickness
- Fresh air; do not call attention to the sickness
- Reduce lesson intensity; end early if needed
- Debrief positively: 'This goes away. Most pilots have some form of this early on.'

Scuba Diving / Dissolved Nitrogen (K1l)

Dissolved nitrogen in blood and tissues can form bubbles at altitude. Result: decompression sickness (DCS) — potentially fatal.

KEY RULE ■ FAA Guidance (AIM 8-1-2): • Non-decompression dives: wait at least 12 hours before flying • Decompression dives or multiple dives: wait at least 24 hours • Conservative standard (dive medicine): always use 24 hours

Teaching moment: Any student who mentions a dive trip — ask:

- When did your last dive end?
- What was the maximum depth?
- Did you require a decompression stop?
- Multiple dives over consecutive days?

Instructor Note: *This is a non-negotiable go/no-go item. Apply the rules strictly. A student who dove to 90 ft yesterday should not be flying cross-country at 9,500 ft today.*

SECTION 4 — COMMON ERRORS

Common Error	How to Recognize It	How to Correct It
Treating IMSAFE as a checkbox, not a decision	Student recites the letters correctly but cannot state what a 'yes' means for the flight.	Force a decision: 'Your Stress item is yes today. What do you do about this flight?' IMSAFE must produce go/no-go decisions, not awareness.
Knowing the 8-hour alcohol rule only	Student cites 'bottle-to-throttle' as the complete 91.17 standard.	Teach all three components. Ask: 'Is it possible to be 10 hours after drinking and still violate 91.17?' (Yes — if BAC still elevated or hangover symptoms present.)
Confusing hypoxia symptoms with hyperventilation	Student lists identical symptoms for both without differentiating euphoria vs. tingling.	Use the comparison table. Run scenarios: 'Feeling great at 15,000 ft — hypoxia or hyperventilation?'
Dismissing spatial disorientation as rare	Applicant describes SD as 'something that happens in actual IMC to inexperienced pilots.'	SD can affect any pilot whenever the horizon is ambiguous. Experience does not protect against vestibular physics. Demonstrate in AATD.
Not integrating optical illusions into approach briefing	Applicant lists illusions correctly but does not mention them in approach planning.	Make illusion briefing a habit: review runway width, slope, terrain, and night conditions as part of every approach brief for unfamiliar airports.
CFI fails to model IMSAFE for themselves	CFI teaches IMSAFE but never does it out loud.	Model it before every lesson: 'Before I brief you, let me run my own IMSAFE check.' Students do what their CFI does, not what their CFI teaches.

SECTION 5 — COMPLETION STANDARDS

✓ Correctly identifies symptoms, causes, and corrective actions for at least 3 of 12 aeromedical conditions; differentiates overlapping symptoms (e.g., hypoxia vs. hyperventilation). *(AI.II.A.S1)*

✓ Conducts a complete verbal IMSAFE self-assessment for an evaluator-presented scenario and produces a documented go/no-go decision with reasoning. *(AI.II.A.S2)*

✓ Identifies all five spatial disorientation illusions, explains the vestibular mechanism for each, and correctly describes graveyard spiral recovery. *(AI.II.A.K1d)*

✓ Recites 14 CFR 91.17 fully (all three components) and applies the standard to a scenario where 8 hours have elapsed but BAC may still be elevated. *(AI.II.A.K2)*

✓ Applies the RMH Risk Assessment Matrix to a scenario with at least two concurrent human factors risks, documents mitigations, and produces a go/no-go recommendation. *(AI.II.A.R1–R4)*

✓ Applies the DECIDE model to a realistic in-flight scenario, narrating all 6 steps and demonstrating evaluation of the outcome. *(AI.II.A.K4)*

✓ Correctly briefs optical illusions for an unfamiliar runway scenario and identifies the specific approach error each illusion would produce. *(AI.II.A.K1k)*

✓ Explains confirmation and expectation bias, gives an in-flight example of each, and describes at least two teaching techniques to counter them. *(AI.II.A.R4)*

SECTION 6 — REVIEW QUESTIONS AND ANSWERS

Q1. A student calls at 7:30 AM for their 8 AM lesson. They had two beers at 9 PM last night. Can they legally fly? Should they? Walk through the full 91.17 analysis.

■ *Full 91.17 standard has THREE components — all must be satisfied: (1) At least 8 hours: 7:30 AM is 10.5 hours after 9 PM — satisfied. (2) BAC <0.04%: Two beers at 9 PM for an average adult are metabolized by ~1 AM. BAC is almost certainly <0.04% at 7:30 AM — likely satisfied. (3) Not 'under the influence': If the student has any hangover symptoms (headache, fatigue, slow thinking), they may still be 'under the influence' by FAA interpretation. Teaching response: 'You're probably compliant, but I want you to ask yourself: Is your performance 100% today? If there's any doubt, we do a ground lesson.'*

Q2. During pre-flight, your student mentions they went scuba diving yesterday — a single 60-foot dive ending at 4 PM. It is now 9 AM (17 hours later). Can they fly? What is your regulatory analysis and instructional response?

■ *FAA guidance (AIM 8-1-2): 12-hour minimum after a non-decompression dive. 17 hours exceeds the 12-hour minimum — technically compliant. Conservative standard (dive medicine): 24 hours for any altitude flying. At 17 hours, the student is below the conservative threshold. Instructional response: 'You're past the FAA minimum but below the conservative 24-hour standard. Today we fly at or below 5,000 ft MSL to minimize pressure change. Any joint pain, rash, or dizziness = land immediately. For future reference: if you dive, we wait 24 hours before any flight.'*

Q3. Describe how you would teach the graveyard spiral to a student who has never experienced spatial disorientation. Include the physiology, demonstration method, and recovery procedure.

■ *(1) Ground briefing: Draw the semicircular canal diagram. Explain that canals only detect angular ACCELERATION — not constant velocity. After 20 seconds in a constant turn, sensation of turning disappears. Rolling wings level then signals a turn in the opposite direction. (2) Analogy: 'Spin in an office chair for 30 seconds — you stop feeling it. When you stop, you feel like you're spinning the other way.' (3) AATD demonstration: Establish 20-second simulated IMC constant turn. Ask: 'What attitude are we in?' Show instruments. The discrepancy is unforgettable. (4) Recovery brief: Wings level on AI. Level pitch with elevator. Verbalize: 'My body says turning. AI says wings level. I believe the AI.'*

Q4. A student consistently makes overconfident go/no-go decisions, pushing into conditions at the edge of their minimums. Which hazardous attitude(s), what antidote, and how do you address it instructionally?

■ *Primary: Invulnerability ('It won't happen to me'). Secondary: Macho ('I can do it'). Antidotes: 'It could happen to me' / 'Taking chances is foolish.' Instructional approach: (1) Use NTSB accident case studies with pilots who had identical experience profiles — make the statistical risk personal and concrete. (2) Require written PAVE + Risk Matrix for every proposed flight; the written process slows impulsive decisions. (3) Model conservative decision-making: 'I'm canceling today because my ceiling minimum for this route is 2,500 ft. Not because it's impossible, but because the margin isn't there.' (4) Name the attitude directly: 'What I'm seeing is the invulnerability attitude. Your skill does not protect you from the statistics.'*

Q5. Differentiate confirmation bias from expectation bias and give an in-flight example of each. How would you build cognitive immunity to both in a student pilot?

■ *Confirmation bias: seeking information that confirms a pre-existing belief. Example: A pilot who has decided to depart interprets a broken ceiling layer as 'mostly clear' because they want to go. The same forecast read by a pilot with no plans looks marginal. Expectation bias: perceiving what is expected, not what is actually present. Example: A pilot cleared for an approach visually acquires what they believe is the runway but it is the parallel taxiway — expectation of the runway creates the visual confirmation. Building immunity: (1) Require students to actively seek disconfirming data: 'What would make you NOT go?' (2) Standardize weather decisions using PAVE out loud — verbalization exposes bias. (3) Use post-flight debrief to identify moments where bias influenced a decision in hindsight.*

Q6. You are 40 miles from your destination at 5,500 ft. Fuel shows 10 gallons remaining. Destination weather: 1,500 ft overcast, 2 SM drizzle. Student is fatigued and task-saturated. Walk through DECIDE.

■ *DETECT: Three simultaneous problems: marginal destination weather (below VFR minimums), fuel state marginal for divert + reserve, fatigued student who should not be primary PIC. ESTIMATE: Severity = high (VFR into IMC risk, potential fuel exhaustion, impaired decision-making). Probability of continuing safely without diverting = low. CHOOSE: (A) Divert to nearest VFR airport with adequate fuel. (B) Request flight following to identify alternate. (C) Continue is NOT an acceptable option. IDENTIFY: Option A is best. DECIDE: Execute divert. Take controls from student. Declare intention to ATC. DO: Divert. EVALUATE: Is alternate weather holding? Is fuel adequate? Continue assessment every 10 minutes.*

Q7. During a descent from 7,500 ft, your student (who has a head cold) reports ear pain. Describe the physiology, the risk, and the correct procedure.

■ *Physiology: Middle ear barotrauma. Eustachian tube blocked by congestion cannot equalize pressure as ambient pressure increases during descent. Tympanic membrane deflected inward by excess external pressure — pain, and potential perforation if severe. Risk: This was foreseeable. IMSAFE Illness item was positive (head cold). The flight should not have been authorized. Procedure: Slow descent rate. Valsalva maneuver (gentle nose-blow with nostrils pinched). Decongestant nasal spray if available. Land if pain is severe. Post-flight: see a physician before next flight if pain persists. Teaching lesson: A head cold = illness item positive = discuss with AME and consider ground lesson only.*

Q8. A student took a Benadryl (diphenhydramine) for allergies the night before and 'slept it off.' It is 9 AM. Can they fly? How do you counsel them?

■ *Pharmacokinetics: Diphenhydramine half-life = 6–9 hours. A 25 mg dose at 10 PM has 1.25–1.5 half-lives by 9 AM — measurable serum levels remain. The active metabolite has its own kinetic profile. 'Slept it off' is not a pharmacokinetic standard. FAA/AME guidance: 1st-generation antihistamines are a disqualifying drug class. AME standard is typically 72 hours from last dose before flying. Counseling: 'The fact that you feel fine does not mean you are unimpaired. Benadryl's effects on reaction time are measurable on cognitive testing long after the drowsiness resolves. Today is a ground lesson. For the future: if you need an antihistamine, use a 2nd-generation (non-sedating) one and contact your AME for specific guidance on flight timing.'*

Instructor: _____ Date: _____ Applicant: _____ Date: _____

AREA OF OPERATION II — TECHNICAL SUBJECT AREAS

Task B: Visual Scanning and Collision Avoidance

References: AC 90-48 | AIM Ch. 8 | FAA-H-8083-25C Ch. 17 | FAA-H-8083-2

K1 Vision Degradation	K2 Visual Illusions	K3 See & Avoid	K4 Scan Technique
K5 Blind Spots	K6 Collision Cues	K7 Risk Situations	K8 Attention Division

R1 Scan Distractions	R2 Focal Distance	R3 High-Volume Ops	R4 Reaction Time	R5 Safety Pilot

Objective:

The applicant demonstrates instructional knowledge of visual scanning and collision avoidance by explaining environmental conditions that degrade vision, vestibular and visual illusions, See and Avoid responsibilities, proper scan technique with peripheral vision emphasis, aircraft blind spots, visual cues of impending mid-air collision, high-risk situations, and division of attention. The applicant also explains associated risk factors and demonstrates correct scan technique in flight.

Why This Matters:

Mid-air collisions are consistently among the most fatal aviation accidents. The majority occur in VMC, below 3,000 ft AGL, within 5 miles of an airport — conditions where pilots rely entirely on visual scanning. **No technology replaces a disciplined, structured visual scan.**

ACS Element	Code
Environmental conditions degrading vision	K1
Vestibular and visual illusions	K2
See and Avoid responsibilities	K3
Visual scanning / peripheral vision	K4
Blind spots and clearing procedures	K5
Visual cues of impending collision	K6
Highest-risk collision situations	K7
Division of attention	K8
Distractions to scanning	R1
Relaxed focal distance	R2
High-volume environments	R3
Collision reaction time	R4
Safety pilot responsibilities	R5

1. Visual Physiology: How the Eye Limits Your Scan (AI.II.B.K1, K2)

A WHAT TO TEACH

Eye Structure and Implications for Flight:

The retina contains two types of photoreceptors: **cones** and **rods**. Cones are concentrated in the **fovea centralis** — a 2° area at the center of vision — and provide sharp color vision in bright light. Rods are distributed across the periphery and provide low-light/motion detection but have poor acuity and no color discrimination.

The Blind Spot (Optic Disc):

Every eye has a blind spot where the optic nerve exits the retina. There are no photoreceptors at this point. In normal binocular vision, each eye compensates for the other. But a pilot scanning with focus on instruments could have an aircraft image fall precisely on the blind spot — and never see it.

- **Empty-field myopia:** In featureless sky/haze, the eye defaults to a resting focal point of ~2–3 ft — everything beyond that is blurry without conscious effort to refocus
- **Night vision:** Off-center (10–15° eccentric) viewing uses rods, providing better detection of dim objects than looking directly at them
- **Mesopic vision:** Dusk/dawn conditions — most dangerous period; both rods and cones are suboptimal, acuity is reduced

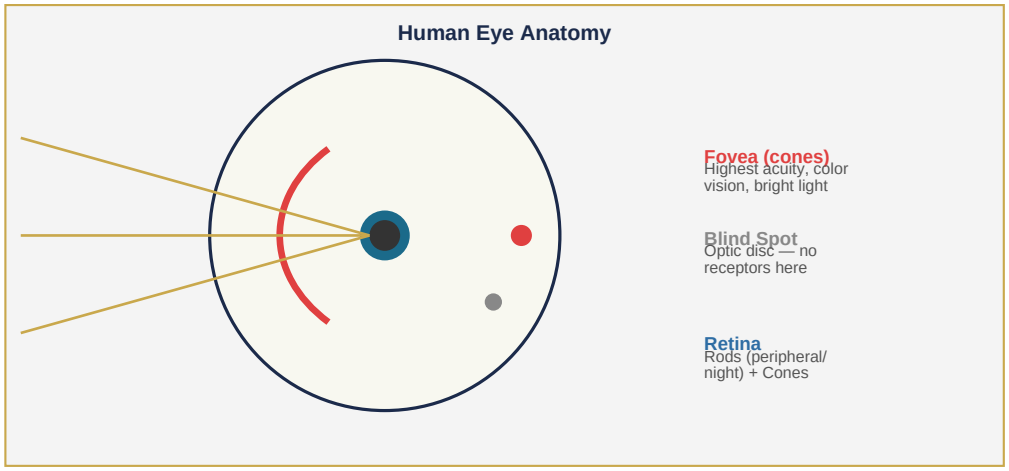


Figure 1 — Human eye cross-section. Fovea provides sharp acuity; rods provide peripheral detection. PHAK Ch. 17

Environmental Conditions That Degrade Vision:

- **Haze / smoke:** Reduces contrast; aircraft appear farther away than actual distance
- **Glare:** Direct sun or reflected sun off water/canopy overwhelms cone response
- **Rain on windscreen:** Distortion + optical diffusion
- **Dark adaptation loss:** Bright lights before night flight destroy 30+ min of dark adaptation
- **Hypoxia:** Night vision degrades markedly above 5,000 ft without O_2
- **Fatigue/medication:** Degrades both focus and scan discipline

B HOW TO TEACH

Ground demonstration — blind spot:
Hold a finger up at arm's length. Close one eye. Slowly move the finger from center outward — at approximately 15° from center it will disappear. This visceral demonstration of the blind spot builds permanent awareness that a non-scanning pilot can be looking directly at converging traffic and see nothing.

Probe question:

- *'If your eye has an actual hole in its visual field, how does a pilot compensate?'* — Answer: binocular overlap, and deliberate scanning to keep aircraft images moving across the retina, never stationary on the blind spot.

Defocus drill (pre-solo lesson):
Have the student stare at the instrument panel for 30 seconds, then immediately look outside. The eyes will take 1–2 seconds to refocus on infinity. This is empty-field myopia in action. Discuss: every time you look inside, you pay a re-focus tax when you look back out. The fix is deliberate, unhurried outside-scan time.

Instructor Note: *Night vision: teach students to use off-center viewing during night flights. Looking 10–15° off-target uses rod cells and dramatically improves detection of dim aircraft lights.*

D ANALOGY

"Your eye's fovea is like a spotlight — brilliant in the center, dark at the edges. The rest of the retina is a motion detector, not a camera. A pilot who stares is using a spotlight to search an entire stadium. A pilot who scans is sweeping that spotlight across every row in sequence."

2. See and Avoid: Regulation, Responsibility, and Right-of-Way (AI.II.B.K3, K7)

A WHAT TO TEACH

Regulatory Basis:

14 CFR 91.113 establishes right-of-way rules. The fundamental principle: *each pilot is responsible for collision avoidance.* An ATC clearance does NOT relieve a pilot of the responsibility to see and avoid other aircraft — even in controlled airspace. **14 CFR 91.111** prohibits operating so close to another aircraft as to create a collision hazard.

Right-of-Way Order (14 CFR 91.113):

- 1. **Balloon** — least maneuverable, highest priority
- 2. **Glider**
- 3. **Airship**
- 4. **Aircraft towing**
- 5. **Powered aircraft** — lowest priority in the hierarchy

- **Converging:** Aircraft to the right has right-of-way (yield to your right)
- **Approaching head-on:** Both turn right
- **Overtaking:** Overtaking aircraft gives way, pass to the right
- **Landing:** Aircraft on final approach or landing has right-of-way over taxiing/airborne

High-Risk Collision Situations (K7):

Most mid-air collisions occur in conditions that feel safest: clear VFR day, below 3,000 ft AGL, near a training airport. Understanding why these conditions are actually the most dangerous is critical to motivating vigilance:

Near airports	High traffic density; arrival/departure corridors concentrate aircraft
Training areas	Multiple aircraft at similar altitude on similar patterns
Cruise altitude (VFR)	Aircraft on popular VFR altitudes converging from opposite directions
Climbs/descents	Aircraft transiting altitude bands; TCAS less effective
VMC conditions	Pilots relax scan in 'beautiful' weather; complacency is highest risk
Reduced vis (haze)	Gives false appearance of more distance than actual

KEY RULE ■ 14 CFR 91.113(b): 'Each pilot of an aircraft shall, insofar as practicable, scan the sky in the vicinity of the aircraft for other aircraft that may be in conflict.' This is a legal obligation, not a suggestion.

C EXAMPLES

Example 1 — ATC clearance is not a shield: *A student asks, 'If I'm in Class C airspace with radar contact and a squawk, won't ATC warn me about traffic?' Correct answer: ATC provides traffic advisories on a workload-permitting basis only. ATC does not guarantee separation of VFR aircraft. You are the last line of defense. The 1978 San Diego Cessna/PSA collision occurred in clear skies with both aircraft on ATC radar — a real-world lesson that resonates.*

Example 2 — Converging scenario: *Two aircraft are at 4,500 ft, one heading 090° and another heading 350°. Both crews have been heads-down on GPS for 90 seconds. Neither has scanned in 30+ seconds. The right-of-way pilot (aircraft to the right of the other's path) has priority but still must maneuver if impact is imminent. This is why scan discipline is non-negotiable: right-of-way is academic if you never see the other aircraft.*

E INSTRUCTOR NOTE

Instructor Note: *When teaching right-of-way rules, emphasize AC 90-48 guidance: the right-of-way rules only apply when pilots see each other. They are useless if neither pilot is scanning. Reframe: 'The purpose of right-of-way rules is to create predictable avoidance behavior once aircraft are already in sight. The purpose of scanning is to get to that point.'*

3. Visual Scanning Technique: How to Search Effectively (AI.II.B.K4, S1, S2, S3)

A WHAT TO TEACH

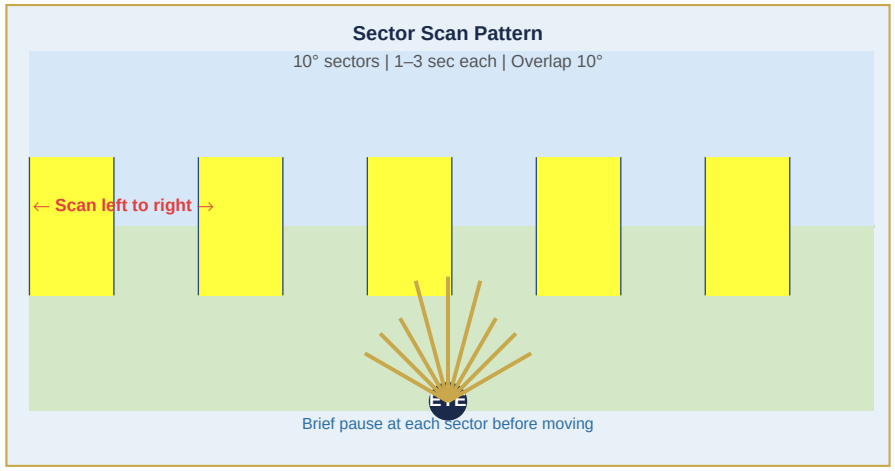


Figure 2 — Sector scan: 10° sectors, 1–3 second pause each, 10° overlap. PHAK Ch. 17 / AC 90-48

The Structured Sector Scan (S1, S3):

- Divide the windscreen into 10°–15° sectors from left to right
- **Pause 1–3 seconds in each sector** — the eye must stabilize to resolve detail
- Overlap each adjacent sector by 10° to ensure no gap in coverage
- Return eye to center (instrument scan) then cycle again
- Do NOT sweep continuously — a moving eye cannot detect detail

KEY RULE ■ AC 90-48: Scanning must consist of SHORT, REGULARLY SPACED EYE MOVEMENTS. Each movement should be ≤10°. Pause 1 second minimum per sector. Continuous sweeping produces zero detection of small/distant aircraft.

The Biology Behind the Technique:

The fovea — the only part of the retina with sharp acuity — subtends only **2 degrees** of visual angle. An aircraft at 3 miles subtends less than 0.01 degrees. The only way to detect it is to have it fall on or near the fovea. A swept scan moves the image across the retina faster than the fovea can process it. Stopping allows an aircraft image to stabilize on the fovea.

Peripheral Vision Role:

Peripheral rods are optimized for **motion detection**. An aircraft on a constant bearing shows **no relative motion** in the peripheral field — it looks stationary. This is the most dangerous converging traffic: it appears as a stable dot, growing slowly larger. The structured sector scan ensures the converging aircraft eventually enters the fovea where detail can be resolved.

Scanning Around Obstructions (S2):

- Wing struts, door frames, and instrument panels block significant arcs
- Lean forward/sideways to visually clear obstructed sectors
- High-wing: lean left/right to clear underneath wings before turns
- Low-wing: momentarily lower wing toward direction of turn
- Verbalize clearing: 'Clear left, clear right, clear above' — instills habit

B HOW TO TEACH

The scan clock (ground lesson tool):

Draw a cockpit windscreen on a whiteboard. Divide into 12 sectors. Have the student verbalize each sector as they 'scan': 'Far left clear, left clear, left-center clear...' This builds the verbal habit that translates directly to the cockpit — and gives the instructor an auditory signal that the student is actually scanning, not fixating.

In-flight scan audit:

- Place a small orange dot on the windscreen at the 10 o'clock position
- If student never looks at the dot, their scan is incomplete
- Ask: 'When did you last check 9 o'clock high?' — most students have no answer

Common scan errors to catch and correct:

Fixation	Student locks onto a single point (ground feature, other aircraft). Correct: 'Move your eyes every 3 seconds. Nothing stays in the fovea.'
Omission sectors	Student scans only ahead, ignores 9 and 3 o'clock. Correct: Use the clock-face framework. Cover ALL sectors.
Continuous sweep	Student sweeps slowly left to right without pausing. Zero detection capability. Correct: Stop and look.
Heads-down	Student prioritizes GPS/tablet over outside scan. Correct: Establish 'inside 20%, outside 80%' as a rule.

D ANALOGY

"Looking for traffic with a continuous sweep is like trying to read a book by dragging your finger across the page without stopping — the words blur. You have to stop at each word to read it. A pilot has to stop at each sector to detect traffic."

4. Aircraft Blind Spots and Clearing Procedures (AI.II.B.K5)

A WHAT TO TEACH

Structural Blind Spots:

Every aircraft design creates areas where the pilot's view is blocked by fuselage, wings, engine nacelles, or window frames. The CFI must teach students to **actively compensate** for these blind zones before any maneuvering.

High-Wing Aircraft Blind Spots:

- Wing blocks the view **above and to the sides** in the direction of a turn
- Before turning left: momentarily **raise the left wing** and scan beneath it
- Before climbing: pitch attitude may block the entire forward-upper hemisphere
- Clearing turn: turn 90° or 180° before entering practice maneuvers in training areas

Low-Wing Aircraft Blind Spots:

- Wing blocks the view **below and to the sides** in the direction of turn
- Before turning right: momentarily **lower the right wing** and scan above it
- On approach to landing: wings block view of traffic on base leg

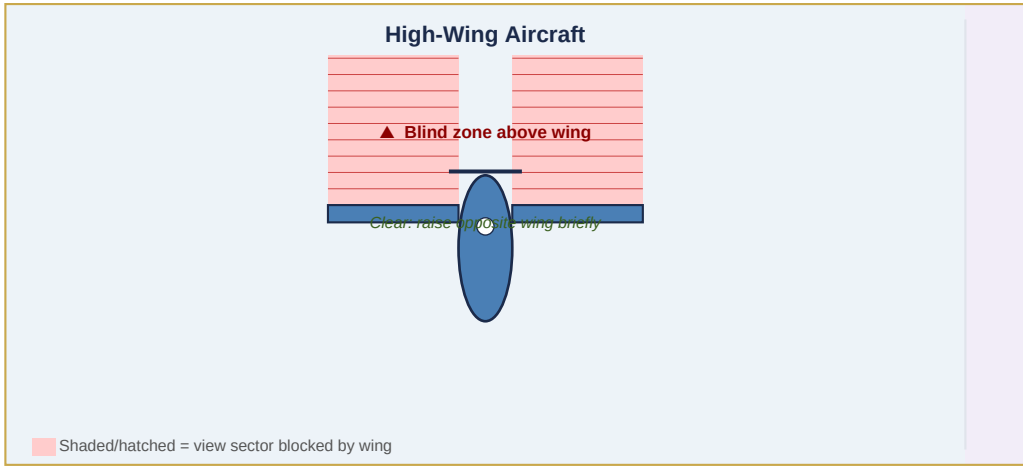


Figure 3 — High-wing vs. low-wing blind zones. Shaded areas require positive clearing action before turns. PHAK Ch. 17

B HOW TO TEACH

The clearing turn habit:

Before every practice maneuver, the student should execute clearing turns — typically 90° in each direction — while actively scanning in the blind zones. This is not just a procedural box to check: the turns physically move the blind zone so that previously hidden airspace is now visible.

- **Verbalize:** Have students say 'clear left... clear right... clear above' before every maneuver entry. This instills the habit and makes the check audible to the instructor.
- **Slow flight setup:** Before configuring for slow flight, complete two 90° turns. This is a standard practice that establishes the correct mental model.

Cockpit preparation:

- Adjust seat height: your eyes should be at the manufacturer's design eye reference point. A seat too low dramatically increases the blind zone under a low wing.
- Keep windscreen clean: even light haze on the inside of a windscreen reduces contrast.
- Remove cockpit clutter from glareshield: maps, iPads, and kneeboard pads placed on the glareshield block significant visual arcs at low sun angles.

■ ***Risk Note:*** *Training operations: Instructors should request that students verbalize clearing procedures on every turn during training. The habit must be automatic before solo. AC 90-48 specifically recommends this verbalization technique.*

5. Visual Cues of an Impending Mid-Air Collision (AI.II.B.K6)

A WHAT TO TEACH

The Constant Bearing Principle:

When two aircraft are on a collision course, the **relative bearing between them remains constant** while the distance decreases. In the visual field, the converging aircraft appears as a **stationary point that grows in size**. There is no relative angular movement — the aircraft appears 'parked' in the windscreen. This makes it the most difficult collision threat to detect.

Recognition cues:

- **No relative movement:** Traffic appears to be a fixed dot at a fixed position in the windscreen — not moving left/right or up/down
- **Growing size:** The image expands but doesn't shift position — this is the only visual indication of closure
- **Aspect angle:** Head-on traffic shows a symmetric silhouette; wing tip lights visible on both sides simultaneously
- **Sudden appearance:** At speed, traffic can appear 'out of nowhere' when it crosses from blind zone to fovea

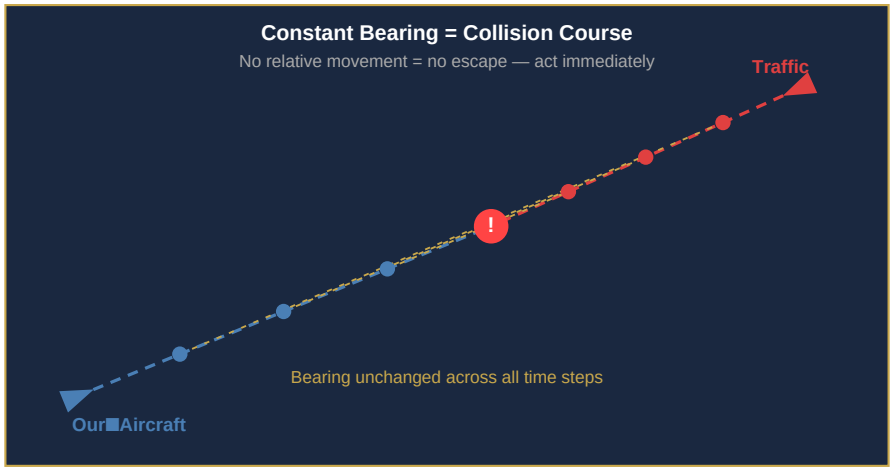


Figure 4 — Constant bearing = collision course. The bearing line (gold) does not rotate across time steps. The only warning is a growing image size. AC 90-48

Reaction Time Reality:

At a combined closure rate of 400 kts (2 aircraft at 200 kts head-on), aircraft close at approximately 675 ft/sec. From the moment traffic becomes visible to the point of impact may be **as little as 12–15 seconds**. From recognition to evasive action typically takes 10–12 seconds including perception, decision, and control input.

CRITICAL ■ At a combined closure rate of 400 kts, a mid-air collision can occur within 12 seconds of first visual contact. There is NO time for hesitation. Recognition must trigger immediate, instinctive evasion.

B HOW TO TEACH

The 'frozen dot' exercise:

During cruise flight, point to a distant object (water tower, antenna) and say: 'That object is not moving in my windscreen. If it were an aircraft and I were an aircraft, and neither of us changed course — we would collide.' Let the student sit with that. Then scan: 'Now look for any dot in the sky that isn't moving. That's your threat.' This makes the abstract concept tangible in real-time flight conditions.

Night traffic detection:

- Look for **navigation light sequences:** white strobes visible from all angles; red = left wingtip; green = right wingtip
- **Red + green lights visible simultaneously** = aircraft coming toward you
- **Red + white light** = aircraft moving away or crossing
- Anti-collision lights (strobes) are required from sunset to sunrise

Somatogravic confusion hazard:

In dark conditions (night VMC over water/desert), a climbing aircraft ahead may look like stars. Its lights do not flash like typical strobes at distance. A student may dismiss a rising steady light as 'just a star.' Teach: any light that grows brighter or appears to rise against the horizon deserves a second look and a radio call.

6. Division of Attention: Inside vs. Outside (AI.II.B.K8, R1, R2)

A WHAT TO TEACH

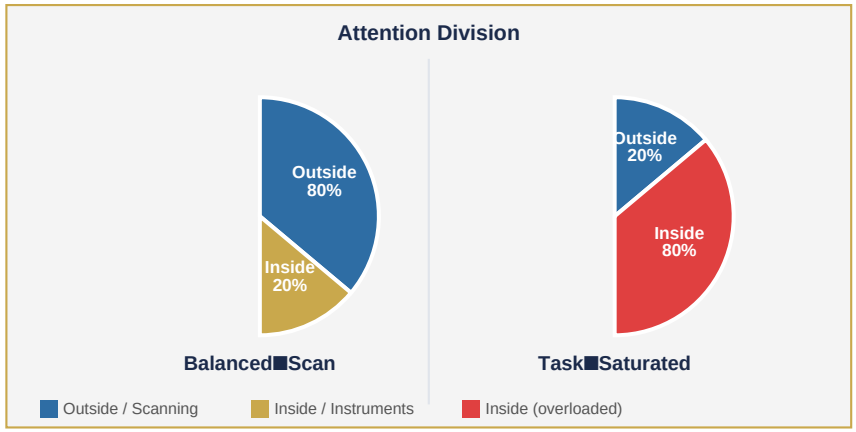


Figure 5 — Attention allocation: balanced scan (left) vs. task-saturated cockpit (right). Task saturation eliminates visual scanning. AC 90-48 / PHAK Ch. 17

The 80/20 Rule:

In VFR flight, pilots should allocate approximately **80% of attention to outside the cockpit** and 20% to instrument cross-check. This ratio deteriorates rapidly as workload increases — student pilots in unfamiliar situations may flip to 90% inside, 10% outside without realizing it.

- **Effective scan requires mental bandwidth:** A pilot managing radio calls, checklists, or GPS programming cannot simultaneously scan effectively
- **Solution:** Reduce inside workload before high-traffic areas. Complete checklist items at cruise, not while maneuvering near airports

Distractions That Kill Scan Discipline (R1):

Passenger conversation	Breaks scan rhythm; student answers and doesn't resume scanning. Train: pause conversation to complete scan before responding.
EFB / tablet use	Screen luminance captures visual attention. Establish instrument scan panel-mounted before using EFB.
ATC workload	Complex clearances require heads-down transcription. Use readback then immediately resume scan.
Turbulence / unusual attitude	Student fixates on instruments. Scan is suspended. Teach: 'Fly first, scan after stability regained.'
Maintenance/abnormal	Abnormal indication draws 100% attention. CFI must verbalize and model the scan resumption.

Relaxed Intermediate Focal Distance (R2):

Empty-field myopia causes the resting eye to focus at 2–3 ft, not infinity. A pilot who 'looks outside' without consciously focusing at distance sees nothing beyond the wingtip clearly. The fix: actively focus on a distant point (horizon, mountain) before beginning each scan cycle.

B HOW TO TEACH

The 'call before you look' technique:

Before making any radio call, complete the current scan sector. After the call, immediately resume the scan. This establishes a specific trigger for scan continuation. Students tend to continue holding the mic and looking at the radio panel. The habit of 'mic down = eyes up' must be drilled.

Scan resumption drill:

During cruise, the CFI deliberately introduces inside-the-cockpit tasks: weight and balance calculation, frequency lookup, or route review. After 30 seconds, the CFI calls 'outside' — the student must immediately scan and report all traffic in sight. This builds the habit of deliberate scan resumption after any inside task.

D ANALOGY

"Attention is like a spotlight battery: it doesn't run out, but you can only point it in one direction at a time. Every minute spent managing the GPS is a minute the spotlight isn't on the sky. The professional pilot learns to bank the spotlight quickly — inside for a second, outside for five — never letting it park."

7. High-Volume Environments and Collision Reaction Time (AI.II.B.R3, R4)

A WHAT TO TEACH

High-Volume Operational Environments (R3):

Certain airspaces and flight conditions concentrate multiple aircraft at the same altitude, speed, and track. Scan discipline must be heightened — not relaxed — in these conditions, even though they appear 'normal.'

- **Traffic pattern:** Multiple aircraft in 1–2 nm rectangle, altitude ±100 ft
- **VFR practice areas:** Multiple training aircraft, uncoordinated, similar altitudes
- **Class B/C veil (outer ring):** VFR aircraft below the floor, concentrated
- **VFR cruise altitudes:** 3,500/5,500/7,500 ft (odd+500 eastbound) bring converging aircraft
- **Common routes:** Mountain passes, coastal highways, popular VFR checkpoints

Collision Reaction Time (R4):

Speed (each)	Closure Rate	Visual Range Needed	Available Time
100 kts (GA)	200 kts / 338 fps	0.5 nm minimum	~9 sec
150 kts (GA)	300 kts / 507 fps	0.75 nm minimum	~8 sec
200 kts (fast GA)	400 kts / 676 fps	1 nm minimum	~8 sec
250 kts (turbo)	500 kts / 845 fps	1.5 nm minimum	~11 sec

Total reaction time from first visual detection to aircraft separation includes: **detect (1–2 sec)** + **recognize as threat (3–4 sec)** + **decide on action (1–2 sec)** + **control input (1–2 sec)** + **aircraft response (2–3 sec)** = **8–13 seconds total.**

The clearing turn before maneuvers:

Before any practice maneuver, two 90° clearing turns are recommended. This exposes the previously blind zone and resets the scan. Altitude: descend 100 ft during each clearing turn so the maneuvering altitude is above the final altitude — traffic above you was behind you in the turn.

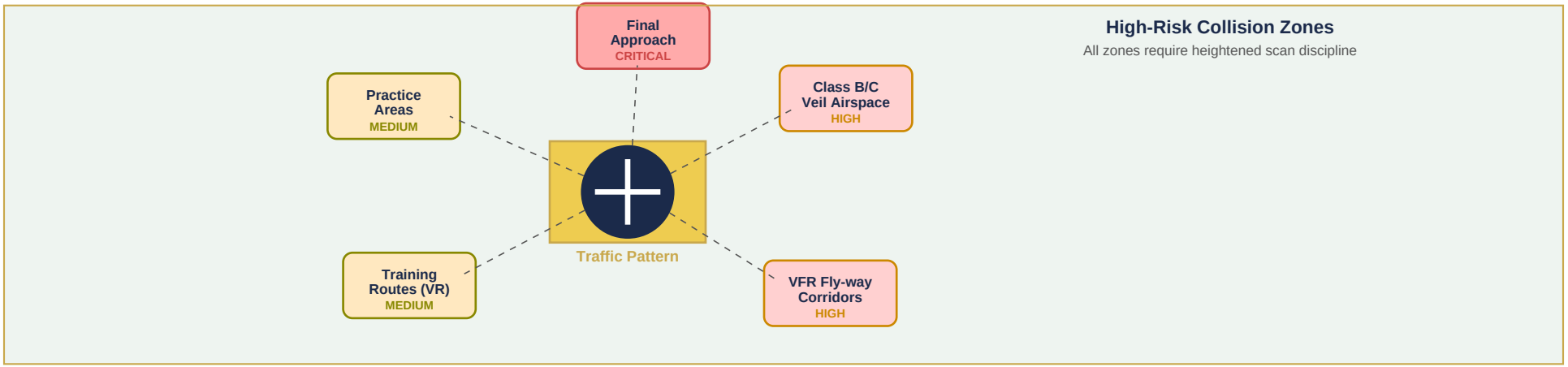


Figure 6 — High-risk collision zones near an airport. All zones require heightened scan frequency. AC 90-48

CRITICAL ■ At GA collision speeds, pilots have 8–12 seconds from first visual contact to aircraft separation. This is NOT a comfortable margin. Scanning at 2+ mile detection range is the only buffer that works.

8. Safety Pilot Operations and Electronic Traffic Systems (AI.II.B.R5, S4)

A WHAT TO TEACH

Safety Pilot Responsibilities (R5):

Under **14 CFR 91.109**, a safety pilot is required when a pilot practices simulated instrument flight under a view-limiting device (foggles, hood). The safety pilot must have at minimum a **private pilot certificate** with appropriate category and class ratings for the aircraft being flown.

Safety pilot duties and certificate:

- Must possess at least a private pilot certificate appropriate to category/class
- Must occupy a control seat and have full outside visual capability
- **Is a required crewmember** — counts as pilot for flight time logging purposes
- Must actively scan for traffic — this is their PRIMARY function
- Cannot be distracted by navigation, radio, or passenger duties
- If acting as PIC (logged), must also have a current medical and be current in type

KEY RULE ■ 14 CFR 91.109(c): No person may operate a civil aircraft in simulated instrument flight unless the other control seat is occupied by a safety pilot who possesses at least a private pilot certificate with appropriate category and class ratings.

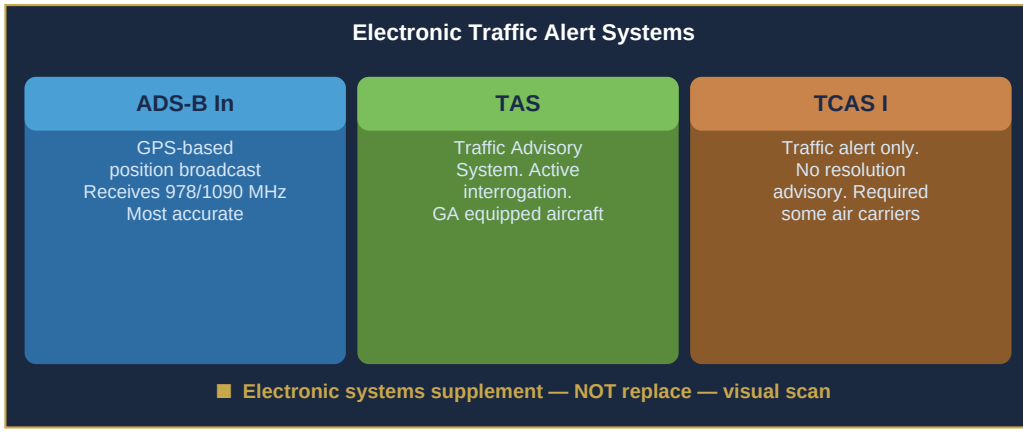


Figure 7 — Electronic traffic advisory systems. All supplement — never replace — visual scan. PHAK Ch. 13

Electronic Systems — Role and Limits (S4):

ADS-B In	Receives GPS position from ADS-B Out equipped aircraft via 978 MHz UAT or 1090 MHz. Highly accurate, near-real-time. Does NOT cover non-equipped aircraft.
TAS	Traffic Advisory System — active interrogation of Mode C/S transponders. Independent of ADS-B. Requires target to have a transponder.
TCAS I	Traffic alert only. No resolution advisory. Required on some air carriers.
TIS-B	ATC radar-derived traffic broadcast from ADS-B ground stations. Covers non-ADS-B-Out aircraft in radar coverage. Updated every ~4.5 sec.
Non-equipped	Ultralights, gliders, balloons, slow-moving aircraft may have NO transponder and NO ADS-B Out — invisible to all electronic systems.

CRITICAL ■ Non-equipped aircraft — ultralights, experimental aircraft, gliders, balloons — are INVISIBLE to all electronic traffic systems. The visual scan is the ONLY collision avoidance tool available against these targets.

SECTION 4 — RISK MANAGEMENT SUMMARY (AI.II.B.R1–R5)

Risk	ACS Code	Mechanism	Mitigation
Distractions to scanning	R1	Passenger talk, radio work, EFB use, checklists pull attention inside; scan stops	Prioritize: outside 80% rule. Pre-complete checklists. 'Call before you look.'
Relaxed focal distance (empty-field myopia)	R2	Eye defaults to focus at 2–3 ft in featureless sky; everything beyond appears blurry	Actively refocus at horizon before each scan cycle. Use distant landmarks.
High-volume environments	R3	Training airports, VFR corridors, class B veil concentrate uncoordinated traffic at same ALT	Heighten scan frequency near airports. Monitor CTAF/ATIS. S-turns before descent.
Collision reaction time	R4	Combined closure at 400 kts = 8–12 sec from visual detection to separation — no margin	Detect traffic at 2+ miles. Immediate unambiguous evasion. No hesitation.
Safety pilot responsibilities	R5	Hood student = zero outside scan. Safety pilot may not understand active duty required	Brief safety pilot before flight: 'Your only job is traffic. Nothing else.'

■ ***Risk Note:*** *AC 90-48 key guidance: The see-and-avoid concept depends entirely on the pilot's ability and willingness to actually scan. ATC, transponders, and TIS are secondary layers — they cannot substitute for a disciplined structured scan. The CFI's job is to build that discipline from the first lesson.*

SECTION 5 — SKILLS ASSESSMENT CRITERIA (AI.II.B.S1–S4)

What the Evaluator Will Assess:

S1 — Short regular scan	Student demonstrates scan using 10°–15° sectors with 1–3 second pause per sector. Scan is visible and deliberate, not a slow sweep.
S2 — Around obstructions	Before each turn, student clears blind zone by momentarily raising/lowering wing and verbalizing 'clear left, clear right.' Technique is automatic.
S3 — Appropriate technique	Student selects and explains correct technique for conditions: daytime sector scan, off-center viewing at night. Adjusts scan based on traffic density.
S4 — Electronic systems	Student demonstrates use of available traffic advisory system (ADS-B, TIS, TAS). Correctly identifies traffic symbol direction and altitude. Explicitly states system limitations.

Instructor Demonstration Checklist:

When demonstrating visual scanning to a student, the CFI should simultaneously explain the technique while performing it. The evaluator will observe that the CFI:

- Divides windscreen into identifiable sectors and names them
- Pauses visibly in each sector before moving to the next
- Returns to center reference point between cycles
- Clears blind spots before initiating any turn or climb
- Uses correct wing-raise or wing-lower technique for aircraft type
- Verbally explains why each technique is physiologically necessary
- Demonstrates off-center viewing technique for night scan
- Describes electronic system display and explains what targets are NOT covered

Examiner oral probe (likely): *'Your student has been under the hood for 20 minutes and the safety pilot hasn't said anything. You remove the foggles. What's the first thing you do?'*

Expected answer: Immediately scan for traffic. Then brief the safety pilot on active scan duties. Verify no traffic in the immediate vicinity before resuming IFR training.

✓ Effectively scans using short regularly spaced eye movements, explains technique and physiological basis. *(AI.II.B.S1)*

✓ Scans around physical obstructions using wing-raise/lower technique; verbalizes clearing procedure before each turn. *(AI.II.B.S2)*

✓ Uses appropriate scan technique for conditions (day/night); describes off-center viewing. *(AI.II.B.S3)*

✓ Uses electronic traffic advisory system if available; correctly identifies limitations — non-equipped aircraft remain invisible. *(AI.II.B.S4)*

SECTION 6 — ORAL REVIEW Q&A;

Q: Your student is scanning by slowly sweeping their eyes left to right continuously. What is wrong with this technique, and how do you correct it?

A: A continuous sweep prevents the fovea from stabilizing on any point long enough to resolve detail. An aircraft image crosses the fovea in <1/10 sec — not long enough to register. Correct by teaching the sector scan: 10°–15° sectors, pause 1–3 seconds each, overlap by 10°. Brief ground demonstration using a simulated windscreen.

Q: Under what circumstances must a safety pilot be used, and what are the minimum qualifications for that person?

A: A safety pilot is required when a pilot practices simulated instrument flight under a view-limiting device (14 CFR 91.109). The safety pilot must hold at least a private pilot certificate with category/class ratings for the aircraft. They must occupy a control seat and actively scan for traffic. If logging PIC, they also need a current medical and aircraft currency.

Q: What is empty-field myopia and how does it affect collision avoidance?

A: Empty-field myopia is the eye's tendency to relax to a near focal point (~2–3 ft) when scanning featureless sky or haze. A pilot who 'looks outside' without consciously focusing at distance cannot resolve aircraft detail at 2+ miles. Mitigation: deliberately focus on a distant landmark (horizon, mountain) to force infinity focus before beginning each scan cycle.

Q: You are flying toward an airport with your student. The student has been looking at the iPad for 90 seconds. What do you do, and why?

A: Direct the student to immediately look outside and scan for traffic. Explain that you are approaching a high-density environment where scan discipline is most critical. Establish the rule: iPad/checklist tasks must be completed before entering the Class D or traffic pattern. Outside scan is the priority from 5 miles out.

Q: A glider is converging on your flight path from the right. You are a powered aircraft. Who has right-of-way, and what is the rule?

A: The glider has right-of-way (14 CFR 91.113(d)). The right-of-way hierarchy prioritizes by maneuverability: balloons > gliders > airships > towed aircraft > powered aircraft. As the less maneuverable aircraft, the glider always has priority over powered aircraft regardless of position.

Q: Your ADS-B display shows no traffic. Is it safe to proceed through a VFR corridor?

A: Not necessarily. ADS-B In only shows aircraft equipped with ADS-B Out or transponders covered by TIS-B. Ultralights, gliders, experimental aircraft, and balloons may have no electronic signature. They are completely invisible to ADS-B. A clear electronic display does not replace the visual scan.

Area II, Task C — Runway Incursion Avoidance

FAA-S-ACS-25 · CFI Airplane Ground Lesson · AC 91-73 · AIM Ch. 4 · FAA-H-8083-25C Ch. 14

Objective

The applicant demonstrates instructional knowledge of runway incursion avoidance by explaining the definition and categories of runway incursions, proper interpretation of taxi instructions and clearances, the importance of recording taxi routes and reviewing airport diagrams, airport markings, signs, and lights, appropriate flight deck activities during taxiing, and communication procedures at uncontrolled airports. The applicant also explains associated risk factors and demonstrates effective instructional delivery.

References

- AC 91-73B — Methods to Prevent Runway Incursions
- AIM Chapter 4 — Air Traffic Control
- FAA-H-8083-25C (PHAK) — Chapter 14 (Airport Operations)
- FAA Chart Supplement / Airport Facility Directory
- 14 CFR §91.129 — Operations at airports with operating control towers

Delivery Format

- Ground lesson — 60–90 minutes
- Open ForeFlight or Chart Supplement to the local airport diagram during lesson
- Pre-taxi brief drill: student traces route before engine start
- Night ops extension: dedicated 20-minute taxi ground lesson before first night solo

Why This Matters

Runway incursions are among aviation's most preventable and most fatal accidents. The 1977 Tenerife collision — the deadliest in aviation history — was a runway incursion. The FAA categorizes roughly 1,000 runway incursions per year, with the majority involving pilot deviations. Most happen in good visibility, in daylight, at familiar airports — where complacency is highest.

ACS Standards — AI.II.C (Knowledge ■ Risk ■ Skills)

Code	ACS Element
Knowledge	
AI.II.C.K1	Definition and categories of runway incursions
AI.II.C.K2	Proper interpretation of taxi instructions and clearances
AI.II.C.K3	Importance of recording taxi routes and reviewing airport diagrams
AI.II.C.K4	Airport markings, signs, and lighting systems
AI.II.C.K5	Appropriate flight deck activities during taxiing
AI.II.C.K6	Communication procedures at uncontrolled airports
Risk Management	
AI.II.C.R1	Distractions, task saturation, and loss of situational awareness
AI.II.C.R2	Confirmation and expectation bias in taxi clearances
AI.II.C.R3	Entering or crossing runways
AI.II.C.R4	Night taxi operations
AI.II.C.R5	Low visibility taxi operations
AI.II.C.R6	Runway incursion risk after landing
AI.II.C.R7	Operations between parallel runways
Skills	
AI.II.C.S1	Demonstrate instructional delivery on runway incursion avoidance

Concept 1 — Runway Incursion: Definition and Categories

AI.II.C.K1 — DEFINITION, ROOT CAUSES & SEVERITY CATEGORIES

A WHAT TO TEACH

FAA Definition (AC 91-73)

A runway incursion is any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle, or person on the protected area of a surface designated for the landing and takeoff of aircraft. This includes the runway itself and its associated safety areas.

How Incursions Occur — Three Root Causes

- **Pilot deviation (PD):** Pilot fails to comply with ATC instructions or applicable rules — the most common type (~65–70% of all incursions)
- **Vehicle/pedestrian deviation (V/PD):** Non-aircraft enters runway environment without clearance
- **Operational error (OE):** ATC issues instruction that creates an unsafe runway situation

ICAO vs. FAA Classification

ICAO uses a similar definition; both align on the four-category severity scale (A–D). The FAA reports Category C and D as the most common. Category A and B events typically result in accidents or serious incidents.

NTSB/FAA Statistics (AC 91-73 context)

Year	Total Incursions	Cat A/B (Serious)
2019	~1,070	7
2020	~712	8
2021	~880	14
2022	~1,048	21
2023	~1,732	14 (est.)

Despite reduced operations during COVID, serious incursion rates did not fall proportionally — demonstrating that incursions are a function of crew behavior, not just traffic volume. Pilot deviations account for approximately 65–70% of all incursions.

Category	Severity	Description
A	**SERIOUS — Near Miss**	Near-miss or collision occurs. Separation lost completely. Evasive action required to avoid collision.
B	**HIGH RISK**	Significant potential for collision. Evasive action required. Separation significantly reduced.
C	**ELEVATED RISK**	Ample time and distance existed to avoid collision. Avoidance was routine.
D	**MINOR VIOLATION**	Little or no immediate safety risk but FAA rule was violated (e.g., crossed hold-short without clearance).

Figure 1 — FAA Runway Incursion Category Scale. Categories A–D based on severity of separation loss. AC 91-73

CRITICAL ■ Runway incursions happen at controlled AND uncontrolled airports, in good weather, during daylight — not just in marginal conditions. Familiarity and complacency are the primary contributing factors in most pilot deviation events.

Concept 1 — Definition & Categories (continued)

B HOW TO TEACH

The Tenerife Analogy

Open every runway incursion lesson with the 1977 Tenerife disaster: 583 people killed when a KLM 747 began its takeoff roll while a Pan Am 747 was still on the same runway. Cause: expectation bias, communication breakdown, and a crew that believed clearance had been given. Ask the student: 'What single action could have prevented it?' — The answer: confirm takeoff clearance before entering the runway.

The Taxiing Mindset Shift

Most student pilots treat taxiing as downtime between flying tasks. Reframe it: taxiing is arguably the highest-risk phase of flight in terms of incursion potential. The cockpit should be as disciplined during taxi as during approach. Introduce the concept of 'sterile taxi' — minimal heads-down time, checklists completed on the ramp, not rolling toward an active runway.

Instructional Sequencing

- Teach airport environment first on a day with no pressure — ground tour if possible
- Use ForeFlight or chart supplement airport diagram while still in the FBO
- Pre-taxi brief: 'Before I release the brakes, you will tell me where each runway hold-short line is on our route'
- Introduce hotspots early — explain that hotspots are history made visible
- Ask 'why?' when the student crosses correctly — reinforce correct habits, not just errors

> ***Instructor Note:*** *CFI self-disclosure works here: share a time you heard a taxi clearance incorrectly or had to request progressive taxi at an unfamiliar airport. Normalizes the ask-if-unsure habit.*

C EXAMPLES

Example 1 — Hold-Short Misread at Towered Airport

Student receives: 'N45Z, taxi to runway 28L via Alpha, hold short of runway 10.' Student writes down 'taxi via Alpha' but misses the hold-short instruction for 10. When approaching the 10 hold-short line, student begins to cross without stopping. CFI must intervene.

CFI Debrief Questions

- At what point in the clearance did situational awareness break down?
- What is the correct read-back of a hold-short instruction?
- What visual cue on the ground should trigger a stop without needing to remember the clearance?
- Where on the diagram was runway 10?

Example 2 — Wrong Runway at Uncontrolled Airport

Solo student at an uncontrolled airport self-announces and taxies to runway 27 per the ATIS. Wind has shifted; pattern activity is now on runway 9. Student does not monitor CTAF closely, lines up on runway 27 for departure, and is nearly head-on with a landing Cessna on runway 9. This is a real-world pattern: uncontrolled airports, self-announcement gaps, and assumption-based decisions.

CFI Debrief Questions

- What CTAF broadcast should have alerted the student to the pattern switch?
- What before-takeoff check should have caught the discrepancy?
- How do you confirm runway in use at a CTAF airport when activity is light?

E SUMMARY & CFI CHECK QUESTIONS

Key Takeaways from Concept 1

- A runway incursion is any unauthorized presence on a protected runway area — aircraft, vehicle, or person
- Categories A–D rate severity from near-collision (A) to technical violation (D)
- Pilot deviations cause ~65% of incursions — this is a skills and discipline problem, not a system failure
- Most incursions occur in good weather and at familiar airports — complacency is the primary risk

CFI Oral Check Questions

- What is the FAA's official definition of a runway incursion?
- Describe the difference between a Category A and Category D incursion
- What percentage of incursions are caused by pilot deviation, and what does that imply for training?
- Name the three root-cause types of runway incursions

Concept 2 — Airport Markings, Signs & Lights

AI.II.C.K4 — SIGN TYPES, MARKING COLORS & LIGHTING SYSTEMS

A WHAT TO TEACH

Mandatory Signs (Red background, White text)

- **Runway designation signs:** e.g., '36-18' — indicates intersection with that runway; you may NOT cross without clearance
- **Critical area boundary:** e.g., 'ILS' — marks ILS critical area hold position when ILS approaches are active
- **No-entry sign:** White letters on red — do not enter; used on one-way taxiways or wrong-way entries

Location Signs (Yellow text on Black)

- Tell you what taxiway/runway you are currently on — e.g., black square with yellow 'B'
- Always collocated with direction signs at intersections — combine yellow/black to answer 'where am I, where do I go'

Direction & Destination Signs (Black text on Yellow)

- Show which direction to turn to reach a taxiway or runway — with arrows
- Destination signs point to specific areas: TERM, CARGO, FBO
- **Critical rule:** A runway designation on a yellow sign is still a direction sign — you need clearance to enter the runway itself

Runway Marking Colors

- **White:** On runway — touchdown zone, centerline, threshold, edge markings
- **Yellow:** On taxiway — centerline (solid = guidance), edge markings, hold short lines
- **Hold short:** Two solid + two dashed yellow lines perpendicular to direction of travel — STOP before the solid lines

Runway Lighting

- **Runway edge lights:** White — last 2,000 ft or last half are yellow (caution zone)
- **Threshold lights:** Green (approach side) / Red (runway end side)
- **Taxiway edge lights:** Blue — distinguish taxiway from runway at night
- **Taxiway centerline lights:** Green — follow these in low visibility operations
- **Stop bar lights:** Red row of lights perpendicular to taxiway — do NOT cross when illuminated, even if you have a verbal clearance
- **Runway Status Lights (RWSL):** Automated red lights embedded in runway that illuminate independently of ATC — a final safety layer

KEY RULE ■ The two SOLID yellow lines face the taxiway side — they mean STOP. If you see the DASHED lines, you are exiting the runway and the marking is advisory only. Never cross the solid lines without explicit ATC clearance. (AIM 2-3-5)

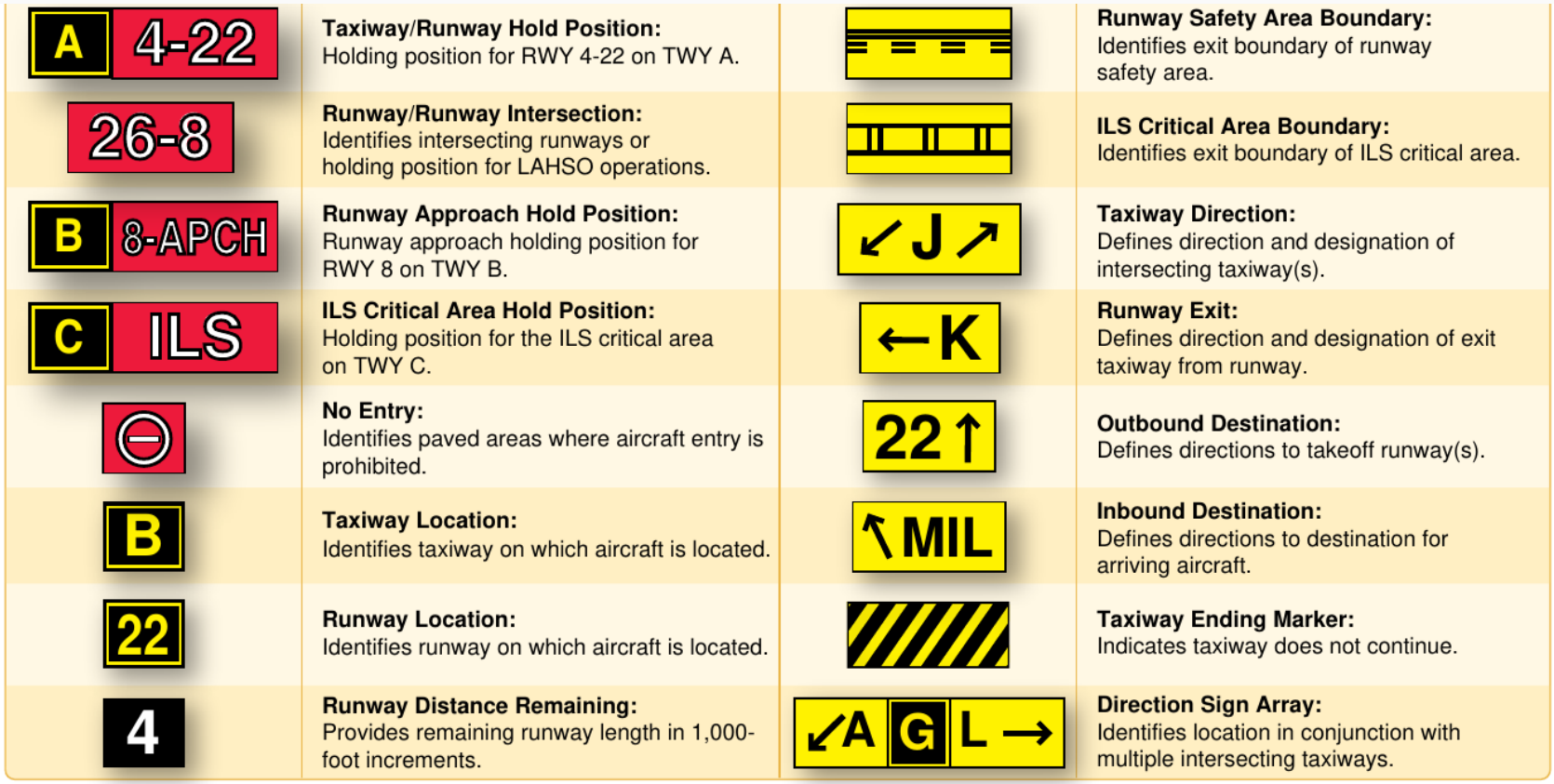


Figure C-1. *Samples and explanations of standard airport signs.*

Figure C-1 — Samples and explanations of standard airport signs. Mandatory signs have red backgrounds; location signs have black backgrounds with yellow text; direction/destination signs have yellow backgrounds with black text. Source: FAA-H-8083-25C (PHAK), Appendix C

B HOW TO TEACH

The Flash Card Method

Before the first solo, quiz students using printed airport sign cards. Hold up a sign — student identifies type, meaning, and required action. Focus on mandatory signs and hold-short markings. The goal: instant recognition, automatic stop behavior. Any hesitation at a hold-short line in the aircraft is a risk.

Ground Walk / Ramp Visit

Walk the taxiway with the student before the first taxi lesson. Stand at the hold-short line together and look at it from both directions. The solid lines face you when you're on the taxiway side — 'these two solid lines are a wall between you and the runway.' Looking the other direction — dashed lines — means you're exiting the runway and the lines are advisory, not a stop point.

Airport Diagram Pre-Brief

- Open chart supplement or ForeFlight Airport page — identify all hold-short positions on today's route
- Identify hotspots and explain their history if available in ASRS database
- Students should be able to trace taxi route before engine start
- Review any active NOTAMs for taxiway or runway closures that shift the usual route

> ***Analogy:*** *"The red sign is like a red light at an intersection — same color, same rule. A yellow sign is like a road sign — informational, keeps you oriented. If you're not sure whether you need clearance, ask yourself: is the background red? If yes, you stop."*

D RISK MANAGEMENT

Common Sign/Marking Misreads

- Confusing a taxiway centerline for a runway centerline at night — taxiway green vs. runway white
- Missing hold-short markings at low-speed intersections where the angle is oblique
- Treating ILS critical area hold line as optional when ILS approaches are active
- At airports with close parallel runways, crossing the wrong hold-short line

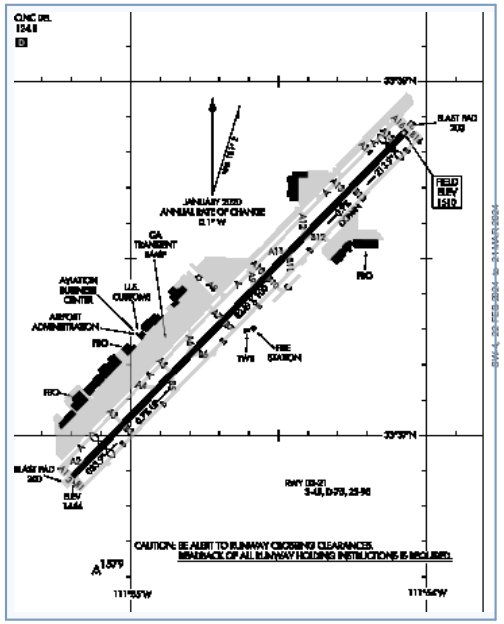
CFI Mitigation Brief

- 'Before we cross any hold-short line, I will say the runway number. You say it back.'
- Point to hold-short signs and markings before first taxi — create visual memory before the pressure of movement
- After errors: stop, taxi back, physically identify where the confusion occurred

Concept 3 — Taxi Instructions, Clearances & Route Planning

AI.II.C.K2 / K3 — READ-BACK REQUIREMENTS, ROUTE RECORDING & CONFIRMATION BIAS

A WHAT TO TEACH



KSDL — Scottsdale Airport Diagram (official FAA chart). RWY 03-21 | Taxiways A1–A7, B, C, D. Note hold-short positions before each runway crossing.

Read-Back Requirements (14 CFR 91.129, AIM 4-3-18)

Pilots operating at controlled airports are required to read back hold-short instructions. By convention and best practice, the complete taxi clearance should be read back — not just the runway designation. The read-back confirms understanding AND gives ATC an opportunity to catch errors. A missed read-back has preceded numerous incursions.

Write It Down — Every Time (K3)

- Write the clearance on a notepad, kneeboard, or scratch pad — before confirming
- Trace the route on the airport diagram while writing — physical confirmation
- If the clearance was too fast: ‘Unable to copy, say again taxi route’
- At complex airports: request the airport diagram page in your EFB before calling for taxi

Anatomy of a Taxi Clearance

Component	Example	Action
Routing	via Alpha, Bravo	Trace on diagram
Hold-short	hold short of 03	Write & read back
Runway assignment	Runway 03	Verify number/letter
Special instruction	cross runway 21	Read back explicitly
Progressive taxi	follow the greens	Acknowledge each turn

At unfamiliar airports or complex layouts, it is always appropriate to request progressive taxi — ATC will provide turn-by-turn instructions. This is a professional tool, not an admission of incompetence.

> ***Instructor Note:*** *Every time — no exceptions. Before calling for taxi at KSDL, the student must (1) open the airport diagram, (2) write the clearance verbatim on their kneeboard, and (3) physically draw their route on the diagram with a finger or pencil. A student who taxis from memory is developing a habit that will one day cause an incursion. The draw-it habit is non-negotiable before solo.*

KEY RULE ■ Never begin taxiing without confirming your route on the airport diagram. A taxi clearance heard but not traced is a clearance not understood.

B HOW TO TEACH

The ‘Write-Trace-Readback’ Drill

Before the student keys the mic for taxi, have them open the airport diagram. Once clearance is received: (1) write the clearance verbatim, (2) trace the route on the diagram with a finger while reading back, (3) confirm each hold-short instruction is in their written notes. This three-step habit becomes reflexive after about five repetitions and dramatically reduces missed hold-short events.

Teaching Confirmation and Expectation Bias (R2)

During a ground debrief, play a recording (or verbalize) two versions of the same clearance — one with a different runway from what was expected. Have the student write down what they heard. Often, students transcribe the runway they expected, not the one given. This is expectation bias made visible. The lesson: read-back protects against your own brain.

D RISK: CONFIRMATION AND EXPECTATION BIAS (R2)

Confirmation Bias in Taxi

- Pilot expects runway 28R (used last five times) — hears ‘28’ in clearance — proceeds to 28R without confirming it wasn’t 28L
- Pilot expects taxi via Alpha — hears a partial clearance — begins taxiing on Alpha before hearing the rest
- **Common fix:** pause before moving, recite clearance from notes, not memory

The ‘Taxi Hold Short’ Blind Spot

Research from NASA ASRS shows that pilots most often drop the hold-short component from their memory — not the runway assignment. The practical reason: the hold-short comes last in the clearance, and working memory has been filled by the routing instructions. **Write the hold-short first. Then write the route.**

Expectation Bias at Work — Real Scenario

Pilot arrives at KXYZ, always uses runway 27. Tower is using runway 9 today due to winds. ATC says: ‘Taxi to runway 9 via taxiway Alpha.’ Pilot writes ‘Taxi via Alpha’ — head is already pointed toward runway 27. At the intersection, pilot turns right (toward 27) instead of left (toward 9). This happens regularly, especially in high-workload moments like when getting the ATIS mid-clearance or setting up avionics.

■ ***Risk Note:*** *Expectation bias is strongest when habits are most ingrained — experienced pilots at familiar airports are MORE susceptible, not less. Teach this explicitly.*

Concept 4 — Flight Deck Discipline During Taxiing & Hotspots

AI.II.C.K5 — STERILE COCKPIT, HOTSPOT AWARENESS & PRE-SOLO STANDARDS

A WHAT TO TEACH

Hotspot Definition (AC 91-73)

An airport hotspot is a location on an airport movement area with a history of or potential for runway incursions or surface incidents. Hotspots are identified by a circled number on airport taxi diagrams: HS 1, HS 2, etc. They indicate locations where extra vigilance is required. Hotspot history is often available in the FAA Airport Facility Directory (Chart Supplement) and in AC 91-73 appendices.

Sterile Cockpit During Taxi (K5)

- Complete run-up checklists on the ramp — not rolling toward an active runway
- Avionics programming: enter flight plan, set frequencies — before calling Ground
- No non-essential conversation during taxi at complex airports or when approaching hold-short lines
- EFB/iPad management: airport diagram should be open and visible; no scrolling to maps or weather during taxi
- ATC radio priority: monitor ground frequency continuously — unexpected clearance changes occur

Critical — Before-Takeoff Checklist Timing

CRITICAL ■ Completing the before-takeoff checklist while rolling toward an active runway is one of the most common factors in incursion-adjacent events. Discipline: run-up area, then taxi, then final checks only — not simultaneously with hold-short line approach.

Pre-Solo Standards for Taxi Competency

- A student who cannot verbalize taxi routes during dual instruction is not ready for solo
- Pre-solo endorsement validation: student must demonstrate independent taxi diagram review, correct read-back, and correct hold-short behavior on at least three consecutive flights
- Night solo taxi preparation requires separate specific briefing on lighting interpretation

B HOW TO TEACH

The ‘Heads-Up Taxi’ Habit

Demonstrate exaggerated eyes-outside taxi on the first lesson. Call out every sign, every hold-short line, every intersecting runway. Then have the student do the same verbally. When they look down, say: ‘Eyes outside. What sign are we passing?’ This builds the heads-up habit before the student develops the opposite one. At busy airports, a student who is heads-down during taxi is a liability regardless of what they’re reading.

Hotspot Pre-Briefing Protocol

Before engine start, open the airport taxi diagram and identify every HS on today’s route. Briefly explain what incident history created the hotspot designation. This takes 60 seconds and completely changes the student’s attentiveness when approaching those locations. Students who know they are approaching HS 3 actively look up and confirm runway status — students who don’t know see it as just another intersection.

E CFI DEBRIEF QUESTIONS

Post-Flight Debrief Prompts

- Did you always know which taxiway you were on during the taxi?
- How many hold-short lines did we cross, and what runway was each associated with?
- If there was a hotspot on today's route, did you notice when we were approaching it?
- At what point during taxi did you feel most saturated or uncertain?

Connect to Solo Preparation

- A student who cannot verbalize taxi routes during dual instruction is not ready for solo
- Pre-solo check: student must demonstrate independent taxi diagram review, correct read-back, and hold-short behavior on at least three consecutive flights
- Night solo taxi preparation requires separate specific briefing on lighting interpretation

Concept 5 — Communication Procedures at Uncontrolled Airports

AI.II.C.K6 — CTAF, SELF-ANNOUNCE PROCEDURES & RUNWAY CROSSING WITHOUT ATC

A WHAT TO TEACH

CTAF and Self-Announce (AIM 4-1-9)

At airports without an operating control tower, the Common Traffic Advisory Frequency (CTAF) is used for position and intention broadcasts. CTAF may be UNICOM, MULTICOM (122.9 MHz), or a discrete frequency noted in the Chart Supplement. There is no requirement to receive clearance — pilots coordinate by broadcasting their intentions and listening for conflicting traffic.

Standard CTAF Broadcast Sequence

- Taxi: '[Airport] traffic, [aircraft], taxiing to runway XX via [route], [airport]'
- Before takeoff: '[Airport] traffic, [aircraft], departing runway XX, [direction], [airport]'
- Pattern: announce at each leg (crosswind, downwind, base, final)
- Landing: '[Airport] traffic, [aircraft], final runway XX, [airport]'
- Clear of runway: '[Airport] traffic, [aircraft], clear of runway XX, [airport]'

Confirm Runway in Use

- Listen to CTAF for at least 3–5 minutes before taxiing — establish pattern in use from traffic calls
- Check AWOS/ASOS for wind — determine favored runway, but verify against actual traffic flow
- If no traffic heard: broadcast blind, watch for aircraft in pattern, check windsock
- At non-ATIS airports, the pilot determines runway in use — this is a judgment call that must be taught explicitly

Runway Crossing at Uncontrolled Airports

- There is no ATC clearance — the pilot is solely responsible for ensuring the runway is clear
- Broadcast intent before crossing: '[Airport] traffic, N12345, crossing runway 27 on Alpha, [Airport]'
- Physically stop, look left and right (and final approach path), confirm clear before crossing

CRITICAL ■ At an uncontrolled airport, there is no ATC safety net. The pilot must personally confirm the runway is clear before every crossing or departure. A CTAF broadcast is a courtesy — not a clearance. Other aircraft may not be listening.

B HOW TO TEACH

Simulated Uncontrolled Environment

During training at a towered field, have the student verbalize what they would broadcast if this were a CTAF airport. Practice the cadence and content until it's automatic. Then fly to the nearest uncontrolled airport and have them practice live — a different mental model is required and students often underestimate the workload.

The 'Radio Silence' Scenario

Brief this risk explicitly: CTAF traffic may be present and not communicating — gliders, ultralights, pattern work at low-traffic hours. Teach the student that silence on CTAF means the radio is quiet, not that the runway is clear. The visual scan — especially on final — is the only reliable confirmation.

Concept 6 — High-Risk Operational Scenarios

AI.II.C.R3–R7 — RUNWAY ENTRY, NIGHT OPS, LOW VISIBILITY, AFTER LANDING & PARALLEL RUNWAYS

A WHAT TO TEACH

Risk Code	Scenario	Common Trigger	Required Mitigation
R3	Entering or crossing runways	Complex intersection, distracted crew	Full stop at every hold-short; visual confirm runway clear; explicit read-back before entry
R4	Night taxi operations	Limited ambient light; signs hard to read; taxiway/runway confusion	Reduce taxi speed 30–50%; identify lights by color (blue=taxiway, white=runway); read every sign
R5	Low visibility taxi	Fog, heavy rain, RVR below 1 mile	Follow centerline lights; stop-bar compliance absolute; SMGCS procedures at large airports
R6	Runway incursion after landing	Rollout workload + ATC crossing instruction during deceleration	Full stop at every hold-short after landing; do not rush exit; never self-authorize a crossing
R7	Operations between parallel runways	Taxiway between two runways looks like a runway at night	Verify surface type via signs, lighting, and runway numbers painted on pavement

R3: Entering or Crossing Runways

The most critical surface operation. Every runway entry and crossing requires an explicit ATC clearance at a towered airport. Before entering or crossing, the pilot must visually confirm the runway is clear — even with ATC clearance. ATC radar does not always show all aircraft, and clearances can be given in error.

- Procedure: Receive clearance → Stop at hold-short → Read back → Confirm runway visually → Enter
- At night: look for approach lights and landing lights before crossing — aircraft on final may not be visible until very close
- After landing: maintain clearance awareness — exit runway promptly but confirm taxi route before moving to a crossing

R7: Operating Between Parallel Runways

When a taxiway runs between two parallel runways, pilots can mistake the adjacent runway for a taxiway. This is especially dangerous at night. Look for: runway numbers painted on the surface, hold-short markings on both sides, and the difference in surface width between runways and taxiways.

R4: Night Taxi Operations

- Reduce taxi speed by 30–50% — response time to visual hazards decreases significantly
- Runway edge lights (white) vs. taxiway edge lights (blue) — blue = you're on a taxiway; white = you may be on a runway
- Signs are harder to read due to light scatter — slow to read each sign before proceeding through intersections
- Green taxiway centerline lights are your primary guide in low visibility and night — follow them continuously

R5: Low Visibility Taxi

- RVR below 600 ft: surface movement may require Low-Visibility Taxi procedures (SMGCS) at large airports
- Never attempt to navigate a hold-short zone in low visibility without confirming runway position on airport diagram
- Use stop-bar lights as an absolute hold point — do NOT cross a lit stop bar

R6: Runway Incursion After Landing

- Rollout phase: pilot focus is on braking, speed, turnoff — SA of runway environment often drops
- ATC may issue immediate crossing instructions during rollout — high workload moment
- Rule: Never cross another runway after landing without explicit clearance

CRITICAL ■ The highest incursion risk after landing is the 'get off the runway quickly' mentality causing pilots to accept or self-authorize a runway crossing without proper confirmation. Prompt exit is important — but stop at every hold-short and confirm, regardless of pressure.

C EXAMPLES

Example 1 — JFK Parallel Taxiway Confusion (2023)

An American Airlines A321 began rolling on Taxiway J, which parallels runway 4L at KJFK. A Delta 737 was cleared for takeoff on 4L simultaneously. The AA aircraft was on the taxiway, not the runway — but from the flight deck, the surface appeared similar. ATC stopped the departure. This real event illustrates R7: at large airports with parallel surface geometry, pilots must actively verify they are on the correct surface type before making any movement decision.

Example 2 — Low Visibility Crossing After Landing

Aircraft lands on runway 31 at night in 1-mile visibility. ATC clears the aircraft to 'cross runway 22' immediately after landing. Pilot is decelerating, searching for the taxiway turnoff, and does not fully register the crossing clearance. Pilot slows, looks up, and sees another aircraft on final for runway 22 — 1 mile out. Pilot stops short. This illustrates R6 + R5: post-landing workload degraded clearance processing. Full stop before any runway crossing.

Risk Management Summary & Skills Assessment

SECTION 4 — RISK MANAGEMENT SUMMARY (R1–R7)

ACS Element	Risk Factor	Typical Trigger	Mitigation Strategy
R1 — Task Saturation	Heads-down during taxi	Avionics setup, checklist, passenger	Complete all cockpit tasks on ramp; sterile taxi concept
R1 — Loss of SA	Disorientation on surface	Unfamiliar airport, night, construction NOTAMs	Airport diagram open before taxi; call for progressive taxi if unsure
R2 — Confirmation Bias	Hearing expected clearance	Familiar airport, routine operation	Write clearance first; read back before moving
R2 — Expectation Bias	Anticipating usual runway patterns	Regular home airport, ingrained habits	Verify runway assignment on airport diagram; do not assume
R3 — Runway Entry	Entering without clearance	Complex intersection, distracted crew	Full stop at every hold-short; visual confirm; explicit read-back
R4 — Night Ops	Misidentifying surface type	Blue vs. white lights, low ambient lighting	Reduce speed; identify lights by color; read every sign
R5 — Low Visibility	Surface disorientation	Fog, heavy rain, RVR below 1 mile	SMGCS procedures; follow centerline lights; stop bar compliance
R6 — After Landing	Runway crossing on rollout	Speed + workload = reduced SA	Stop at every hold-short after landing; do not rush exit
R7 — Parallel Runways	Wrong surface selection	Taxiway between two runways	Verify surface type via signs, lighting, runway numbers on pavement

KEY RULE ■ The single most effective incursion prevention tool is the habit of stopping at every hold-short line — regardless of confidence level, familiarity, or workload — and confirming runway status before crossing. This one behavior alone addresses R3–R7.

SECTION 5 — SKILLS ASSESSMENT (AI.II.C.S1)

S1: The applicant demonstrates how to deliver instruction on the elements and techniques for runway incursion avoidance.

Skill Area	Evaluator Looks For	Common Deficiency

Scenario presentation	CFI uses a realistic taxi scenario; identifies incursion type; explains correct procedure	Generic description without specific airport context or visual aid
Sign/marking identification	CFI correctly identifies all sign types, their regulatory significance, and required action	Confusion between location signs (black/yellow) and direction signs (yellow/black)
Taxi route briefing	CFI demonstrates write-trace-readback method with an airport diagram	Does not use airport diagram; describes concept without demonstrating
Hotspot briefing	CFI identifies hotspot, explains history/risk, describes attention protocol	Hotspot defined but not applied to a specific operational scenario
Risk discussion	CFI explains confirmation bias, night risk, and post-landing risk with teaching analogies	Lists risks without explaining why pilots make these errors or how training addresses them
Instructional clarity	Explanation is logically sequenced, uses clear aviation terminology, ties back to ACS elements	Information dump without structure; does not close the loop on how student would demonstrate competency

Section 6 — Q&A Review

Q1: What is the FAA's definition of a runway incursion, and what areas are included?

Any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle, or person on the protected area of a surface designated for landing and takeoff. Includes the runway itself, associated safety areas, and stopway/clearway areas. (AC 91-73)

Q2: Describe the difference between a Category A and Category D runway incursion.

Category A: Most severe — actual near-miss or collision where separation was completely lost and evasive action was necessary to avoid collision. Category D: Least severe — a rule violation occurred (e.g., crossing hold-short without clearance) but there was little or no immediate safety risk. Category A events typically result in mandatory reporting and investigation.

Q3: What are the two solid and two dashed yellow lines on the taxiway surface, and from which side do you stop?

They are the runway hold short markings. You stop at (and must not cross) the two solid lines — which face the taxiway side (i.e., you see them approaching from the taxiway). The two dashed lines face the runway side, meaning if you see dashes, you are exiting the runway and the marking is advisory only. (AIM 2-3-5)

Q4: What items must be included in a read-back of a taxi clearance containing a hold-short instruction, per the AIM?

Per AIM 4-3-18, pilots must read back hold-short instructions verbatim — including the runway designation. Best practice is to read back the entire taxi clearance: routing and hold-short instruction. ATC will correct any error in the read-back, providing a safety check of pilot understanding.

Q5: What is an airport hotspot, and where is this information found for a specific airport?

A hotspot is a location on an airport movement area with a history of or potential for runway incursions or surface incidents (AC 91-73). Hotspots are shown on airport taxi diagrams with circled numbers (HS 1, HS 2, etc.). Specific descriptions can be found in the FAA Chart Supplement for that airport and in the Airport/Facility Directory.

Q6: An aircraft has just landed on runway 28. ATC clears it to 'cross runway 10' during rollout. What should the pilot do before crossing?

Come to a full stop at the runway 10 hold-short line. Read back the clearance explicitly including the runway number. Visually scan the runway in both directions — and specifically check the final approach path for landing traffic. Only after visual confirmation that the runway is clear should the pilot cross. Post-landing workload is high; a full stop resets situational awareness before entering another runway environment. (AI.II.C.R3, R6)

End of Area II, Task C — Runway Incursion Avoidance · EGH Aviation CFI Airplane Ground School · FAA-S-ACS-25

Area II, Task D — Principles of Flight

FAA-S-ACS-25 | CFI Airplane — Ground Lesson

Objective

The applicant demonstrates understanding of the aerodynamic principles that govern airplane flight — including airfoil design, the four forces, stability and controllability, left-turning tendencies, load factors, and wingtip vortices — and can provide effective instruction on at least three of the six knowledge elements.

References

- FAA-H-8083-25 (PHAK) — Chapters 4 & 5
- FAA-H-8083-3 (AFH) — Chapter 3
- FAA-H-8083-9 (AIH) — Chapter 7
- FAA-H-8083-2 — Weight and Balance
- POH/AFM — Limitations section

Delivery Format

- Ground lesson with visual aids — 45–60 min
- Use aircraft POH V-speeds during load factor discussion
- Relate all concepts to real maneuvers and scenarios

ACS Knowledge Elements

Code	Element
AI.II.D.K1	Airfoil design characteristics
AI.II.D.K2	Airplane stability, maneuverability and controllability
AI.II.D.K3	Turning tendencies (torque, P-factor, slipstream, gyroscopic precession)
AI.II.D.K4	Forces acting on an airplane
AI.II.D.K5	Load factors in airplane design
AI.II.D.K6	Wingtip vortices and appropriate precautions

ACS Risk Management

Code	Element
AI.II.D.R1	The basic aerodynamic principles of flight

ACS Skills

Code	Element
AI.II.D.S1	Deliver instruction on principles of flight covering at least 3 of K1–K6

1. Forces Acting on an Airplane (AI.II.D.K4)

A WHAT TO TEACH

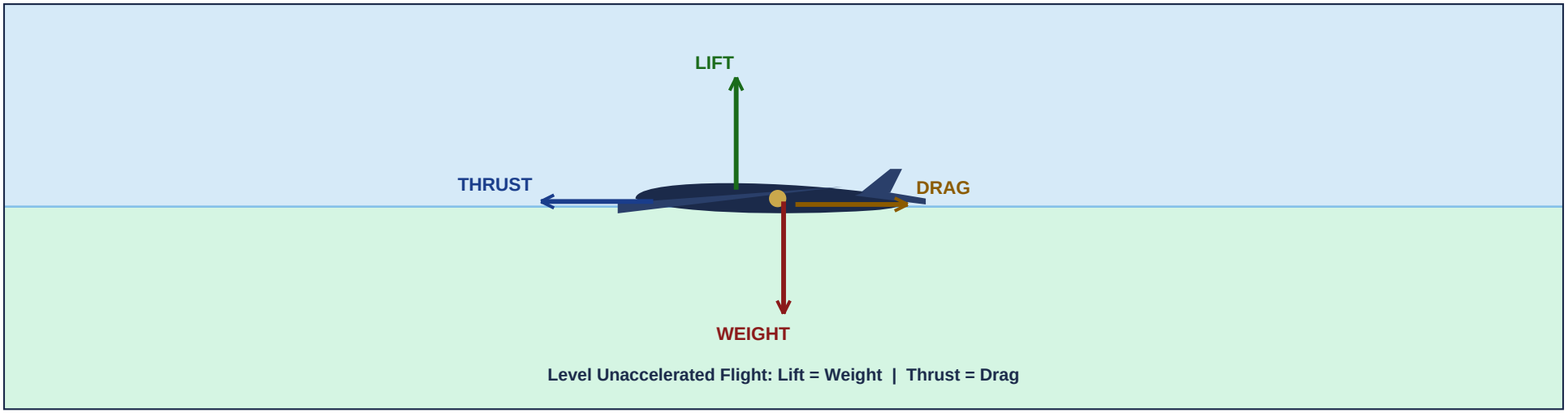


Figure 1 — Four forces of flight. In unaccelerated, level flight: Lift = Weight and Thrust = Drag. Any imbalance produces acceleration in that direction. PHAK Ch. 4

Lift

- Generated primarily by wings — acts perpendicular to the relative wind
- Directly proportional to: air density, wing area, velocity^2, and C_L (coefficient of lift)
- Lift equation: **$L = C_L \times \frac{1}{2}\rho V^2 \times S$** — teach students to recognize which variables are pilot-controllable

Weight

- Force of gravity acting through the aircraft center of gravity (CG) — always acts straight down
- Not constant — changes with fuel burn, loading; must be within CG envelope at all times
- CG position affects stability and control authority — forward CG = more stable, less maneuverable; aft CG = less stable, control issues

Thrust

- Produced by propeller — acts roughly parallel to the longitudinal axis
- Thrust changes with RPM, propeller pitch, density altitude, and airspeed
- At high angles of attack, thrust vector tilts — a component acts *upward*, partially supporting weight

Drag

- **Parasite drag:** Form, friction, interference drag — increases with speed squared
- **Induced drag:** By-product of lift — increases as speed decreases / AOA increases
- **Total drag curve:** The minimum drag point (L/D max) = best glide speed; critical for engine-out scenarios
- Drag equation mirrors lift: **$D = C_D \times \frac{1}{2}\rho V^2 \times S$**

KEY RULE ■ In straight-and-level unaccelerated flight all four forces are in equilibrium. Any deviation — power change, pitch change, weight shift — momentarily unbalances the forces and must be corrected.

2. Airfoil Design Characteristics (AI.II.D.K1)

A WHAT TO TEACH

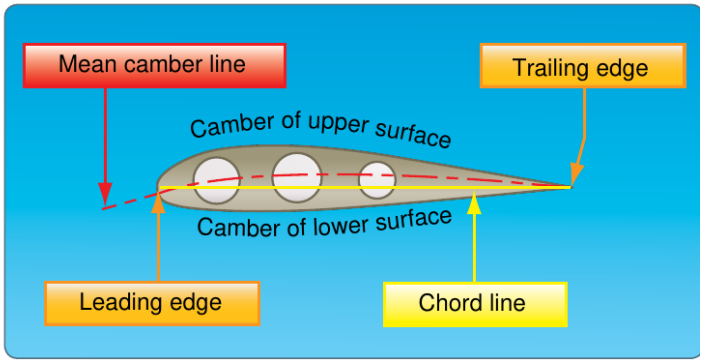


Figure 2 — PHAK Fig. 4-5. Airfoil anatomy: chord line, mean camber line, upper/lower camber, leading edge, trailing edge.

Angle of Attack vs. Airspeed Lift = $C_L \times \frac{1}{2}\rho V^2 \times S$ — to maintain level flight, as airspeed decreases the pilot must increase AOA to maintain the same lift coefficient. The airfoil stalls when critical AOA (≈16–18°) is exceeded regardless of airspeed.

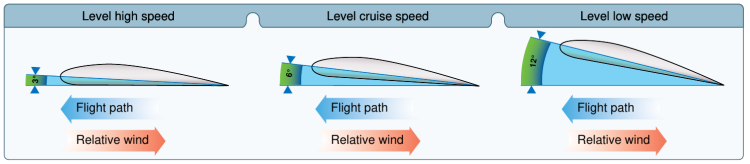


Figure 3 — PHAK Fig. 5-3. Same level flight, three different speeds: high speed = low AOA; cruise = moderate AOA; low speed = high AOA.

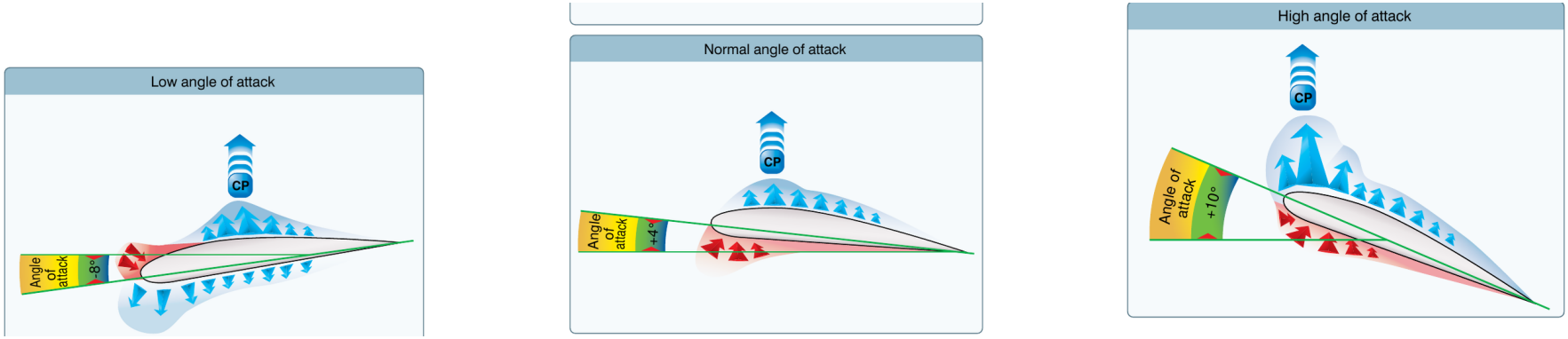


Figure 4 — PHAK Fig. 4-7. Pressure distribution and center of pressure (CP) at low, normal, and high angle of attack. Blue arrows = low-pressure (suction) above wing; red arrows = high-pressure below. CP moves forward as AOA increases toward critical angle.

CRITICAL ■ AOA is the most critical aerodynamic concept. Pitch attitude and AOA are NOT the same thing. An aircraft can stall at ANY airspeed and ANY pitch attitude by exceeding critical AOA (≈16–18°). High-camber airfoils generate more lift at low AOA; symmetrical airfoils generate equal lift inverted and upright. Relative wind defines AOA — not the horizon.

3. Stability, Maneuverability & Controllability (AI.II.D.K2)

A WHAT TO TEACH

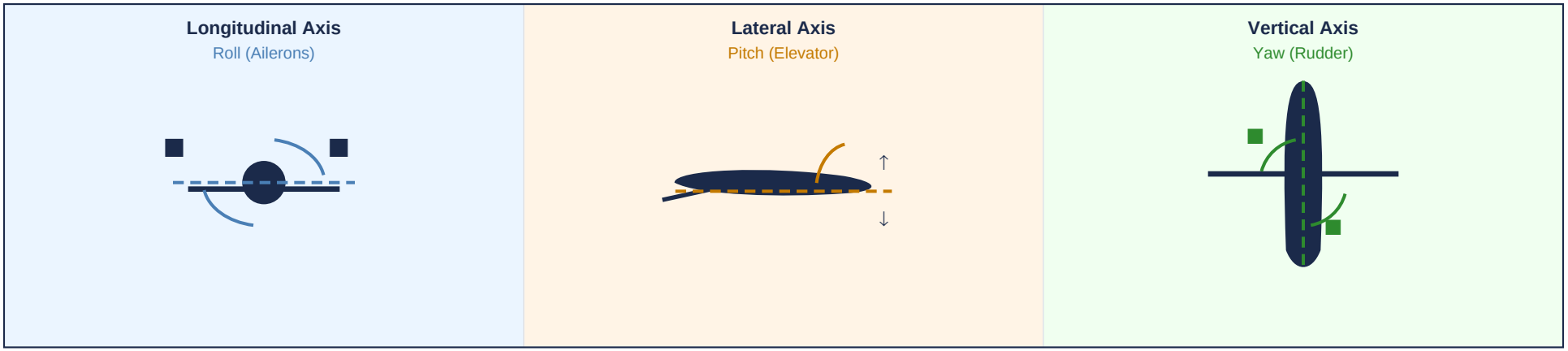


Figure 3 — Three axes of flight. All rotational motion occurs about one or more axes. PHAK Ch. 5

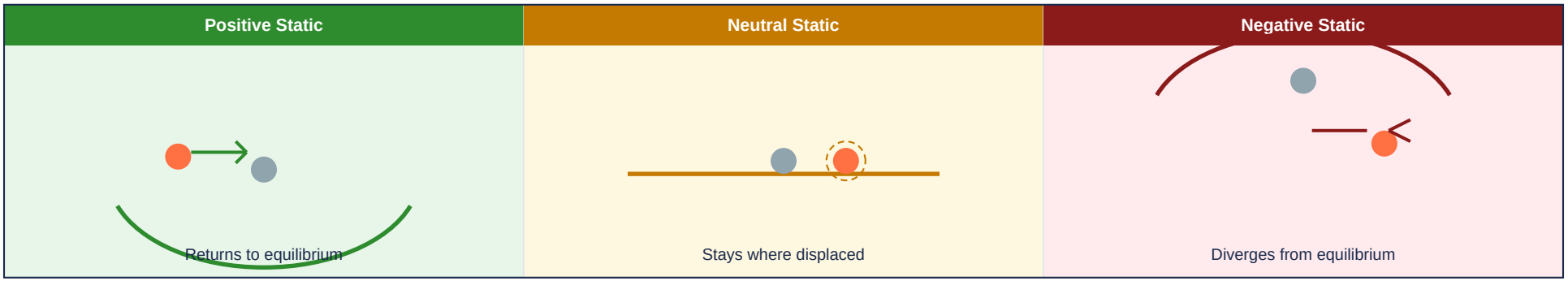


Figure 4 — Static stability types. Positive: aircraft returns after displacement. Neutral: remains displaced. Negative: diverges further — dangerous. PHAK Ch. 5

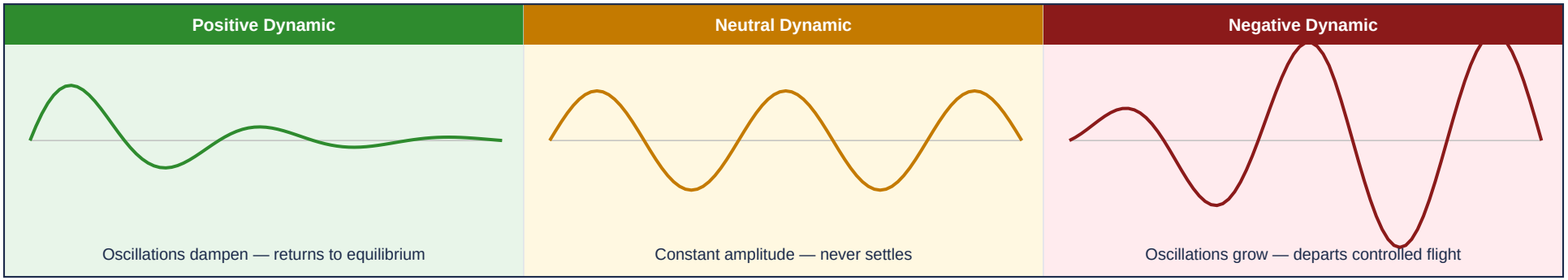


Figure 5 — Dynamic stability types. Positive dynamic: oscillations dampen over time. Neutral: constant amplitude. Negative dynamic: oscillations grow — uncontrollable departure. PHAK Ch. 5

Static vs. Dynamic Stability

- **Static stability:** Initial tendency after displacement — positive = returns toward equilibrium
- **Dynamic stability:** Long-term behavior — do oscillations dampen, stay constant, or grow?
- Can have positive static but negative dynamic: initially returns, but oscillations worsen over time

Longitudinal Stability (Pitch — Lateral Axis)

- Horizontal stabilizer acts as 'tail feather' — resists pitch disturbances
- Forward CG → stronger longitudinal stability; aft CG → reduced stability

Lateral Stability (Roll — Longitudinal Axis)

- **Dihedral:** Wings angled up from root — dropped wing gains AOA → restoring roll moment
- **High vs. low wing:** High-wing has pendulum stability; low-wing relies more on dihedral

Directional Stability (Yaw — Vertical Axis)

- Vertical stabilizer provides weathervaning tendency to align with relative wind
- **Adverse yaw:** Aileron input creates momentary opposite yaw — corrected with coordinated rudder

3. Center of Gravity Effects (AI.II.D.K2 — continued)

B CG AND WEIGHT/BALANCE

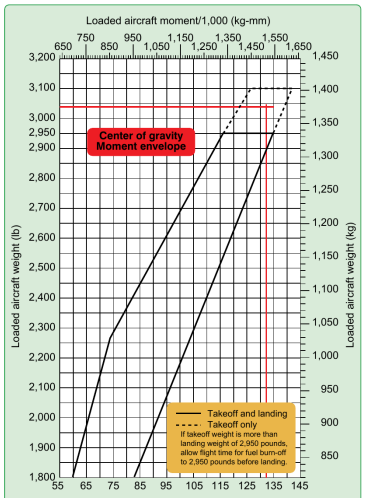


Figure 6 — CG moment envelope (FAA-H-8083-1, Fig. 5-8). Red shaded area = approved CG range. Lines drawn from loaded weight and moment must intersect inside the envelope. Solid = takeoff & landing limit; dashed = takeoff-only limit.

Forward CG Effects

- Greater longitudinal stability — aircraft 'wants' to pitch nose down when disturbed
- Requires more back-pressure to maintain level flight and flare
- Reduces elevator authority — forward CG limit set to ensure adequate flare control
- Higher stall speed — horizontal tail must generate downward force, reducing net lift

Aft CG Effects

- Reduces longitudinal stability — pitch corrections become sluggish or diverge
- In extreme cases: stall/spin recovery may be impossible with aft CG
- Aft CG limit set to ensure minimum acceptable static stability margin
- **Critical hazard:** Aft-loaded aircraft has killed pilots who did not verify W&B; before flight

How to Calculate CG

- Moment = Weight × Arm (in·lbs)
- Total Moment ÷ Total Weight = CG location (inches aft of datum)
- Plot result on CG envelope — must be within limits at takeoff AND landing weights

CRITICAL ■ Both forward AND aft CG limits represent real accident categories. Forward: inability to flare = hard landing/nose gear collapse. Aft: loss of pitch control = unrecoverable stall/spin. Always calculate W&B; — 'it's probably fine' is not airmanship.

4. Left-Turning Tendencies (AI.II.D.K3)

A WHAT TO TEACH

Torque	P-Factor	Spiraling Slipstream	Gyroscopic Precession
			
Reaction → rolls LEFT	**Yaws nose LEFT**	**Hits left vertical tail**	**Force = 90° ahead**
Aircraft rolls LEFT clockwise (pilot view) Engine/prop rotates	yaws aircraft LEFT Descending blade High AOA + Power:	of vertical tail → LEFT yaw strike left side Corkscrew airflow	ahead in rotation Force applied 90° Prop = gyroscope:

Figure 4 — The four left-turning tendencies: torque reaction, P-factor, spiraling slipstream, and gyroscopic precession. All four act simultaneously at high power and high AOA. PHAK Ch. 5

1 — Torque Reaction

- Newton's 3rd Law: Engine/prop rotates clockwise (viewed from cockpit) → aircraft tends to rotate counterclockwise → rolls LEFT
- Most noticeable in low-speed, high-power situations (initial takeoff roll in tailwheel aircraft)
- Corrected with: right aileron (in roll-coupled aircraft) or design features like offset engine thrust

2 — P-Factor (Asymmetric Thrust)

- At high AOA, the descending prop blade (right side) moves through the air at a greater relative angle → produces more thrust than ascending blade
- Creates asymmetric thrust → yaws nose LEFT
- Most pronounced at high power, high pitch attitude — critical during initial climb

3 — Spiraling Slipstream

- Propwash corkscrews rearward in a clockwise spiral (viewed from behind)
- Strikes the LEFT side of the vertical stabilizer → yaws nose LEFT
- Constant at a given airspeed/power setting — partially compensated by vertical fin offset in design

4 — Gyroscopic Precession

- Spinning propeller acts as a gyroscope — any applied force results in precession 90° ahead in the direction of rotation
- During takeoff rotation (pitch up): force applied at top of prop disc → precesses to left side → yaws nose LEFT
- Primarily affects tailwheel aircraft during the tail-raise phase of takeoff — strong left yaw

KEY RULE ■ All four tendencies act together during high-power, high-AOA flight (e.g., climb after takeoff). The cumulative effect is a strong left-yawing and left-rolling tendency. Right rudder is the primary correction. Teach students to anticipate — not react — to left-turning tendency.

"Tell your student: 'Imagine the propeller is a clock lying flat, spinning clockwise. If you tilt the top of the clock toward you (pitch up), the clock face wants to rotate left — that is gyroscopic precession. Same physics, different application.'"

5. Load Factors in Airplane Design (AI.II.D.K5)

A WHAT TO TEACH

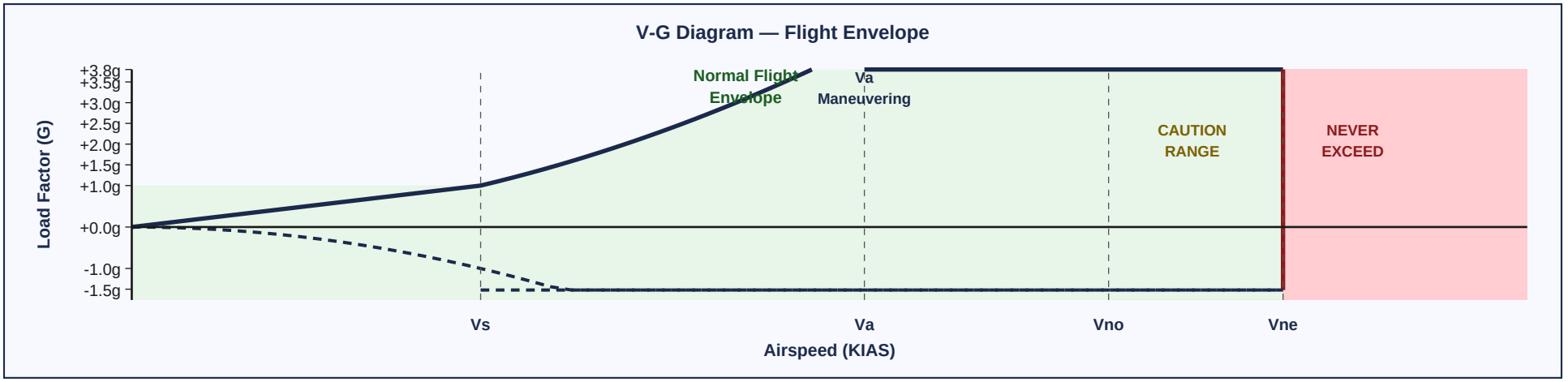


Figure 8 — V-G flight envelope. Green = normal operating zone. Yellow = caution range. Red line = Vne. Va = max speed for full single control input. PHAK Ch. 4 / POH Limitations



Figure 9 — Airspeed indicator with color-coded V-speed arcs. White arc = flap range (Vso–Vfe). Green arc = normal ops (Vs1–Vno). Yellow arc = caution/structural (Vno–Vne). Red radial = Vne. Blue radial = Vy.

Load Factor Defined

- Load factor (n) = Lift ÷ Weight — expressed in G's
- Straight-and-level = 1.0 G; 45° bank ≈ 1.41 G; 60° bank = 2.0 G; 75° bank ≈ 3.86 G
- Formula: **n = 1 / cos(bank angle)**
- Category limits: Normal = +3.8g / –1.52g; Utility = +4.4g; Aerobatic = +6.0g

Stall Speed Increases with Load Factor

- Stall speed: $\mathbf{Vs_n = Vs \times \sqrt{n}}$
- 60° bank (2G): stall speed increases × √2 ≈ +41%
- 75° bank (3.86G): stall speed nearly doubles

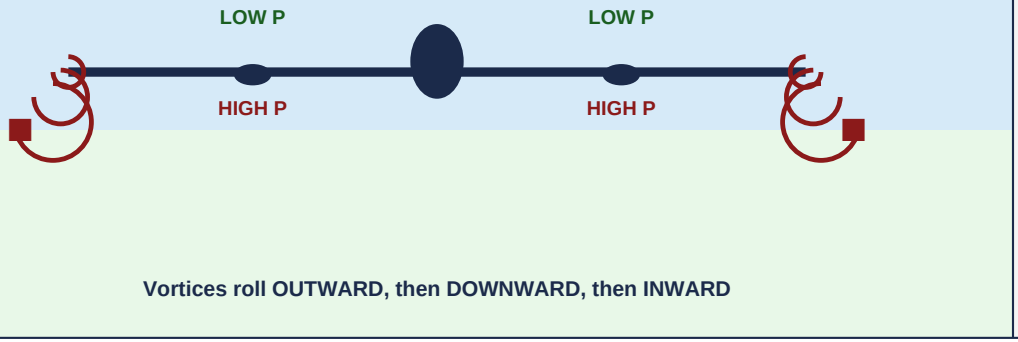
Maneuvering Speed (Va)

- Va = max speed for SINGLE full control deflection without overstress
- Above Va: abrupt inputs CAN cause structural failure
- Va decreases with reduced aircraft weight — check POH for each weight
- In turbulence: slow to Va; do NOT fight the aircraft

CRITICAL ■ Va is designed for a SINGLE full deflection only. Simultaneous inputs above Va (e.g., full elevator + aileron in turbulence) can exceed design load limits even at Va. Slow down and relax the controls.

6. Wingtip Vortices and Wake Turbulence (AI.II.D.K6)

A WHAT TO TEACH



Wake Avoidance Rules

On Takeoff:
Rotate BEFORE preceding aircraft's rotation point; climb above & upwind of their flight path

On Landing:
Note touchdown point of preceding aircraft; land BEYOND that point or go around

Light vs Heavy:
Vortex strength ∝ aircraft weight — worst behind large/heavy jets in slow, clean configuration

Wind Effect:
Crosswind pushes upwind vortex toward runway; use upwind side of runway when possible

Figure 10 — Wingtip vortex formation (rear view). High pressure below each wing rolls up and around the wingtip, creating a strong rotating column of air. Vortex strength is proportional to aircraft weight. PHAK Ch. 4 / AIM 7-3-3

Vortex Formation

- High-pressure air below the wing rolls up around the wingtip to the low-pressure area above
- Creates two counter-rotating vortices — each rotating outward at the tip, then downward, then inward
- Vortex strength ∝ wing loading (weight/speed) — heaviest, slowest aircraft generate most dangerous vortices
- Vortices begin at rotation and end at touchdown — max strength at low speed, full gross weight, clean configuration

Vortex Behavior

- Vortices sink at approximately 300–500 fpm and level off about 900 feet below flight path
- In no-wind conditions, vortices drift laterally away from centerline
- Crosswind component can hold one vortex near the runway — use upwind runway half
- Vortices dissipate over 1–2 minutes — wait 3 minutes when following heavy aircraft for safety margin

Practical Avoidance Procedures

- **Departing behind heavy:** Note rotation point, rotate before that point, climb above and upwind of their flightpath, then turn to avoid their projected course
- **Departing intersection:** Consider full length departure — intersection reduces separation from vortices above
- **Landing behind heavy:** Maintain visual contact; note touchdown point; aim to land beyond their touchdown zone; remain above their glide path
- **Go-around scenario:** If a heavy aircraft performs a go-around, its vortices now trail ahead of you — expedite landing or go around with a wide turn

Vortex Severity Scale

- Light aircraft behind heavy/jumbo in IMC is a serious hazard — full upset possible
- FAA separation minimums exist for vortex dissipation — ATC applies these but pilots must understand them
- Ground effect does NOT eliminate vortex hazard — vortices roll laterally along the surface

KEY RULE ■ Wingtip vortices are invisible. A VFR student trained to 'see and avoid' cannot see wake turbulence. Teach them to visualize where vortices MUST be based on the preceding aircraft's position, weight category, and the wind — then actively avoid that space.

SECTION 2 — RISK MANAGEMENT (AI.II.D.R1)

R1 — Basic Aerodynamic Principles of Flight

- Misunderstanding aerodynamics is a root cause of loss-of-control (LOC-I) accidents — the leading fatal accident category
- Students who memorize definitions without understanding relationships are at risk in unusual attitudes
- Key risk gaps: confusing pitch attitude with AOA; not understanding load factor effects on stall speed; underestimating wake turbulence from larger aircraft

Risk Mitigation Through Instruction

- Use the POH to ground every concept — 'This is your aircraft, these are its actual V-speeds and limits'
- Require students to calculate load factor and stall speed for a 45° and 60° banked turn before steep turns lesson
- Debrief all left-turning tendency corrections during first solo prep — understand before correcting by feel

Common Misconceptions to Address

Misconception	Correct Teaching
'You can't stall at high speed'	Stall = critical AOA exceeded — possible at any speed with abrupt pull
'Straight pitch up = climbing'	Pitch attitude ≠ AOA ≠ flight path — all three are separate
'Va means turbulence is safe'	Va assumes single input — simultaneous inputs at Va can still overstress
'High-wing is always safer in wake'	Wing position does not protect from vortex — avoidance procedures apply equally
'Light aircraft don't create vortices'	All wings create vortices — size determines severity, not presence

HOW TO TEACH (AI.II.D — TEACHING TECHNIQUES)

B — Sequencing the Lesson

- **Start with forces:** Establish K4 first — all other concepts build on it
- **Airfoil → AOA:** Show the diagram and immediately drill: 'If I increase AOA, what happens to lift? Drag? Up to what limit?'
- **Stability before left-turning:** Students must understand the 3 axes before appreciating why the aircraft yaws
- **Load factor + stall speed:** Use the bank angle formula; have students calculate aloud — real numbers reinforce the hazard
- **End with wake turbulence:** Real accident stories make this tangible — reference NTSB reports

C — Teaching Aids and Demonstrations

- **Sheet of paper as airfoil:** Hold by leading edge, blow across top — paper rises (Bernoulli)
- **Spinning gyroscope:** Demonstrate precession physically before explaining prop behavior
- **POH V-G diagram:** Use actual aircraft document — students see their aircraft's real limits
- **Bank angle load factor table:** Write on whiteboard: 30°→1.15G, 45°→1.41G, 60°→2G, 75°→3.86G
- **PHAK animated figures:** Show PHAK figures for stall sequence, vortex formation, stability oscillations

Instructor Note: *Consider using a model airplane to demonstrate all four left-turning tendencies in sequence. Physical demonstration of prop rotation → torque, nose pitching up → precession is more memorable than any diagram.*

SECTION 3 — SKILLS ASSESSMENT (AI.II.D.S1)

Oral Demonstration Checklist

#	Skill Element	Method
1	Explain the four forces and their relationships in level, climbing, and turning flight	Whiteboard or diagram — 5 min
2	Describe airfoil design and demonstrate how AOA relates to lift and stall	PHAK diagram + sheet of paper demo
3	Explain the three axes and each type of stability; relate CG to stability	Model aircraft or diagram
4	Describe all four left-turning tendencies and when each is most pronounced	TT diagram — quiz each one
5	Calculate load factor for 45° and 60° banked turns; state stall speed impact	Whiteboard calculation
6	Explain wingtip vortex formation and state avoidance procedures for a specific scenario	Scenario-based oral

ACS Compliance Note

- AI.II.D.S1 requires instruction on **at least three** of K1–K6 elements
- Plan to cover all six in ground lessons; the ACS minimum is a floor, not a ceiling
- Evaluate quality and accuracy of the instruction delivery — not just knowledge recall
- Student should be able to connect concepts: e.g., explain why AOA (K1) relates to load factor stall speed increase (K5)

Completion Standards

- Student accurately describes each element taught without prompting
- Student correctly identifies misconceptions when presented with common errors
- Student can apply concepts to practical scenarios (banked turn stall speed, wake avoidance, left-turning correction during takeoff)

SECTION 4 — REVIEW QUESTIONS

Q1: A student is performing a 60° banked turn at 80 KIAS. The POH lists Vs at 52 KIAS. What is the approximate stall speed in this turn, and what is the load factor?

A: Load factor in 60° bank = 1/cos(60°) = 2.0G. Stall speed = 52 × √2 ≈ 73.5 KIAS. At 80 KIAS in a 60° bank the margin above stall is only ~6.5 knots — very small. Teach students to feel the buffet cues and not over-bank in slow flight.

Q2: Name the four left-turning tendencies and state which is most pronounced during the tail-raise phase of a tailwheel aircraft's takeoff.

A: Torque, P-factor, spiraling slipstream, gyroscopic precession. During the tail-raise (pitch forward) phase: gyroscopic precession is dominant — force applied at top of prop disc precesses 90° ahead (to the left) causing strong left yaw. Right rudder required.

Q3: What is the difference between static and dynamic stability? Give an example where an aircraft has positive static but negative dynamic stability.

A: Static stability = initial tendency after displacement (positive returns toward equilibrium). Dynamic stability = long-term behavior — whether oscillations dampen (stable) or diverge. An aircraft could have positive static stability (initially returns) but negative dynamic stability if the oscillations grow with each cycle — the phugoid mode can exhibit this in some designs.

Q4: You are departing behind a Boeing 737 that rotated at mid-field. You are in a Cessna 172. Describe your departure strategy to avoid wake turbulence.	A: Note the 737's rotation point (mid-field). Rotate before that point. Climb at Vy and track to the UPWIND side of the runway centerline. Maintain above the 737's climb path (they climb at ~2,500 fpm; the 172 climbs at ~700 fpm, so lateral offset is necessary). Avoid the area the 737 was over for at least 3 minutes.
Q5: Explain how CG position affects both stability and controllability. What are the risks of an aft CG?	A: Forward CG → more stable longitudinally (horizontal stabilizer generates more downward force to balance), but requires more back pressure to rotate; reduces aft control authority — forward CG limit exists to ensure adequate elevator for flare. Aft CG → less stable; pitch oscillations may diverge; possible uncontrollable pitch-up; stall/spin recovery may be impossible — never exceed aft CG limit.
Q6: A student asks: 'If I'm flying fast and pull back hard, can the wings fall off?' How do you explain Va and structural limits?	A: Below Va, pulling back to full deflection will cause the aircraft to stall before reaching the structural load limit — stall is the safety relief. Above Va, the wing generates enough lift before stalling to exceed the design limit load — structural failure is possible. Va is the max speed where a single, full control input remains within structural limits. Combined/abrupt inputs above Va can overstress even at Va.

Area II, Task E — Aircraft Flight Controls and Operation of Systems

FAA-S-ACS-25 | CFI Airplane — Ground Lesson

Objective

The applicant demonstrates instructional knowledge of all airplane systems — primary and secondary flight controls, powerplant, landing gear, fuel/oil, electrical, avionics, pitot-static, environmental, deicing, and oxygen — and can identify system abnormalities, manage associated risks, and provide effective dual instruction including simultaneous demonstration and explanation.

References

- FAA-H-8083-25C (PHAK) — Chapters 6, 7, 8
- FAA-H-8083-3B (AFH) — Chapter 2
- FAA-H-8083-2 (Pilot's Handbook of Aeronautical Knowledge)
- FAA-H-8083-9 (Aviation Instructor's Handbook)
- POH/AFM — Aircraft-specific systems chapter (Section 7)

Delivery Format

- Ground lesson with PHAK diagrams and POH references — 60–90 min
- Bring the POH for the student's airplane; reference Section 7 (Systems)
- If possible, integrate walk-around during or after ground lesson

ACS Knowledge Elements

Code	Element
AI.II.E.K1	Airplane systems (all sub-elements K1a–K1l)
AI.II.E.K1a	a. Primary flight controls
AI.II.E.K1b	b. Secondary flight controls
AI.II.E.K1c	c. Powerplant and propeller
AI.II.E.K1d	d. Landing gear
AI.II.E.K1e	e. Fuel, oil, and hydraulic
AI.II.E.K1f	f. Electrical
AI.II.E.K1g	g. Avionics
AI.II.E.K1h	h. Pitot-static, vacuum/pressure, and instruments
AI.II.E.K1i	i. Environmental
AI.II.E.K1j	j. Deicing and anti-icing
AI.II.E.K1k	k. Water rudders (ASES/AMES — N/A ASEL)
AI.II.E.K1l	l. Oxygen system
AI.II.E.K2	Indications/procedures for managing system abnormalities

ACS Risk Management

Code	Element
AI.II.E.R1	Detection of system malfunctions or failures
AI.II.E.R2	Management of a system failure
AI.II.E.R3	Monitoring and management of automated systems
AI.II.E.R4	Providing instruction in unfamiliar aircraft/avionics

ACS Skills

Code	Element
AI.II.E.S1	Operate at least three systems from K1a–K1l while simultaneously explaining

1. Primary Flight Controls (AI.II.E.K1a)

A WHAT TO TEACH

Three Axes of Rotation

Every airplane maneuvers about three axes that intersect at the center of gravity. Each primary flight control governs rotation about one axis.

during normal maneuvers.

A properly designed aircraft is stable and easily controlled during normal maneuvering. Control surface inputs cause movement about the three axes of rotation. The types of stability an aircraft exhibits also relate to the three axes of rotation. *[Figure 6-4]*

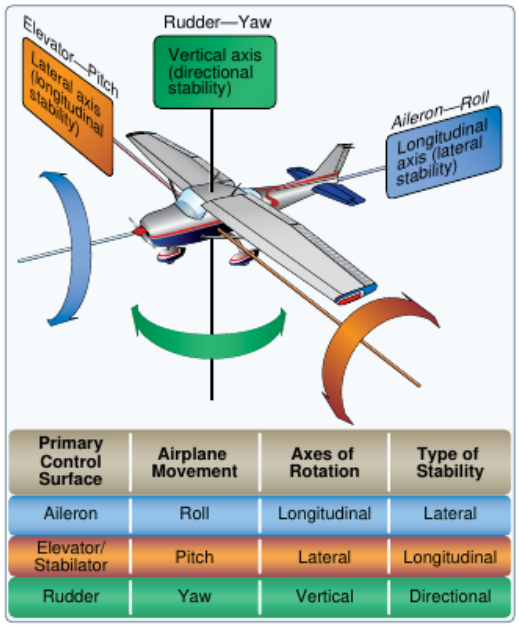


Figure 6-4. *Airplane controls, movement, axes of rotation, and*

Figure 1 — PHAK Fig. 6-4. Three axes of rotation intersecting at the CG. Longitudinal (roll), lateral (pitch), and vertical (yaw).

Primary Control Surfaces

Surface	Axis	Motion	Location
Ailerons	Longitudinal	Roll (bank)	Outboard trailing edge, each wing
Elevator	Lateral	Pitch (nose up/down)	Horizontal stabilizer trailing edge
Rudder	Vertical	Yaw (nose L/R)	Vertical stabilizer trailing edge

How Each Control Works

- **Ailerons:** Differential movement — one deflects up, the other down. Down aileron increases camber/lift on that wing; up aileron decreases lift. Aircraft rolls toward the up-aileron (rising drag) side.
- **Elevator:** Deflect up — tail pushes down, nose pitches up. Controls angle of attack directly. Critical for stall recognition.
- **Rudder:** Deflect left — vertical tail surface pushes right, nose yaws left. Used to counteract adverse yaw and coordinate turns.

Control Effectiveness

- Effectiveness increases with airspeed — small inputs at high speed have amplified effect.
- At low airspeed (high AOA), larger deflections needed for same response.
- Trim controls relieve sustained control pressure — trim is not a primary control but essential for pilot workload management.

CRITICAL ■ AI.II.E.K1a — All three controls must be coordinated. Crossed controls at low altitude (e.g., skidding base-to-final with inside rudder and outside aileron) is a leading cause of loss-of-control accidents. This is the #1 stall/spin scenario the CFI must prevent.

2. Secondary Flight Controls (AI.II.E.K1b)

A WHAT TO TEACH

Flap Types & Leading Edge Devices

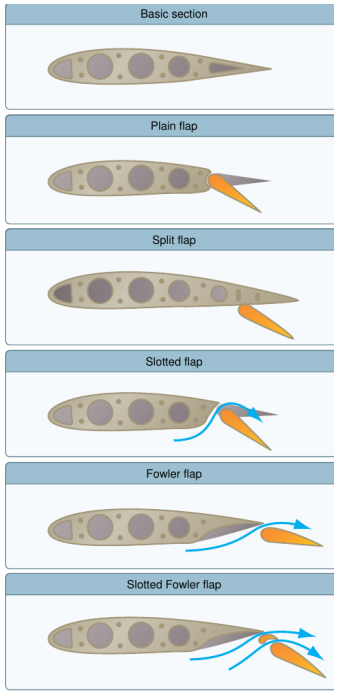


Figure 6-17. *Five common types of flaps.*

Fig. 6-17 — PHAK. Five common flap types: basic section, plain, split, slotted, fowler, and slotted fowler.

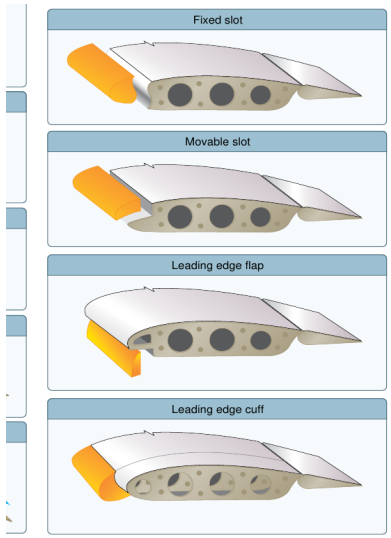


Figure 6-18. *Leading edge high lift devices.*

6-9

Fig. 6-18 — PHAK. Leading edge high-lift devices: fixed slot, movable slot, leading edge flap, and leading edge cuff.

Flap Types

Flap Type	Lift Effect	Drag Effect	Common Aircraft
Plain	Moderate CL	Moderate CD	Older designs
Split	Moderate CL	High CD	WWII era GA
Slotted	High CL	Moderate CD	C-172, PA-28, most trainers
Fowler	Very High CL	Low-Mod CD	Complex GA, turboprops

Trim Systems

- **Elevator trim:** Most critical — trim for level flight before every power change. Transitions (climb to cruise, etc.) require immediate retrim.
- **Rudder trim:** Offsets engine torque/P-factor in cruise, reducing foot pressure for long legs.
- **Aileron trim:** Levels wings for fuel imbalance or asymmetric loads.

Leading Edge Devices

- **Slats:** Move forward/down, creating a slot to energize boundary layer airflow — delays flow separation, reduces stall speed.
- **Leading edge flaps:** Increase leading edge camber; extend stall AOA.
- Most ASEL training aircraft (C-172, PA-28) do not have leading edge devices — focus on trailing edge flaps and their effect on stall speed.

KEY RULE ■ FLAP RULE: Select flap setting, then retrim. Students often forget to trim after flap changes, resulting in ballooning or nose-low tendencies. Make retrimming a conditioned response.

3. Powerplant & Propeller (K1c) — Landing Gear (K1d)

A WHAT TO TEACH

K1c — Powerplant

- **Engine type:** Most training aircraft use horizontally opposed, air-cooled, 4-cylinder engines (Lycoming O-320/360, Continental O-200/300). Simple, lightweight, reliable.
- **Carbureted vs. fuel-injected:** Carbureted engines (most trainers) are susceptible to carburetor ice in moist air below +21°C (70°F). Apply carb heat when roughness or power loss occurs. FI engines are immune to carb ice.
- **Ignition:** Dual magneto system — each plug fires independently. Mag check: RPM drop of 125 RPM max, differential max 50 RPM. Both mags off = engine stops.

K1c — Propeller

- **Fixed-pitch:** Simple, one lever. Optimized for one speed (climb or cruise). RPM changes with throttle.
- **Constant-speed:** Governor maintains RPM; pilot sets RPM with prop lever and manifold pressure with throttle. 'Big prop, small throttle' for power reduction.

Prop Effect	When Strongest	Correction
Torque (left roll/yaw)	High power, low speed	Right rudder
P-factor (left yaw)	High AOA climb	Right rudder
Slipstream (left yaw)	Full power application	Right rudder
Gyroscopic (pitch/yaw)	Attitude changes	Anticipate with rudder

K1d — Landing Gear

- **Fixed tricycle gear:** Most training aircraft (C-172, PA-28). Always down — no retraction system. Simple, reliable; higher drag in cruise.
- **Retractable tricycle:** Higher performance aircraft. Electric or hydraulic retraction. Reduces cruise drag significantly. Requires discipline.
- **Conventional (tailwheel):** Requires advanced endorsement. Limited forward visibility on ground; harder to control on takeoff/landing.

Gear Type	Advantages	Key Risk
Fixed Tricycle	Simple; no GUMPS; low cost	Higher drag
Retractable Tricycle	Low drag; faster cruise	Gear-up landing risk
Tailwheel	Simpler; better prop clearance	Ground handling; visibility

GUMPS Checklist (Retractable Aircraft)

- **G** — Gas: proper tank selected, boost pump on
- **U** — Undercarriage: DOWN, 3 green lights confirmed
- **M** — Mixture: full rich (or per POH for altitude)
- **P** — Prop: full forward (low pitch, high RPM)
- **S** — Switches: lights, master, carb heat off

CRITICAL ■ Gear-up landings are among the most preventable and costly GA accidents. Teach GUMPS as mandatory — complete it by mid-downwind, every approach, every time. Never skip it when rushed.

4. Fuel, Oil & Hydraulic (K1e) — Electrical System (K1f)

A WHAT TO TEACH

K1e — Fuel System

- **Fuel grades:** 100LL (blue) is the standard GA avgas. Check POH Section 1 for minimum octane. NEVER use automotive fuel unless covered by STC.
- **Fuel flow path:** Wing tanks → fuel selector valve → strainer (gascolator) → carburetor or fuel injector → engine. Drain from all low points every preflight.
- **Sump drains:** Drain until sample is clear and blue (water settles to bottom, appears as bubbles or clear drops). Check multiple drain points per POH.
- **Mixture control:** Lean in cruise above 3,000 ft for fuel economy and engine health. Richen for landing. Over-rich = rough engine, fouled plugs, excessive fuel consumption.

K1e — Oil System

- Oil cools and lubricates all engine bearings and moving parts. Check quantity on every preflight; minimum levels are in POH Section 8.
- Normal oil pressure: 60–90 PSI typical (check POH for specific aircraft). Dropping pressure or rising temp = land ASAP.
- Low oil pressure is an emergency. A zero-oil-pressure indication in flight may indicate imminent engine seizure.

K1e — Hydraulic (if installed)

- Used for gear retraction and brakes in more complex aircraft. Simple trainers use direct mechanical braking.
- Spongy brakes = possible air in system or low fluid. Check hydraulic fluid level on preflight.

K1f — Electrical System

- **Alternator:** Main power source during engine operation. Provides current at any RPM above ~1,000. Most GA aircraft use 14V or 28V systems.
- **Battery:** Powers engine start and backup if alternator fails. Typical endurance with full electrical load: 20–30 minutes.
- **Bus bar / circuit breakers:** Power distributes from bus through individual circuit breakers. Popped breaker = circuit overload. Reset once; if trips again, leave it out.
- **Ammeter / loadmeter:** Ammeter shows charge (+) or discharge (–). In flight, ammeter should show positive (charging). Any discharge is an alternator issue.

Indication	Meaning	Immediate Action
Ammeter discharging	Alternator failed or low output	Alt off/on; shed loads; land soon
Low voltage light on	System voltage below threshold	Check alt switch; reduce loads; land if persists
Circuit breaker pops	Circuit overload or short	Reset once only; do not force if trips again
High ammeter charge	Battery depleted, now charging	Normal after start or long electrical load period

KEY RULE ■ Alternator failure is manageable if caught early. The key is recognizing the discharging ammeter before the battery dies. Teach: (1) shed non-essentials, (2) estimate time to battery exhaustion, (3) land ASAP — do not delay.

5. Avionics (K1g) — Pitot-Static & Instruments (K1h)

A WHAT TO TEACH

K1g — Avionics

- **COM radios:** VHF 118.000–136.975 MHz. Verify squelch, volume, and antenna on preflight.
- **NAV radios:** VOR, ILS. IFR VOR check required every 30 days (14 CFR 91.171). GPS database must be current.
- **Transponder:** Mode C required above 10,000 ft MSL and in Class A/B/C. ADS-B Out required in Class B, C and above FL180 since 2020.
- **GPS/WAAS:** WAAS GPS provides precision approach capability. Most common primary nav in modern GA.
- **Autopilot (if installed):** Know modes, mode change behavior, and how to disconnect quickly.

System	Preflight Check	Key Limitation
COM Radio	Freq, vol, squelch	Line-of-sight ~100–150 NM range
Transponder	Test, IDENT, alt encoding	ADS-B Out required in Class B/C airspace
GPS	Database date, RAIM check	Not sole IFR source without WAAS approval
EFB/iPad	Battery, app currency	Not certificated — backup charts req. IFR

K1h — Pitot-Static System

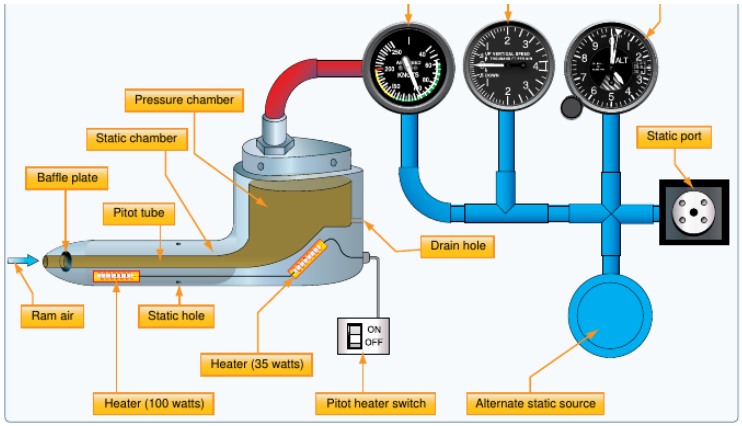


Figure 8-1. *Pitot-static system and instruments.*

Figure 3 — PHAK. Pitot tube and static ports supply ASI, altimeter, and VSI.

Instrument	Pitot	Static	Reads
ASI	Yes	Yes	Dynamic pressure (pitot – static) → IAS
Altimeter	No	Yes	Absolute static pressure → altitude
VSI	No	Yes	Rate of static pressure change → fpm

- **Vacuum system:** Powers AI and HI on most trainers. Failure is insidious — gyros precess slowly. Cross-check with electric turn coordinator.
- **Alternate static:** Cabin air port — altimeter reads slightly high, ASI slightly fast when used.

CRITICAL ■ Pitot heat must be ON in visible moisture and any icing conditions. A blocked pitot tube in IMC has caused fatal accidents. Test on every preflight — feel warmth within 30 sec of activation. Verify the green light illuminates.

6. Environmental (K1i) — Deicing (K1j) — Oxygen (K1l)

A WHAT TO TEACH

K1i — Environmental / Cabin Systems

- **Cabin heat:** Most light aircraft use a heat exchanger around the exhaust manifold — hot exhaust heats cabin air. A cracked heat exchanger introduces CO into the cabin.
- **Carbon Monoxide:** Odorless, colorless. Symptoms: headache, dizziness, nausea. CO detectors (card or electronic) are essential. If CO suspected: turn off heat, open vents, descend, land.
- **Ventilation:** Fresh air vents must be used in conjunction with cabin heat. Closing all vents with heat on is dangerous.
- **Air conditioning (if installed):** Parasitic drag on engine. May reduce available power at high density altitudes.

K1l — Oxygen System

- **Regulatory requirements (14 CFR 91.211):**
- Above 12,500 ft MSL for more than 30 min — flight crew must use O2
- Above 14,000 ft MSL — flight crew required at all times
- Above 15,000 ft MSL — all occupants must use O2
- **System types:** Continuous-flow cannula/mask (most portable systems); diluter-demand or pressure-demand for high altitude.
- O2 is an oxidizer — **no smoking or open flame near oxygen equipment**.

> ***Instructor Note:*** *For most ASEL training operations, oxygen is rarely used. However, CFI candidates must know the regulations precisely — altitude thresholds are commonly tested.*

K1j — Deicing and Anti-Icing

System	Type	Function / Notes
Pitot heat	Anti-ice (electric)	Prevent pitot icing. Use in visible moisture and any suspected icing conditions.
Carb heat	Anti-ice (engine exhaust)	Melts carb ice. Typically causes 100–150 RPM drop on application; RPM rises again as ice melts.
De-ice boots	Deice (pneumatic)	Inflate/deflate to crack leading edge ice. Do not activate too early (smooth ice is harder to shed).
TKS fluid	Anti/deice (liquid)	Weeping fluid on leading edges. Effective but limited supply.
FIKI certified	Anti-ice (system)	Flight Into Known Icing certification — requires specific equipment and AFM supplement.

Structural Icing — Hazard Summary

- Even 1/4 inch of ice on leading edges can reduce CLmax by 30% and increase stall speed significantly.
- VFR aircraft without FIKI must avoid known icing conditions — encountering icing inadvertently is an emergency.
- Clear ice is the most hazardous: forms smoothly at near-0°C in freezing rain; dense, hard to remove.
- Rime ice is rougher, less dense; forms in clouds with small supercooled droplets.

CRITICAL ■ A non-FIKI aircraft entering known icing = emergency. Teach students to check AIRMETs (Sierra, Zulu), PIREPs, and freezing levels before every flight in fall, winter, and spring.

7. System Abnormalities and Failures (AI.II.E.K2)

A WHAT TO TEACH

Recognizing System Abnormalities

- Know normal parameters for every gauge before flight. Brief the student on normal ranges during walk-around — green arc, yellow arc, red line.
- **Engine instruments — priority order:** Oil pressure first, then oil temp, then CHT/EGT, then fuel quantity. Any instrument outside the green arc is a warning.
- **Electrical:** Discharging ammeter, low voltage light, or burning smell = shed load and land.
- **Pitot-static:** Instrument disagreement (ASI and altimeter not consistent with known conditions) suggests blocked port — activate pitot heat, open alternate static.
- **Vacuum:** AI and HI precess slowly. Confirm with turn coordinator (electric). Fly partial panel and contact ATC for assistance if IMC.

Emergency Priority Order — Aviate, Navigate, Communicate

- **1. Aviate:** Maintain aircraft control first. Distraction from a system fault is a leading accident cause.
- **2. Navigate:** Identify nearest suitable airport; route away from terrain. Know your options before they're needed.
- **3. Communicate:** Declare emergency 121.5 or ATC. Squawk 7700. ATC will provide assistance.
- **4. Troubleshoot:** Memory items first (bold in checklist), then published procedures.

System Failure Quick Reference

Failure	Symptoms	Immediate Action
Engine failure	RPM drops; rough/silence	Best glide; nearest airport; restart per POH; MAYDAY
Alternator failure	Ammeter discharging; low volt	Alt off/on; if no recovery, shed loads; land ASAP
Pitot blocked	ASI incorrect or frozen	Pitot heat on; alternate static; use attitude + power
Vacuum failure	AI/HI tumble or precess	Cover failed instruments; partial panel; TCA; contact ATC
Gear unsafe	No green light; red unsafe	Fly pattern; try manual extension; request CFR standby
Engine fire	Smoke; fire warning; smell	Fuel off; mixture off; master off; land immediately; evacuate
Electrical fire	Smoke; burning smell	Master off; CO2 if available; land; ventilate

KEY RULE ■ Abnormal procedures must be briefed and practiced proactively. A student who has never thought about engine failure before it happens will be unprepared when it does. Brief every flight: 'If the engine quits on takeoff below 500 ft, we land straight ahead.'

"Teach your student to be the airplane's doctor. A good doctor knows what healthy looks like. If you don't know what normal oil pressure looks like on a standard day, you will not recognize when it starts to drop."

SECTION 2 — RISK MANAGEMENT (AI.II.E.R1–R4)

R1 — Detection of System Malfunctions

- Emphasize continuous instrument monitoring throughout flight — not just during start and run-up. Scan oil pressure, EGT, fuel quantity every 10 minutes in cruise.
- Before flight, brief normal ranges for every engine instrument. Students who know normal values will detect deviations immediately.
- Teach the 'instrument cross-check' habit as a fundamental discipline — not something done only when something seems wrong.

R2 — System Failure Management

- Aviate first — control the aircraft before troubleshooting any system. Accident reports show that distraction during minor failures leads to loss of aircraft control.
- Use checklists — memory items first (bold in the QRH), then reference checklist if time permits. Never skip items to save time.
- Know emergency landing options before departure. Identify airports, fields, and roads along route before takeoff.
- Practice simulated emergencies regularly to build muscle memory — partial panel, engine out glide, electrical failure drills.

R3 — Monitoring Automated Systems

- Automation dependency is a growing safety issue in GA. Students who rely on autopilot and GPS lose basic flying skills over time.
- Teach students to monitor autopilot modes actively — verify it executes what was commanded.
- Teach 'automation surprise' scenarios: unexpected mode changes, GPS disconnect, GPSS deviation.
- Require regular hand-flying practice, including partial panel and without GPS, to maintain proficiency.

R4 — Unfamiliar Aircraft / Avionics

- A CFI may be asked to give instruction in an aircraft they are unfamiliar with — this adds risk for both instructor and student.
- Before flying an unfamiliar aircraft: study the POH thoroughly, get a ground orientation from a knowledgeable CFI, complete a solo flight before introducing a student.
- Unfamiliar glass cockpit (G1000, Avidyne Entegra) requires dedicated ground training before flight. Do not learn EFIS systems airborne while instructing.

■ ***Risk Note:*** *Accepting instruction in a system or aircraft you are not proficient in is a duty-of-care violation. The student trusts you to be the most prepared person in the cockpit at all times.*

SECTION 3 — HOW TO TEACH (AI.II.E — TEACHING TECHNIQUES)

Sequencing the Lesson

- **Ground first:** Use POH Section 7 as the foundation. Walk through each system in writing before touching anything on the airplane.
- **Walk-around integration:** Physically identify each system during preflight. Point to the oil cap, fuel strainer, pitot tube, static ports, alternator.
- **Airborne demo:** Show each system operating in real time. Demonstrate ammeter response to electrical loads; carb heat RPM change.
- **Debrief:** Review any abnormal readings encountered; reinforce normal parameter ranges.

Instructor Note: *Walk-around teaching is the most effective method. Touching the oil cap, looking at the pitot tube, and draining the fuel sumps makes abstract systems tangible. Do this every lesson — not just the first one.*

Teaching Aids and Demonstrations

- Use PHAK Chapters 6, 7, and 8 diagrams — flight controls, fuel systems, and pitot-static are all clearly illustrated.
- Bring a pitot tube cover to demonstrate blocked pitot effects during ground discussion.
- Use a color-coded systems diagram from the POH showing fuel flow, electrical bus, and vacuum lines.
- For retractable gear: demonstrate GUMPS, gear indicator lights, and manual extension in a dedicated ground briefing before the first flight.
- Use simulator or BATD for electrical failure, vacuum failure, and partial-panel exercises in a low-risk environment.

SECTION 4 — SKILLS ASSESSMENT (AI.II.E.S1)

Skill Demonstration Checklist

#	System (from K1 list)	Demo Method	Time
1	Primary flight controls (K1a) — coordinated aileron, elevator, rudder in turns	In-flight narrated maneuver	5 min
2	Flap system (K1b) — select, configure, trim after each change	In-flight full-flap approach with explanation	5 min
3	Pitot-static instruments (K1h) — ASI/altimeter/VSI cross-check	In-flight or partial-panel exercise	5 min
4	Electrical system (K1f) — ammeter monitoring and load management	In-flight: demonstrate electrical loads affecting ammeter	4 min
5	Fuel system (K1e) — mixture leaning procedure in cruise	In-flight: lean with EGT explanation	3 min

ACS Note on S1

AI.II.E.S1 requires demonstration and simultaneous explanation of at least **three systems** from K1a–K1l. The evaluator selects the systems. The applicant must demonstrate the *ability to teach* — running commentary, common errors, and student-focused language are expected. Demonstrating correctly but unable to explain why is an unsatisfactory performance.

Evaluation Standards

- Operate selected systems smoothly and safely while providing continuous, clear instructional narration.
- Explanation must be at student pilot level — avoid jargon; use relatable analogies.
- Must correctly identify normal vs. abnormal system indications.
- Must explain what a student should do if the system fails or shows abnormal indication.

Common Deficiencies to Avoid

- Demonstrating the system correctly but failing to explain why it works that way.
- Not connecting system knowledge to risk management (e.g., carb heat without explaining when and why).
- Giving generic answers instead of aircraft-specific information from the POH.
- Failing to mention alternate procedures if the primary system fails.
- Inability to describe normal parameter ranges for the specific aircraft flown.

Completion Standards

- Student can identify all major systems by location and function during preflight.
- Student can operate each covered system within POH limits and explain the action.
- Student can verbalize appropriate response to any single system abnormality covered in lesson.

SECTION 5 — REVIEW QUESTIONS

Q1: A student asks why the nose yaws to the left during a right-banked turn even though no rudder is applied. How do you explain adverse yaw?	A: Adverse yaw occurs because the descending wing's aileron is deflected upward (decreasing lift and drag) and the rising wing's aileron deflects downward (increasing lift and drag). The extra drag on the rising wing momentarily yaws the nose toward the outside of the turn. Rudder coordination (in the direction of turn) corrects this. Differential and frise-type ailerons reduce — but do not eliminate — adverse yaw.
Q2: During cruise, your student notices the ammeter showing a steady discharge. What do you instruct them to do, and why?	A: A discharging ammeter indicates the alternator is not supplying adequate power. Instruct: (1) cycle alternator switch off/on to reset, (2) if still discharging, shed non-essential electrical loads (landing light, radios you don't need, etc.), (3) estimate battery endurance and plan to land at the nearest suitable airport. Declare an emergency if IMC or unable to reach airport before battery exhaustion.
Q3: What happens to the airspeed indicator, altimeter, and VSI if the static port becomes blocked during a climb?	A: Altimeter freezes at the altitude at time of blockage (no new static input). VSI drops to zero (no rate of change). ASI reads erroneously high — as the aircraft climbs, actual static pressure decreases, but the trapped static reference stays constant, increasing the apparent dynamic pressure. Use alternate static (cabin air) to restore near-normal indications — altimeter will read slightly high, ASI slightly fast on cabin air.
Q4: At what MSL altitudes does 14 CFR 91.211 require supplemental oxygen for flight crew?	A: Above 12,500 ft MSL for the portion of flight exceeding 30 minutes; above 14,000 ft MSL for all crew at all times; above 15,000 ft MSL for all occupants. Note: these thresholds are for non-pressurized aircraft. Pressurized aircraft have different requirements. Know the exact thresholds — they are commonly tested on the ACS practical.
Q5: A student is about to fly a retractable gear aircraft for the first time. What systems briefing items are mandatory before the first flight?	A: Cover: (1) gear selector operation (up/down), (2) gear indicator lights — 3 green = down and locked, (3) gear warning horn activation conditions, (4) GUMPS checklist — Gas, Undercarriage, Mixture, Prop, Switches, (5) manual extension procedure in case of hydraulic/electrical failure, (6) landing with gear unsafe indication — declare emergency, request emergency services. Emphasize: always verify gear down visually (tower or mirror if available) before landing.
Q6: Your student smells something unusual in the cockpit shortly after turning the cabin heat on. What do you suspect, and what is your immediate action?	A: Suspect carbon monoxide from a cracked heat exchanger. Immediate actions: (1) turn off cabin heat, (2) open fresh air vents fully, (3) check CO detector if installed, (4) land as soon as practicable. CO is odorless and colorless — the smell (often described as exhaust) may indicate other combustion products entering. Err on the side of caution and land. The engine may still be safely used for landing unless other symptoms appear.

Area II, Task F — Performance and Limitations

FAA-S-ACS-25 | CFI Airplane — Ground Lesson

Objective

The applicant demonstrates instructional knowledge of aircraft performance and limitations — explaining use of charts, tables, and data; factors affecting performance; weight and balance terms and computations; methods for computing CG; and the aerodynamic basis for performance — and can manage associated risks and provide effective dual instruction.

References

- FAA-H-8083-25C (PHAK) — Chapters 10, 11
- FAA-H-8083-3B (AFH) — Chapter 2
- FAA-H-8083-2 (Pilot's Handbook of Aeronautical Knowledge)
- FAA-H-8083-9 (Aviation Instructor's Handbook)
- POH/AFM — Section 4 (Normal Procedures), Section 5 (Performance), Section 6 (W&B;)

Delivery Format

- Ground lesson with POH/AFM Sections 5 & 6 open — 60–90 min
- Use actual POH performance charts (takeoff, climb, cruise, landing) from student's airplane
- Walk through at least one complete takeoff distance calculation and one W&B; using the POH
- E6B (mechanical or app): compute density altitude, time/speed/distance, and fuel burn
- ForeFlight: demonstrate Weight & Balance module, Performance planning, and weather-adjusted numbers
- Compare POH 'book' numbers to ForeFlight computed values to reinforce real-world application

ACS Knowledge Elements

Code	Element
AI.II.F.K1	Use of charts, tables, and data to determine performance
AI.II.F.K2	Factors affecting performance, including:
AI.II.F.K2a	a. Atmospheric conditions
AI.II.F.K2b	b. Pilot technique
AI.II.F.K2c	c. Airplane configuration
AI.II.F.K2d	d. Airport environment
AI.II.F.K2e	e. Loading and weight and balance
AI.II.F.K3	Weight and balance terms (BEW, max gross weight, arm, moment, datum, CG, CG limits, useful load)
AI.II.F.K4	Methods for computing CG
AI.II.F.K5	Aerodynamics

ACS Risk Management

Code	Element
AI.II.F.R1	Use of performance charts, tables, and data
AI.II.F.R2	Airplane limitations
AI.II.F.R3	Possible differences between calculated and actual performance
AI.II.F.R4	Exceeding weight limits
AI.II.F.R5	Operating outside of CG limits
AI.II.F.R6	Shifting, adding, and removing weight

ACS Skills

Code	Element
AI.II.F.S1	Use appropriate airplane performance charts, tables, and data
AI.II.F.S2	Compute W&B;, correct out-of-CG loading errors, confirm within limits during all phases of flight

1. Using Performance Charts, Tables & Data (AI.II.F.K1) + Atmospheric Conditions (AI.II.F.K2a)

A WHAT TO TEACH

POH Performance Data — Where to Find It

All certified aircraft have an FAA-approved Pilot's Operating Handbook (POH) or Airplane Flight Manual (AFM). Section 5 contains all performance data. The CFI must teach students to always reference the correct aircraft's POH — not generic charts.

POH Section	Content
Section 2 — Limitations	Vne, Vno, Vx, Vy, Va, Vfe, Vs, Vs0; max weights; CG range; fuel limits
Section 4 — Normal Procedures	Performance speeds used in checklists
Section 5 — Performance	Takeoff, climb, cruise, landing charts; density altitude table
Section 6 — Weight & Balance	Reference datum, arms, loading graph, CG envelope

How to Read a Performance Chart

- Identify conditions: OAT, pressure altitude, aircraft weight, headwind/tailwind
- Enter chart from the known condition axis, follow lines to intersection, read result
- Interpolate between lines when exact values aren't on a grid line
- Always note chart notes: e.g., 'paved, level, dry runway' or 'hard braking' assumptions

KEY RULE ■ CHART DISCIPLINE: After computing a number, apply the POH correction factor. Typically add 50% for grass or soft field, and note that book numbers assume a new engine and perfect technique. A 15–25% safety margin is standard practice.

Density Altitude — The Performance Killer

Density altitude is pressure altitude corrected for non-standard temperature. It is the altitude at which the aircraft 'thinks' it is flying. High density altitude = thin air = degraded engine power, reduced prop efficiency, and longer wings needed to generate lift — all translating to significantly longer takeoff rolls and reduced climb rates.

Factor	Effect on Density Altitude	Effect on Performance
High Temperature	Increases DA	Longer T/O roll, reduced climb
High Elevation (PA)	Increases DA	Less air, longer T/O roll
High Humidity	Increases DA slightly	Reduces engine power ~3–7%
Low Pressure (low altimeter)	Increases DA	Compound effect with heat

Standard Atmosphere Reference

- Sea level standard: 29.92 inHg / 1013.25 mb, 15°C (59°F)
- Temperature lapse rate: –2°C per 1,000 ft (approx. –3.5°F/1,000 ft)
- Pressure lapse rate: approx. 1 inHg per 1,000 ft below 10,000 ft

Computing Density Altitude

- **E6B (manual or app):** Set OAT on temperature scale vs. pressure altitude window — read density altitude in center window. Drill this with a student before every cross-country briefing.
- **ForeFlight:** Wx → Airport details shows current DA for any field. Performance planning auto-corrects charts for current conditions.
- **POH density altitude table:** Most POHs include a quick-reference DA table in Section 5. Cross-check against E6B.

CRITICAL ■ AI.II.F.K2a — High-density-altitude departures are a leading cause of GA accidents. A C-172 at 8,000 ft DA may need 3,000+ ft to clear a 50-ft obstacle — more than double sea-level performance. Always calculate before departure, never estimate.

2. Factors Affecting Performance: Technique, Configuration, Airport & Loading (AI.II.F.K2b–K2e)

A WHAT TO TEACH

K2b — Pilot Technique

Book performance numbers assume proper pilot technique. Deviations from published procedures can dramatically alter actual performance.

Technique Factor	Impact
Holding brakes at full power before brake release (short-field)	Reduces T/O roll by 10–15%
Rotating too early (before Vr)	Dragging on runway, increases roll distance
Climbing below Vx or Vy	Reduced obstacle clearance or time-to-altitude
Improper flap setting	Wrong chart was used; actual performance varies significantly
Improper leaning at altitude	Engine produces less than rated power

K2c — Airplane Configuration

- **Flap setting:** POHs provide separate T/O charts per flap setting. Wrong flap = wrong chart.
- **Gear (retractable):** Separate climb data for gear up vs. down. Failing to retract sharply degrades climb.
- **Cowl flaps / Carb heat:** Open cowl flaps in climb for cooling. Carb heat reduces power 3–5% — never during T/O.

K2d — Airport Environment

Factor	Correction / Effect
Grass or soft field	Add 20–40% to T/O distance vs. paved dry runway
Wet or icy runway	Landing distance may increase 45%+ — consult POH notes
Runway slope	Uphill departure: add ~10%/degree. Downhill landing: degrades stopping.
Wind (T/O)	10 kt headwind: reduces roll 10–15%. 10 kt tailwind: increases roll 20–25%.
Obstacles	Use 50-ft obstacle distance column, not ground roll only

Wind Components (E6B / ForeFlight)

The POH lists a *demonstrated* crosswind component, not a maximum. Use the E6B wind grid or ForeFlight to resolve wind into headwind and crosswind components before every departure.

K2e — Loading and Weight & Balance

- Weight directly affects stall speed, T/O roll, landing roll, climb rate, and fuel burn.
- Every 100 lb over gross weight adds ~200–300 ft to 50-ft obstacle distance (C-172, sea level).
- **CG position:** Forward CG = more stable, higher Vs, more drag. Aft CG = less stable, harder stall recovery.

■ ***Risk Note:*** *Operating overweight is illegal AND dangerous. POH charts are only valid within the certified weight envelope — outside it, published numbers are meaningless.*

KEY RULE ■ PERFORMANCE PLANNING WORKFLOW: (1) Check weather/winds → (2) Compute density altitude (E6B or ForeFlight) → (3) Confirm W&B; within limits → (4) Open POH Section 5, find correct chart → (5) Calculate ground roll AND 50-ft obstacle distance → (6) Apply corrections for surface, slope, wind → (7) Compare available vs. required runway → (8) Verify a comfortable margin exists before departure.

3. Weight & Balance Terms (AI.II.F.K3) — Methods for Computing CG (AI.II.F.K4)

A WHAT TO TEACH

Weight & Balance Terminology (K3)

Term	Definition
Basic Empty Weight (BEW)	Airframe + engine + unusable fuel + full oil. Fixed for the aircraft.
Useful Load	Max Gross Weight – BEW. Includes pilot, pax, fuel, baggage.
Maximum Gross Weight	FAA-certified maximum T/O weight per POH Section 2.
Reference Datum	Imaginary vertical plane from which all arm measurements are taken. Varies by aircraft (e.g., firewall, leading edge of wing).
Arm	Horizontal distance from reference datum to any item's center of gravity. Positive = aft; Negative = forward of datum.
Moment	Arm × Weight. Describes the rotational force an item exerts about the datum. Units: in-lb or ft-lb.
CG (Center of Gravity)	Total Moment ÷ Total Weight. The balance point of the loaded aircraft.
CG Limits (Forward / Aft)	Range of permissible CG positions published in POH Section 2 or Section 6. Must remain within limits throughout flight.
Zero Fuel Weight (if applicable)	Some aircraft specify a max weight without usable fuel (relevant for twins/complex aircraft).

Instructor Note: *Have the student find these terms in the actual POH. Point to the reference datum location on the aircraft diagram. Confirm the student knows which section lists CG limits.*

Methods for Computing CG (K4)

Method 1 — Computational (Arm × Weight = Moment)

The most precise method. Each weight item is multiplied by its arm (from the POH loading table) to get its moment. Total weight and total moment are summed, then divided to find CG.

Item	Weight (lb)	Arm (in)	Moment (in-lb)
BEW (example)	1,670	39.1	65,297
Pilot + Front Pax	340	37.0	12,580
Rear Pax	170	73.0	12,410
Baggage	30	95.0	2,850
Fuel (38 gal × 6 lb)	228	48.0	10,944
TOTAL	**2,438**	—	**104,081**
CG = 104,081 ÷ 2,438			**= 42.7 in**

Method 2 — Loading Graph (POH Section 6)

- Each weight station (pilot, passengers, fuel, baggage) has its own arm.
- The POH provides a graph: enter weight on Y-axis → read moment on X-axis.
- Sum all moments, plot on the CG Moment Envelope to confirm within limits.

Method 3 — ForeFlight Weight & Balance Module

- Load the aircraft profile in ForeFlight W&B.; Enter weights for each station.
- ForeFlight plots the CG against the envelope and shows pass/fail in real time.
- Confirm fuel burn: the CG must remain within limits throughout the flight as fuel burns off — check departure, cruise, and landing CG.

CRITICAL ■ AI.II.F.K4 — The CG envelope must be checked at takeoff weight AND at landing weight. Fuel burn can shift CG significantly. A C-172 loaded forward heavy with full fuel may be legal at takeoff but land with CG forward of limits after burning fuel from rear-mounted tanks.

4. Aerodynamics Related to Performance (AI.II.F.K5) — Risk Management — Instructor Application

A WHAT TO TEACH

K5 — Aerodynamics and Performance Speeds

Aircraft performance is directly governed by aerodynamic principles. The CFI must connect POH speed definitions to the aerodynamic forces they represent.

Speed	Definition	When to Use
Vs0	Stall speed in landing config (full flaps, gear down)	Approach minimum reference
Vs1	Stall speed in clean config (flaps up)	Base for Vr, Va calculations
Vx	Best angle of climb — most altitude per horizontal distance	Obstacle clearance on departure
Vy	Best rate of climb — most altitude per minute	Climb after obstacle clearance
Va	Design maneuvering speed — max speed for full control input	Turbulence penetration; varies with weight
Vfe	Max flap extended speed	Do not extend flaps above this speed
Vno	Normal operating range limit (top of green arc)	Avoid above in turbulence
Vne	Never exceed speed (red line)	Structural limitation — absolute maximum

Region of Reversed Command

Below L/D max (best glide speed), the aircraft operates in the 'region of reversed command': more power is required to fly slower. This is critical during approach and go-around. A student who reduces power on final while below L/D max will accelerate the descent rate — not slow the airplane. This is the aerodynamic foundation behind the stabilized approach concept.

Risk Management (AI.II.F.R1–R6)

Code	Risk Element	Teach It By…
R1	Use of performance charts	Work through a real scenario from the student's POH. Calculate before every XC.
R2	Airplane limitations	Open Section 2. Emphasize Vne, weight limits, and CG range are legal limits.
R3	Calculated vs. actual	Explain POH assumptions: new engine, ideal technique, sea level, standard day.
R4	Exceeding weight limits	Overweight = illegal + overstress + degraded performance. No exceptions.
R5	Outside CG limits	Aft CG reduces stability and spin recovery; forward CG may prevent flare.
R6	Shifting weight	Fuel burn shifts CG. Recheck W&B; if passengers or cargo change mid-trip.

Instructor Application

- **Open the POH together:** Have the student find Sections 5 & 6. Walk through one complete performance calc and W&B; for the actual planned flight.
- **E6B drill:** Give a scenario (elevation + temp + altimeter). Student computes density altitude on E6B; cross-check with ForeFlight airport weather.
- **ForeFlight W&B;:** Build the W&B; in ForeFlight together. Show how CG shifts as fuel burns from departure to landing.
- **Go/no-go decision:** Present a marginal scenario (hot day, high elevation, short runway, heavy load) — walk through the full decision process.

CRITICAL ■ AI.II.F — On the checkride, the evaluator presents a scenario and expects the applicant to work through it with the POH open. Skill elements S1 and S2 are performance-based: the student must DO it, not just describe it.

5. Oral Knowledge Questions — Area II, Task F

B ORAL EXAM PREP — USE THESE TO QUIZ THE STUDENT BEFORE THE CHECKRIDE

1	**What is density altitude and why does it degrade performance?** Pressure altitude corrected for non-standard temperature. High DA = thin air — less engine power, less prop thrust, more speed needed for lift. T/O roll can more than double compared to sea level. *K2a*
2	**How do you compute density altitude on an E6B?** Set OAT against pressure altitude in the center window; read DA directly. Cross-check with the POH Section 5 DA table or ForeFlight airport weather (which shows current DA automatically). *K2a*
3	**Where is takeoff distance data found in the POH, and what does it assume?** Section 5. Assumes new engine at rated power, paved level dry runway, standard day, and perfect technique. Real-world performance is worse — apply a 15–25% safety margin. *K1*
4	**Name four factors that increase takeoff distance.** (1) High temp / high elevation (density altitude). (2) Tailwind — 10 kt adds 20–25%+ to ground roll. (3) Uphill slope — add ~10%/degree. (4) Grass or soft surface — add 20–40% vs. paved. *K2a, K2b, K2d*
5	**Define arm, moment, and CG. How are they mathematically related?** Arm = distance from reference datum to item's CG (in). Moment = Arm × Weight (in-lb). CG = Total Moment ÷ Total Weight. All three are required to verify the aircraft is loaded within limits. *K3*
6	**What are the three CG computation methods?** (1) Computational: each item's Weight × Arm = Moment; sum and divide. (2) Loading graph (POH Sec. 6): enter weight, read moment, plot on envelope. (3) ForeFlight W&B; module: enter station weights; app plots CG vs. envelope at T/O, cruise, and landing. *K4*
7	**Why must CG be checked at both takeoff and landing weight?** Fuel burn shifts CG in flight. A legal takeoff CG may move out of limits by landing — especially in aircraft where fuel burns from forward or aft tanks. Check departure, cruise, and landing configurations. *K4*
8	**What is the region of reversed command and why does it matter on approach?** Below L/D max (best glide), MORE power is needed to fly slower. Reducing power below this speed accelerates the descent rather than slowing the aircraft. A student who pulls power when slow on final may hit short of the runway. *K5*
9	**What are the dangers of operating outside the CG envelope?** Forward of limits: elevator may not flare; stall speed rises. Aft of limits: reduced stability, pitch-sensitive, spin recovery impaired or impossible. Both are potentially fatal — CG limits are legal limits. *R5*
10	**How does Va differ from Vno, and how does weight affect each?** Va = max speed for full control input without overstress — decreases with lower weight. Vno = top of green arc (normal ops limit); do not exceed in turbulence. Vno is a fixed structural limit and does not change with weight. *K5*

Instructor Note: *Oral exam tip: Have the student answer with the POH open. If they hesitate on density altitude or W&B;, return to E6B and ForeFlight drills before the checkride. The evaluator will probe K3 terms and K4 computation — student must answer fluently, not read from notes.*

Area II, Task G — National Airspace System

FAA-S-ACS-25 | CFI Airplane — Ground Lesson

Objective

The applicant demonstrates instructional knowledge of the National Airspace System — explaining airspace classes and their requirements, chart symbols, special use airspace, currency of publications, and Special VFR requirements — and can manage associated risks and provide effective instruction.

References

- 14 CFR Part 71 — Airspace Designations and Reporting Points
- 14 CFR Part 91 — General Operating Rules (91.119, 91.155, 91.157, 91.215, 91.225)
- 14 CFR Part 93 — Special Air Traffic Rules (SFRA, SATR)
- AIM Chapter 3 — Airspace
- FAA-H-8083-25C (PHAK) — Chapter 15: National Airspace System
- VFR Sectional Aeronautical Chart — Current 56-day edition
- Chart Supplement (AF/D) — Airport/Airspace Legend, current edition

Delivery Format — Instructor Setup

- **Paper VFR Sectional Chart (current):** Spread on table. Identify the local Class B/C/D, trace each ring, read altitude notations, locate SUA areas. Point to chart symbols in real time.
- **Chart Supplement (AF/D):** Open to local airport listing. Walk through the airspace class entry, tower hours, frequencies, and 'No-SVFR' notation together.
- **ForeFlight:** Maps → Layers → enable Airspace. Demonstrate TFR tap, SUA display, airspace alerting during route planning, and cycle date verification.
- **Duration:** 90–120 min | **Audience:** CFI Applicant

ACS Knowledge Elements

Code	Element
AI.II.G.K1	Airspace classes and associated requirements and limitations
AI.II.G.K2	Chart symbols
AI.II.G.K3	Special use airspace (SUA), special flight rules areas (SFRA), TFRs, and other airspace areas
AI.II.G.K4	Currency of publications
AI.II.G.K5	Special visual flight rules (VFR) requirements

ACS Risk Management

Code	Element
AI.II.G.R1	Various classes and types of airspace

ACS Skills

Code	Element
AI.II.G.S1	Identify and comply with VFR weather minimums for each airspace class
AI.II.G.S2	Correctly identify airspace; operate per comm and equipment requirements
AI.II.G.S3	Identify SUA/TFR requirements; comply with SATR and SFRA, if applicable

Lesson Objectives — Student Will Be Able To:

- Classify any piece of airspace from a paper sectional or ForeFlight
- State VFR weather minimums and comm/equipment requirements for each class
- Locate and interpret SUA, TFRs, and SFRA boundaries on chart and app
- Verify that charts and publications are current before every flight
- Explain and apply Special VFR procedures and night-SVFR limitations

1. Airspace Classes, Requirements & Limitations (AI.II.G.K1)

A WHAT TO TEACH

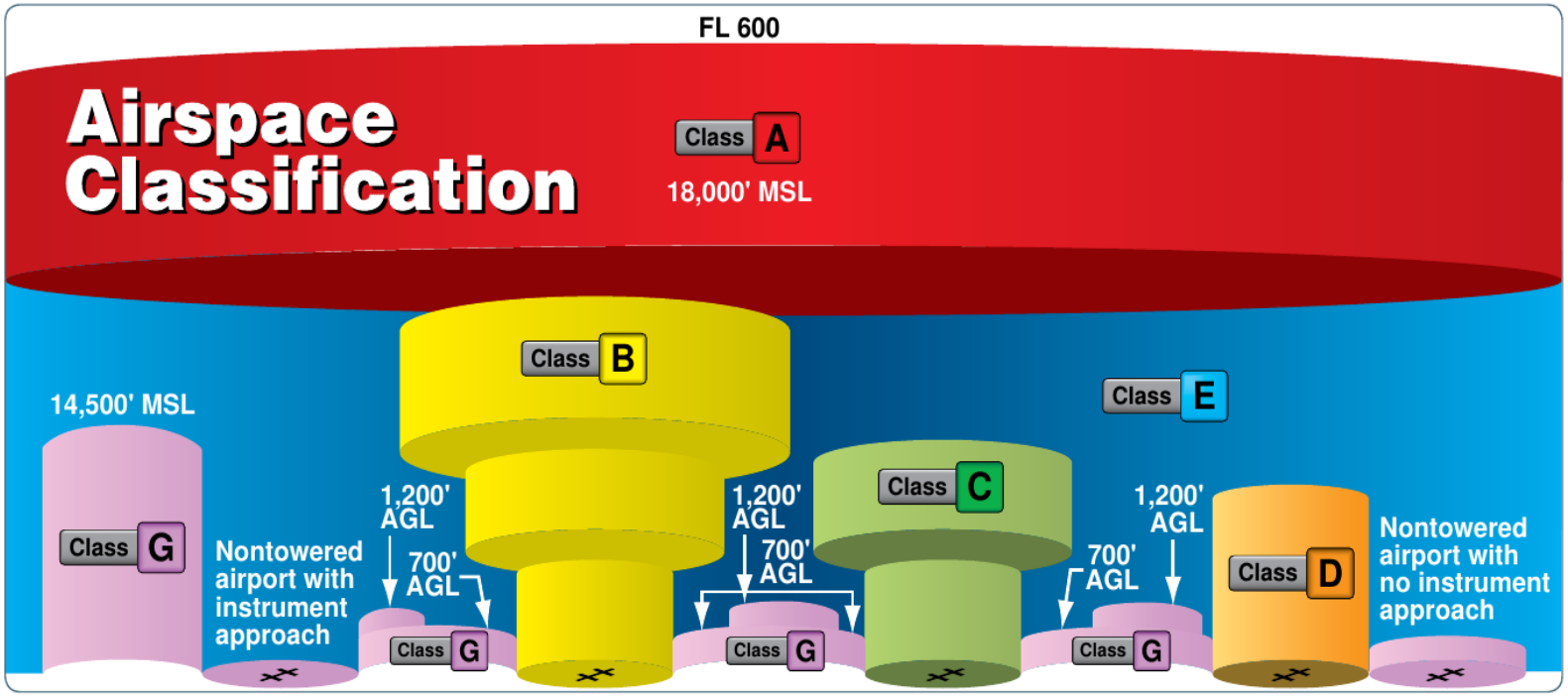


Figure 15-1 — Airspace Classification Profile. Source: FAA-H-8083-25C (PHAK), Chapter 15. Reference: AIM 3-2-1 through 3-2-6. Use actual sectional chart alongside this diagram. Boundaries are representative; verify with current VFR Sectional for exact altitudes.

Class	Lateral / Vertical Limits	Entry Requirement	Equipment Required	Pilot Cert
A	18,000 MSL – FL600 (Contiguous U.S. and Alaska above 1,500 AGL)	ATC IFR clearance No VFR permitted at any time	Mode C transponder ADS-B Out Two-way radio IFR equipment	Instrument rated

B	SFC – ~10,000 MSL (Upside-down wedding cake See chart for each tier floor)	ATC clearance: “Cleared into the Bravo” required (specific; not just traffic advisory)	Mode C transponder ADS-B Out Two-way radio	Private certificate (Student only with specific CFI endorsement for that airport)
C	SFC – ~4,000 AGL Inner shelf 0–5 NM / Outer 5–10 NM (Verify on chart; varies by airport)	Two-way radio contact established before entry (ATC saying “Stand by” = contact established)	Mode C transponder ADS-B Out Two-way radio	Student OK
D	SFC – ~2,500 AGL Typically 4–5 NM radius (See chart; part-time → AF/D for hours)	Two-way radio contact before entry (ATC uses your callsign = established)	Two-way radio (Transponder not required unless in 30-NM Mode C veil)	Student OK
E	Begins at 700 AGL (magenta vignette) or 1,200 AGL (magenta dashed or no depiction) or surface (blue-dashed surface area) Up to 18,000 MSL	No clearance required (CTAF/FSS recommended at non-towered)	None below 10,000 MSL (ADS-B Out + transponder at/above 10,000 MSL and in Mode C veils)	Student OK
G	Surface to Class E floor (700 or 1,200 AGL, varies by location) Not depicted on charts	No requirement (CTAF / multicom recommended)	None below 1,200 AGL (Transponder if above 10,000 MSL)	Student OK

CRITICAL ■ AI.II.G.R1 — The #1 airspace enforcement action in GA is **entering Class B without an explicit ATC clearance**. Stress to students: “Cleared into the Bravo” is mandatory — a traffic advisory or frequency change alone is NOT clearance. Operating VFR in Class A is a federal violation and immediate certificate action risk.

2. VFR Weather Minimums (AI.II.G.K1) + Chart & ForeFlight Symbols (AI.II.G.K2)

A WHAT TO TEACH

VFR SECTIONAL CHART SYMBOL LEGEND | How Airspace Looks on Paper and ForeFlight

	**CLASS B**	Solid blue concentric rings altitude fraction each tier (e.g. 100/SFC)	Blue polygon fill tap boundary for floor/ceiling	*Mode C veil: 30 NM from primary airport*
	**CLASS C**	Solid magenta rings (inner/outer shelf) altitude fraction each ring	Magenta polygon tap for floor & ceiling altitudes	*2-way comms before entry* *Mode C + ADS-B Out req'd*
	**CLASS D**	Blue dashed ring/rectangle ceiling in hundreds (e.g. 24T = 2,400)	Blue dashed outline tap for hours of operation	*Check AF/D for hours* *reverts to E or G after hours*
	**CLASS E (700 AGL)**	Magenta vignette — color fades inward from boundary edge	No dedicated overlay included in E airspace layer	*Surrounds most instrument approach procedures*
	CLASS E (1,200 AGL)	Magenta dashed line (transition area boundary)	Subtle E layer in Layers → Airspace settings	*Covers most of the U.S. at 1,200 AGL*
	**CLASS G**	No chart symbol found where B/C/D/E is absent	No fill or outline gap in E/B/C/D layers	*Surface to E floor* *no comms required*
	**CLASS A**	Not depicted on VFR charts — above 18,000 MSL	Dark band at top of ForeFlight altitude filter view	*IFR only* *Mode C + ADS-B Out required*

Figure 2 — VFR Sectional Chart Symbol Legend. Reference: FAA Aeronautical Chart User's Guide. Point to each symbol on the open paper sectional as you explain it. Confirm the student can locate each one independently.

VFR Weather Minimums by Airspace (14 CFR 91.155)

Airspace	Flight Visibility	Cloud Clearance
Class A	N/A — IFR only	N/A
Class B	3 SM	Clear of clouds
Class C	3 SM	500’ below | 1,000’ above | 2,000’ horiz.
Class D	3 SM	500’ below | 1,000’ above | 2,000’ horiz.
Class E below 10,000 MSL	3 SM	500’ below | 1,000’ above | 2,000’ horiz.
Class E at/above 10,000 MSL	5 SM	1,000’ below | 1,000’ above | 1 SM horiz.
Class G ≤ 1,200 AGL — Day	1 SM	Clear of clouds
Class G ≤ 1,200 AGL — Night	3 SM	500’ below | 1,000’ above | 2,000’ horiz.

KEY RULE ■ MEMORY AID: “B = 3 & Clear. C/D/E = 3–1–5–2 (3 SM, 152 cloud clearance). Class G day SFC = 1 & Clear. At or above 10,000 MSL: 5–1–1–1.” Quiz students on these before every cross-country lesson.

Reading Altitude Notation on Paper Charts

Airspace floors and ceilings are printed as fractions inside each ring on VFR sectionals. The **top number** is the ceiling in hundreds of feet MSL; the **bottom number** is the floor in hundreds of feet MSL (or ‘SFC’ for surface). Always read both numbers for each tier.

Chart Notation	Meaning
“100” over “SFC”	Ceiling 10,000 MSL / Floor at Surface — common in Class B inner ring
“80” over “30”	Ceiling 8,000 MSL / Floor 3,000 MSL — outer shelf or Class C
“41” over “14”	Ceiling 4,100 MSL / Floor 1,400 MSL — typical Class C outer shelf
No fraction (single ring)	Class D — ceiling given in parentheses, e.g. (24T) = 2,400 MSL, part-time Tower
T or * after frequency	Part-time — check AF/D for hours; airspace reverts when tower closed

ForeFlight: Airspace Tools in Detail

- **Maps → Layer Settings → Airspace:** Enables color-coded airspace overlay on any map view
- **Tap any airspace boundary:** Shows class, altitude floor and ceiling, hours of operation, and ATC frequency
- **TFR Layer:** Red polygon shows TFR area; tap for full NOTAM text, altitude, time window, and authority
- **SUA (Special Use Airspace) Layer:** MOAs amber/gray (active/inactive); Restricted red; tap for schedule
- **Route Airspace Alerting:** ForeFlight flags any airspace intersection on a filed route during planning
- **AIRAC Cycle Date:** ForeFlight → Account → Avionics — verify current 28-day cycle is loaded

Chart Tip: Always cross-check ForeFlight with a current paper sectional. ForeFlight updates every 28 days (AIRAC cycle). Paper VFR sectionals publish every 56 days. Confirm both are current before teaching and flying. An expired chart is not valid for navigation (14 CFR 91.103).

3. Special Use Airspace & TFRs (AI.II.G.K3)

A WHAT TO TEACH

Special Use Airspace (SUA) — 14 CFR Part 73 | AIM 3-4

SUA Type	Chart Color	Purpose	VFR Entry?
Prohibited (P-xxx)	Blue	Strictly prohibited — national security (e.g., P-56 DC)	Never. Violation = immediate enforcement.
Restricted (R-xxx)	Blue	Hazardous ops: artillery, gunnery, missiles. Hours on chart.	COLD = VFR OK. HOT = ATC authorization required.
Warning (W-xxx)	Blue	Like Restricted but over international waters (3 NM+).	VFR legal — not U.S. controlled. Extreme caution.
MOA	Magenta	Military aerobatics, formation, high-speed training.	VFR legal. Call ARTCC for activation status.
Alert (A-xxx)	Magenta	High-volume pilot training / unusual aerial activity.	VFR legal. No clearance. Extreme caution.
CFA	Not charted	Firing halts when non-participating aircraft detected.	No restriction — self-policing. No action needed.
NSA	Varies	Sensitive installations. Voluntary avoidance requested.	Avoidance strongly recommended. May have TFR.

> ✍ ***Chart Tip:*** *Open paper sectional: locate one Prohibited, one Restricted, and one MOA in your local area. Then open ForeFlight Layers → SUA and compare boundaries. Check the chart margin table for each SUA's altitudes and controlling agency. Teach students to do this on every cross-country preflight.*

Temporary Flight Restrictions (TFRs) — 14 CFR 91.137–91.145

TFR Type (CFR)	Size / Altitude	Pilot Action
Disaster/Hazard 91.137(a)(1–3)	Typically 3 NM / 2,500 AGL	Avoid unless specifically authorized by ATC.
Aerial Demonstration 91.145	Per NOTAM	Stay out during event window. Check NOTAM geometry.
Space Operations 91.143	Per NOTAM	Avoid during active launch/recovery.
Presidential/VIP 91.141	30 NM / 18,000 MSL	Hard prohibited. Violation = intercept/arrest/cert action.
Stadium/Sporting 91.145	3 NM / 3,000 AGL	1 hr before/after; attendance 30,000+. Automatic.

CRITICAL ■ Presidential TFRs move with POTUS and can appear with little notice. Check the ForeFlight TFR layer AND file a NOTAM brief on 1800wxbrief.com before EVERY flight — including short local hops. Violation of a TFR can result in military intercept, immediate certificate action, or arrest.

SUA on Paper Chart vs. ForeFlight

Tool	SUA Display	Check Status How
Paper Sectional	Blue (Prohibited/Restricted/Warning) Magenta (MOA/Alert) ID + altitudes in margin table	Call controlling agency on chart margin or NOTAM/Chart Supplement
ForeFlight Layers → SUA	Active MOA = red; Inactive = gray Restricted = red shading Tap for altitudes + agency	Tap boundary for NOTAM or schedule. SiriusXM/ADS-B shows real-time status.
Chart Supplement	SUA listed by state with hours/altitudes	Cross-reference with NOTAM brief for temp changes.

Instructor Note: *Drill: Open ForeFlight, tap a nearby MOA, then find the same MOA on the paper sectional. Cross-reference altitudes and controlling agency. This builds the dual-tool habit evaluators expect.*

4. Special VFR (AI.II.G.K5) + SFRA Operations + Publication Currency (AI.II.G.K4)

A WHAT TO TEACH

Special VFR (SVFR) — 14 CFR 91.157

SVFR allows flight in a Class B/C/D/E surface area with ceiling below 1,000 ft or visibility below 3 SM, provided conditions allow clear of clouds with at least 1 SM visibility.

SVFR Item	Details
Weather minimums	Clear of clouds + 1 SM flight visibility (day)
How to request	Contact Tower/Approach: "[Facility], N12345, request Special VFR"
ATC authority	ATC approves or denies based on traffic. Not guaranteed.
Night SVFR	Instrument rating + IFR-equipped aircraft required (91.157(b))
Not available at ~12 airports	Chart Supplement 'No SVFR' notation; all Class B primaries
Does NOT waive	91.119 minimum safe altitude still applies

CRITICAL ■ SVFR is NOT a workaround for IMC. Once below 1 SM or unable to remain clear of clouds, only an IFR clearance will do. Teach SVFR as a last-resort tool, never a routine shortcut.

SFRA — Special Flight Rules Area (AI.II.G.K3 / AI.II.G.S3)

DC SFRA Requirement	Details
Applicability	All aircraft within 30 NM of DCA, including VFR
Equipment	Mode C transponder + ADS-B Out + two-way radio
Flight plan	File SFRA flight plan before departure
Squawk	ATC-assigned discrete code — NOT 1200
Inner ADIZ (15 NM)	Explicit ATC authorization required. Violation = intercept.

KEY RULE ■ Teach SFRA requirements before any cross-country within 60 NM of DCA. Other SFRAs exist (e.g., Grand Canyon SFRA). Identify local SFRAs on the chart with every new student.

Currency of Publications (AI.II.G.K4)

Publication	Cycle	Verification Method
VFR Sectional Chart	56 days	Edition date on chart face. Expired = not valid for nav per 91.103.
Terminal Area Chart	56 days	Same as Sectional. Required near Class B airports.
Chart Supplement (AF/D)	56 days	Cover date. Airspace class, hours, SVFR, frequencies.
AIM	~Annual	Cover date. Authoritative NAS narrative.
NOTAMs	Real-time	Brief every flight: 1800wxbrief.com, Leidos FSS, or ForeFlight.
TFRs	Dynamic	ForeFlight TFR layer + NOTAM brief before every flight.
ForeFlight Database	28-day AIRAC	Account → Avionics. Confirm current cycle before teaching.

Chart Supplement (AF/D) — Airspace Fields to Review with Student

Open to a local towered airport. Walk through each field together.

AF/D Field	Airspace Significance
Airport class (e.g. Class D)	Confirms airspace type; drives comms/equipment requirements
CT – xxx.x (*)	Tower freq; asterisk (*) = part-time. Reverts to E/G outside hours.
ATIS – xxx.x	Tower is operational; provides ceiling/vis/altimeter pre-call
Tower hours (local)	Class D active ONLY during listed hours. Check before every lesson.
‹No SVFR›	Special VFR not authorized (Class B primaries and ~12 others)

KEY RULE ■ CURRENCY DRILL: Start every lesson by asking the student: "Is the sectional current? When does it expire? Is the Chart Supplement current? Have you checked NOTAMs and TFRs today?" This habit satisfies 91.103 preflight duties and builds airmanship from day one.

5. Risk Management (AI.II.G.R1) + Common Errors + Scenario-Based Teaching

A WHAT TO TEACH

Airspace Risk Management (AI.II.G.R1)

Risk Scenario	Mitigation Strategy
Class B penetration without clearance	Always confirm: “Cleared into the Bravo.” Traffic advisory alone is NOT clearance. If uncertain, stay out.
Part-time Class D after tower hours	Check AF/D for exact tower hours. After hours = CTAF only; no Class D comms requirement.
TFR discovered airborne	Check ForeFlight TFR layer before engine start. Recheck en route via SiriusXM or ADS-B weather.
Active MOA during lesson	Contact controlling ARTCC (listed on chart margin) for activation status. Active = avoid or remain clear.
Mode C veil confusion	Transponder + ADS-B Out required within 30 NM of Class B primary airport — even when flying below or outside the B rings.
Night SVFR attempt by VFR pilot	Night SVFR requires instrument rating + IFR-equipped aircraft (91.157). Non-negotiable.
Expired chart used in flight	Check date before every lesson. Expired chart = violation of 91.103 preflight requirements.

Common Student Errors

- Confusing Class C radio contact *established* with ATC *clearance* (only B requires explicit clearance)
- Skipping the NOTAM/TFR check before local flights (“it’s just a quick local”)
- Misreading Class B tier altitude notation — reversing the ceiling and floor fraction
- Neglecting ADS-B Out + transponder within 30-NM Mode C veil
- Using ForeFlight as the sole authority without confirming against a current paper sectional
- Treating all SUA as prohibited — not distinguishing Restricted (HOT/COLD) from Prohibited (never)
- Forgetting that Class D reverts to E or G after tower hours — arriving expecting comms requirement

Scenario-Based Teaching (AI.II.G.S1–S3)

The ACS requires the CFI applicant to *demonstrate and simultaneously explain* how to identify and comply with airspace requirements. Use the scenarios below on both the paper sectional and ForeFlight.

Scenario	Teaching Method
S1 — Chart Read 5 Random Points	Open sectional. Point to 5 random positions. Student must name the airspace class, state floor and ceiling, list entry requirements (comms/clearance/equipment), and state VFR weather minimums.
S2 — ForeFlight TFR Identification	Show a ForeFlight map with a TFR active. Student identifies: type, altitude, radius, time window, pilot action required, and the regulatory authority (91.137–91.145).
S3 — Part-time Tower AF/D Drill	Open Chart Supplement to a local towered airport. Ask: “You arrive at 2200 local. What airspace? What comms? Can you request SVFR?” Student must work through AF/D entry.
S4 — MOA Crossing Decision Making	Route crosses an active MOA. Student must find controlling agency on chart, determine legality, describe risk, and demonstrate how to call ARTCC for activation status.
S5 — Mode C Veil Equipment Check	Present a scenario: local flight staying below Class B but within 25 NM of the primary airport. Student must confirm transponder + ADS-B Out are on and explain the regulation (91.215, 91.225).

> ***Instructor Note:*** *CFI Practical Test Tip: The evaluator will expect you to point to chart symbols on the actual sectional, state VFR minimums from memory, and clearly explain your instructional approach for each ACS element — not just recite regulations. Use both tools (paper chart + ForeFlight) throughout the lesson to demonstrate dual-source proficiency.*

Area II, Task H — Navigation Systems and Radar Services

FAA-S-ACS-25 | CFI Airplane — Ground Lesson

Objective

The applicant demonstrates instructional knowledge of ground-based and satellite-based navigation systems, radar services available to VFR aircraft, and transponder/ADS-B requirements. The applicant can identify and manage associated risks, demonstrate the required skills, and simultaneously explain procedures to a student at various stages of training.

References

- AC 91-78 — Use of Class 1 and Class 2 EFBs
- AIM — Chapters 1 (Navaids), 4 (ATC Procedures), 5 (Air Traffic Procedures)
- FAA-H-8083-25C (PHAK) — Chapters 16 (Navigation), 17 (Aeromedical)
- FAA-H-8083-3B (AFH) — Navigation and cross-country chapters
- FAA-H-8083-9B (AIH) — Teaching and learning techniques
- 14 CFR §§ 91.205, 91.215, 91.225, 91.227 — Equipment & ADS-B requirements

Delivery Format

- Ground lesson using sectional chart and GPS receiver — 60–75 min
- Use a tablet with ForeFlight to demonstrate RAIM, traffic, and weather features
- Reference the specific aircraft avionics (G1000, GNS 430W, or Garmin Pilot)
- Follow with in-flight demonstration on a local VOR radial or GPS flight plan

ACS Knowledge Elements

Code	Element
AI.II.H.K1	Ground-based navigation (identification, orientation, course determination, equipment, tests, regulations, interference, nav data, signal integrity)
AI.II.H.K2	Satellite-based navigation (equipment, regulations, authorized use of databases, RAIM)
AI.II.H.K3	Radar assistance to VFR aircraft (operations, equipment, available services, traffic advisories)
AI.II.H.K4	Transponder (Mode A, C, and S) and ADS-B

ACS Risk Management

Code	Element
AI.II.H.R1	Management of automated navigation and autoflight systems
AI.II.H.R2	Distractions, task prioritization, loss of situational awareness, or disorientation
AI.II.H.R3	Limitations of the navigation system in use
AI.II.H.R4	Loss of a navigation signal
AI.II.H.R5	Use of an electronic flight bag (EFB), if used

ACS Skills

Code	Element
AI.II.H.S1	Use an airborne electronic navigation system
AI.II.H.S2	Determine the airplane’s position using the navigation system
AI.II.H.S3	Intercept and track a given course, radial, or bearing
AI.II.H.S4	Recognize and describe the indication of station or waypoint passage
AI.II.H.S5	Use proper communication procedures when utilizing radar services

SECTION 2 — MOTIVATION

A moving map and a magenta line have become the default navigation tool for nearly every VFR pilot flying today — and that is both a gift and a danger. When the GPS signal degrades, the database expires, RAIM warns of insufficient satellite geometry, or a student unknowingly loads the wrong flight plan, the pilot who never truly learned navigation is suddenly helpless. A CFI who cannot teach ground-based navigation with precision is producing pilots who depend entirely on a tool they do not understand and cannot replace.

Radar services are equally underused and undertaught. VFR flight following is one of the most powerful safety tools available — a second set of eyes watching for traffic, terrain, and weather. Yet many pilots never request it because they were never taught how, or because a previous CFI treated it as optional. Teaching transponder operation, ADS-B, and radar phraseology is not box-checking. It is the difference between a pilot who is part of the system and one who is invisible to it. This lesson prepares you to teach all of it — clearly, confidently, and to ACS standard.

VOR Navigation — The Indicator and Common Errors

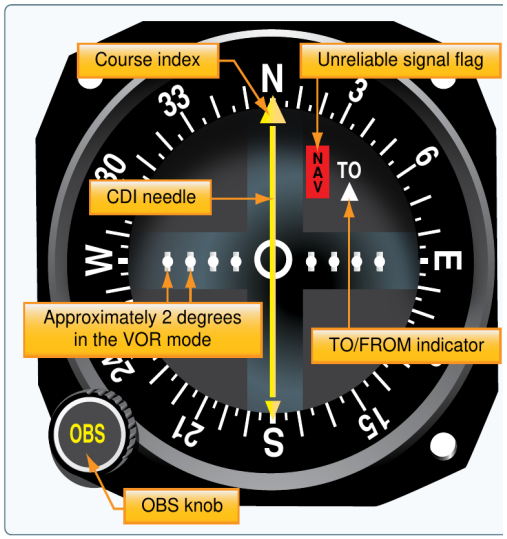


Figure 16-29. *VOR indicator.*

Figure 16-29. VOR indicator. Source: FAA-H-8083-25C (PHAK), Ch. 16

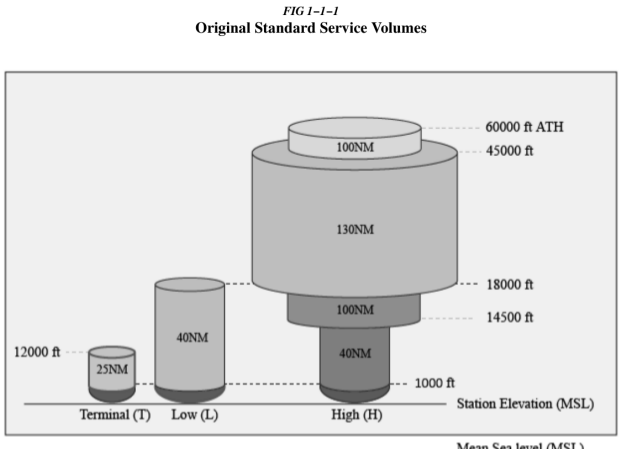


FIG 1-1-1. Original Standard Service Volumes. Source: AIM §1-1-8

How the VOR Signal Works

The VOR ground station transmits two signals simultaneously: a **reference phase** (omnidirectional) and a **variable phase** that rotates 30×/sec. The airborne receiver compares the phase difference to determine the aircraft's magnetic bearing *from* the station. The **OBS** selects which radial to track; the **CDI needle** shows left/right displacement from that radial. Full-scale deflection = 10°; each dot = 2°. Always identify the VOR by Morse code ID before use.

Common VOR Errors

■ **1. Cone of Confusion** Directly overhead the station the aircraft enters a cone where signals point nearly straight up. CDI becomes erratic; TO/FROM flag may fluctuate. This is **normal and brief**. Maintain heading — confirm passage by timing, DME, or GPS.

■ **2. Reverse Sensing** Occurs when OBS is set to the **opposite** of the intended course. CDI deflects backwards — flying toward the needle makes it worse. **Always set OBS to match your intended course** and confirm the TO/FROM flag matches direction of flight.

■ **3. Line-of-Sight Limitations** VOR signals are VHF and travel **line of sight** — terrain blocks reception below the published service volume (see diagram at left). Always verify reception at planned altitude and distance before departure.

■ **4. Area of Ambiguity** When the aircraft is near the **perpendicular** (roughly 90° to the selected course), the CDI is minimally sensitive and may appear nearly centered even though the aircraft is far off course. TO/FROM flag may also be unreliable. Never navigate with a course set 90° to your actual flight path.

1. Ground-Based Navigation (AI.II.H.K1)

A WHAT TO TEACH

VOR Fundamentals

- **Identification:** Tune the VOR frequency, then listen for the Morse code identifier (3 letters). Always verify before use. A 'T' prefix in the identifier = test signal — do NOT use for navigation.
- **OBS (Omni-Bearing Selector):** Dials in the desired course. The CDI centers when you are on that radial/course — with a TO or FROM flag indicating direction of station.
- **CDI Deflection:** Each dot = 2° off course (most indicators). Full deflection = 10° off course.
- **TO / FROM Flag:** TO = flying toward the station on the selected course. FROM = flying away. Ambiguity flag (blank or red) = unreliable signal — do not use for navigation.
- **Radials:** Radials radiate FROM the VOR station. 'On the 090 radial' means the airplane is due east of the VOR. Courses TO the station are reciprocal of the radial.

VOR Accuracy Checks (AIM 1-1-4)

Check Type	Tolerance	Requirement
VOT (VOR Test Facility)	±4°	IFR — if available
FAA ground checkpoint	±4°	IFR — published airports
FAA airborne checkpoint	±6°	IFR — published fix/altitude
Dual VOR check	Within 4° of each other	IFR — any location
Airborne (self-selected)	±6°	IFR — known fix overhead

KEY RULE ■ IFR: VOR check required within 30 days (14 CFR 91.171). Entry in logbook required. VFR: No legal requirement, but teach students to verify VOR accuracy on every preflight as a professional habit.

Tracking a VOR Radial or Course

- **Intercept angle:** Use a 45° intercept as the standard. Shallower for minor corrections; steeper only when far off course and time-critical.
- **Bracketing:** Once established on course, use half the previous wind correction to find the zero-wind track. 10° correction gives drift → split to 5°. Repeat until stable.
- **Station passage:** CDI becomes erratic, then reverses. TO flag flips to FROM. Do NOT change the OBS — this is normal and expected at station passage.
- **Cone of confusion:** Area directly overhead the VOR where signal is unreliable. Brief but definitive. Confirm passage with timing, DME, or GPS cross-check.

Other Ground-Based Navigation Aids

- **NDB / ADF:** Non-Directional Beacon. ADF needle always points TO the station. Must apply magnetic variation manually. Susceptible to precipitation static and lightning. Largely being decommissioned across the NAS.
- **DME (Distance Measuring Equipment):** Reports slant-range distance to the station, not ground distance. Error is greatest at high altitude close to the station. Often co-located with VOR (VORTAC or VOR-DME).

> ✍ ***Chart Tip:*** *✍ Chart Tip: On a sectional, VOR stations show a compass rose. Frequency and Morse identifier appear inside the box. Blue pentagon = VORTAC. Magenta circle = VOR only. Small boxes below the compass rose indicate service class (T=Terminal, L=Low, H=High).*

> ***Instructor Note:*** *Instructor Note: Project a sectional on the screen and have the student locate the nearest VOR, identify its frequency and Morse ID, draw the 090 and 270 radials, then ask: 'If I am on the 090 radial flying to the station, what course will I fly and what will the CDI do at station passage?'*

CRITICAL ■ VOR signals are LINE OF SIGHT — terrain, buildings, and excessive distance can degrade or block reception. Below the published service volume, the signal is not guaranteed. A 'T', 'D', or 'B' identifier flag (TEST, DEGRADED, or BLANK) means the VOR is under maintenance or test and MUST NOT be used for navigation.

2. Satellite-Based Navigation — GPS, WAAS, and RAIM (AI.II.H.K2)

A WHAT TO TEACH

GPS System Overview

- **Architecture:** 24+ satellites in medium Earth orbit (~20,200 km). Ground control stations monitor orbits and upload corrections. Receiver calculates position by timing signals from at least 4 satellites simultaneously.
- **Accuracy:** Standalone GPS ■15–25 m horizontal. With WAAS corrections, typically < 3 m horizontal, < 4 m vertical — sufficient for precision approaches.
- **Vulnerability:** RF interference, ionospheric disturbances, multipath (signal bounce off terrain or buildings), and deliberate jamming or spoofing can degrade or falsify GPS position information.

WAAS — Wide Area Augmentation System

- Ground reference stations across the U.S. and Canada measure GPS signal error and broadcast correction data through two geostationary satellites.
- Enables LPV approaches (Localizer Performance with Vertical guidance) — equivalent to ILS Cat I minimums at hundreds of airports without installed ILS equipment.
- Required for GPS approaches using LPV or LP (Localizer Performance) lines of minima.
- Look for 'W' symbol on approach chart minimums table to confirm WAAS is required.

Database Currency Requirements

Operation	Database Requirement
IFR — GPS approach (LNAV, LP, LPV)	Current 28-day cycle REQUIRED
IFR — en route/terminal only	Current, or manually verify fixes and routes
VFR navigation	No legal requirement — NOT RECOMMENDED with expired DB
EFB (ForeFlight, Garmin Pilot)	Advisory only — keep current per AC 91-78

RAIM — Receiver Autonomous Integrity Monitoring

- **What it does:** The GPS receiver continuously monitors satellite geometry and signal quality. It provides an alert if it cannot guarantee navigation integrity within specified limits — separate from accuracy. RAIM is about trustworthiness, not just precision.
- **RAIM prediction:** Before IFR flight, predict RAIM availability for the entire route and approach. Available in ForeFlight, Garmin flight planning, and the FAA SatNav prediction tool (sapt.faa.gov).
- **Fault Detection and Exclusion (FDE):** Advanced RAIM variant that can identify and exclude a faulty satellite and continue navigation. Required for oceanic/remote operations.

RAIM Status	Instrument Indication	Required Action
RAIM available	No alert — normal GPS operation	Navigate normally
RAIM caution	Integrity caution flag displayed	Verify position on backup navaid; consider alternate routing
RAIM failure	GPS FAIL / RAIM NOT AVAILABLE	Immediately revert to VOR, ADF, or dead reckoning. Notify ATC if IFR.
No GPS signal	NO GPS / NO POSITION	Revert to backup nav; contact ATC; declare emergency if needed

KEY RULE ■ GPS alone cannot be used as the primary IFR navigation source unless WAAS capability is present OR RAIM is confirmed available for the entire route and approach. Always have a backup navigation plan: VOR, chart, and dead reckoning.

*✍ **Chart Tip:** ✍ ForeFlight Tip: Check GPS source in Settings → Device. The internal iPad/iPhone GPS is NOT TSO-certified. For IFR, use an external WAAS GPS receiver (Stratus, Sentry, Bad Elf Pro+) connected via Bluetooth.*

CRITICAL ■ An expired GPS database is LEGAL for VFR but NOT RECOMMENDED — waypoints, frequencies, and airspace may have changed. For IFR GPS approaches, a current database is required by FAA policy. Teach students to update the database as a preflight habit every 28 days, not an afterthought.

3. Radar Assistance to VFR Aircraft (AI.II.H.K3)

4. Transponder (Mode A, C, S) and ADS-B (AI.II.H.K4)

A WHAT TO TEACH

VFR Radar Services Overview

- **Basic Radar Service:** Traffic advisories and safety alerts provided to VFR aircraft in Terminal Radar Service Areas (TRSA). Participation is voluntary but strongly encouraged.
- **VFR Flight Following:** The most commonly used radar service. ATC assigns a discrete transponder code and provides traffic and safety alerts on a workload-permitting basis. Available from TRACON (Terminal) and ARTCC (Center) facilities.
- **Safety Alerts:** Two types — Aircraft Conflict (traffic) and Terrain/Obstruction. ATC issues these IMMEDIATELY upon detection, regardless of workload. Non-discretionary.
- **Radar Contact:** ATC confirms they have positively identified the aircraft on radar display. Without radar contact, advisory services cannot be provided.

Requesting VFR Flight Following — Phraseology

- **Departure:** '[Facility], Cessna 1234A, Cessna 172, [altitude], departing [airport], VFR to [destination], request flight following.'
- **En route (ARTCC):** 'Denver Center, Cessna 1234A, VFR, 8,500, 40 miles northwest of Denver, VFR to Colorado Springs, request flight following.'
- **After squawk assignment:** Read back squawk code and set on transponder. Confirm when ATC says 'radar contact.' ATC may terminate at any time due to workload.

KEY RULE ■ Radar services are WORKLOAD PERMITTING — ATC may terminate traffic advisories during busy periods. Safety alerts are mandatory. See-and-avoid always remains the pilot's responsibility regardless of radar coverage.

Transponder Modes

Mode	Function	Data Transmitted
Mode A	Replies to ATC interrogation	4-digit squawk code only — identification, no altitude
Mode C	Mode A + altitude encoding	Squawk code + pressure altitude in 100-ft increments
Mode S	Enhanced selective address	Squawk + altitude + ICAO aircraft address + data link capability

Special Squawk Codes

Code	Meaning	When to Use
1200	VFR standard — no ATC assignment	All VFR flights without an assigned code
7700	Emergency	Immediately upon declaring emergency — ATC alerted instantly
7600	Radio communications failure	All radios inoperative — lost comms
7500	Unlawful interference (hijack)	ONLY if actual hijacking in progress

ADS-B Out Requirements (14 CFR 91.225)

- Required in: Class A, B, C; Class E at or above 10,000 ft MSL (except below 2,500 ft AGL); Class E over the Gulf of Mexico at or above 3,000 ft MSL within 12 NM of coast.
- Equipment must meet TSO-C166b (1090 ES) or TSO-C154c (UAT 978 MHz) standards.
- ADS-B transmits: position, altitude, velocity, aircraft ID, and ICAO address once per second.
- ADS-B In (traffic / weather display) is optional but highly recommended for situational awareness.

CRITICAL ■ Squawk 7700 (Emergency), 7600 (Lost Comms), and 7500 (Hijack) trigger IMMEDIATE ATC alerts. NEVER use these codes during training without prior coordination. IDENT is pressed ONLY when instructed by ATC.

Instructor Note: *Instructor Note: Have the student write and rehearse the flight following call on the ground before the lesson flight. Script it on the whiteboard: 'Denver Approach, Cessna 1234A, Cessna 172, 5,500, VFR to Boulder, request flight following.' Practice until it flows naturally. Most students freeze on initial ATC calls — verbal rehearsal eliminates this.*

SECTION 3 — RISK MANAGEMENT (AI.II.H.R1–R5)

R1 — Automated Navigation and Autoflight Systems

- Autopilot coupled to GPS follows whatever is programmed — including loading errors. Verify the correct flight plan is active before engaging autopilot.
- Autopilot mode annunciation: Confirm current mode (HDG, NAV, VNAV, APPR) matches intended operation. Unintended mode changes are a leading factor in CFIT accidents.
- Step-down fixes and altitude constraints: GPS CDFA paths may not account for all step-down fixes. Monitor altitude actively; never rely solely on automation for terrain clearance on approach.

R2 — Distractions and Loss of Situational Awareness

- Programming GPS in flight is among the leading causes of distraction-related accidents. Brief: 'Fly first, fix second.' Program before takeoff or after leveling off.
- Fixation on the magenta line (GPS tunnel vision) without monitoring altitude, airspace, or terrain clearance. Mountains do not move for pilots who aren't looking.
- Task saturation during high-workload phases (arrival, approach, descent) coincides with highest navigation complexity. Pre-brief and pre-program the full route en route.

R3 — Limitations of the Navigation System

- **VOR:** Service volume limits, terrain shielding, signal scalloping (mountain reflection), and VOR NOTAM decommissioning reduce availability.
- **GPS:** RAIM failure, satellite geometry gaps (PDOP), ionospheric degradation, and deliberate jamming or spoofing are real operational risks.
- **ILS:** Sensitive to parallel taxiway traffic, terrain, and large aircraft reflections. Always cross-check localizer and glideslope independently.

R4 — Loss of a Navigation Signal

- **VOR loss:** CDI flag goes red or blank. Note last known position; switch to backup navaid; contact ATC if IFR. Fly by dead reckoning until signal restored.
- **GPS loss / RAIM failure:** Immediately revert to VOR, ADF, pilotage, or dead reckoning. Notify ATC if IFR. Do NOT continue GPS-based navigation until RAIM is restored.
- **Radio/comms failure:** Squawk 7600. If VFR, land as soon as practicable. If IFR, follow 14 CFR 91.185 and the AVEF memory aid (Assigned, Vectored, Expected, Filed).
- **Radar contact lost:** ATC terminates service. Pilot resumes self-navigation on last clearance or filed route. Resume squawk 1200 unless otherwise instructed.

R5 — Electronic Flight Bag (EFB) Use

- AC 91-78 governs portable EFB use (Class 1/2). ForeFlight, Garmin Pilot, and similar apps are Class 1 EFBs — advisory tools, not certified navigation systems.
- Cross-check EFB data against panel-mounted avionics. Discrepancies in database cycles can create dangerous situational confusion on approaches.
- Secure the device: tablets become projectiles in turbulence or abrupt maneuvers. Use a kneeboard mount or cockpit holder rated for the device weight.
- Battery and temperature management: heat from direct sunlight can trigger thermal shutdown. Carry a charging cable; pre-plan battery needs for long flights.

Common Misconceptions

Misconception	Correct Teaching
'GPS is always accurate — trust it 100%'	GPS provides accuracy, not integrity. RAIM provides integrity. They are different concepts.
'ATC will see all traffic around me'	Radar advisory is workload-permitting. See-and-avoid is always the pilot's legal responsibility.
'Mode C gives ATC my exact position'	Mode C gives squawk code + pressure altitude only. ATC radar triangulates your position independently.
'Flight following = IFR clearance'	Flight following is a VFR advisory service only. IFR requires a filed flight plan and ATC clearance.

SECTION 4 — HOW TO TEACH (AI.II.H — TEACHING TECHNIQUES)

B — Sequencing the Lesson

- **Open with the problem:** 'GPS fails en route, 50 miles from the nearest airport, ceilings dropping. What do you do?' Students who can answer this are navigators. Those who can't are passengers.
- **Ground-based navigation first:** Teach VOR before GPS. Students who learn GPS first rarely develop true positional awareness — they follow the line instead of understanding it.
- **Layer the technology:** VOR → DME → GPS standalone → WAAS/LPV → ADS-B Out/In. Each layer builds on the conceptual foundation of the last.
- **Practice ATC phraseology on the ground:** Write the flight following request on the whiteboard. Have students say it out loud before entering the airplane.
- **In-flight demonstration:** Turn off the GPS (or cover it) and navigate by VOR to a nearby airport. Students are often surprised by how capable — or how lost — they are.
- **Debrief radar service:** After the flight, review the discrete squawk assigned, all traffic calls received, and any corrections made to the route on ATC suggestion.

C — Teaching Aids and Demonstrations

- **Sectional chart:** Print and annotate VOR compass roses, service volumes, and VOR airways (Victor routes). Have student plot a 3-leg VOR flight before touching any GPS.
- **VOR CDI trainer (app or simulator):** Multiple tablet apps simulate a VOR indicator. Walk through TO/FROM, CDI deflection, and course reversal before the flight.
- **GPS RAIM prediction:** Pull up the FAA SatNav tool (sapt.faa.gov) or ForeFlight and show how satellite geometry changes through the day. Discuss RAIM hole scenarios.
- **ADS-B traffic demo:** Open ForeFlight Ground View or FlightAware and project real traffic with discrete squawks. Show students how ADS-B makes them visible to everyone.
- **Comm scripting card:** Give students a 3×5 laminated card with the flight following initial call. It goes in the kneeboard on every flight until it is automatic.
- **NTSB case study:** Use an accident report where GPS dependency (wrong waypoint, expired database, or RAIM failure) contributed to an accident. Reality motivates learning.

Instructor Note: *Instructor Note: The best way to teach VOR is to actually fly a VOR radial or approach. Even if the student is not instrument rated, tracking inbound on a VOR radial to an airport reinforces every concept in K1 with immediate feedback. Ask: 'Without GPS, how would you find this airport?' The answer defines whether the student is a navigator or a passenger.*

SECTION 5 — SKILLS ASSESSMENT (AI.II.H.S1–S5)

In-Flight Skills Demonstration Checklist

#	ACS Skill Element	Demonstration Method
S1	Use an airborne electronic navigation system	Tune and identify VOR (Morse code), set OBS, verify CDI. On GPS: confirm database currency, activate direct-to or flight plan, verify RAIM.
S2	Determine airplane's position using the navigation system	State current position as VOR radial/DME fix or GPS waypoint. Cross-check against chart or second navaid.
S3	Intercept and track a given course, radial, or bearing	ATC assigns a specific radial or course. Student intercepts at 45° and tracks with bracketed wind corrections. No chasing the needle.
S4	Recognize and describe station or waypoint passage	Student identifies CDI reversal (VOR) or auto-sequencing (GPS), explains the indication to examiner as they would explain to a student.
S5	Use proper comm procedures when utilizing radar services	Student initiates flight following request, reads back squawk assignment, makes position reports, and closes service at destination.

ACS Compliance Notes

- AI.II.H.S1–S5 require the applicant to SIMULTANEOUSLY demonstrate AND explain each skill — exactly as they would instruct a student during a dual flight lesson.
- The DPE evaluates instruction quality, not just execution. Explanations must be accurate, logically sequenced, and appropriate for the student's experience level.
- Navigation system selection is at the DPE's discretion. The applicant must be proficient on the aircraft's panel-mounted avionics, not only tablet applications.
- RAIM or signal loss may be simulated by the DPE. The applicant must recognize the failure and revert to backup navigation without hesitation or prompting.

Completion Standards

- Correctly uses the navigation system appropriate to the flight phase and environment
- Determines aircraft position within the published accuracy tolerance of the system
- Intercepts and tracks assigned course with smooth, bracketed corrections — no chasing the needle or excessive overcorrections
- Identifies station or waypoint passage without prompting; describes the indication accurately and in student-teachable language
- Uses proper ATC phraseology for flight following requests, squawk assignments, position reports, and service termination
- Successfully identifies and manages at least one simulated navigation failure (RAIM alert, VOR flag, or loss of comms) during the lesson demonstration

SECTION 6 — REVIEW QUESTIONS

Q1: You are flying VFR cross-country and your GPS shows a RAIM caution followed by a RAIM failure flag. What does this mean, and what is your immediate action?	A: RAIM failure means the receiver cannot verify the integrity of the GPS position — the reported position may be unreliable even if it appears accurate. Immediately revert to VOR, pilotage, or dead reckoning. If IFR, notify ATC and request navigation assistance. Do NOT continue navigating by GPS until RAIM is restored.
Q2: A student asks why they need to learn VOR navigation when GPS does everything. What is your response?	A: GPS is not a reliable sole source. Signal loss, RAIM failure, expired databases, ionospheric degradation, and military jamming can render GPS unusable without warning. VOR provides an independent backup and remains the primary IFR navigation infrastructure for airways. A pilot who cannot navigate without GPS is not fully qualified to fly safely in the NAS.
Q3: Explain the difference between Mode A, Mode C, and Mode S transponder operation to a student who has never used a transponder before.	A: Mode A transmits only the 4-digit squawk code so ATC can identify your radar return. Mode C adds pressure altitude encoding, giving ATC your altitude in 100-ft increments — this is what creates the altitude readout next to your radar target. Mode S transmits your unique ICAO aircraft address (linked to your tail number) plus expanded data link capability.
Q4: When is it appropriate to press the IDENT button on the transponder? When is it not?	A: Press IDENT ONLY when instructed by ATC — typically during initial radar identification ('Cessna 1234A, squawk 4521 and ident'). Pressing IDENT at any other time causes an unwanted bloom on the radar display and may cause the controller confusion. Never press IDENT as a check-in habit or to attract ATC attention.
Q5: A student asks what squawk code to use and when they would ever change it to 7700. What do you tell them?	A: Standard VFR squawk is 1200. Change to 7700 (Emergency) only upon declaring an actual emergency. Code 7600 is for radio communications failure; 7500 is for unlawful interference (hijacking). All three codes trigger immediate ATC alerting and emergency response — never use them for practice, training, or testing without prior coordination with ATC.

Area II, Task I — Navigation and Cross-Country Flight Planning

FAA-S-ACS-25 | CFI Airplane — Ground Lesson

Objective

The applicant demonstrates instructional knowledge of navigation and cross-country flight planning, including pilotage, dead reckoning, chart reading, magnetic compass errors, E6B calculations, VFR flight plan procedures, weather-based go/no-go decision-making, diversion and lost procedures, and inflight intercept procedures. The applicant can apply this knowledge, manage associated risks, demonstrate the required skills, and simultaneously explain procedures to a student at various stages of training.

References

- FAA-H-8083-25C (PHAK) — Chapters 15 (Navigation), 16 (Navigation Systems)
- FAA-H-8083-3B (AFH) — Chapter 10 (Night / X-Country)
- FAA-H-8083-2B (Pilot's Handbook of Weight & Balance)
- AIM — Chapter 5 (Air Traffic Procedures), 7 (Safety of Flight)
- 14 CFR §§ 91.103, 91.151, 91.153, 91.155, 91.157, 91.159
- Chart Supplements (CS), NOTAMs, VFR Navigation Charts

Delivery Format

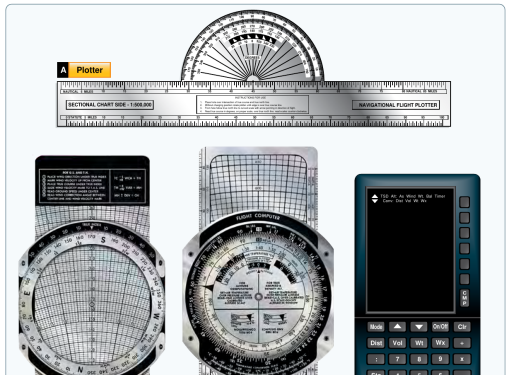
- Ground lesson — 90–120 min (this is a complex lesson; plan accordingly)
- Bring all materials listed at right; use iPad for EFB demonstration
- Use sectional/TAC at the table; instructor works through navlog with student
- Follow with dedicated cross-country planning flight to reinforce all skills

ACS Knowledge, Risk & Skills

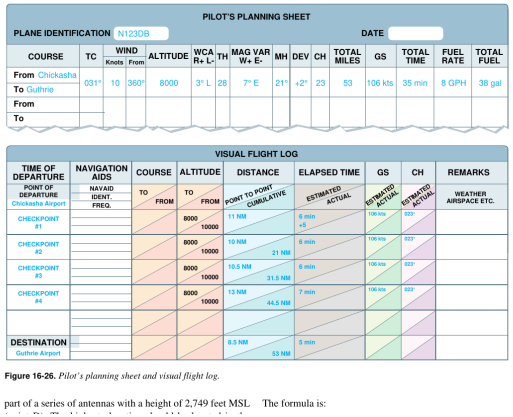
Code	Element
K1	Route planning, airspace (SUA), navigation/comms systems
K2	Altitude selection: terrain, obstacles, VFR cruising altitudes, wind
K3	Plotting a course
K4	Power setting selection
K5a	Calculations: time, climb/descent, course, distance, heading, TAS, GS
K5b	ETA computation including UTC (Zulu) conversion
K5c	Fuel requirements including reserve
K6	Elements of a VFR flight plan
K7	Correlate weather information for go/no-go decision
K8	Activating and closing a VFR flight plan
K9	Magnetic compass errors
K10	Pilotage and dead reckoning
K11	Planned calculations vs. actual results and corrections
K12	Diversion and lost procedures
K13	Inflight intercept procedures
K14	Use of an electronic flight bag (EFB)
K15	Chart symbols
R1	Pilot — fatigue, currency, recency, ADM
R2	Aircraft — performance, equipment, fuel quantity
R3	Environment — weather, airspace, terrain, obstacles
R4	External pressures — get-there-itis, schedule, passengers
R5	Limitations of ATC services
R6	Fuel planning
S1	Prepare/present cross-country plan with risk analysis to first fuel stop
S2	Apply charts, Chart Supplements, NOTAMs, and publications
S3	Create nav plan and simulate filing VFR flight plan
S4	Recalculate fuel reserves based on evaluator-provided scenario

Materials Required for This Lesson

✓ **Completed Jeppesen NavLog** — bring one fully worked example with all calculations for instructor reference and demonstration ✓ **Partial NavLog** — bring a half-completed NavLog for the student to finish during the lesson ✓ **TAC (Terminal Area Chart)** — local area for chart reading exercises ✓ **E6B Flight Computer** — mechanical and/or electronic ✓ **Plotter / Sectional Ruler** — for course plotting exercise ✓ **POH/AFM** — for cruise performance, fuel burn, and weight & balance calculations ✓ **iPad with ForeFlight** — to demonstrate EFB flight planning workflow ✓ **1800wxbrief.com Briefing Form** — printed or on screen, to walk through standard briefing structure



E6B Flight Computer & Plotter



PILOT'S PLANNING SHEET

PLANE IDENTIFICATION N123DB DATE

COURSE	TC	WIND Knots	WIND From	ALTITUDE	WCA R+ L-	TH	MAG VAR W+ E-	MH	DEV	CH	TOTAL MILES	GS	TOTAL TIME	FUEL RATE	TOTAL FUEL
From Chickasha															
To Guthrie	031°	10	360°	8000	3° L	28	7° E	21°	+2°	23	53	106 kts	35 min	8 GPH	38 gal
From															
To															

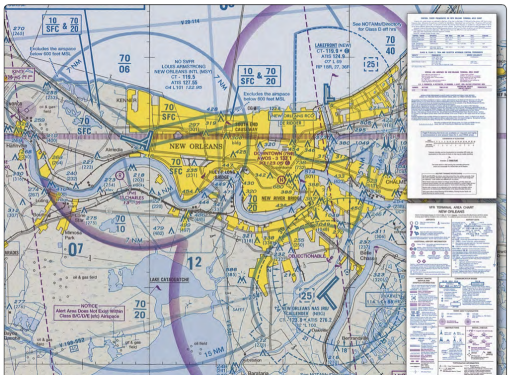
VISUAL FLIGHT LOG

TIME OF DEPARTURE / POINT OF DEPARTURE	NAVIGATION AIDS / NAVAID IDENT. FREQ.	COURSE TO / FROM	ALTITUDE TO / FROM	DISTANCE POINT TO POINT / CUMULATIVE	ELAPSED TIME ESTIMATED / ACTUAL	GS ESTIMATED / ACTUAL	CH ESTIMATED / ACTUAL	REMARKS WEATHER AIRSPACE ETC.
Chickasha Airport								
CHECKPOINT #1			8000 / 10000	11 NM	6 min +5	106 kts	023°	
CHECKPOINT #2			8000 / 10000	10 NM / 21 NM	6 min	106 kts	023°	
CHECKPOINT #3			8000 / 10000	10.5 NM / 31.5 NM	6 min	106 kts	023°	
CHECKPOINT #4			8000 / 10000	13 NM / 44.5 NM	7 min	106 kts	023°	
DESTINATION Guthrie Airport				8.5 NM / 53 NM	5 min			

Figure 16-26. *Pilot's planning sheet and visual flight log.*

part of a series of antennas with a height of 2,749 feet MSL The formula is:

Jeppesen NavLog — Pilot Planning Sheet



VFR Terminal Area Chart

Instructor Note — ACS Sequencing: *This lesson deliberately departs from the ACS element order (K1–K15) to present content in a more logical teaching sequence for the student. We begin with the foundational concept of how we navigate (pilotage and dead reckoning), then build outward to route and altitude planning, chart reading, compass errors, calculations, flight plan filing, weather decision-making, EFB use, and finally emergency navigation scenarios (diversion, lost, intercept). All ACS knowledge elements K1–K15 are covered in full. Present the content in this sequence rather than stepping through K1–K15 in order, which can feel disjointed to a student first encountering cross-country planning.*

SECTION 1 — PILOTAGE AND DEAD RECKONING [AI.II.I.K10]

Pilotage

Pilotage is navigation by visual reference to landmarks. The pilot identifies checkpoints on the chart — towns, roads, rivers, lakes, railroads, towers — and confirms position by comparing what they see out the window to what is depicted on the sectional. It is the oldest and most intuitive form of VFR navigation.

- Works best with distinctive, easily identified checkpoints
- Degrades rapidly in marginal visibility, haze, or featureless terrain
- Requires continuous chart reference; student must *look ahead*, not just current position
- Lesson technique: pre-select and circle 3–5 prominent checkpoints per leg before departure

Dead Reckoning (DR)

Dead reckoning calculates current position from a known starting point, elapsed time, true airspeed, and heading. It is your fallback when checkpoints are obscured, and the mathematical foundation of all pre-flight nav log work.

- Formula: **Distance = Groundspeed × Time** (D = GS × T)
- Requires accurate TAS, wind correction angle (WCA), and magnetic variation
- Errors compound over time — DR without periodic visual fixes will drift
- Use DR to arrive in the area; use pilotage to confirm the specific fix

The Combined Method — How It Works in Practice

Use pilotage and dead reckoning together, with electronic navigation as a supplement. Teach this workflow:

Step	Action	Technique
1	Pre-flight	Plot course; select checkpoints every 10–15 nm; compute headings and ETAs on navlog
2	Departure	Log wheels-up time in Zulu; note HI vs. compass; confirm first checkpoint visually
3	En Route	Track elapsed time at each checkpoint; if >2 min early/late, recalculate GS and update ETAs
4	Position Fix	At checkpoint: note actual vs. planned time; calculate actual GS; update remaining ETAs
5	Arrival	Compare actual fuel used to planned; record in logbook for future planning reference

Instructor Note: *Have students write planned ETAs on the navlog before flight, then log actual times at each checkpoint in flight. Comparing planned vs. actual builds the core habit of situational awareness — use the partial NavLog you brought for this exercise.*

SECTION 2 — ROUTE PLANNING & ALTITUDE SELECTION [AI.II.I.K1, K2]

Route Planning Considerations

A good VFR route is not always the straight line between two airports. Teach students to consider all of the following before drawing a single line on the chart:

- **Airspace:** Identify all Class B, C, D, and E airspace along the route; determine which require ATC communication or clearance; note MOAs, Restricted, Warning, and Prohibited areas
- **Terrain and Obstacles:** Check highest terrain within 10 nm of course; look for towers, antennas, and powerlines in low-altitude segments
- **Navigation Aids:** Identify VORs, intersections, GPS waypoints, and prominent visual checkpoints that will serve as DR confirmation points
- **Weather Escape Routes:** Know in advance where you can divert if weather deteriorates; avoid routes with limited diversion options (mountain passes, over water)
- **Fuel Planning:** Identify alternate airports every 50–80 nm; know fuel burn at cruise and plan with at least 30 min VFR day reserve (45 min night)
- **Communications:** Note ATIS/ASOS frequencies, relevant FSS frequencies, approach frequencies for en route services, and guard frequency 121.5

KEY RULE ■ The FAA requires the pilot to become familiar with all available information concerning a flight (14 CFR § 91.103). Teach students that preflight planning is a legal obligation, not just good practice.

VFR Cruising Altitude Selection — 14 CFR § 91.159

Magnetic Course	Direction	Altitude (MSL)
0° – 179°	East	Odd thousands + 500 ft (3,500 – 5,500 – 7,500...)
180° – 359°	West	Even thousands + 500 ft (4,500 – 6,500 – 8,500...)

Additional Altitude Factors:

- **MEF (Maximum Elevation Figure):** Check each quadrangle on the sectional; your cruising altitude must provide at least 1,000 ft clearance over MEF in flat terrain; 2,000 ft in mountains
- **Glide Distance:** At best-glide speed, a typical trainer glides ~1.5 nm per 1,000 ft AGL. Higher altitude → more options in the event of engine failure
- **Wind:** Winds aloft forecast (FD); consider using MountainWeather or skewT for wind optimization; a 20-kt headwind at 7,500 vs. 9,500 ft can change your flight time significantly
- **Density Altitude:** Hot/high conditions reduce aircraft performance; recalculate TAS and verify runway performance at destination

■ ***Risk Note:*** *Get-there-itis risk: external pressures (passengers, schedule, fuel cost) can push pilots to fly lower or in marginal conditions. Teach students to make altitude and route decisions before the flight, when pressure is lowest.*

SECTION 3 — PLOTTING A COURSE [AI.II.I.K3]

Step-by-Step Course Plotting (Sectional Chart)

Step	Action	Tool
1	Mark departure and destination airports on sectional with pencil dot	Pencil
2	Connect airports with straight line; extend across compass rose or use plotter	Plotter
3	Read the True Course (TC) from the plotter scale	Plotter
4	Measure total distance in nautical miles using plotter scale	Plotter
5	Divide route into legs at visual checkpoints every 10–15 nm	Plotter/pencil
6	Record TC and leg distances on the NavLog	NavLog
7	Apply winds aloft to calculate Wind Correction Angle (WCA) on E6B	E6B
8	TC ± WCA = True Heading; then apply variation and deviation (TVMDC)	E6B + chart
9	Compute GS and leg time on E6B; enter on NavLog	E6B
10	Calculate fuel burn per leg; confirm totals including 30-min reserve	POH + NavLog

Instructor Note: *Have the student actually use the plotter and E6B on the TAC during this portion. Physical manipulation of tools is far more memorable than watching the instructor do it. Assign a short practice route before the lesson if time allows.*

TVMDC — The Heading Correction Chain

True Course (TC)	Measured from sectional; referenced to True North
± Wind Correction Angle	Calculated on E6B using winds aloft; right of course = + WCA
= True Heading (TH)	Direction aircraft points through the air mass
± Variation (Var)	From isogonic lines on chart; East is least, West is best
= Magnetic Heading (MH)	Referenced to magnetic north; what most instruments use
± Deviation (Dev)	From compass correction card in cockpit; unique per aircraft
= Compass Heading (CH)	What the wet compass actually shows; what you fly

Instructor Note: Memory Aid — TVMDC: *True → Variation → Magnetic → Deviation → Compass. Mnemonic: "True Virgins Make Dull Companions". Add East corrections, subtract West (applies to both variation and deviation). Practice by having the student solve 3 TVMDC problems with different variation/deviation combinations.*

Isogonic Lines on the Sectional

Isogonic lines connect points of equal magnetic variation. They appear as dashed magenta lines on the sectional labeled with the variation value (e.g., “5°E”). The agonic line (zero variation) runs roughly through the eastern U.S. West of it, variation is east; east of it, variation is west. Always use current charts — variation shifts slowly over time.

KEY RULE ■ The compass correction card in the cockpit accounts for deviation from *that specific aircraft's* compass and its installed equipment. Never use another aircraft’s deviation card.

SECTION 4 — CHART SYMBOLS [AI.II.I.K15]

Sectional charts (scale 1:500,000) and Terminal Area Charts (TAC, scale 1:250,000) use a standardized legend that every VFR pilot must know. This section introduces the categories of chart symbols and their significance. **Use the TAC you brought to the lesson and have the student identify each symbol type on the actual chart as you teach it.**

Airport Data Block

Each airport on a VFR chart has a data block. Students must decode every field:

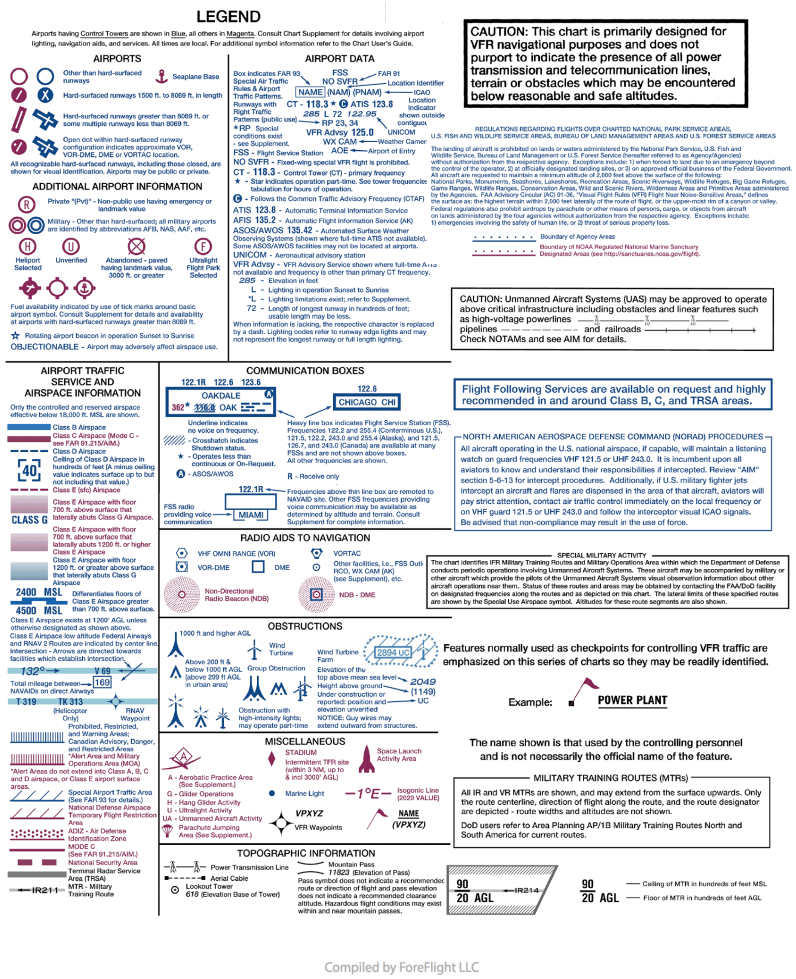
Field	Meaning	Example
Airport name (bold)	Name of airport or heliport	KORF — Kill Devil Hills
CT – xxx.x	Control Tower freq (blue = part time)	CT–118.1
ATIS xxx.x	Automatic Terminal Info Service freq	ATIS 127.25
Elevation	Field elevation in feet MSL	13
Runway length	Longest runway in hundreds of feet	60 (= 6,000 ft)
L	Lighting available sunset to sunrise	L
Star (*)	Part-time control tower	*CT–119.5
RP 28	Right-hand traffic pattern, Rwy 28	RP 28

Terrain and Obstacle Symbols

Symbol	Meaning
MEF (blue box)	Max Elevation Figure — highest terrain/obstacle in quadrangle + 200 ft buffer
Tower (black)	Obstruction under 1,000 ft AGL
Tower (high, bold)	Obstruction 1,000 ft AGL or more
Group of towers	Numerous obstructions in area
Brown contour lines	Elevation; closely spaced = steep terrain
Spot elevation	Highest known point in area (feet MSL)

> *Tip: Hands-on: have the student identify one of each symbol type on the TAC you brought. Full symbol legend is shown at right.*

VFR Chart Symbols — Complete Reference



Source: ForeFlight VFR chart legend. Sectional 1:500,000 — TAC 1:250,000.

SECTION 5 — MAGNETIC COMPASS ERRORS [AI.II.I.K9]

The magnetic compass is the only heading instrument that requires no electrical power. A thorough understanding of its errors is essential for every VFR and IFR pilot. Each error has a predictable cause and a known correction. Teach the student to *anticipate* compass behavior, not just memorize acronyms.

Compass Errors — Reference Table

Error	Cause	Effect	Fix / Mnemonic
Variation	Magnetic pole ≠ geographic pole	Offset between true and magnetic headings; varies by location	TVMDC chain; East is least, West is best
Deviation	Aircraft metals and electronics distort local field	Compass error per heading; unique to each aircraft	Compass correction card on panel; swing after avionics work
Oscillation	Turbulence makes compass card swing	Can't read exact heading in rough air	Use heading indicator as primary; reset to compass every 15 min
Magnetic Dip	Flux lines angle toward poles; not horizontal	Parent cause of ANDS and OSUN errors	Worst at poles; nil at equator
Acceleration (ANDS)	Dip causes north-seeking end to dip forward on accel on E/W hdg	Accelerate on E/W: shows turn to North. Decelerate: shows South	**A**ccelerate **N**orth, **D**ecelerate **S**outh
Turning (OSUN)	Dip affects card rotation when turning through N or S	Turning through N: lags. Turning through S: leads	**O**vershoot **S**outh, **U**ndershoot **N**orth

Using the Compass Correctly in Flight

- Compass is most accurate in **straight, level, unaccelerated flight (SLUF)**
- In a bank, compass is unreliable — use gyro to roll out, then cross-check
- Set heading indicator to compass every **15 minutes** or after each 180° turn
- In gyro failure, revert to compass — fly *straight and level* for at least 30 sec before reading

ANDS Error — Acceleration on E/W Headings

Heading	Accelerate	Decelerate
East (090°)	↑ Shows turn to North	↓ Shows turn to South
West (270°)	↑ Shows turn to North	↓ Shows turn to South
North / South	Minimal effect	Minimal effect

OSUN Error — Turning Through North and South

Turn Through	Compass Behavior	Roll-Out Technique
North (360°)	Compass LAGS — reads less than actual heading	Undershoot: roll out BEFORE compass reaches desired heading
South (180°)	Compass LEADS — reads more than actual heading	Overshoot: roll out AFTER compass passes desired heading

KEY RULE ■ Lead/lag for OSUN varies with latitude. Rule of thumb: roll out early/late by approximately half your latitude. At 35°N: roll out ~17–18° early when turning to north; let compass overshoot ~17–18° when turning to south.

SECTION 6 — CALCULATIONS [AI.II.I.K5A, K5B, K5C, K4]

Every number on a navigation log has a source and a method. The E6B flight computer (mechanical or electronic) solves wind correction, groundspeed, time, and fuel problems. **Bring the E6B and POH to this lesson. Teach by working an actual example, not abstract formulas.**

NavLog Calculations — Column by Column

NavLog Column	Source / Method
True Course (TC)	Measured from sectional with plotter; direction of each leg
Winds Aloft (WD/WV)	FD forecast; interpolate for planned altitude and route midpoint
True Airspeed (TAS)	POH cruise table at planned altitude and power; or E6B density altitude side
Wind Correction Angle	E6B wind side; WCA corrects heading into the wind
True Heading (TH)	TC ± WCA (wind from left: subtract; from right: add)
Variation	From isogonic lines on sectional; East subtract, West add
Magnetic Heading (MH)	TH ± Variation
Deviation	From compass correction card in that specific aircraft
Compass Heading (CH)	MH ± Deviation; what you actually steer
Groundspeed (GS)	E6B wind side after setting up wind triangle
Leg Distance (nm)	Plotter measurement from sectional
Leg Time (min)	Distance ÷ GS × 60 (or E6B)
Fuel Burn (gal)	Leg time (hrs) × Fuel Flow (GPH from POH)
ETA (Zulu)	Off-block Zulu + cumulative leg times; include UTC offset
Actual vs. Planned	Filled in-flight; recalculate forward ETAs if >2 min off

E6B Wind Side — Step by Step

Step	Action
1	Rotate compass rose: wind direction at top index mark
2	Slide grid: plot wind dot above center by wind speed (kts)
3	Rotate compass rose: True Course (TC) at top index
4	Slide grid: TAS under the center grommet
5	Read GS under the grommet; read WCA at the wind dot
6	Apply WCA: wind from left → subtract; from right → add

E6B Calculator Side — Key Functions

Calculation	Setup
Leg time	Distance on outer over GS on inner; read time at index
Fuel burn	GPH on inner; read gallons for elapsed time on outer
TAS from IAS	Align pressure altitude + OAT; read TAS over IAS
Density altitude	Use density altitude window with temp correction
Zulu conversion	EST=UTC–5, EDT=UTC–4, CST=UTC–6, CDT=UTC–5, MST=UTC–7, PST=UTC–8

Fuel Requirements — 14 CFR § 91.151

Operation	Minimum Fuel Required
Day VFR	Destination + 30 min at normal cruise (14 CFR § 91.151)
Night VFR	Destination + 45 min at normal cruise (14 CFR § 91.151)
Personal Minimum	Recommend 1-hr minimum reserve for student pilots; build the habit early
Best practice	Never land with less fuel than your personal minimum; know nearest fuel stop

■ ***Risk Note:*** *Fuel exhaustion is a leading cause of GA engine failures. Teach students: visual fuel check (not just gauges), use POH burn rates, and always fly with a personal reserve above the legal minimum. Establish a personal fuel minimum before they fly solo cross-country.*

SECTION 7 — ELEMENTS OF A VFR FLIGHT PLAN [AI.II.I.K6]

A VFR flight plan is a *search and rescue tool*, not an ATC clearance. It does not grant any special access to airspace. However, it is the only mechanism that triggers search and rescue if you fail to arrive. Teach students that filing is a professional habit, not an optional formality.

VFR Flight Plan Elements — FAA Form 7233-1

Blk	Field	What to Enter
1	Type	VFR (or DVFR if crossing an ADIZ)
2	Aircraft ID	N-number (e.g., N12345)
3	Type / Equipment	ICAO type + suffix (e.g., C172/U — Mode C equipped)
4	True Airspeed	Planned cruise TAS in knots
5	Departure Point	ICAO identifier (e.g., KORF)
6	Departure Time	Proposed off-block time in Zulu (UTC)
7	Cruising Altitude	Per § 91.159 (e.g., 4,500)
8	Route of Flight	Waypoints, airways, or DIRECT if applicable
9	Destination	ICAO identifier
10	ETE	Estimated Time En Route (hours + minutes)
11	Remarks	Student pilot, planned fuel stop, any special info
12	Fuel on Board	Hours and minutes of fuel on board
13	Alternate Airport	Nearest suitable alternate if destination unavailable
14	Pilot Info	Full name, address, phone number — for SAR contact
15	Souls on Board	Total occupants including pilot
16	Aircraft Color	Paint scheme; helps SAR locate aircraft
17	Destination Contact	Person to notify if flight plan is not closed

Section 8 — Using an EFB [AI.II.I.K14]

The EFB does not replace understanding — it executes the same calculations. A pilot who cannot manually plan a cross-country cannot verify the EFB is correct. Teach the manual method first; then demonstrate ForeFlight as a validation tool.

ForeFlight Workflow — Step by Step

Step	ForeFlight Action
1	**Maps:** Open sectional/TAC; toggle airspace overlays; identify B/C/D rings, SUAs, TFRs
2	**Flight Plan:** Tap '+'; enter departure and destination ICAO IDs
3	**Route:** Draw direct or add waypoints; view course line on sectional
4	**Aircraft:** Confirm correct profile with current performance data
5	**Winds:** Check FD data; review wind-optimized altitude suggestion
6	**NavLog:** Tap NavLog tab; review GS, WCA, time, fuel per leg; compare to manual
7	**Briefing:** Tap Briefing; send to 1800wxbrief.com; review all items
8	**TFRs/NOTAMs:** Review TFRs on map; read NOTAMs for all airports
9	**File:** Tap File to submit VFR flight plan to FAA
10	**Activate:** Call FSS 1-800-WX-BRIEF by phone or radio after takeoff

Instructor Note: *Demonstrate ForeFlight live on the iPad. Compare EFB navlog to the student's manually computed Jeppesen navlog. Differences in GS or fuel are teaching moments.*

Tip: *AC 91-78: Class 1/2 EFBs (tablets, phones) are acceptable for VFR chart display. No FAA authorization required as a supplement to approved instruments. Ensure charts, obstacles, and terrain databases are current before every flight.*

SECTION 9 — WEATHER INFORMATION & GO/NO-GO DECISION [AI.II.I.K7]

Weather is the most common cause of VFR into IMC accidents — the deadliest category in general aviation. Teach students to obtain a thorough standard briefing every flight, not just check the phone app. The go/no-go decision is not made once; it is reassessed continuously throughout the flight.

Standard Briefing Sources

Source	Access	Best For
1800wxbrief.com	Web / ForeFlight integrated	Full standard briefing; official SAR record; files flight plan
FSS (1-800-WX-BRIEF)	Phone call	Personalized briefing; complex wx; training environment
ATIS/ASOS/AWOS	VHF radio / 1-877-4ATIS	Current conditions; altimeter; ceiling and vis
aviationweather.gov	FAA website	METARs, TAFs, PIREPs, AIRMETs, SIGMETs, prog charts
ForeFlight/Garmin Pilot	EFB app	Graphical weather; NEXRAD; winds aloft; TFR overlay

Standard Briefing Structure (in order received)

Item	Content
Adverse Conditions	SIGMETs, AIRMETs, TFRs, NOTAMs affecting safety; stated first for early abort
VFR Not Recommended	Briefer's advisory; not a prohibition but always take seriously
Synopsis	Big-picture weather: fronts, pressure systems, general pattern
Current Conditions	METARs at departure, en route reporting points, destination
En Route Forecast	AIRMETs along route; winds aloft; cloud coverage
Destination Forecast	TAF or area forecast for the ETA window
Winds Aloft	FD forecast; use to select optimal cruise altitude
NOTAMs	Airport, runway, navaid, TFR; filter for relevance to route

> ***Instructor Note:*** *Use the WXBRIEF form you brought. Walk through a simulated briefing for your planned route. Have the student verbally state their go/no-go with justification.*

Go/No-Go Decision Framework

Any single factor can be a no-go even if everything else is fine:

Category	Student Minimum	No-Go Trigger
Ceiling	3,000+ ft AGL	Forecast below 1,500 ft at any point en route
Visibility	5+ sm	Forecast below 3 sm en route or at destination
Winds	Within XW limit	Gusts >15 kt or XW beyond pilot proficiency
Thunderstorms	None within 50 nm	Any convective SIGMET; embedded TS in forecast
AIRMET Sierra	VFR conditions	IFR AIRMET active along any portion of route
AIRMET Tango	Light turbulence OK	Severe turbulence AIRMET
AIRMET Zulu	No icing forecast	Any icing AIRMET (aircraft not certified for ice)
TFRs	None on route	TFR overlapping route without coordination
NOTAMs	Runway usable	Destination runway closed or critical navaid out of service
Pilot Currency	61.57 compliant	Not current for night, XC, or required conditions
Fuel	Legal + personal reserve	Cannot reach destination with 45-min reserve

CRITICAL ■ VFR into IMC is the accident chain's most deadly link. Average time from entering IMC to loss of control: **178 seconds.** Teach students: turning back is never a failure. Continuing into deteriorating weather is.

SECTION 10 — ACTIVATING & CLOSING A VFR FLIGHT PLAN [AI.II.I.K8]

A VFR flight plan filed but not activated provides zero search and rescue protection. A VFR flight plan activated but not closed triggers a full SAR response when the ETE expires. Teach students the exact procedures for both, and build the habits that prevent unnecessary SAR activations and ensure real protection when needed.

VFR Flight Plan Lifecycle

Phase	Action	Method
File	Submit flight plan before departure	1800wxbrief.com, ForeFlight, or call FSS 1-800-WX-BRIEF (up to 24 hrs in advance)
Activate	Open the flight plan after takeoff	Call FSS 1-800-WX-BRIEF by phone, contact FSS by radio (122.2 MHz or ARTCC freq), activate via ForeFlight, or request activation from approach/departure if in communication.
Monitor ETE	Track fuel / weather; ensure on schedule	Compare actual GS to planned; if significantly delayed, call FSS to extend ETE
Close	Close the flight plan upon arrival	Call FSS 1-800-WX-BRIEF by phone (preferred), or by radio; or ask tower/unicom to close. **Closing by phone is fastest and most reliable.**
Failure to Close	FSS initiates SAR when ETE + 30 min expires	SAR involves USAF, Coast Guard, CAP; extremely expensive and time-consuming; can result in FAA enforcement action if reckless

CRITICAL ■ Always close your flight plan. If you forget, you can expect a phone call from the FAA or a knock on the door from law enforcement while expensive SAR assets are searching for you. The phone number for FSS is 1-800-WX-BRIEF — commit it to memory.

FSS Radio Procedures

- Call FSS by transmitting on 122.2 MHz while listening on the VOR: “Pilotsburg Radio, N12345, transmitting on 122.2, receiving [VOR name], over”
- After takeoff, activate by stating: “N12345, VFR flight plan [departure] to [destination], activate at [Zulu time], over”
- To close: “N12345, request close VFR flight plan [destination], landing at [Zulu time], over”

Section 11 — Planned vs. Actual [AI.II.I.K11]

The navigation log is not just a planning document — it is a real-time situational awareness tool used in flight to detect and correct deviations. Teach students to maintain the ‘actual’ columns in flight:

NavLog Column	In-Flight Action
Actual Departure Time	Write wheels-up time in Zulu immediately after takeoff
Checkpoint Actual Time	Note actual time over each checkpoint; compare to planned ETA
Actual vs. Planned Δt	If >2 min early or late, recalculate actual GS and update forward ETAs
Actual GS	Actual GS = (Leg Distance) ÷ (Actual Leg Time in hours)
Fuel Remaining	Note fuel time remaining at each stop; compare to plan
Weather Update	Note actual ceiling/visibility if different from forecast; reassess go/no-go

Correcting for Groundspeed Deviation

- If actual GS is lower than planned: increase fuel burn estimate forward; check fuel reserves; consider lower altitude for better winds; update ETA at destination and any required fuel stops
- If actual GS is higher: update ETAs forward; reassess fuel burn (may have more reserve)
- If more than 5 kt off: consider requesting updated winds aloft from FSS or checking ForeFlight for updated METARs along route

Instructor Note: *During the practice cross-country, have the student log actual times in the partial NavLog you brought. At each checkpoint, ask: ‘Are we on time? What is our actual groundspeed? How much fuel should we have remaining?’ This is the highest-value in-flight habit a student can develop.*

KEY RULE ■ The minimum in-flight navigation loop is: **Time check** → **Position fix** → **Fuel check** → **Weather look-ahead.** Teach students to complete this loop at every checkpoint, every time.

SECTION 12 — DIVERSION AND LOST PROCEDURES [AI.II.I.K12]

Lost and diversion scenarios are among the most stress-inducing situations for student pilots because they feel like a failure. Teach students that being temporarily uncertain of position is manageable — it only becomes dangerous when the pilot continues pressing on, hoping the situation will resolve itself. The response must be *immediate, structured, and calm.*

Diversion to an Alternate Airport

Immediate-action sequence when diverting due to weather, fuel, or airspace:

Step	Diversion Action
1 — Position	Confirm current position on sectional, EFB, VOR cross-fix, or GPS; identify nearest suitable airports
2 — Select	Choose closest airport with suitable runway, fuel, and clear weather
3 — Course	Estimate direct course on sectional; thumb rule: 1 thumb ≈ 10 nm
4 — Distance/Time	Rough GS × time; E6B or ForeFlight if time allows; rough estimates OK
5 — Fuel	Confirm fuel available vs. needed; never divert to an airport out of reach
6 — Communicate	Inform ATC or FSS; update ETE; monitor 121.5; squawk 1200 if VFR
7 — Navigate	Fly new course; continue wx and fuel monitoring; brief passengers calmly

> ✍ ***Tip: Thumb Rule:*** *On a 1:500,000 sectional, one thumb width ≈ 10 nm. Use for rapid estimates when the plotter isn't practical.*

Lost Procedures — The 5 C's

C	Action	Detail
Climb	Gain altitude	Better landmark visibility; improved radio range; more glide options
Circle	Hold position	Orbit to survey the area; don't continue into unknown territory
Communicate	Declare uncertainty	Current freq or 121.5; squawk 7700 (emergency) or 7600 (lost comm); "N12345, VFR, uncertain of position, request radar ID"
Confess	Tell ATC	Controllers can't help if you don't ask. Pride kills pilots.
Comply	Follow ATC	Once radar/DF established, follow vectors exactly without deviation

Additional Lost Techniques

- **EFB:** ForeFlight GPS shows position on sectional instantly; zoom out for nearest airports
- **Squawk 7700:** Emergency; "EMG" tag appears at all ATC facilities
- **121.5 MHz:** Guard frequency; monitored by ATC, military, and airline crews
- **VOR Cross-Fix:** Tune 2 VORs; center CDI on each; intersection = your position
- **Linear Feature:** Fly to a river, highway, or coastline; follow to a recognizable point

CRITICAL ■ Fuel is the #1 constraint when lost. You may need it to hold, divert, or make an off-airport landing. Never trade fuel for more time when already behind the airplane.

SECTION 13 — INFLIGHT INTERCEPT PROCEDURES [AI.II.I.K13]

When an Intercept Can Occur

Military or law enforcement aircraft may intercept a civil aircraft that has deviated into restricted or prohibited airspace, failed to respond to radio calls, squawked an emergency code without radio contact, or is suspected of illegal activity. The procedures below are drawn from the AIM Chapter 5-6 and ICAO standards.

Visual Signals from the Intercepting Aircraft

Intercept Signal	Meaning	Your Response
Day: rocks wings; Night: flashes nav lights	I am intercepting you; follow me	Rock wings; follow the interceptor aircraft
Interceptor turns left, heads toward destination	Proceed to this aerodrome for landing	Follow the interceptor; prepare to land
Interceptor circles aerodrome, lowers landing gear	Land at this aerodrome	Comply; lower gear when appropriate; land
Interceptor makes a sudden climbing turn to the left	You may proceed	Rock wings; resume normal flight

Intercepted Pilot Actions — AIM 5-6-2

- **Step 1:** Do not maneuver aggressively; maintain present heading and altitude initially
- **Step 2:** Attempt radio contact with intercepting aircraft on 121.5 MHz: “Military aircraft intercepting N12345, do you read on 121.5?”
- **Step 3:** Squawk 7700 unless otherwise instructed
- **Step 4:** If visual signals are received, acknowledge by rocking wings in daylight or flashing nav lights at night
- **Step 5:** Follow the interceptor’s lead; do not make sudden or unexpected maneuvers
- **Step 6:** If instructed to land, comply; lower gear, configure for landing; do not land without a clear visual signal to do so
- **Step 7:** Once on the ground, contact ATC and appropriate authorities immediately; do not attempt to depart until cleared to do so

■ ***Risk Note:*** *The most common reason for intercept in the U.S. is inadvertent TFR penetration (typically near presidential movement) or communication failure. Brief TFRs before every flight and ensure avionics are functional before departure.*

Instructor Note: *Intercept procedures are rarely tested in detail on the checkride but are required ACS knowledge elements. Have the student recite the visual signals and actions from memory; use AIM 5-6-2 as the source for any follow-up questions.*

SECTION 14 — RISK MANAGEMENT [AI.II.I.R1–R6]

PAVE Risk Identification Framework

The ACS identifies six specific risk elements for Task I. Map each to the PAVE checklist and teach students to run through PAVE before every cross-country:

PAVE Element	ACS Risk Code	Key Risks for This Task
P — Pilot	R1	Fatigue (early departure, overnight, time zone); currency (night, instrument, XC hours); recency (last cross-country >90 days ago?); stress; complacency with EFB
A — Aircraft	R2	Fuel quantity (gauges vs. visual check); equipment availability (GPS NOTAM?); weight and balance for full load; performance at density altitude; ELT function
V — enVironment	R3	Weather: ceiling, vis, winds, icing, turbulence, convection; terrain; mountain wave; unfamiliar airports; airspace complexity; NOTAMs
E — External Pressures	R4	Get-there-itis (must attend event); passenger pressure; schedule pressure; instructor endorsing student who isn't ready; business commitments
ATC Limitations	R5	Flight following is advisory only; ATC may not see all traffic; radar coverage gaps at low altitude; controller workload; no SAR value if flight plan not filed
Fuel Planning	R6	Optimistic fuel burn estimate; not accounting for climb fuel; fuel stops that add to flight time; difference between POH 'best power' and 'best economy' burn rates; vapor lock risk in hot wx

ACS Completion Standards

To meet Task I ACS standards, the applicant must demonstrate the ability to simultaneously instruct while performing the following:

ACS Skill	Standard
S1 — Present a cross-country plan	Plan must include complete navlog, altitude selection with justification, risk analysis to first fuel stop, airspace review, and weather-based go/no-go rationale
S2 — Apply aeronautical publications	Must demonstrate use of current charts, Chart Supplement, and NOTAMs; identify at least one chart symbol, airspace type, and airport data element
S3 — Create nav plan and simulate filing	Must complete a VFR flight plan form with all 17 blocks correctly populated; describe activation and closing procedures accurately
S4 — Recalculate fuel reserves	Given evaluator scenario (e.g., "GS was 15 kts lower than planned"), must recalculate fuel remaining and new ETE to destination within acceptable margin

Instructor Oral Assessment Prompts

- Walk me through how you would plan a VFR cross-country from [KDEP] to [KDST].
- You are 45 nm from your destination and your actual GS is 20 kts below planned. What do you do?
- Identify this symbol on the sectional [point to MOA boundary]. What are your legal options for penetrating it?
- You are uncertain of your position over featureless terrain with 30 min of fuel. What are your immediate actions?
- An aircraft pulls alongside you, rocks its wings, and begins turning left. What does that mean and what do you do?
- Your weather briefing said VFR flight not recommended for the first half of your route. Your passenger says 'we need to leave now.' How do you respond?

KEY RULE ■ This is the most comprehensive knowledge task in Area II. Reserve adequate lesson time — 90–120 minutes minimum. Consider splitting into two lessons: (1) planning and calculations, (2) procedures, weather, and emergency navigation.

"Every cross-country is a chain of decisions. The pilot who pre-briefs risk has time to think. The pilot who ignores it is reactive — managing crises instead of flying the airplane."

Area II, Task J — 14 CFR and Publications

FAA-S-ACS-25 | CFI Airplane — Ground Lesson

Objective

The applicant demonstrates instructional knowledge of the Code of Federal Regulations and other relevant aviation publications. The applicant explains 14 CFR Parts 1, 61, and 91; 49 CFR Part 830; Advisory Circulars, INFOs, and SAFOs; Airman Certification Standards; Pilot's Operating Handbooks; and the Aeronautical Information Manual. The applicant identifies and manages risks associated with outdated publications and demonstrates the ability to teach at least one of these elements to ACS standard.

References

- 14 CFR Part 1 — Definitions and Abbreviations
- 14 CFR Part 61 — Certification: Pilots, Flight Instructors, Ground Instructors
- 14 CFR Part 91 — General Operating and Flight Rules
- 49 CFR Part 830 — NTSB Notification and Reporting
- FAA-H-8083-2 — Risk Management Handbook
- FAA-H-8083-3 — Airplane Flying Handbook
- FAA-H-8083-25C — Pilot's Handbook of Aeronautical Knowledge
- AIM — Aeronautical Information Manual
- POH/AFM — Aircraft Specific Pilot's Operating Handbook

Delivery Format

- Ground lesson with printed FARs or eCFR open on tablet — 45–60 min
- Have the student navigate e-CFR.gov and FAA.gov to locate publications in real time
- Use the aircraft's POH/AFM as a physical prop throughout the lesson
- Follow with a scenario-based debrief: "Your student asks you to explain their solo requirements—where do you look?"

ACS Knowledge Elements

Code	Element
AI.II.J.K1	14 CFR parts 1, 61, and 91
AI.II.J.K2	49 CFR part 830
AI.II.J.K3	Advisory Circulars, INFOs, and SAFOs
AI.II.J.K4	Airman Certification Standards or Practical Test Standards
AI.II.J.K5	Pilot's Operating Handbooks or flight manuals
AI.II.J.K6	Aeronautical Information Manual (AIM)

ACS Risk Management

Code	Element
AI.II.J.R1	Use of expired charts, manuals, or publications without current updates

ACS Skills

Code	Element
AI.II.J.S1	Teach at least one of the elements listed in K1 through K6

Motivation

The regulations are not fine print — they are the framework every flight rests on. A CFI who cannot navigate 14 CFR Part 61 quickly and confidently will give students incorrect currency guidance, miss solo endorsement requirements, and fail checkride prep. Worse, a pilot who treats regulations as a checklist to be memorized rather than a system to be understood will eventually break one. This lesson builds the regulatory fluency that separates a professional instructor from someone who "just knows the rules."

SECTION 2 — 14 CFR PART 1: DEFINITIONS AND ABBREVIATIONS

Part 1 is the dictionary of aviation regulations. Every definition used throughout Parts 61 and 91 traces back here. Misunderstanding a Part 1 definition leads to misapplying an operational rule. Key definitions a CFI must teach with precision include:

Term	14 CFR Part 1 Definition — CFI Teaching Points

Aircraft	A device used or intended to be used for flight. Includes airplanes, helicopters, gliders, balloons. Relevant when determining applicability of Part 91 rules (e.g., §91.119 altitudes apply to “aircraft”).
Airplane	An engine-driven, fixed-wing aircraft heavier than air, supported in flight by the dynamic reaction of air against its wings. Students often conflate “aircraft” and “airplane” — the distinction matters for certificate privileges.
Air carrier	A person operating large civil aircraft for compensation or hire under Part 119. Important for distinguishing Part 91 (general aviation) from Part 121/135 operations.
Controlled airspace	An airspace of defined dimensions within which ATC service is provided. Triggers equipment requirements (§91.205, §91.215), clearance requirements, and weather minimums.
Flight time	Pilot time that commences when an aircraft moves under its own power for the purpose of flight and ends when the aircraft comes to rest after landing. Critical for logging requirements under §61.51.
Pilot in command (PIC)	The person who has final authority and responsibility for the operation and safety of the flight. Has a duty to determine the aircraft is airworthy (§91.7) and is responsible regardless of whether physically flying the aircraft.
Large aircraft	Aircraft of more than 12,500 lbs maximum certificated takeoff weight. Triggers different certification and operational requirements. A common student confusion point.
Night	The time between the end of evening civil twilight and the beginning of morning civil twilight. Distinguished from “1 hour after sunset to 1 hour before sunrise” for logging night flight time and currency under §61.57.

14 CFR Part 61 — Pilot Certification | 14 CFR Part 91 — Operating Rules

14 CFR Part 61 — Key Sections for CFIs

Section	Subject — CFI Teaching Points
§61.3	Certificate and rating requirements. Pilot must hold certificate and rating for aircraft category/class. Medical must be current. Students need solo endorsement for each aircraft and area.
§61.19	Certificate duration. Most certificates are issued without expiration. Student pilot certificates no longer time-limited (2016 rule change). Medical currency is separate from certificate.
§61.51	Pilot logbooks. Must log: date, total flight time, departure/arrival airports, type/ID of aircraft, conditions of flight, PIC time, and dual received.
§61.56	Flight review. Required every 24 calendar months to act as PIC. Minimum 1 hr ground + 1 hr flight. Not a “checkride” — endorsement only.
§61.57	Recent flight experience. Passengers: 3 takeoffs and landings in preceding 90 days, same category/class. Night passengers require full-stop landings.
§61.89	Student pilot limitations. No passengers, no compensation, not in furtherance of business. Solo endorsements required for each aircraft and each area.
§61.93	Solo cross-country. CFI must review planning and endorse logbook. Each solo XC to unfamiliar airports requires specific endorsement per flight.
§61.109	Private pilot experience. 40 hours total (35 approved course): 20 dual, 10 solo, 3 XC dual, 3 night dual (10 T/Os + landings), 3 hrs instrument reference, 3 hrs dual within 60 days of practical test.
§61.183	CFI eligibility. Hold commercial or ATP (ASEL); instrument rating; pass written exams. CFI certificate expires every 24 calendar months.
§61.189	CFI endorsements. Must sign logbook for each student, each training element. Use FAA-recommended language from AC 61-65. Maintain records.

KEY RULE ■ §61.57 Passenger Currency: 3 T/Os and landings in preceding 90 days, same category/class. Night currency requires full-stop landings. IFR currency governed separately under §61.57(c).

14 CFR Part 91 — Key Sections for CFIs

Section	Subject — CFI Teaching Points
§91.3	PIC responsibility. Final authority for safety of flight. May deviate from any rule in emergency; must submit report if requested by FAA.
§91.7	Airworthiness. PIC must determine aircraft is airworthy before each flight. Inoperative equipment evaluated per MEL or KOEL (14 CFR §91.213).
§91.9	POH/AFM on board. The Pilot’s Operating Handbook or FAA-approved flight manual must be carried in the aircraft for legal operation.
§91.17	Alcohol and drugs. 8-hour bottle-to-throttle; 0.04% BAC limit; no acting as crew while impaired by any drug, including prescriptions.
§91.103	Preflight action. PIC must review all available information: weather, fuel, NOTAMs, alternates (IFR), runway lengths, and aircraft performance data.
§91.113	Right-of-way. Distress > balloons > gliders > airships > airplanes > rotorcraft. Converging: yield to aircraft on right. Overtaken: has right-of-way.
§91.119	Minimum safe altitudes. Congested: 1,000 ft above highest obstacle within 2,000 ft radius. Non-congested: 500 ft AGL. Open water: 500 ft from persons.
§91.151	VFR fuel. Day: destination + 30 min. Night: destination + 45 min. Both at normal cruise power. IFR: destination + alternate + 45 min.
§91.155	VFR weather minimums by airspace class. Class G below 1,200 ft day: 1 sm, clear of clouds. Teach by airspace class using the cloud clearance table.
§91.159	VFR cruising altitudes. Above 3,000 ft AGL: odd thousands +500 ft eastbound (0°–179°); even thousands +500 ft westbound (180°–359°).
§91.205	Required equipment VFR day/night. Mnemonics: TOMATO FLAMES (day) + FLAPS (night). IFR adds GRABCARD. Teach students to derive, not memorize only.
§91.409	Inspections. Annual: every 12 calendar months. 100-hr: required for hire. Altimeter/static: every 24 months for IFR. Transponder: every 24 months.

CRITICAL ■ §91.205 TOMATO FLAMES (Day VFR): Tachometer, Oil pressure, Manifold pressure [if used], Airspeed indicator, Temperature [liquid-cooled engine], Oil temperature, Fuel gauges, Landing gear indicator, Altimeter, Magnetic compass, ELT, Seat belts. Night adds FLAPS: Fuses, Landing light, Anti-collision lights, Position lights, Source of power.

49 CFR Part 830 | Advisory Circulars & SAFOs | ACS/PTS | POH/AFM | AIM

49 CFR Part 830 — NTSB Notification and Reporting

Part 830 governs when operators must notify the NTSB and what must be preserved after an accident or incident. This is FAA-adjacent authority — it comes from the National Transportation Safety Board, not the FAA, but violations carry serious consequences.

Term / Rule	Definition and CFI Teaching Points
Accident	Occurrence where any person suffers death or serious injury, or the aircraft receives substantial damage. Substantial damage adversely affects structural strength, performance, or flight characteristics. Engine failure alone is generally NOT substantial damage.
Incident	Occurrence other than accident that affects or could affect safety. Some incidents require immediate NTSB notification: flight control malfunction, in-flight fire, in-flight structural failure, crew incapacitation, near mid-air collision.
Immediate Notification §830.5	Operator must notify nearest NTSB field office immediately (fastest available means) after an accident or listed serious incident. “Immediately” = as soon as practicable. Do not wait for investigation to begin.
Preserve Wreckage §830.10	Preserve wreckage, cargo, mail, records, and instruments until NTSB releases. May move wreckage only to protect from further damage, protect the public, or remove persons. Document original position before moving anything.
Report Required §830.15	Accident report must be filed within 10 days. Incident reports filed on request. Filed with NTSB field office. CFIs must know the 10-day timeline — oral exam staple.

Advisory Circulars, INFOs, and SAFOs

Type	Purpose and Authority
Advisory Circular (AC)	FAA guidance — NOT regulatory. Provides acceptable means of compliance. Key ACs: 61-65 (endorsements), 60-22 (ADM), 91-73 (Part 91 ramp). Cite in lesson plans; direct students to relevant ACs.
INFO	Information for Operators. Targeted safety notices from FAASTeam. Not regulatory; useful for current operational guidance.
SAFO	Safety Alert for Operators. Communicates safety-critical information and recommended actions. Not regulatory but reflects FAA safety priorities. Review when issued.
NOTAM	Notice to Air Missions. TFRs, navaid outages, runway closures. Required preflight review under §91.103 for IFR and away from departure airport operations.

ACS and PTS — Certification Standards

The **Airman Certification Standards (ACS)** replaced the Practical Test Standards (PTS) for most certificates beginning in 2016. The ACS integrates knowledge, risk management, and skill into each task — matching the structure of this lesson plan series.

Doc	Key Points for CFIs
ACS	Current standard for most FAA certificates. Defines Knowledge (K), Risk Management (R), and Skills (S) per task. DPEs evaluate to ACS. CFIs must teach to ACS — not just maneuvers. Free at FAA.gov.
PTS (legacy)	Still used where ACS is not yet released. Areas of Operation contain Tasks. Know which document applies to each certificate your student is pursuing.
FAA-S-ACS-25	CFI Airplane ACS governing this checkride. Area II (Technical Subject Areas) is the oral exam standard. Demonstrate *instructional* knowledge, not just personal knowledge.

Pilot’s Operating Handbook (POH) / AFM

The POH or FAA-Approved Airplane Flight Manual (AFM) is the primary reference for that specific aircraft. It must be on board (§91.9) and current. The standard 9-section GAMA format makes navigation consistent across manufacturers:

§	Title — Content Summary
1	**General** — Airplane description, engine specs, definitions
2	**Limitations** — Speeds (Vne, Vno, Va, Vs), weight, CG, engine limits, placards. **Has regulatory authority.**
3	**Emergency Procedures** — Engine failure, fire, electrical failure. Immediate action items must be memorized; details reference the book.
4	**Normal Procedures** — Checklists: preflight through shutdown
5	**Performance** — Takeoff/landing, climb, cruise charts. Teach chart use.
6	**Weight & Balance** — Loading graphs and moment envelopes
7–9	**Systems, Handling, Supplements** — How systems work; ground ops; FAA-approved additions for installed avionics (must be current).

Aeronautical Information Manual (AIM)

The AIM is the FAA’s official guide to the NAS. **Not regulatory** — advisory and explanatory. Updated twice yearly. Chapters: Navaids (1), Lighting (2), Airspace (3), ATC Procedures (4), Air Traffic (5), Emergency (6), Safety of Flight (7), Medical (8). Direct students to the AIM for the “why” behind regulations.

SECTION 5 — RISK MANAGEMENT, TEACHING THE TASK — AI.II.J.R1 & S1

AI.II.J.R1 — Expired Publications Risk

The ACS identifies one specific risk element for this task: the use of expired charts, manuals, or publications without current updates. This is deceptively common. Teach students to treat every publication as perishable and establish a habit of verifying currency before each flight and before each lesson.

Publication	Currency Check — How and Where
Sectional Chart	Effective 56 days. Date printed on cover. NOTAM NOTAMs may update before expiration. EFBs update automatically — verify database subscription is current.
Terminal Area Chart	Effective 56 days. Same cycle as sectional. Class B airports only.
Chart Supplement	Effective 56 days. Includes airport information, frequencies, procedures. Required for IFR alternates (§91.169).
POH/AFM	Must be current revision with all FAA-approved supplements. Check revision pages. STC supplements must be installed when the STC is installed. Avionics database (GPS, WAAS) must be current for IFR use (per AIM 1-1-17, for RAIM).
14 CFR	e-CFR.gov is the most current source. Printed copies go out of date. Regulations change via Federal Register rulemaking — always verify online.
AIM	Updated twice yearly (roughly March and September). Previous editions should be retired or clearly marked superseded.

■ ***Risk Note:*** *Students and CFIs frequently brief from outdated chart supplements or forgotten database subscription lapses. The "it was fine last month" mindset causes violations. Build a pre-lesson currency check into your standard briefing.*

AI.II.J.S1 — Teaching the Task

The applicant must *demonstrate how to teach* at least one of the K1–K6 elements. This is not a recitation exercise — the DPE is evaluating whether the applicant can structure and deliver instructional content clearly. Recommended approach:

Step	Teaching Technique
1. Choose a topic	Select one element (e.g., §61.57 currency). Know it cold. Pick an element with practical daily relevance to the student.
2. State the objective	Tell the student what they will be able to do after the lesson. "After this, you'll be able to determine whether you are legally current to carry passengers tonight."
3. Motivate	Why does this matter to this student right now? "You have 3 solo hours and want to take a friend flying next week."
4. Explain & demonstrate	Walk through the rule. Show it in the actual CFR. Use a real-world scenario — not abstract definitions.
5. Apply with scenario	Present a scenario: "You flew 3 night T/Os and touch-and-gos 75 days ago. Your friend wants to fly tonight at 8 PM. Legal?" (No — full stops required for night passenger currency.)
6. Check understanding	Ask the student to explain it back, or create their own scenario. Correct misconceptions immediately with reference to the regulation.

Instructor Notes — Common Oral Exam Traps

Trap	Correct Answer
"When does my student pilot certificate expire?"	It doesn't. Student pilot certificates are issued without expiration (post-2016). Solo endorsements do expire (§61.87 — 90 days).
"Is the AIM legally binding?"	No. The AIM is advisory. However, failure to follow AIM guidance may constitute careless or reckless operation under §91.13.
"My logbook was destroyed in a flood. Am I legal to fly?"	Yes — the logbook proves training, but the certificate is what grants privileges. Recreate the logbook from records, instructor endorsements, and school records.
"Do I need the POH on board a rental?"	Yes. §91.9 requires the POH/AFM to be on board. It must be the correct edition for that specific aircraft serial number.
"Is a SAFO the same as a regulation?"	No. SAFOs are non-regulatory safety communications. They cannot legally compel action, but ignoring a SAFO that relates to a known hazard could be evidence of negligence.

Instructor Note: *For the CFI practical, be prepared to open the actual regulation during the oral and teach from it live. DPEs are evaluating instructional ability — not just that you know the answer, but that you can explain it clearly to a student who doesn't.*

Area II, Task K — Logbook Entries & Certificate Endorsements

FAA-S-ACS-25 | CFI Airplane — Ground Lesson | AC 61-65 & 14 CFR §61.51, §61.189

Objective

The applicant demonstrates instructional knowledge of the requirements for completing pilot logbook entries and issuing certificate endorsements. The applicant explains the elements required by §61.51 for each logged flight, identifies when endorsements are required under 14 CFR Part 61, correctly writes endorsements using language consistent with AC 61-65, and identifies the risks associated with improper or missing endorsements. The applicant demonstrates the ability to teach at least one element to ACS standard.

References

- 14 CFR §61.51 — Pilot Logbooks
- 14 CFR §61.189 — Flight Instructor Records
- 14 CFR §61.87 — Student Pilot Solo Endorsements
- 14 CFR §61.93 — Student Pilot XC Endorsements
- 14 CFR §61.95 — Operations in Class B Airspace
- 14 CFR §61.56 — Flight Review
- 14 CFR §61.57 — IPC (Instrument Proficiency Check)
- AC 61-65 — Certification: Pilots and Flight Instructors (Current Edition)
- FAA-H-8083-25C — PHAK

Delivery Format

- Ground lesson with an actual student logbook and AC 61-65 open — 45–60 min
- Have student write a practice endorsement using the AC 61-65 template language
- Use a blank logbook page to practice filling in a complete, compliant entry
- Scenario: “You just completed your student’s first solo. What do you write? Where?”

ACS Knowledge Elements

Code	Element
AI.II.K.K1	Logbook or training record entry requirements (§61.51)
AI.II.K.K2	Endorsement requirements and CFI recordkeeping (§61.189)
AI.II.K.K3	Endorsements for student solo flight privileges (§61.87, §61.93, §61.95)
AI.II.K.K4	Endorsements for pilot certificates, ratings, and reviews (§61.56, §61.57, §61.31)

ACS Risk Management

Code	Element
AI.II.K.R1	Improper, expired, or missing endorsements allowing unpermitted solo or XC flight
AI.II.K.R2	Inaccurate logbook entries affecting currency determinations and certificate eligibility

ACS Skills

Code	Element
AI.II.K.S1	Correctly write logbook endorsements consistent with AC 61-65 language
AI.II.K.S2	Correctly complete and evaluate pilot logbook entries per §61.51

Motivation

A missing endorsement grounds your student. An improper one can invalidate a checkride. A solo student flying without a valid endorsement means the CFI is legally exposed and the student is flying illegally — regardless of proficiency. Logbooks are legal documents. Endorsements are contracts of competency. Every CFI must be able to write them precisely, from memory, and know exactly which regulation each one satisfies. This lesson eliminates guesswork and builds the habits that protect both the student and the CFI.

SECTION 2 — §61.51 REQUIRED LOGBOOK ENTRY ELEMENTS

Under §61.51(b)(1), every logged flight or lesson must contain the following elements. The FAA does not prescribe a specific logbook format, but all elements must be present for a flight to count toward any aeronautical experience or currency requirement. Teach students to complete every column on every flight.

#	§61.51(b)(1) Required Element	What to Record — CFI Teaching Points
(i)	**Date**	Date of the flight or lesson. Month/Day/Year. Required for every entry, no exceptions.
(ii)	**Total flight time or lesson time**	Logged in tenths of an hour. Flight time begins when the aircraft moves under its own power for the purpose of flight and ends when it comes to rest after landing (§1.1 definition). Ground training sessions use lesson time, not flight time.
(iii)	**Departure and arrival locations**	ICAO identifier (e.g., KRAL) for each airport. For lessons not involving flight, the location where training was given. For XC flights, list all intermediate stops.
(iv)	**Type and identification of aircraft**	Make and model (e.g., C172S) AND the N-number / aircraft registration. Both are required. Category and class may be implicit from make/model but should be noted when logging toward certificate or rating experience requirements.
(v)	**Name of safety pilot** (if required)	Required only when a safety pilot is used for simulated instrument flight under §91.109. The safety pilot's name and certificate number should appear in the remarks column.
(vi)	**Type of pilot experience or training**	How the time is categorized: solo, PIC, SIC, dual received, ground trainer, simulator, instrument (actual or simulated). This is the most misunderstood column — a student can log both dual received AND PIC time on the same flight under §61.51(e)(1).
(vii)	**Conditions of flight**	Day or night (per the Part 1 definition of night). Actual IMC or simulated instrument. Night is *not* simply after sunset — it is between the end of evening civil twilight and the beginning of morning civil twilight. Night currency requires full-stop landings (§61.57(b)).

Example: Completed Logbook Entry (Training Flight)

DATE §61.51(b)(1)(i)	AIRCRAFT TYPE	IDENT (N-Number)	FROM / TO Locations	DAY Hours	NIGHT Hours	DUAL RCVD	SOLO	PIC	TOTAL TIME	REMARKS / ENDORSEMENTS / SAFETY PILOT NAME
04/04/26	C172S SEL	N12345	KRAL KONT	1.2		1.2			1.2	Pattern work, stalls, slow flight. Dual with J. Smith CFI #1234567
04/05/26	C172S SEL	N12345	KRAL KRAL	0.8			0.8	0.8	0.8	First supervised solo — 3 solo T/Os & full-stop landings. Pre-solo endorsements on file.
04/10/26	C172S SEL	N12345	KRAL KSDL-KRY N-KRAL	2.3			2.3	2.3	2.3	Solo XC. Student planned route. Specific XC endorsement per §61.93(c)(2) given day of flight.

Row 2 (highlighted amber) = first supervised solo. The endorsement is written in the student's logbook AND in the CFI's own records (§61.189). Each column maps to one of the seven §61.51(b)(1) required elements.

CRITICAL ■ §61.51(a): Logbooks are required to establish pilot certificate/rating eligibility and currency. While the FAA does not require a specific logbook format, all §61.51(b)(1) elements MUST be present for a flight to count toward any aeronautical experience requirement. Incomplete entries can invalidate hours at a checkride. — **Instructor Note:** Remind students that a student pilot acting as sole manipulator on a solo flight logs both **Solo** time AND **PIC** time — these are not mutually exclusive columns.

Certificate Endorsements — Student Pilot Solo Privileges

Advisory Circular 61-65 provides the FAA-recommended language for every required endorsement. Use this language verbatim or substantially equivalent wording. Before a student can solo, a CFI must verify three prerequisites and then complete five endorsements. The memory aid **TIM loves BCN OP** captures all eight steps in sequence.

T	I	M	B	C	N	O	P
TSA	**IACRA**	**MEDICAL**	**§61.87(b)**	**§61.87(c)**	**§61.87(n)**	**§61.87(o)**	**§61.87(p)**
Citizenship & background check required first	Student pilot certificate via FAA IACRA system	3rd class medical (or BasicMed / Sport Pilot LSI)	Pre-solo aeronautical knowledge test endorsement	Pre-solo flight training endorsement	Solo flight endorse (aircraft-specific 90-day)	Solo flights within 25 nm of airport endorsement	Repeated solo XC flights same route endorsement
49 CFR §1552	*§61.89*	*§61.23*	*AC 61-65 A-3*	*AC 61-65 A-4*	*AC 61-65 A-6*	*AC 61-65 A-7*	*AC 61-65 A-11*

■ **Memory Aid ■ TIM loves BCN OP — Student Pilot Solo: 3 Prerequisites + 5 Endorsements** **T**SA check • **I**ACRA student pilot certificate • **M**edical — then — §61.87(**b**) knowledge test endorsement • §61.87(**c**) pre-solo flight training endorsement • §61.87(**n**) solo flight endorsement (90-day, aircraft-specific) • §61.87(**o**) solo within 25 nm endorsement • §61.87(**p**) repeated solo XC flights endorsement. No student flies solo without ALL of TIM. No student flies solo without BCN. OP unlocks local and XC solo privileges beyond the home airport. **TIM loves BCN OP is the absolute minimum — your student may still need additional endorsements depending on the planned flight: Class B airspace (§61.95(a)), Class B primary airport (§61.95(b)), or a specific solo XC to an unfamiliar airport (§61.93(c)(2)).**

§61.87 Student Pilot — Solo Flight Endorsements

1. Pre-Solo Aeronautical Knowledge Test [AC 61-65 Endorsement A-3 | §61.87(b)]

```
I certify that [First name, MI, Last name] has satisfactorily completed the pre-solo aeronautical knowledge test of §61.87(b) for the [make and model aircraft]. /s/ [Signature] [Date] J. Smith CFI #1234567 Exp. 12/31/26
```

2. Pre-Solo Flight Training [AC 61-65 Endorsement A-4 | §61.87(c)(1)]

```
I certify that [First name, MI, Last name] has received the required pre-solo flight training of §61.87(c) in a [make and model aircraft]. I find [him/her/them] competent to make solo flights. /s/ [Signature] [Date] J. Smith CFI #1234567 Exp. 12/31/26
```

3. Student Solo Flight (Initial & Recurring) [AC 61-65 Endorsement A-6 | §61.87(n)]

```
I certify that [First name, MI, Last name] has received solo flight training in the past 90 days and [he/she/they] is competent to make solo flights in a [make and model aircraft]. /s/ [Signature] [Date] J. Smith CFI #1234567 Exp. 12/31/26
```

KEY RULE ■ §61.87(n): The solo endorsement is valid for 90 calendar days. You MUST re-endorse every 90 days for continued solo flight. No re-endorsement = student cannot legally solo, regardless of proficiency.

4. Repeated Solo XC Flights (Same Route) [AC 61-65 Endorsement A-11 | §61.93(b)(1)]

```
I certify that [First name, MI, Last name] has received solo XC flight training, and I find [him/her/them] competent to make repeated solo XC flights over the route from [departure] to [destination] via [route] under VFR with [conditions or limitations]. /s/ [Signature] [Date] J. Smith CFI #1234567 Exp. 12/31/26
```

§61.93 Solo XC & §61.95 Class B/C/D Endorsements

5. Pre-Solo XC Flight Training [AC 61-65 Endorsement A-9 | §61.93(c)(1)]

```
I certify that [First name, MI, Last name] has received the pre-solo XC flight training required by §61.93(c)(1). /s/ [Signature] [Date] J. Smith CFI #1234567 Exp. 12/31/26
```

6. Specific Solo XC Flight (Each Unfamiliar Airport) [AC 61-65 Endorsement A-10 | §61.93(c)(2)]

```
I certify that [First name, MI, Last name]'s solo XC flight to [destination airport] via [route] has been reviewed and found to meet the requirements of §61.93(c)(2). Limitations [if any]. /s/ [Signature] [Date] J. Smith CFI #1234567 Exp. 12/31/26
```

Instructor Note: *Each XC to an unfamiliar airport requires its own specific endorsement on the day of the flight or the day before. Review the student's planning: weather, NOTAM, fuel, route, alternates. Your signature means you found it safe to proceed.*

7. Solo Flight in Class B/C/D Airspace [AC 61-65 Endorsement A-12 | §61.95(a)]

```
I certify that [First name, MI, Last name] has received the training required by §61.95(a) in [name of Class B/C/D] airspace. I find [him/her/them] competent for solo flight operations in that airspace. /s/ [Signature] [Date] J. Smith CFI #1234567 Exp. 12/31/26
```

8. Solo Flight to/from a Class B Primary Airport [AC 61-65 Endorsement A-13 | §61.95(b)]

```
I certify that [First name, MI, Last name] has received the training required by §61.95(b) for solo flight to and from [name of Class B primary airport]. I find [him/her/them] competent for solo operations to/from that airport. /s/ [Signature] [Date] J. Smith CFI #1234567 Exp. 12/31/26
```

CRITICAL ■ §61.95(b) Class B solo airport endorsements must name the specific Class B airport. A general Class B airspace endorsement does NOT cover landing at the primary airport. Two endorsements are required: one for the airspace (§61.95(a)) and one for the airport (§61.95(b)).

Certificate Endorsements — Knowledge Tests, Checkrides, Reviews & Special Qualifications

Written Exam, Pre-Checkride, Flight Review & IPC

9. Aeronautical Knowledge Test [AC 61-65 A-1 | §61.35(a)(1)]

I certify that [First name, MI, Last name] has received the training required by §61.35(a)(1). I find [him/her/them] prepared for the [name of knowledge test] knowledge test.
/s/ [Sig] [Date] J. Smith CFI #1234567 Exp. 12/31/26

10. Pre-Practical Test (Checkride) [AC 61-65 A-2 | §61.39(a)(6)(i)&(ii)]

I certify that [First name, MI, Last name] has received and logged the training time required by §61.109 and is prepared for the private pilot practical test.
/s/ [Sig] [Date] J. Smith CFI #1234567 Exp. 12/31/26

13. Flight Review [AC 61-65 A-65 | §61.56(a)]

I certify that [First name, MI, Last name], holder of certificate No. [cert #], has satisfactorily completed a flight review of §61.56(a) on [date].
/s/ [Sig] [Date] J. Smith CFI #1234567 Exp. 12/31/26

14. Instrument Proficiency Check (IPC) [AC 61-65 A-67 | §61.57(d)]

I certify that [First name, MI, Last name] has satisfactorily demonstrated the IFR skills and passed the IPC of §61.57(d) in a [make and model] aircraft.
/s/ [Sig] [Date] J. Smith CFI #1234567 Exp. 12/31/26

KEY RULE ■ Pre-checkride endorsement: Valid 60 calendar days. Must certify: (1) required training logged AND (2) student is prepared. Both statements are required. If checkride not completed within 60 days, new endorsement required.

KEY RULE ■ Flight Review: Min 1 hr ground + 1 hr flight. No required maneuver list. Must review Part 61 currency rules and Part 91 rules. Valid 24 calendar months. No pass/fail.

Special Qualification Endorsements — §61.31 (One-Time, No Expiration)

Qualification	Definition	Reg
High-Performance	Engine >200 HP. Includes most retractable singles.	§61.31(f)
Complex Aircraft	Retractable gear + flaps + controllable pitch prop (all 3).	§61.31(e)
High-Altitude	Pressurized aircraft with service ceiling or MEA above FL250.	§61.31(g)
Tail-Wheel	Conventional gear (tail dragger). Required for solo/PIC.	§61.31(i)

Instructor Note: *One-time endorsements do not expire. Write in pilot's logbook AND keep a CFI copy per §61.189.*

CFI Recordkeeping Requirements (§61.189)

Requirement	Details
Copy of each endorsement	CFI must maintain a signed copy of every endorsement given to a student.
3-year retention	Records kept for at least 3 years. No format required — notebook, spreadsheet, or photocopy all qualify.
What to record	Student name, date, endorsement type, regulatory basis, your signature. Photocopy of the logbook page satisfies the requirement.
Best practice	CFI endorsement binder, one section per student. Date-stamp all photocopies.

Common CFI Errors — Endorsements & Logbooks

Error	Consequence
Missing CFI expiration date	Technically incomplete per AC 61-65 — may be challenged by DPE
Expired solo endorsement (>90 days)	Student legally cannot solo — violation if they fly
No aircraft type in solo endorsement	Endorsement does not cover that specific aircraft
Class B: airspace endorse, no airport	Does not satisfy §61.95(b) for Class B primary airport landing
Pre-checkride endorse >60 days old	Applicant cannot begin practical test — new endorsement required
CFI keeps no copy of endorsements	§61.189 violation; legally exposed if student disputes training
Logbook entry missing one TIM BCN OP element	Hours may not count toward aeronautical experience requirements

Teaching Scenarios, Quick Reference & Common Errors

SECTION 3 — TEACHING TIPS, SCENARIO DEBRIEF & QUICK REFERENCE

CFI Teaching Scenarios

Use these scenarios to build students' regulatory thinking — not just their ability to recall answers, but their ability to reason through edge cases the way a DPE will probe them during the oral exam.

Scenario	Teaching Points
"Your student's 90-day solo endorsement expires tomorrow. Can they solo today?"	Yes — if today is within the 90-day window. But re-endorse now so they don't lose solo privileges tomorrow mid-lesson. Teach students to track their own endorsement expiration.
"A student soloed 3 months ago. His logbook shows the endorsement. Can he solo again today?"	No — 90-day solo endorsement has expired. Cannot solo without a fresh CFI endorsement, even if fully proficient. This is a legal requirement, not a proficiency check.
"Your student wants to fly solo from KSDL to KRYN. What endorsements do they need?"	§61.87(n) current solo flight endorsement (aircraft-specific, within 90 days) + §61.93(c)(2) specific solo XC endorsement for this route (reviewed day of flight). KSDL is Class D and KRYN is Class D — check if a §61.95(a) airspace endorsement is needed depending on the departure/arrival procedures. TIM loves BCN OP covers the baseline; the specific XC and airspace endorsements are on top of that.
"A pilot comes to you for a flight review. After 1.5 hrs total, you don't feel they're ready. What do you do?"	Do NOT endorse. The flight review is not a checkride — you are not required to pass or fail them. Simply don't endorse and tell them additional training is needed. Log the time as dual instruction given.
"A pilot asks you to back-date a logbook entry they forgot to make 6 months ago. Is that OK?"	No. Altering logbook records is falsification of official records — grounds for certificate action. The correct approach is to make a new entry with the current date and a note that it's a late entry for [original date].

Endorsement Quick Reference — CFI Binder Card

Situation	Endorsement(s) Required	Reg
Pre-solo knowledge test	Knowledge test sign-off	§61.87(b)
Pre-solo flight training	Flight training competency	§61.87(c)
Student first solo	Solo flight endorsement	§61.87(n)
Solo flight after 90 days	Renewed solo endorsement	§61.87(n)
Solo flight, new aircraft type	Aircraft-specific solo	§61.87(n)
XC training received	Pre-solo XC training	§61.93(c)(1)
Specific solo XC flight	Specific route sign-off	§61.93(c)(2)
Solo in Class C/D	Airspace endorsement	§61.95(a)
Solo in Class B	Airspace + Airport (2 needed)	§61.95(a)(b)
Knowledge test (written)	Written test ready	§61.35(a)(1)
Practical test (checkride)	Pre-checkride ready (60-day)	§61.39
Flight review	FR satisfactorily completed	§61.56(a)
IPC (IFR currency lapsed)	IPC completed	§61.57(d)
High-performance aircraft	HP qualified (one-time)	§61.31(f)
Complex aircraft	Complex qualified (one-time)	§61.31(e)
High-altitude (pressurized)	HA qualified (one-time)	§61.31(g)
Tail-wheel aircraft	Tail-wheel qualified (one-time)	§61.31(i)

■ **Memory Aid ■ TIM loves BCN OP — Student Solo: 3 Prerequisites + 5 Endorsements (in order)** **T**SA background check • **I**ACRA student pilot certificate • **M**edical (3rd class) — then — §61.87(**b**) knowledge test endorsement • §61.87(**c**) pre-solo flight training endorsement • §61.87(**n**) solo flight endorsement (90-day, aircraft-specific) • §61.87(**o**) solo within 25 nm endorsement • §61.87(**p**) repeated solo XC same-route endorsement.

Area II, Task M — Night Operations

FAA-S-ACS-25 | CFI Airplane — Ground Lesson | PHAK Ch. 17, AIM 2-1, 14 CFR §91.205(c), §61.57(b)

Objective

The applicant demonstrates instructional knowledge of night operations: how the human eye functions at night, physiological factors affecting night vision, and mitigation of visual and vestibular illusions that cause spatial disorientation. The applicant identifies night VFR equipment requirements, airport lighting systems, pilot-controlled lighting, and currency requirements. The applicant demonstrates the ability to teach at least one element to ACS standard.

References

- FAA-H-8083-25C (PHAK) — Ch. 17: Aeromedical Factors (Night Vision, Illusions)
- FAA-H-8083-25C (PHAK) — Ch. 14: Airport Traffic Area & Lighting
- AIM — Section 2-1: Airport Lighting Aids
- 14 CFR §91.205(c) — Night VFR Equipment Requirements
- 14 CFR §61.57(b) — Night Takeoff and Landing Currency
- 14 CFR §1.1 — Definition of Night

Delivery Format

- Ground lesson with PHAK Ch. 17 and AIM 2-1 diagrams open — 60–75 min
- Demonstrate off-center viewing technique with a pen light in a darkened room
- Scenario: “You’re on a 5-mile final at night over black terrain — what are you relying on?”

ACS Standards — AI.II.M (Knowledge ■ Risk ■ Skills)

Code	Element
Knowledge	
K1	Applicable regulations for night flight requirements
K2	Lighting systems: position, anti-collision, landing lights
K3	Personal and aircraft equipment for night flight
K4	Airport lighting: runway, taxiway, approach, beacon
K5	Pilot vision at night — rods vs. cones, scotopic/photopic
K6	Night visual illusions and mitigation techniques
K7	Spatial disorientation — vestibular and somatogravic illusions
K8	Night flight planning and navigation
K9	Night emergency procedures
Risk	
R1	Night visual illusions — CFIT (black hole, dark terrain)
R2	Spatial disorientation from vestibular/visual limits
R3	Degraded vision from fatigue, hypoxia, medications
R4	Failure of aircraft or instrument lighting
R5	Weather deterioration / inadvertent IMC at night
R6	Night flight over unlit terrain, mountains, or water
R7	Impaired night vision from cockpit light mismanagement
Skills	
S1	Demonstrate instructional knowledge of night operations

Motivation

Night flight is one of the most physiologically demanding environments a pilot enters. The human eye was not designed for cockpit work in the dark — and the vestibular system will lie. The CFI who understands why night is different — at the cellular level of the retina, at the physics of airport lighting, at the perceptual level of the black hole approach — is the CFI who can protect a student from the leading cause of night VFR accidents: CFIT.

Human Vision at Night — Physiology & Technique

SECTION 2 — THE HUMAN EYE: RODS, CONES, AND THE THREE VISION MODES

The retina contains two types of photoreceptors: **cones** and **rods**. Understanding their distinct roles is the foundation of all night vision technique. The eye operates in one of three modes depending on ambient light level:

Vision Mode	Light Level	Primary Receptors	Color Perception	Acuity	Key Implication for Night Flying
Photopic (Day Vision)	Bright sunlight >3 cd/m²	Cones (fovea) Center of field	Full color	Highest — reads fine print	Normal daytime operations. Focus center of vision on target.
Mesopic (Twilight)	Dusk/dawn Intermediate	Both rods & cones	Reduced color	Moderate	Transition zone — neither system fully optimized. Most deceptive period for VFR.
Scotopic (Night Vision)	Starlight, moonless <0.001 cd/m²	Rods Periphery of retina	No color (gray only)	Lowest — no fine detail	Off-center viewing required. Night blind spot at 5–10° from fovea.

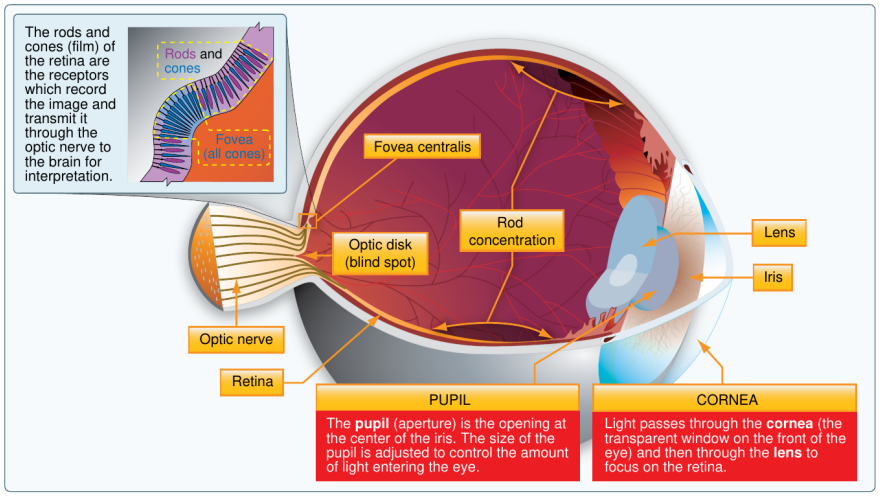


Figure 17-12. *The human eye.*

Fig. 17-12 — Anatomy of the Human Eye (PHAK Ch. 17)

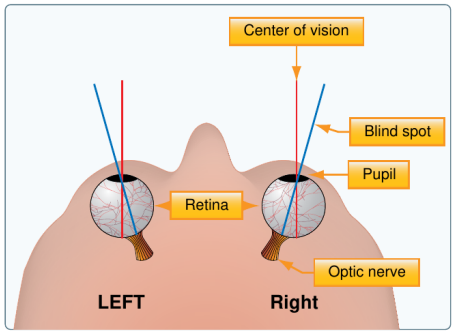


Figure 17-14. *Central blind spot.*

has in each eye. Under normal binocular vision conditions (both eyes are used together), this is not a problem because an object cannot be in the blind spot of both eyes at the same time. On the other hand, where the field of vision of one eye is obstructed by an object (windshield divider or another aircraft), a visual target could fall in the blind spot of the

Fig. 17-14 — Central Blind Spot — Foveal Region (PHAK Ch. 17)

Cone Distribution and the Foveal Blind Spot

Cones are concentrated in the **fovea**, a small pit at the center of the retina. The fovea delivers the sharpest daytime vision but contains almost no rods. During night flight, staring directly at an object — runway end, obstacle, traffic — places that object on the cone-rich but rod-poor fovea. The object appears to disappear or dim significantly, a phenomenon called the **night blind spot**.

Off-Center Viewing Technique (PHAK 17-22)

To use the rod-rich periphery, the pilot must look **5–10 degrees to the side** of the object of interest, keeping it slightly off-center in the visual field. This technique places the object on the more sensitive peripheral retina where rods are densely packed. Practiced night scanning moves in slow, deliberate 10–degree sectors, pausing briefly at each position rather than sweeping continuously.

Dark Adaptation (PHAK 17-21)

Rods require approximately **30 minutes of darkness** to fully dark-adapt by building up rhodopsin (visual purple), the photochemical that enables scotopic sensitivity. Cones adapt in about 5–7 minutes. Critical points for the CFI to teach:

- Exposure to **bright white light** (including a phone screen or landing light reflection) destroys dark adaptation in seconds — requires the full 30-minute rebuild
- **Red cockpit lighting** preserves dark adaptation because rods are relatively insensitive to red wavelengths — use red light for chart reading
- Hypoxia, smoking, vitamin A deficiency, and certain medications all reduce night visual acuity by impairing rhodopsin production
- Even at full dark adaptation, scotopic acuity is far below photopic — instruments must be cross-checked constantly; do not rely on outside references alone

Vestibular System

The inner ear's semicircular canals detect angular acceleration. At night, when visual references are lost or degraded, the vestibular system becomes the dominant source of orientation cues — and it will lie. (PHAK Fig. 17-3)

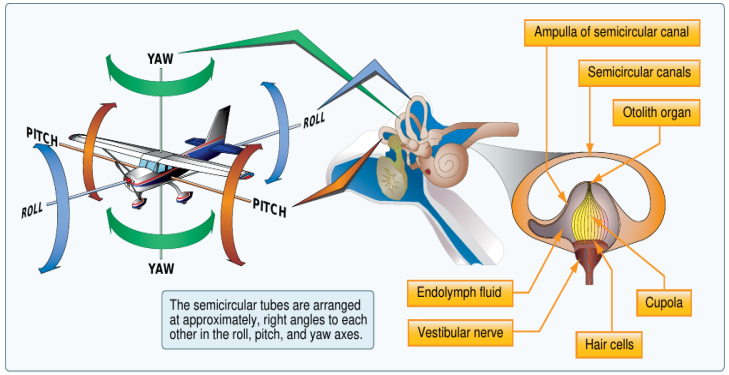


Figure 17-3. *The semicircular canals lie in three planes and sense motions of roll, pitch, and yaw.*

*Three semicircular canals (superior, posterior, lateral) sense rotation in each anatomical plane. Sustained turns at constant rate cause the fluid to stop moving, creating the illusion of straight-and-level flight. When the turn is stopped, the opposite sensation is felt — leading the pilot to roll back into the turn. This is the **leans**.*

KEY RULE ■ At night, **trust instruments, not sensations.** The vestibular system adapts to sustained motion — it will tell a pilot in a 30-second constant-rate turn that they are in straight-and-level flight.

CRITICAL ■ Hypoxia and night vision are directly linked. Even at 5,000 ft MSL, night visual acuity is measurably degraded by hypoxic effects on rod function. At 12,000 ft without supplemental oxygen, night vision is reduced by approximately **50%**. Oxygen use on night cross-countries is not optional — it is a direct safety measure. Smoking reduces night vision equivalent to an altitude increase of 8,000 ft.

Night Visual Illusions & Spatial Disorientation

SECTION 3 — VISUAL ILLUSIONS SPECIFIC TO NIGHT FLIGHT

■ ***Memory Aid: D–E–A–T–H*** *— Five Spatial Disorientation-Causing Illusions at Night (PHAK Fig. 17-20):* ***D****ark adaptation failure* ■ ***E****mpty field myopia* ■ ***A****utokinesis* ■ ***T****errain/featureless approach (black hole)* ■ ***H****orizon confusion (false horizon)*

Illusion	What the Pilot Perceives	Actual Condition	Mitigation / CFI Teaching Point
Autokinesis	A stationary point of light (star, tower light) appears to move slowly across the sky after staring at it for several seconds	Light is completely stationary. Motion is generated by random eye movements interpreted by the visual cortex as object movement.	Never fixate on a single light for more than a few seconds at night. Keep eyes scanning. If unsure whether a light is moving, look away and check instruments. Teach students this is why we scan — not just for traffic, but for perceptual accuracy.
False Horizon	A sloping cloud layer, row of lights on a hillside, or shoreline is perceived as the natural horizon, causing the pilot to bank toward the “flat” side	The actual horizon is obscured or absent. Visual reference is a ground-level feature misinterpreted as the horizon.	Cross-check attitude indicator immediately when outside references are ambiguous. Overwater night flight, flying above broken cloud layers, and approaches toward city skylines are all high-risk scenarios. If there is any doubt about the horizon, fly by instruments.
Featureless Terrain / Black Hole	On final approach over dark, unlit terrain with only runway lights visible, the pilot perceives a normal glidepath but is actually flying a dangerously low, flat approach. Runway appears further and higher than actual.	Without intermediate ground lighting, the visual cues that normally confirm glidepath are absent. The brain defaults to assuming a “normal” visual scene that doesn’t exist.	**Use VASI/PAPI on every night approach.** Never trust visual glidepath judgments over dark terrain. If no VASI/PAPI is available, use approach plate glidepath (ILS/RNAV) or published VFR traffic pattern altitude. Fly by numbers, not feel.
Empty Field Myopia	In conditions with no visual references (dark sky, overcast night), the eye relaxes to its resting focal length of approximately 3 feet, causing the pilot to stare at “nothing” effectively blind to distant objects	Eye is physiologically focused at arm’s length. Objects at distance—traffic, terrain, towers—are out of focus even though vision appears normal.	Scan instruments regularly. Use cockpit lighting and chart maps to force the eye to refocus at varying distances. Maintain active lookout even when visibility appears clear — clear dark sky does not mean you can see distant traffic.

Somatogravic Illusion	Rapid acceleration (e.g., go-around with full power) creates a pitch-up sensation. The pilot instinctively pushes forward to "correct" what feels like a nose-high attitude.	Aircraft is in normal climb attitude. The otoliths (linear acceleration sensors) interpret forward G-force as a nose-high pitch.	During night go-arounds and takeoffs, establish attitude by reference to instruments immediately. Teach students: *"If it feels like you're pitching up on the go-around at night, believe your AI, not your gut."* This illusion has caused gear-up or terrain strikes during low-visibility go-arounds.

The Black Hole Approach — Instructor Briefing Points

The black hole approach is one of the most lethal night visual illusions because it affects experienced pilots as much as students. The accident chain is predictable: VFR night flight, dark approach path over water or unlit terrain, pilot flying a visually normal-looking approach, aircraft below glidepath without CFIT warning until impact. The NTSB has attributed numerous fatal accidents to this illusion. The mitigation is procedural, not perceptual — use the electronic glidepath.

- Always brief the approach lighting environment before a night arrival
- If VASI/PAPI is inoperative, request it be NOTAMed and use an instrument approach
- Night VFR over water with no cultural lighting is IMC-equivalent from a risk standpoint
- Flying stabilized by airspeed and power — not visual glidepath — is the mitigation

CRITICAL ■ A black hole approach is indistinguishable from a normal approach until terrain contact. **If no VASI/PAPI is available at a dark destination, treat it as a night instrument approach environment and use all available electronic glidepath guidance.**

Vestibular Illusions at Night — Summary

Illusion	Cause	Effect
The Leans	Abrupt recovery from undetected bank; canals adapt to slow roll	Pilot feels tilted even when wings are level per AI. May hold aileron pressure against instruments.
Graveyard Spiral	Undetected slow entry into banked turn; pilot perceives straight-and-level	Bank steepens, nose drops, airspeed and G build. Pulling back tightens spiral.
Coriolis Illusion	Head movement during prolonged coordinated turn	Sudden violent tumbling sensation. Can cause pilot to make large, sudden control inputs.
Somatogravic (Pitch-Up)	Rapid forward acceleration	Perceived nose-high pitch. Pilot pushes forward. Can cause descent into terrain.
Elevator Illusion	Upward gust or updraft	Perceived climb. Pilot pushes forward. Can push aircraft below intended altitude.

■ ***Risk Note:*** *Night disorientation often begins before the pilot is aware of it. By the time the instruments confirm the situation, the aircraft may be in an unusual attitude. Teach* ***prevention*** *(scan, trust instruments) more than recognition — because recognition at night may come too late.*

Airport Lighting Systems

SECTION 4 — APPROACH, RUNWAY, AND TAXIWAY LIGHTING



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Fig. 14-33 — Runway Edge Lighting: White edge lights transition to Yellow in the last 2,000 ft. Blue taxiway lights are visible at left. (PHAK Ch. 14)

Visual Approach Slope Indicators (VASI / PAPI)

VASI and PAPI provide glidepath guidance to the runway threshold. They are the primary tool for preventing the black hole approach illusion. Available day and night; visible up to 20 miles at night.

System	Indication	Meaning
2-Bar VASI	Both bars WHITE	High — descend
2-Bar VASI	Near bar RED, far bar WHITE	On glidepath (3° nominal)
2-Bar VASI	Both bars RED	Low — climb immediately
PAPI (4-light)	4 WHITE	High — above 3.5° glidepath
PAPI (4-light)	2 WHITE / 2 RED	On glidepath
PAPI (4-light)	1 WHITE / 3 RED	Slightly low
PAPI (4-light)	4 RED	Dangerously low — go around

REIL & Approach Lighting

REIL: Two synchronized flashing white strobe lights at the threshold, one on each side. Identify the runway threshold against a complex lighting background. Extremely useful at unfamiliar airports at night. **ALS (MALSR):** 1,400-foot bar system extending from threshold plus 5 sequencing strobe “rabbits” pointing toward runway. Provides lateral and vertical orientation cues on approach.

> ***Instructor Note:*** *PAPI mnemonic:* ***2 White 2 Red = Right on the money. 4 Red = You’re dead.*** *PAPI is the most common and most critical night approach lighting system your students will encounter. Know it cold.*

Runway & Taxiway Lighting Colors

Color	Location	Meaning
WHITE	Runway edge (first portion)	Usable runway. Threshold to midpoint.
YELLOW	Runway edge (last 2,000 ft)	Caution zone / departure end.
RED	Runway end / threshold bar	Runway end. Stop or go-around territory.
GREEN	Threshold (from approach)	Beginning of usable landing surface.
BLUE	Taxiway edge lights	Taxiway only. Never land on blue.
GREEN	Taxiway centerline	Follow to exit after landing.
RED/WHITE	Runway guard lights	Hold short point. Verify ATC clearance.

Airport Beacon Flash Patterns

Flash Pattern	Airport Type
White–Green (alternating)	Lighted land airport
White–White–Green (2 whites)	Military airport
White–Yellow (alternating)	Lighted water airport
Green–Yellow–White (3 colors)	Lighted heliport

Beacon operating during daytime = airport below VFR minimums (ceiling <1,000 ft or visibility <3 SM). Standard practice, not a regulatory requirement.

Pilot-Controlled Lighting (PCL) — AIM 2-1-7

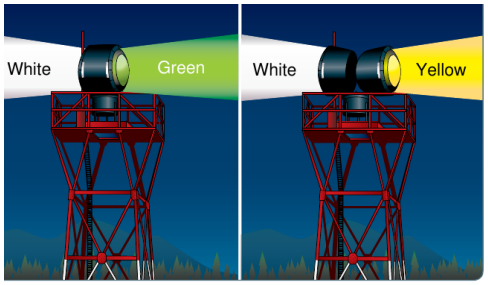
At uncontrolled airports, runway lighting is activated via CTAF mic clicks:

Clicks / 5 sec	Systems	Result
7 clicks	REIL, VASI, runway edge	High intensity (120 sec)
5 clicks	REIL, VASI, runway edge	Medium intensity (120 sec)
3 clicks	Runway edge only	Low intensity (120 sec)

KEY RULE ■ PCL resets the 15-min timer each activation. Transmit 7 clicks on CTAF 5–10 miles out on every night arrival at a PCL airport — then again short final.

Airport Lighting — Visual Reference (PHAK Figures)

FIGURES FROM FAA-H-8083-25C — APPROACH SLOPE, RUNWAY & TAXIWAY LIGHTING



igure 14-28. *Airport rotating beacons.*

Fig. 14-28 — Airport Rotating Beacon Flash Patterns (PHAK Ch. 14)

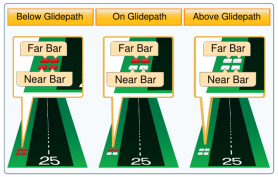


Figure 14-29. *Two-bar VASI system.*

A tri-color system consists of a single-light unit projecting a three-color visual approach path. Below the glidepath is indicated by red, on the glidepath is indicated by green, and above the glidepath is indicated by amber. When descending below the glidepath, there is a small area of dark amber. Pilots should not mistake this area for an "above the glidepath" indication. *[Figure 14-31]*

Fig. 14-29 — Two-Bar VASI — High / On-Path / Low Positions (PHAK Ch. 14)

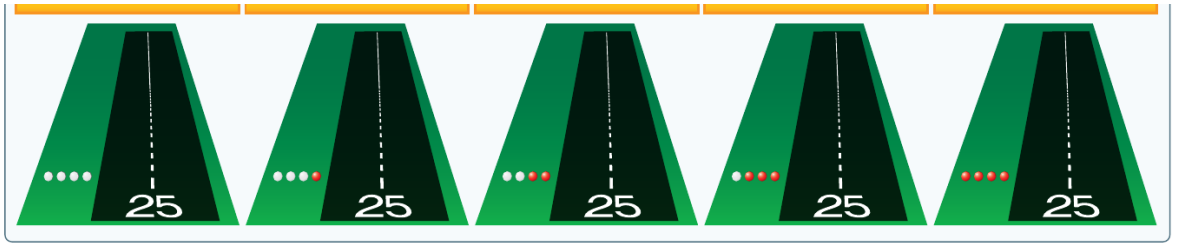


Figure 14-30. *Precision approach path indicator for a typical 3° glide slope.*

Fig. 14-30 — PAPI (4-Light) — All Five Glidepath Indications: 4W (high) ■ 3W1R ■ 2W2R (on-path) ■ 1W3R ■ 4R (dangerously low / go-around) (PHAK Ch. 14)



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Fig. 14-33 — Runway Edge Lights — White-to-Yellow Transition (PHAK Ch. 14)

Runway Edge Lighting Colors

- **White** — runway edge, threshold to midpoint (usable surface)
- **Yellow** — last 2,000 ft of runway (caution / departure end)
- **Red** — runway end lights; stop / go-around territory
- **Green** — threshold from approach side (start of usable surface)
- **Blue** — taxiway edge (never land on blue-lit surface)

Night VFR Regulations, Equipment, Planning & Operations

SECTION 5 — REGULATIONS AND REQUIRED EQUIPMENT (§91.205 / §61.57 / §1.1)

Definition of Night — 14 CFR §1.1

Night is defined as the period **from the end of evening civil twilight to the beginning of morning civil twilight**, as published in the American Air Almanac. This is *not* the same as sunset/sunrise. Civil twilight ends when the center of the sun is 6° below the horizon (approximately 20–30 minutes after sunset, depending on latitude and season).

Concept	Definition	CFI Note
Night (14 CFR §1.1)	End of evening civil twilight to beginning of morning civil twilight	This is when night logging begins, dark adaptation matters most, and night visual illusions are active.
Night Currency (§61.57(b))	3 full-stop takeoffs & landings at night, within 90 days, same category/class/type	Touch-and-go landings do NOT satisfy night currency. Must be full stop.
Night Logging (§61.51(b)(3)(i))	Flight time logged at night per the §1.1 definition	Students often log 'night' time beginning at sunset — this is incorrect. Begin night time at end of civil twilight.

Night VFR Equipment — §91.205(c) — The FLAPS Mnemonic

■ ***Memory Aid: F–L–A–P–S*** *— Night VFR additions beyond daytime (§91.205(b)) equipment:* ***F****uses (spare set or CBs)* ■ ***L****anding light (if for hire)* ■ ***A****nti-collision light system* ■ ***P****osition lights (red left, green right, white tail)* ■ ***S****ource of power (adequate for all installed equipment)*

Equipment Item	Regulation	Detail
Position (Nav) Lights	§91.205(c)(1)	Red = left wing, Green = right wing, White = tail. Required from sunset to sunrise. Steady burn, not flashing.
Anti-collision Lights	§91.205(c)(2)	Approved red or white flashing system. May be turned off by PIC if the safety of flight so requires (e.g., in clouds where reflection impairs vision).
Landing Light	§91.205(c)(3)	Required only if the aircraft is *operated for hire*. Highly recommended for all night ops regardless of regulatory requirement.
Spare Fuses	§91.205(c)(5)	One spare set, or three spare fuses of each kind required. Not applicable if CBs are installed. Important for night IFR.

Night Preflight — Additional Considerations

A standard preflight covers the aircraft. A night preflight also covers the pilot and the environment. Both must be airworthy.

- **Flashlight:** Carry two — one white for preflight, one red for cockpit use during the flight. Verify batteries on both before departure.
- **Aircraft lighting check:** Verify all position lights, anti-collision strobes, and landing light(s) functional on the ground. A burned landing light is not a minor issue at night.
- **Instrument/panel lighting:** Check that all instruments and radios have working backlighting. Adjust rheostat to dimmest readable level before taxiing.
- **Dark adaptation:** Spend 30 minutes in low light before the flight. Avoid bright screens and lights in the hour before departure.
- **Medications and alcohol:** Night vision is far more sensitive to physiological impairment. Self-assess using the IMSAFE checklist before every night flight.
- **Cockpit familiarity:** Know every control by touch before it's dark. Practice locating switches and selectors blindfolded during daytime training.

Night Navigation and Planning

- **Terrain clearance:** Add at least 1,000 ft to normal cruising altitude over mountainous or unfamiliar terrain. At night, terrain is invisible until it's too late.
- **Route planning:** Follow highways, rivers, or lighted cities. Avoid long over-water or unlit terrain segments under VFR.
- **Alternates:** Identify alternates with lighting and instrument approaches. Weather deterioration at night is harder to detect.
- **Checkpoints:** Use lighted landmarks. Unlighted towers are invisible at night — check sectional for obstruction symbols and carry conservative altitudes.
- **Lost procedures:** Climb for radio/GPS coverage. Contact ATC immediately. Night disorientation escalates faster than in day VMC.

■ ***Advisory:*** *Night VFR weather minimums are the same as day VFR in controlled airspace (3 SM, 500-1000-2000 ceiling/cloud clearances). However, the ability to visually detect weather deterioration is severely reduced at night. Treat any convective SIGMET or AIRMET Sierra as a no-go for night VFR.*

SECTION 6 — NIGHT TAKEOFF, TRAFFIC PATTERN, LANDING & EMERGENCY PROCEDURES

Takeoff

- Align with runway centerline using runway edge lights for orientation
- Use aircraft heading indicator to verify aligned with runway heading before rolling
- During roll, maintain centerline by edge light symmetry (equal spacing each side)
- Rotate and climb to traffic pattern altitude by reference to instruments and altitude — outside horizon may be indistinct
- Reduce cockpit lighting during climbout to allow dark adaptation to develop

Traffic Pattern

- Maintain altitude by instruments. Pattern altitude may not be visually apparent against a dark background.
- Use airport beacon and runway lighting to orient. Identify VASI/PAPI early in pattern.
- Turn base at the standard pattern point, confirmed by aircraft heading and distance — not by visual cues alone
- Begin VASI/PAPI crosscheck on base leg; do not wait until final

Approach & Landing

- Fly stabilized approach: airspeed, power, trim — do not chase the VASI visually
- The runway approach end will be the brightest feature visible. Aim for the threshold lighting, not the middle of the visible runway light string.
- Flare judgment is more difficult at night. Use landing light illumination of the runway surface for visual flare reference, not ground horizon.
- If the runway lights are the only visible reference (black hole), execute a go-around and reassess — do not trust visual glidepath alone

Night Emergency Procedures

Engine failure at night is the highest-stakes scenario in night VFR flight. Procedures must be memorized and practiced — cockpit task saturation in darkness makes checklist-only responses inadequate.

- **Engine failure in flight:** Establish best glide (memory item). Troubleshoot per checklist (fuel, ignition, primer in). Declare emergency on current frequency (121.5 as alternate). Squawk 7700. Aim for lighted areas — highways, lit fields, airports visible on sectional. At night, a lit road is preferable to a dark field.
- **Electrical failure:** Switch to backup battery if available. Use handheld flashlight/radio as backup. Position and anti-collision lights will be inoperative — declare emergency. Land as soon as practical.
- **Cockpit fire:** Execute published procedures. Land immediately if fire cannot be confirmed extinguished. Night amplifies disorientation during emergency — maintain aircraft control above all else.
- **Alternating between instruments and outside:** At night, always re-establish instrument scan immediately after any external task.

CRITICAL ■ At night, the first priority in *any* emergency is maintaining aircraft control by reference to instruments. Spatial disorientation is most likely to occur immediately following an emergency, when attention is diverted and situational awareness degrades. Altitude awareness is the second priority. Terrain clearance must be confirmed before any systems troubleshooting begins.

■ ***Risk Note:*** *Night fatigue is cumulative. A pilot who conducted multiple day flights before the night departure may be dangerously fatigued. Fatigue degrades decision-making, impairs night vision, and increases susceptibility to spatial disorientation. The FAA's IMSAFE checklist — especially the **F** for Fatigue — is non-optional before every night flight.*

CFI Teaching Guide — Instructional Knowledge & Risk Management

SECTION 7 — COMMON STUDENT ERRORS AND HOW TO ADDRESS THEM

Common Student Error	Root Cause	Instructor Correction / Teaching Strategy
Staring directly at objects at night rather than using off-center viewing	Daytime visual habit. Student not yet internalizing the photoreceptor physiology.	Demonstrate: ask student to stare directly at a dim star or far tower light for 5 seconds, then look 10° to the side. The object reappears brighter. Physiological demonstration is far more effective than explanation alone.
Flying the traffic pattern by outside visual reference alone at night	Overreliance on visual cues developed during daytime training. Pattern looks different at night.	Transition to instrument altitude awareness for pattern altitude. Emphasize: “The altimeter tells you if you’re at pattern altitude — not the ground.” Have student call out altitude at each leg.
Forgetting to activate PCL at dark airports	Habit not yet formed. Student may not be familiar with PCL-equipped airports.	Include PCL airports in night cross-country planning exercises. Build habit: every CTAF broadcast on night arrival includes 7 clicks regardless of lighting status.
Late or improper glidepath on night approach	Absence of VASI/PAPI or failure to track it. Black hole illusion active.	Require student to identify VASI/PAPI on base leg and begin tracking it before turning final. If no VASI/PAPI available, use RNAV/GPS glidepath or published traffic pattern altitude approach.
Logging night time beginning at sunset rather than end of civil twilight	Regulatory confusion. Students conflate sunset with night definition.	Correct during debrief. Use the §1.1 definition. Show how to calculate civil twilight end using AFD/supplement or phone app. Have students log correctly on every night flight.
Failing to brief instrument scan discipline before night departure	Daytime habit. Students do not expect disorientation in VMC night conditions.	Brief before every night flight: “At night, we fly by instruments and verify with outside references — not the other way around.” Make this an explicit reversal of daytime habit.

SECTION 8 — RISK MANAGEMENT SUMMARY (AI.II.M.R1 – R7)

Code	Risk Element	Mitigation Strategies
R1	Night visual illusions (CFIT via black hole / featureless terrain)	Use VASI/PAPI on every night approach. Treat dark approach environments as instrument approach environments. Never trust visual glidepath over unlit terrain.
R2	Spatial disorientation from vestibular / visual system limitations	Trust instruments above all. Brief disorientation prevention before every night flight. Practice unusual attitude recovery under foggles during day to build instrument trust.

R3	Degraded vision from fatigue, hypoxia, smoking, medications	Complete IMSAFE checklist. Use supplemental oxygen at night above 5,000 ft MSL. Prohibit smoking before flight. Verify medications are not on DO NOT FLY list.
R4	Failure of aircraft lighting and instrument/panel lighting	Carry two flashlights. Verify all aircraft lighting during preflight. Know the alternate lighting source for each instrument. Brief electrical failure checklist before night departure.
R5	Weather deterioration and inadvertent IMC at night	Obtain thorough weather briefing including AIRMET Sierra and IFR conditions aloft. Treat any forecasted IFR at destination as a night go/no-go condition. File IFR if instrument-rated.
R6	Night flight over unlit terrain, mountains, or water	Add 1,000+ ft over mountainous terrain. Avoid extended over-water VFR. Identify terrain-clear altitude corridors on sectional before departure. Use GPS with terrain awareness if available.
R7	Impaired night vision from cockpit light mismanagement	Set panel/instrument lighting to lowest readable level. Use red light only for chart reading. Never activate white cabin lights during cruise flight.

Completion Standards — AI.II.M.S1

The applicant is evaluated on the ability to demonstrate instructional knowledge by explaining the elements of night operations. The applicant:

- Accurately explains the physiological basis of night vision (rods, cones, scotopic/photopic, off-center technique, dark adaptation timelines)
- Correctly explains and demonstrates VASI/PAPI light interpretations for all conditions (on slope, above, below, PAPI 4-light vs. 2-bar VASI)
- Identifies all night VFR equipment requirements per §91.205(c) and explains each item's purpose
- Accurately states the definition of night per §1.1 and night currency requirements per §61.57(b)
- Explains at least three specific night visual illusions by name, mechanism, and mitigation
- Explains how to activate PCL correctly on CTAF frequency
- Identifies the specific risk of the black hole approach and the instrument-based mitigation

Lesson Review Questions

Use these to check student comprehension before solo night endorsement:

- **Q:** You're on a 5-mile final at night. The PAPI shows all 4 red lights. What do you do? **A:** Go around immediately — you are well below glidepath. Do not attempt to salvage the approach.
- **Q:** At what exact moment does night begin for logging and currency purposes? **A:** End of evening civil twilight (not sunset), per 14 CFR §1.1.
- **Q:** You arrive at a dark PCL airport at night. What is your first action 10 miles out? **A:** Transmit 7 clicks on CTAF to activate runway lighting at highest intensity.
- **Q:** You've been staring at a tower light for 30 seconds and it appears to be slowly moving. What is this and what should you do? **A:** Autokinesis. Scan away from the light, check instruments. It is not moving.
- **Q:** After 30 minutes of night flying you suddenly switch on the white cabin overhead light to read a chart. What's the problem? **A:** You just destroyed your dark adaptation. It requires another 30 minutes to fully rebuild.
- **Q:** Why does staring directly at a dimly lit runway threshold at night sometimes make it appear to vanish? **A:** The fovea (direct vision) contains mostly cones with almost no rods. Dim light registers better on peripheral rods. Off-center viewing resolves this.

KEY RULE ■ The evaluator is looking for the CFI candidate to **teach** these items, not just recite them. Connect each item to a real scenario. Ask the applicant: "How would you explain off-center viewing to a student during preflight?" The best applicants demonstrate, not just describe.

Area II, Task N — High Altitude Operations: Supplemental Oxygen

FAA-S-ACS-25 • CFI Airplane Ground Lesson • 14 CFR §91.211 • PHAK Ch.7 & 17 • AC 61-107 • FAA O2 Equipment Brochure

Objective

The applicant exhibits satisfactory knowledge, risk management, and skills associated with flight at higher altitudes where supplemental oxygen is required or recommended. The applicant can apply that knowledge, manage associated risks, demonstrate appropriate skills, and provide effective instruction on supplemental oxygen systems to ACS standard.

References

- 14 CFR §91.211 — Supplemental Oxygen
- FAA-H-8083-25C (PHAK) — Chapters 7 (Aircraft Systems) and 17 (Aeromedical Factors)
- FAA-H-8083-2 — Risk Management Handbook
- AC 61-107 — Operations of Aircraft Above 25,000 Feet MSL
- AIM Chapter 8 — Medical Facts for Pilots
- FAA Pilot Safety Brochure: Oxygen Equipment Use in General Aviation Operations
- POH/AFM — Aircraft-specific oxygen system procedures

Delivery Format

- Ground lesson with supplemental oxygen equipment present if available — 45–60 min
- Use PHAK Figures 7-43 to 7-47 and Figure 17-1 (TUC table) as visual aids
- Walk through FAA PRICE Check using actual or mock equipment
- Scenario: “You’re flying at 13,000 ft for 45 min, then climbing to 15,500 ft for 1 hour. What are your oxygen requirements and how do you determine quantity needed?”

Motivation

Hypoxia is insidious — a pilot becomes impaired before they recognize it. The first symptom is often euphoria and a false sense of competence. A CFI who cannot teach the regulatory requirements and physiological realities of high altitude flight is leaving students exposed to one of aviation’s most silent killers. This lesson builds the physiological understanding and regulatory fluency that makes a student genuinely safe above 10,000 feet.

ACS Knowledge Elements

Code	Element
AI.II.N.K1	Regulatory requirements for supplemental oxygen use by flight crew and passengers
AI.II.N.K2a	Physiological factors — Impairment
AI.II.N.K2b	Physiological factors — Symptoms of hypoxia
AI.II.N.K2c	Physiological factors — Time of Useful Consciousness (TUC)
AI.II.N.K3a	Characteristics, limitations, and applicability of continuous-flow, demand, and pressure-demand oxygen systems
AI.II.N.K3b	Differences between “aviator’s breathing oxygen” and other oxygen types
AI.II.N.K3c	Precautions when using supplemental oxygen systems

ACS Risk Management

Code	Element
AI.II.N.R1	High altitude flight
AI.II.N.R2	Use of supplemental oxygen
AI.II.N.R3	Management of compressed gas containers
AI.II.N.R4	Combustion hazards in an oxygen-rich environment

ACS Skills

Code	Element
AI.II.N.S1	Provide an adequate briefing on use of supplemental oxygen equipment
AI.II.N.S2	Operate or simulate operation of installed or portable oxygen equipment in aircraft
AI.II.N.S3	Determine the quantity of supplemental oxygen required in a given scenario

SECTION 2 — 14 CFR §91.211: REGULATORY REQUIREMENTS FOR SUPPLEMENTAL OXYGEN

§91.211 Supplemental Oxygen — The Rule

Cabin Pressure Altitude	Who Must Use O_2	When
12,500 – 14,000 ft MSL	Required flight crew only	Only after 30+ continuous minutes at those altitudes
Above 14,000 ft MSL	All required flight crew members	At all times while at or above that altitude
Above 15,000 ft MSL	Each occupant of the aircraft	Must be *provided* supplemental oxygen (not necessarily using it)

§91.211(b) — Pressurized Aircraft Additional Requirements

Altitude	Requirement
Above FL250	10-minute emergency O_2 supply available for each occupant in event of loss of pressurization
Above FL350	One pilot at controls must wear and use an O_2 mask (secured and sealed) at all times. Exception: below FL410 with two pilots and quick-don masks (don in 5 sec with one hand).
Above FL350 — one pilot leaves seat	Remaining pilot at controls must don and use O_2 mask until other pilot returns.

CRITICAL: *§91.211 applies to* ***cabin pressure altitude****, not MSL altitude. In an unpressurized aircraft at 13,000 ft, after 30 min the crew must use O_2. In a pressurized aircraft maintaining 8,000 ft cabin altitude at FL250, crew oxygen is NOT triggered. Know the difference.*

Key Definitions — CFI Teaching Points

Term	CFI Teaching Point
Cabin pressure altitude	Pressure inside the aircraft expressed as equivalent altitude. Unpressurized aircraft: equals actual altitude. Pressurized aircraft: maintained lower than aircraft altitude.
Required flight crewmember	Only those required to be on the flight deck. Non-required observers may not be covered until above 15,000 ft.
"Provided" O_2 (above 15,000 ft)	Each occupant must have O_2 *available* — they do not have to use it, but it must be accessible for each person on board.
Aviator's Breathing Oxygen (ABO)	Must meet SAE AS8010 purity standard. Medical and industrial oxygen contain moisture that can freeze in aircraft O_2 lines and regulators at altitude. Only ABO is approved for aviation oxygen systems.
Quick-don mask	Must be donnable with one hand within 5 seconds from the ready position, while accommodating prescription glasses. Required for FL350+ single-pilot exception.

FAA Recommended Use (Beyond Regulatory Minimums)

The FAA recommends pilots use supplemental oxygen above **10,000 ft during the day** and above **5,000 ft at night**. Night vision degrades significantly with reduced O_2 even at low altitudes. Fatigue and individual physiology lower the onset altitude for impairment well below the legal threshold.

Instructor Note: *The legal minimums in §91.211 are a floor, not a safety standard. A pilot could be meaningfully impaired at 10,000 ft on a long night flight and still be fully legal. Teach the why — not just the rule.*

★ O_2 Altitudes Memory — 12.5 • 14 • 15
12,500–14,000 ft: Crew O_2 after 30 min | **14,000+ ft:** All crew O_2 all the time | **15,000+ ft:** O_2 available for every occupant | **Best practice:** O_2 above 10,000 day / 5,000 night

Physiological Factors — Hypoxia & Time of Useful Consciousness

SECTION 2 (CONTINUED) — AEROMEDICAL: HYPOXIA, TUC & TREATMENT

The Four Types of Hypoxia — PHAK Ch.17

Type	Cause	Aviation Relevance & CFI Teaching
Hypoxic (most common in GA)	Insufficient O_2 partial pressure at altitude. O_2 stays at 21% but molecules are too sparse to pass through respiratory membranes.	Primary concern above 10,000 ft in unpressurized aircraft. Progressive with altitude. Insidious — pilot often unaware of impairment. Treatment: O_2 + descend.
Hypemic	Blood cannot carry adequate O_2. Most common cause in aviation: CO poisoning (hemoglobin binds CO with 200× greater affinity than O_2). Also: anemia, recent blood donation.	CO from exhaust leaks is a real-world hazard. Symptoms mimic hypoxic hypoxia but supplemental O_2 alone is insufficient. Land immediately and seek medical care.
Stagnant	O_2-rich blood in lungs is not circulating to tissues. Caused by high G-forces, shock, or cardiac problems.	Relevant during aerobatic/high-G maneuvers. Cold temperatures also restrict circulation and reduce O_2 delivery to extremities.
Histotoxic	Cells cannot utilize O_2 even though it is present. Caused by alcohol, narcotics, and other toxins.	1 oz of alcohol ≈ 2,000 ft additional physiological altitude. Supplemental O_2 does NOT reverse histotoxic hypoxia. No workaround exists.

Symptoms of Hypoxia

Symptoms vary significantly between individuals. The most dangerous symptom is **euphoria** — a false sense of well-being that prevents the pilot from recognizing impairment. Common symptoms include:

Early Onset	Progressive
Euphoria — carefree feeling, false confidence	Visual impairment, tunnel vision
Headache, lightheadedness, dizziness	Slowed reaction time, impaired judgment
Tingling in fingers and toes	Cyanosis (blue fingernails/lips)
Drowsiness, warmth, numbness	Loss of muscle coordination, incapacitation

Treatment

(1) **100% supplemental O_2 immediately** — select pure O_2 on regulator. (2) **Descend** if possible. Recovery from hypoxic hypoxia is rapid with O_2. CO poisoning (hypemic) is not reversed by O_2 alone — land immediately.

Time of Useful Consciousness (TUC) — PHAK Fig. 17-1

TUC is the maximum time to make rational, life-saving decisions without O_2. **Rapid decompression reduces TUC by 1/3 to 1/4** because O_2 is expelled from the lungs.

Altitude	TUC Without O_2
45,000 ft MSL	9 to 15 seconds
40,000 ft MSL	15 to 20 seconds
35,000 ft MSL	30 to 60 seconds
30,000 ft MSL	1 to 2 minutes
28,000 ft MSL	2½ to 3 minutes
25,000 ft MSL	3 to 5 minutes
22,000 ft MSL	5 to 10 minutes
18,000 ft MSL	20 to 30 minutes
Below 15,000 ft	30 minutes or more

Source: PHAK Figure 17-1 | FAA-H-8083-25C Chapter 17

***Risk:** At FL350, rapid decompression leaves only **30–60 seconds** to don an O_2 mask. This is why quick-don masks (1 hand, 5 sec) are a hard regulatory requirement at FL350+. Crew O_2 masks are always immediately accessible — never stowed.*

★ Hypoxia vs. Hyperventilation — Critical Distinction

Both share similar symptoms (lightheadedness, tingling). **If on oxygen**: confirm equipment and flow rate before assuming hyperventilation. **Hyperventilation**: slow controlled breathing restores CO_2 balance. **Hypoxia**: apply O_2 and descend. Incorrect treatment (bag when hypoxic) can be fatal.

***Instructor Note:** 1 oz of alcohol ≈ 2,000 ft additional physiological altitude (histotoxic hypoxia). Supplemental O_2 does NOT reverse alcohol-induced impairment. CAMI offers altitude chamber physiological training (faa.gov/go/aerophys) — strongly recommend to any student flying above 10,000 ft.*

Oxygen Systems, Equipment & The PRICE Preflight Check

SECTION 2 (CONTINUED) — STORAGE SYSTEMS, DELIVERY TYPES, MASKS & EQUIPMENT INSPECTION

Oxygen Delivery Systems — FAA Brochure & PHAK Ch.7

System	How It Works	Max Altitude	CFI Teaching Points
Continuous-Flow	O_2 flows constantly. Reservoir bag collects O_2 during exhalation to boost inhalation flow.	≤28,000 ft	Least efficient — O_2 wasted during exhalation. Simplest, least expensive. Common for passengers.
Diluter-Demand	O_2 flows only on inhalation. Automix lever blends cabin air + O_2 per altitude. Tight mask required.	Up to 40,000 ft	More efficient. Beards/mustaches can break mask seal — verify fit on the ground.
Pressure-Demand	Delivers O_2 under positive pressure above 34,000 ft, slightly over-inflating the lungs.	Above 40,000 ft	Only system safe above FL400. Mask-mounted regulator eliminates hose purge delay.
Pulse-Demand (Electronic)	Electronic sensor delivers O_2 only at start of each inhalation. Internal barometer adjusts per altitude.	Varies — see POH	50–85% more efficient than continuous-flow. Battery life critical — check pre-flight.

Oxygen Storage Systems — FAA Brochure

Storage Type	Key Facts	CFI Teaching Points
Gaseous ABO (most common)	1,800–2,200 psi (high) or 400–450 psi (low). Must meet SAE AS8010.	Economical, heavy/bulky. Pressure ∝ temperature — low gauge on cold morning ≠ empty.
Liquid O_2 (LOX)	Stored at –197°F. 900:1 expansion ratio. 3:1 space savings vs gaseous.	Volatile with petroleum. LOX on skin causes severe frostbite. Military/commercial use.
Solid-State Candles	600:1 expansion ratio. Heated to 350°F to activate.	Cannot be stopped once activated. Produces heat — fire hazard. Airline emergency use.
MSOG	Concentrates O_2 from ambient air (21% O_2).	Military/medical applications. Not common in GA but emerging.

Oxygen Masks & Cannulas — FAA Brochure

Mask Type	Alt. Limit	Key Facts
Nasal Cannula	≤18,000 ft	Continuous-flow. Most comfortable. FAR limits to 18,000 ft — mouth breathing or talking reduces blood O_2 saturation. Check green flow bead regularly.
Oral-Nasal Re-Breather	≤25,000 ft	Most common and least expensive. Reservoir bag stores exhaled air + 100% O_2 for the next inhalation cycle.
Quick-Don Mask	≤40,000 ft	Donnable ONE hand, 5 seconds, with prescription glasses. Required for FL350+ two-pilot exception under §91.211(b). Always stored accessible.
Airline Drop-Down (Phase-Dilution)	Emergency ≤40,000 ft	Reservoir bag + one-way valves. Pulls down to activate. Exhaled air vented to cabin, not returned to bag.

Instructor Note: *Mask compatibility is critical — ensure mask and delivery system are compatible when inter-changing components. Aircraft certified above 18,000 ft must use masks, not cannulas.*

The PRICE Pre-Flight Check — FAA O_2 Equipment Brochure

Perform the **PRICE** check before every flight using oxygen equipment.

P	R	I	C	E
PRESSURE	**REGULATOR**	**INDICATOR**	**CONNECTIONS**	**EMERGENCY**
Confirm O_2 pressure and quantity sufficient for the planned flight. Check gauge. Allow for diversions and reserves.	Inspect regulator for proper function. Verify outlet assembly and plug-in coupling compatibility for continuous-flow systems.	Don mask. Verify steady O_2 flow via flow indicator (green bead or gauge in delivery tube).	All connections secured: O_2 lines, plug-in couplings, mask. No loose fittings.	Equipment accessible and ready. Brief passengers on O_2 location and use. Plan for hypoxia, smoke/fumes, decompression.

Source: FAA Pilot Safety Brochure — Oxygen Equipment Use in General Aviation Operations

CRITICAL: *Oxygen dramatically increases combustibility. Materials nearly fireproof in air can ignite in O_2. Oils and greases may spontaneously ignite.* ***No smoking around O_2. Clean hands required. No oil or lip salve near fittings. Service outdoors only. Secure cylinders against movement at all times.***

Oxygen Quantity, Risk Management & CFI Teaching Skills

SECTION 2 (CONTINUED) — QUANTITY CALCULATION, ACS SKILLS S1–S3 & SCENARIOS

Determining O_2 Quantity Required (ACS Skill S3)

DPEs present a scenario requiring determination of whether O_2 aboard is sufficient. Requires: system type, occupant count, time above threshold, and flow rate.

Step	Action
1. Time above threshold	How long above 12,500 ft (crew) or 15,000 ft (all occupants)? Include diversion reserves.
2. Flow rate	Consult POH/AFM or system manufacturer chart. Flow rate varies by altitude and system type.
3. Volume needed	Volume (L) = Flow rate (L/min) × Time (min) × Number of users. Calculate per altitude segment.
4. Available supply	Read cylinder gauge. Compare PSI to capacity chart. Cold temp ↓ pressure (Gay-Lussac) — warm cylinder before assuming low O_2.
5. Add reserve	Always plan above minimum. Diversions and ATC delays reduce margins.

Container Management (Risk R3)

- Secure cylinders — never loose in baggage compartment
- Pressure ∝ Temperature: cold reading ≠ empty — warm and recheck
- Mark psi tolerance before filling; use SAE AS8010 ABO only
- Service outdoors; no oil/grease/lip salve near fittings
- After use: verify ALL valves closed; confirm pressure before next flight

ACS Skill S1: Oxygen Equipment Briefing

Demonstrate a complete passenger oxygen briefing to the DPE:

Element	Cover This
Regulatory basis	Above 15,000 ft cabin altitude: each occupant must be provided O_2 (§91.211(a)(3))
System ID	Identify type (continuous-flow, demand, portable) and demonstrate activation
Mask fitting	Demonstrate donning; verify seal; explain reservoir bag function if present
Flow check	Verify O_2 flowing: green bead, gauge, or breathing confirmation
Supply duration	Inform passengers of available supply at planned altitude
Fire safety	No smoking around O_2 equipment in use or during recharging
Emergency use	Don mask at first hypoxia symptom — do not wait for confirmation from others

CFI Teaching Scenarios

Scenario	Teaching Points
"You're flying at 13,500 ft for 45 min, then climbing to 15,500 ft for 1 hr in an unpressurized C172. What are your O_2 obligations?"	13,500 ft: crew O_2 required after 30 continuous min (§91.211(a)(1)). 15,500 ft: crew O_2 at all times AND O_2 must be *provided* to each occupant (§91.211(a)(2)&(3)). Plan continuous supply from takeoff through landing.
"O_2 gauge shows 800 psi this cold morning. You expected 1,800 psi. Empty?"	Not necessarily. Cold temperature reduces indicated pressure (P ∝ T). Warm cylinder to ambient temperature and recheck before assuming depletion.
"A passenger feels fine at 14,000 ft and refuses O_2. Is there a concern?"	Euphoria is a primary hypoxia symptom — feeling fine may indicate impairment. Above 15,000 ft, O_2 must be provided (not forced). FAA recommends O_2 above 10,000 ft; legal minimum ≠ safety standard.

Scenario	Teaching Points
"Can they use the camping O_2 canister in the aircraft?"	No. Recreational/medical O_2 lacks SAE AS8010 purity. Moisture freezes in aircraft lines/regulators at altitude, potentially cutting off supply. Only Aviator's Breathing Oxygen (ABO) is approved.
"When must a pressurized-aircraft pilot wear an O_2 mask above FL350?"	One pilot at controls must wear sealed/secured O_2 mask at all times above FL350. Exception: below FL410, two pilots at controls, BOTH with quick-don masks (1 hand, 5 sec). If one pilot leaves the seat, remaining pilot must immediately don mask.



PHAK Fig. 7-43 — Oxygen system regulator (pressure-demand). Source: FAA-H-8083-25C Ch.7.

★ PRICE • O_2 Preflight Check — FAA Brochure
Pressure (quantity sufficient) • **R**egulator (functioning, compatible) • **I**ndicator (flow confirmed, mask donned) • **C**onnections (all secure) • **E**mergency (accessible; passengers briefed)

★ O_2 Regulation Memory — 12.5 • 14 • 15
12,500–14,000 ft: Crew O_2 after 30 min | **14,000+ ft:** All crew O_2 all the time | **15,000+ ft:** O_2 *provided* for every occupant | **Best practice:** O_2 above 10,000 day / 5,000 night

CRITICAL: *Oxygen dramatically increases combustibility. Oils and greases may spontaneously ignite in O_2.* ***No smoking, no petroleum products near O_2. Clean hands. Service outdoors only.***

Area II, Task O — High Altitude Operations: Pressurization Systems

FAA-S-ACS-25 · CFI Airplane Ground Lesson · 14 CFR §91.211 · AC 61-107 · PHAK Ch.7 & 17

Objective

The applicant exhibits satisfactory knowledge, risk management, and skills associated with flight in pressurized aircraft at high altitudes. The applicant understands how pressurization systems work, can describe system failure modes, explain the physiological consequences of decompression and hypoxia, apply time of useful consciousness data, and teach emergency response procedures to ACS standard.

References

- AC 61-107B — Aircraft Operations at Altitudes Above 25,000 Feet MSL
- FAA-H-8083-25C (PHAK) — Ch. 7 (Aircraft Systems) and Ch. 17 (Aeromedical Factors)
- FAA-H-8083-2 — Risk Management Handbook
- AIM Chapter 8 — Medical Facts for Pilots
- 14 CFR §91.211 — Supplemental Oxygen (includes pressurized aircraft requirements)
- POH/AFM — Aircraft-specific pressurization system procedures and limitations

Delivery Format

- Ground lesson using POH/AFM pressurization section and system diagrams — 45–60 min
- Use TUC chart and cabin altitude vs. flight altitude table as visual aids
- Walk through decompression emergency using memory items from POH
- Scenario: “You’re at FL280 in a pressurized single. You hear a bang and notice the cabin altitude is climbing through 12,500 ft and still rising. What are your first three actions?”

Motivation

Pressurization is the system that makes high-altitude flight survivable — but it creates a hidden danger: a pilot flying at FL350 in a comfortable 8,000 ft cabin has no sensory warning of the lethal environment just inches away. When pressurization fails, the window for correct action at altitude may be measured in seconds. A CFI who teaches pressurization systems only as a systems check item — without building a student’s visceral understanding of TUC and decompression physiology — is leaving that student without the most critical tool: the knowledge to act immediately and correctly before incapacitation.

ACS Standards — AI.II.O (Knowledge ■ Risk ■ Skills)

Code	ACS Element
Knowledge	
AI.II.O.K1	Fundamental concepts of aircraft pressurization system, including failure modes
AI.II.O.K2a	Physiological factors — Impairment
AI.II.O.K2b	Physiological factors — Symptoms of hypoxia
AI.II.O.K2c	Physiological factors — Time of Useful Consciousness (TUC)
AI.II.O.K2d	Effects of rapid decompression on crew and passengers
Risk Management	
AI.II.O.R1	High altitude flight
AI.II.O.R2	Malfunction of pressurization system, if equipment is installed
Skills	
AI.II.O.S1	Operate the pressurization system, if equipment is installed
AI.II.O.S2	Respond appropriately to simulated pressurization malfunctions, if equipment is installed

Aircraft Pressurization Systems — Fundamentals & Failure Modes

Pressurization Sources — By Aircraft Type

Source	Aircraft Type	How It Works
Bleed Air	Turbine (jets & turboprops)	Hot, high-pressure air tapped from engine compressor stages. Cooled through air conditioning packs before entering cabin. Most common in transport category and turbine GA aircraft (TBM, King Air, Citation).
Turbocharger Bleed	Piston-turbocharged	Compressed air from the turbocharger is routed to the cabin. Used in piston GA pressurized aircraft (Cessna P210, Piper Seneca, Piper Navajo Chieftain). Less efficient; limits max cabin differential.
Engine-Driven Compressor	Some older piston	A dedicated compressor driven by the engine provides cabin pressurization air. Separate from the induction/turbo system.

Key System Components

- **Outflow Valve** — Controls rate of air escape to maintain cabin altitude; primary pressure regulator
- **Safety/Relief Valve** — Pop-off protection against over-pressurization; also prevents negative differential on ground
- **Pressurization Controller** — Crew interface to set cabin altitude and rate; AUTO or MANUAL mode
- **Cabin Altitude Indicator** — Monitor continuously; primary instrument for detecting pressurization loss
- **Differential Pressure Gauge** — Shows ΔP in PSI; red-arc limit is a structural limit, not a suggestion
- **Cabin Rate-of-Climb Indicator** — Normal 300–500 fpm; rapid unexpected rise = immediate action required

Pressure Differential (ΔP) — The Core Concept

Differential pressure (ΔP) is the difference between cabin pressure and outside ambient pressure. It is what the aircraft structure must contain. Every pressurized aircraft has a maximum ΔP limit that must not be exceeded to prevent structural failure.

KEY RULE ■ ΔP = Cabin Pressure – Ambient Pressure. The **higher** you fly, the lower ambient pressure becomes, so ΔP increases for the same cabin altitude. Max ΔP is a structural limit — not a comfort guideline.

Cabin Altitude vs. Flight Altitude — Typical Values

Flight Level	Flight Alt (ft)	Typical Cabin Alt	ΔP (approx)
FL180	18,000	6,000 ft	4.2 PSI
FL250	25,000	7,000 ft	6.4 PSI
FL280	28,000	7,500 ft	7.3 PSI
FL350	35,000	8,000 ft	8.9 PSI
FL410	41,000	8,000 ft	10.9 PSI

Pressurization Failure Modes (AI.II.O.K1)

Failure Type	Cause	Rate	Warning Signs / CFI Teaching
Explosive Decomp.	Structural failure, window/door loss	<0.5 sec	Loud bang, mist/fog in cabin, rapid temperature drop, objects displaced. TUC begins immediately. No diagnostic time.
Rapid Decomp.	Seal failure, pressurization component failure	0.5–10 sec	Audible hiss, cabin altitude warning, rapid rise on cabin alt indicator, ear pain.
Slow/Gradual Decomp.	Partial seal failure, controller malfunction	Minutes to hours	**Most insidious.** Cabin altitude rises slowly. Cognitive impairment begins before pilot notices. Monitor cabin alt continuously.
Outflow Valve Malfunction	Stuck open or closed, motor failure	Gradual	Stuck open: cabin altitude climbs. Stuck closed: possible over-pressurization on ground. Switch to manual.

Physiological Factors — Hypoxia & Time of Useful Consciousness (TUC)

Hypoxia in the Pressurization Context

In a pressurized aircraft, hypoxia is caused by **cabin altitude**, not flight altitude. A crew at FL350 with an 8,000 ft cabin is physiologically at 8,000 ft. If pressurization fails and cabin altitude reaches FL350, TUC begins immediately. The transition from normal to incapacitated can occur faster than the crew can react.

Signs and Symptoms of Hypoxia (AI.II.O.K2a-b)

Cabin Altitude	Typical Symptoms
5,000–10,000 ft	Subtle night vision impairment; slight performance degradation. Generally no noticeable symptoms. Color vision begins to degrade.
10,000–14,000 ft	**Most dangerous zone.** Euphoria, impaired judgment, delayed reaction, difficulty with complex tasks — pilot feels fine while degraded.
14,000–16,000 ft	Poor motor control, definite mental impairment, headache, tunnel vision, tingling extremities. Incapacitation likely.
Above 20,000 ft	Rapid incapacitation. Unconsciousness within minutes. Convulsions possible above 25,000 ft from nitrogen evolution.

■ ***Memory Aid: CHESS*** *— Common Hypoxia Symptoms:* ***C****yanosis ■* ***H****eadache ■* ***E****uphoria ■* ***S****leepiness ■* ***S****hortness of breath. The most dangerous symptom: the pilot does not know they are impaired.*

KEY RULE ■ Euphoria is the great deceiver. A pilot becoming hypoxic often feels **better** than normal, not worse. This is why TUC — not symptoms — is the operationally useful number. If you know you have 30 seconds, you act. If you wait for symptoms, you may have already lost the ability to act.

Time of Useful Consciousness (TUC) — AI.II.O.K2c

TUC is the time available after loss of pressurization during which a pilot can take effective, goal-directed action. It is shorter than time-to-unconsciousness. Physical activity cuts TUC roughly in half.

Altitude	TUC (Rest)	TUC (Active)	CFI Teaching Point
18,000 ft	20–30 min	5–10 min	O_2 recommended. Cognitive decline begins.
25,000 ft	3–5 min	2–3 min	Loss of pressurization = immediately life-threatening. Descent must begin within TUC.
28,000 ft	2.5–3 min	1–2 min	§91.211(b) 10-min O_2 requirement at FL250+ is because of this altitude range.
35,000 ft	30–60 sec	15–30 sec	**Don O_2 FIRST. Declare emergency SECOND. No time for anything else first.**
40,000 ft	15–30 sec	9–12 sec	Must have immediately accessible quick-don mask. Pre-position before every flight above FL350.
45,000 ft	9–15 sec	<9 sec	100% O_2 at ambient pressure insufficient. Pressure-demand equipment required.

CRITICAL ■ TUC is cut in half by physical activity. A pilot who has responded to an emergency (grabbed checklist, adjusted seat, called passengers) may have only 15–20 seconds at FL350. At altitude, the **first and only** action before any other is: **oxygen mask on, check flow, then everything else.**

KEY RULE ■ §91.211 applies to **cabin pressure altitude** (a-rules) and **flight level** (b-rules). A pressurized aircraft at FL350 with 8,000 ft cabin is NOT triggering §91.211(a) oxygen rules — but IS fully subject to §91.211(b) pressurized aircraft rules. Know both sets of rules.

Rapid Decompression Effects, Emergency Actions & System Operation

Effects of Rapid Decompression (AI.II.O.K2d)

Rapid decompression causes multiple simultaneous physiological insults. Responses must be automatic because there is no time to process:

Effect	What Happens	Key Teaching Point
Immediate Hypoxia	Cabin instantly equalizes to ambient altitude pressure	At FL350: TUC = 30–60 sec. Don O_2 BEFORE any other action.
Lung Over-pressure	Expanding gas ruptures lung tissue if breath is held	Brief occupants: breathe normally, never hold breath at altitude.
Decompression Sickness	Dissolved nitrogen evolves as bubbles above ~18,000 ft	Joint/chest pain, neuro symptoms. Medical evaluation mandatory post-event.
Temperature Drop	Adiabatic cooling — dramatic cabin temp drop	Mist, fog, loose items displaced. Physical and visual disorientation.
Noise/Blast	Pressure wave and wind noise	Communication impaired at the worst moment. Use interphone.

§91.211(b) — Pressurized Aircraft Requirements

Condition	Requirement
Above FL250	10-min emergency O_2 for each occupant available at all times
Above FL350	At least one pilot must wear O_2 mask (secured and sealed) at all times
FL350–FL410, two pilots	One pilot may remove mask temporarily if both have quick-don masks donnable within 5 sec

KEY RULE ■ §91.211(a) triggers on **cabin pressure altitude**. §91.211(b) triggers on **flight level**. At FL350 with 8,000 ft cabin: §(a) does NOT apply, but §(b) fully applies.

Immediate Actions — Loss of Pressurization (Memory Items)

These are memory items. At FL350, there is no time to reach for the checklist before step 1:

Step	Action	Why
1	**O_2 masks ON — 100%, emergency**	Stops TUC clock. All other actions are secondary.
2	**Confirm crew O_2; communicate**	Verify both pilots have flow. Assign tasks.
3	**Squawk 7700**	ATC awareness before descent. Priority handling.
4	**ATC: PAN-PAN / MAYDAY**	Type, position, altitude, nature, POB, intentions.
5	**Emergency descent to 10,000 MSL**	Max safe descent rate per POH. MEA if higher.
6	**Pressurization checklist**	Isolate source, check outflow valve, switch to manual.

CRITICAL ■ Emergency descent technique: idle power, speed brakes full, descend at/below Vmo/Mmo. Up to 45° bank may increase descent rate. At 10,000 ft: level off, reassess, complete checklist, arrange medical evaluation for all occupants.

Normal Pressurization Operation (AI.II.O.S1)

Phase	Action
Preflight	Check outflow valve, cabin alt indicator reads field elev, verify O_2 qty
Before T/O	Set cabin altitude and rate (300–500 fpm); AUTO mode; brief crew on TUC
Climb	Monitor cabin alt and ΔP. Cabin should pressurize within a few hundred feet of brake release.
Cruise	Monitor cabin alt every 15–20 min. Verify ΔP in limits. Set alert if available.
Descent	Verify cabin will reach field elev at/before touchdown. Reduce rate for comfort.
After Lndg	Confirm depressurized before opening doors. Log any discrepancies.

■ ***Risk Note: R1 — High altitude:*** *Brief TUC before every FL250+ flight. Pre-position O_2 masks. Know emergency items by memory.* ***R2 — Pressurization failure:*** *Monitor cabin alt continuously. Never delay O_2 if cabin altitude is in any doubt. Maintain manual pressurization proficiency.*

Area III, Task A — Pilot Qualifications

FAA-S-ACS-25 · CFI Airplane Ground Lesson · 14 CFR Parts 61, 68, 91 · AC 60-28 · AC 68-1 · PHAK Ch. 1

ACS Code	Element
Knowledge	
AI.III.A.K1	Certification, currency, and recordkeeping requirements, including training and logbook entries
AI.III.A.K2	Privileges and limitations of pilot certificates and ratings — student, sport, recreational, private, commercial, and flight instructor
AI.III.A.K3	Medical certificates: class, expiration, privileges, temporary disqualifications, and operations under BasicMed
AI.III.A.K4	Documents pilots must possess to exercise privileges of the specified certificate(s) and rating(s)
Risk Management	
AI.III.A.R1	Proficiency versus currency
AI.III.A.R2	Flying unfamiliar aircraft or operating with unfamiliar flight display systems and avionics
Skills	
AI.III.A.S1	Deliver instruction on at least two of the elements specified in K1 through K4

References:

- **14 CFR Part 61** — Certification: Pilots, Flight Instructors, and Ground Instructors
- **14 CFR Part 68** — Requirements for Operating Certain Aircraft as a Private Pilot (BasicMed)
- **14 CFR Part 91** — General Operating and Flight Rules (§91.103, §91.205)
- **AC 60-28B** — FAA English Language Standard for an FAA Certificate Issued Under 14 CFR Parts 61, 63, 65, a
- **AC 68-1** — BasicMed Comprehensive Medical Examination Checklist
- **FAA-H-8083-2** — Risk Management Handbook
- **FAA-H-8083-3** — Airplane Flying Handbook (AFH)
- **FAA-H-8083-23** — Seaplane, Skiplane, and Float/Ski Equipped Helicopter Operations Handbook
- **FAA-H-8083-25C** — Pilot's Handbook of Aeronautical Knowledge (PHAK), Chapter 1
- **POH/AFM** — Aircraft-specific Pilot's Operating Handbook / Airplane Flight Manual

Objective: To determine the applicant understands pilot training and qualification requirements for different levels of pilot certificate including student pilot, sport pilot, recreational pilot, private pilot, commercial pilot, and flight instructor; can apply that knowledge, manage associated risks, demonstrate appropriate skills, and provide effective instruction.

Instructor Note: *This task covers the FULL breadth of Part 61 and is heavily tested on the oral. Every certificate level has unique age, aeronautical experience, knowledge test, and practical test requirements. The CFI applicant must be able to teach these distinctions clearly. Primary regulatory source:* ***14 CFR Part 61*** *(ecfr.gov or faa.gov). PHAK Chapter 1 provides a good narrative overview of the certificate structure.*

1. CERTIFICATION, CURRENCY & RECORDKEEPING (AI.III.A.K1)

A WHAT TO TEACH

14 CFR Part 61 establishes the complete framework for pilot certification. The six primary pilot certificate levels, in ascending order, are: Student, Sport, Recreational, Private, Commercial, and Airline Transport Pilot (ATP). Each level has distinct minimum age, aeronautical knowledge test, practical test, and logbook hour requirements.

Certificate	Min. Age	Knowledge Test	Practical Test Req.	Primary CFR
Student Pilot	16 (14 glider/balloon)	None required	None (solo endorsements required)	§61.83, 61.87, 61.89
Sport Pilot	17	FAA Knowledge Test	Practical Test (DPE)	§61.303–61.327
Recreational Pilot	17	FAA Knowledge Test	Practical Test (DPE)	§61.96–61.101
Private Pilot (ASEL)	17	PAR Knowledge Test	Practical Test (DPE)	§61.102–61.117
Commercial Pilot (ASEL)	18	CAX Knowledge Test	Practical Test (DPE)	§61.121–61.133
Airline Transport (ATP)	23 (21 restricted)	ATM Knowledge Test	Practical Test (DPE)	§61.151–61.171
Flight Instructor (CFI)	18	FIA + FOI Tests	Practical Test (DPE)	§61.183–61.201

Instructor Note: *Source: **14 CFR §61.83** (student), **§61.96** (recreational), **§61.102** (private), **§61.121** (commercial), **§61.151** (ATP), **§61.183** (CFI). Knowledge test codes are found in **FAA-G-ACS-1** (Airman Knowledge Testing Supplement). Age minimums apply on the date the practical test is passed, not when training begins.*

Aeronautical Experience Requirements (Private Pilot ASEL Example)

Under **14 CFR §61.109**, a private pilot certificate (ASEL) requires a minimum of **40 hours total flight time**, including:

- **20 hrs** flight training with an authorized instructor (dual)
- **10 hrs** solo flight time
- **3 hrs** cross-country flight training
- **3 hrs** night flight training, including 1 cross-country over 100 NM and 10 night takeoffs and landings
- **3 hrs** flight solely by reference to instruments (simulated/actual)
- **3 hrs** in preparation for the practical test within the preceding 2 months
- **5 hrs** solo cross-country time
- **1** solo cross-country flight of at least 150 NM total distance, with full-stop landings at 3 points, one leg of at least 50 NM
- **3** solo takeoffs and full-stop landings at a controlled airport

Instructor Note: *Full breakdown at **14 CFR §61.109**. Commercial is §61.129. ATP is §61.159. All minimums may be increased by Part 141 or airline requirements.*

Currency Requirements — 14 CFR §61.56, 61.57

Currency is the *legal minimum* to act as pilot-in-command. It does not guarantee proficiency. The two most common currency requirements for GA pilots are:

Requirement	Regulation	Details
Flight Review (BFR)	14 CFR §61.56	At least 1 hr ground + 1 hr flight with CFI; required every 24 calendar months. Alternatives: WINGS phase, practical test, military proficiency check. NOTE: No logbook endorsement = not current as PIC.
Passenger-Carrying Currency (Day)	14 CFR §61.57(a)	3 takeoffs and 3 full-stop landings within the preceding 90 days in the same category, class, and type (if applicable) of aircraft.
Passenger-Carrying Currency (Night)	14 CFR §61.57(b)	3 takeoffs and 3 full-stop landings to a full stop between 1 hour after sunset and 1 hour before sunrise, within preceding 90 days.
Instrument Currency (IFR)	14 CFR §61.57(c)	Within 6 calendar months: 6 instrument approaches, holding procedures, intercepting/tracking of courses using nav systems. Can use AATD/BATD/FTD/FFS.
Instrument Proficiency Check (IPC)	14 CFR §61.57(d)	If not instrument current for more than 6 months, an IPC from a CFII or DPE is required before acting as PIC under IFR or in IMC.
High-Altitude Endorsement	14 CFR §61.31(g)	Required to act as PIC of pressurized aircraft certified above 25,000 ft MSL. Endorsement from authorized instructor.

CRITICAL ■ A flight review is NOT an annual requirement — it is every 24 **calendar months**. If a pilot passes a practical test, that counts as a flight review for that calendar month period. Source: **14 CFR §61.56(d)**. A pilot who is not current for carrying passengers may still fly solo.

Logbook and Recordkeeping — 14 CFR §61.51

14 CFR §61.51 governs pilot logbook requirements. Aeronautical experience required for a certificate or rating must be documented in a logbook or training record.

- Pilots must log all flight time used to meet aeronautical requirements
- Each logbook entry must include: date, total flight time, departure/destination, type of piloting time (solo, PIC, SIC, dual), type and ID of aircraft
- Instrument time must record: type of instrument time (actual or simulated), place or airport of each instrument approach
- **§61.51(b)(3)**: Night flight must be logged for currency and certificate requirements
- Solo flight must be logged in the logbook; CFI endorsement is required for solo (§61.87)

Instructor Endorsements (14 CFR §61.189, 61.195)

- A CFI must maintain a record of each student endorsed for solo flight and each person endorsed for a knowledge/practical test for 3 years
- Endorsements must include the date, and the CFI's signature, certificate number, and expiration date
- Standard endorsement language is found in **AC 61-65** (Certification: Pilots and Flight and Ground Instructors) — the most current edition is required
- Logbook falsification is a federal offense — **§61.59** prohibits knowingly making false entries

Instructor Note: *AC 61-65 contains all FAA-accepted endorsement language. CFI applicants must know this document. Available free at faa.gov. Use the most current version — it is updated regularly.*

KEY RULE ■ Logbook entries must be made in ink or indelible pencil. Digital logbooks are acceptable (e.g., Foreflight, Garmin Pilot) but a pilot must be able to produce records on request by the FAA. Source: **14 CFR §61.51(a)**. AC 61-65 endorsement language is the accepted standard for all endorsements.

2. PRIVILEGES AND LIMITATIONS OF PILOT CERTIFICATES (AI.III.A.K2)

A WHAT TO TEACH

Each certificate level grants specific privileges while imposing specific limitations. CFIs must be able to articulate the privileges AND limitations at every level. This is a heavily tested area — examiners frequently probe edge cases and limitations.

Student Pilot (14 CFR §61.89–61.93)

Privileges:

- May act as sole occupant of an aircraft after CFI solo endorsement
- May fly solo cross-country after specific route endorsement (§61.93)

Limitations — cannot:

- Carry passengers
- Fly for compensation or hire
- Act as PIC in furtherance of a business
- Fly in Class A airspace
- Fly in Class B, C, D airspace without specific endorsement and, for Class B, airport-specific training
- Fly international flights
- Fly in weather less than basic VFR minimums

> ***Instructor Note:*** *Student pilot solo endorsements are the* ***most common endorsements*** *a new CFI will give. See* ***AC 61-65*** *for exact endorsement language for §61.87 (solo), §61.93 (cross-country), and solo at Class B/C airports.*

Sport Pilot (14 CFR §61.303–61.327)

Privileges:

- Carry 1 passenger in Light-Sport Aircraft (LSA)
- May fly sport pilot if holding valid U.S. driver's license in lieu of medical (if not previously denied/revoked)

Limitations — may NOT:

- Fly at night (1 hr after sunset to 1 hr before sunrise)
- Fly in Class A, B, C, D airspace without endorsement (B/C/D) or ATC clearance (A)
- Fly in furtherance of a business for compensation
- Fly above 10,000 ft MSL or 2,000 ft AGL (whichever is higher)
- Fly at speeds exceeding 250 kts IAS
- Fly with more than 1 passenger
- Tow any object

CRITICAL ■ If a sport pilot's most recent medical was denied, revoked, or suspended, they CANNOT use a driver's license in lieu of medical. Source: **14 CFR §61.303(c)**.

Recreational Pilot (14 CFR §61.96–61.101)

Privileges:

- Carry 1 passenger
- Fly powered aircraft up to 4 seats, single engine, fixed-pitch/ground-adjustable prop, fixed gear, 180 HP max

Limitations — may NOT:

- Fly more than 50 NM from departure airport (without endorsement for cross-country)
- Fly to/from an airport within Class B, C, D airspace (without endorsement)
- Fly in furtherance of a business
- Fly for compensation or hire
- Fly a tailwheel airplane (without endorsement)
- Fly at night
- Fly above 10,000 ft MSL or 2,000 ft AGL

> ***Instructor Note:*** *Recreational pilot is rarely pursued today — the 50 NM restriction makes it impractical. In practice, students typically skip directly to private pilot. Still tested on the oral. Source:* ***14 CFR §61.101****.*

Private Pilot (14 CFR §61.102–61.117)

Privileges:

- Carry passengers in aircraft for which rated
- Share expenses with passengers (pro-rata fuel/oil/airport/rental — cannot profit)
- Act as PIC on charity flights (subject to limitations in §61.113(c))
- Fly in furtherance of a business if not the primary purpose (§61.113(b))
- Conduct certain aerial work: aerial photography, banner towing (with limitations)

Limitations — may NOT:

- Carry passengers or property for compensation or hire
- Fly complex, high-performance, or tailwheel aircraft without endorsement
- Act as PIC of pressurized aircraft above 25,000 ft without high-altitude endorsement
- Conduct instrument flight without instrument rating and currency

KEY RULE ■ 'Compensation' includes anything of value, not just money. Carrying a passenger in exchange for car repair = compensation = illegal without commercial. Source: **14 CFR §61.113**; FAA Legal Interpretations (various).

Commercial Pilot (14 CFR §61.121–61.133)

Privileges:

- Act as PIC of aircraft for compensation or hire
- Carry persons or property for compensation or hire within the US
- Act as SIC of aircraft requiring a type rating

Additional Required Endorsements/Ratings:

- **Instrument Rating** required to carry passengers for hire at night or on cross-country >50 NM (§61.133(b))
- **Complex aircraft endorsement** required for commercial operations in complex aircraft (§61.31(e))
- **High-performance endorsement** for aircraft with >200 HP (§61.31(f))

Certificate Requirements:

- 250 hours total time (200 if Part 141)
- At least a 2nd class medical certificate
- Must pass commercial knowledge test (CAX) and practical test

> ***Instructor Note:*** *Instrument rating is NOT required to get commercial certificate but IS required to carry passengers for hire at night or on cross-countries over 50 NM. Source:* ***14 CFR §61.133(b)****.*

Flight Instructor (14 CFR §61.183–61.201)

Privileges:

- Provide flight instruction in aircraft for which certificated and rated
- Endorse logbooks for training, solo flight, knowledge tests, and practical tests
- Conduct flight reviews (§61.56)
- Endorse pilots for instrument proficiency checks (CFII only)

Limitations — must have:

- Current flight review (§61.56) to act as PIC
- Current medical certificate OR BasicMed to act as required crewmember
- Endorsement for each aircraft category/class in which they instruct

Certificate Validity and Renewal:

- CFI certificate expires 24 calendar months from issuance
- Renewal requires: practical test, FIRC completion, CFI Gold Seal with 5 students passed in 24 months, or Wings Phase meeting renewal criteria
- Renewal extends certificate 24 months from current expiration date (not from date of renewal)

CRITICAL ■ A CFI with an expired certificate CANNOT provide instruction or sign endorsements. Source: **14 CFR §61.197, §61.199**. Renewal deadline is midnight on the last day of the expiration month.

3. MEDICAL CERTIFICATES (AI.III.A.K3)

A WHAT TO TEACH

Pilots must hold the appropriate medical certificate to exercise the privileges of their certificate. Medical certificates are issued by FAA Aviation Medical Examiners (AMEs) and are classified as 1st, 2nd, or 3rd class. The BasicMed pathway under **14 CFR Part 68** provides an alternative to a traditional 3rd class medical.

Class	Required For	Validity Under Age 40	Validity Age 40+	Key CFR
1st Class	Airline Transport Pilot (ATP) — required when exercising ATP privileges	12 calendar months (1st class privileges)	6 calendar months (1st class privileges) 12 months (2nd class) 60 months (3rd class)	§61.23(d)(1)
2nd Class	Commercial Pilot operations (for hire)	12 calendar months (2nd class privileges) 60 months (3rd class)	12 calendar months (all lower class privileges)	§61.23(d)(2)
3rd Class	Private, recreational, student pilot	60 calendar months	24 calendar months	§61.23(d)(3)
BasicMed	Private pilot operations only (see Part 68 limits)	Valid if driver's license valid + exam every 48 months + course every 24 months	Same requirements	14 CFR Part 68; AC 68-1

Instructor Note: *Key concept: A 1st class medical DOWNSTEPS as it ages. When a 1st class medical exceeds 6 months (age 40+), it provides 2nd class privileges until month 12, then 3rd class privileges until expiration. A pilot exercising commercial privileges needs 2nd class privileges to be valid. Source:* ***14 CFR §61.23(d)****. This is a frequent oral test question.*

Medical Standards

Medical standards are found in **14 CFR Part 67**. Standards cover vision, ears/hearing, mental health, neurological, cardiovascular, general medical, and substance dependence. Each class has progressively stricter requirements.

- Vision: 1st class requires 20/20 distant; 3rd class requires 20/40
- Blood pressure: acceptable limits stated in Part 67
- Color vision: deficiency may result in limitations on certificate; isochromatic plate test or alternative signal light test
- Conditions such as diabetes (insulin-treated), epilepsy, mental health history, cardiac history require Special Issuance

Special Issuance (SODA/SI)

When a pilot has a condition that does not meet the standard requirements of Part 67, they may apply for a Special Issuance (SI) authorization from the FAA. A Statement of Demonstrated Ability (SODA) is issued for certain static conditions (e.g., color blindness with demonstrated ability). Special Issuance certificates require periodic re-evaluation.

> ***Instructor Note:*** *Part 67 is not directly listed as a reference for this ACS task but AMEs operate under it. CFIs should be familiar with the concept of Special Issuance to advise students. Refer students to an AME or AOPA Medical Certification Services for specific medical questions — do NOT attempt to provide medical advice.*

Temporary Disqualifications

Certain conditions *temporarily* disqualify a pilot from acting as PIC even if they hold a valid medical: illness, alcohol or drug influence, prescription medications with impairing effects.

- **14 CFR §91.17**: 8 hours bottle-to-throttle minimum; no flying under the influence; BAC limit 0.04%
- **14 CFR §61.53**: Pilot shall not act as PIC if they know of any medical condition that would make them unable to meet medical standards
- OTC medications (antihistamines, decongestants, etc.) may cause disqualifying impairment even if the pilot holds a current medical — always check AOPA's drug database or FAA CAMI
- Pregnancy: no specific prohibition but medical certificate standards apply; AME consultation recommended
- Blood donation: FAA recommends 72-hour deferral before flight

BasicMed (14 CFR Part 68 / AC 68-1)

- Pilot must have held an FAA medical at any time after July 14, 2006
- Must hold a valid U.S. driver's license
- Must receive a physical examination from a state-licensed physician using the CMEC (Comprehensive Medical Examination Checklist) every **48 calendar months**
- Must complete a medical education course every **24 calendar months** (FAA-approved online course)
- Most recent medical certificate must NOT have been revoked, suspended, or withdrawn

CRITICAL ■ BasicMed RESTRICTIONS: Cannot fly above FL180, at more than 250 KIAS, in aircraft requiring more than 6 seats or over 6,000 lbs MTOW. Cannot fly internationally. Cannot exercise commercial privileges. Source: **14 CFR §68.9**.

■ ***Memory Aid:*** *Medical Expiration Memory Trick:* ***"1-2-3, 6-12-60"*** *— 1st class ages 40+: 6 months (ATP), 12 months (commercial downstep), 60 months (private downstep). 2nd class: 12 months commercial, 60 months private. 3rd class: 24 months (40+), 60 months (<40). Source:* ***14 CFR §61.23(d)****.*

4. DOCUMENTS PILOTS MUST POSSESS (AI.III.A.K4)

A WHAT TO TEACH

14 CFR §61.3 specifies the documents a pilot must have in their personal possession or readily accessible in the aircraft when exercising the privileges of a certificate. These are separate from aircraft documents (which are covered in Task B — Airworthiness).

Required on the Pilot's Person (§61.3)

- **Pilot Certificate** — Valid FAA pilot certificate for the category/class/type being flown (or student pilot certificate with appropriate endorsements)
- **Medical Certificate** — Appropriate class medical certificate, OR evidence of BasicMed compliance (physician exam records + course completion), OR valid U.S. driver's license (sport pilot only)
- **Photo ID** — Government-issued photo ID (driver's license, passport, military ID) if the pilot certificate does not include a photo — required when operating at controlled airports or where requested
- **Current logbook** — Student pilots and sport pilots using driver's license as medical must have their logbook with appropriate endorsements within 90 days

Specific Endorsements That Must Be Available

- Student solo endorsement (§61.87)
- Student cross-country endorsement (§61.93) — must be specific to the route and date if solo XC
- High-performance aircraft endorsement if flying >200 HP aircraft (§61.31(f))
- Complex aircraft endorsement for aircraft with retractable gear, flaps, and controllable-pitch prop (§61.31(e))
- Tailwheel endorsement for tailwheel airplanes (§61.31(i))
- High-altitude/pressurized aircraft endorsement above FL250 (§61.31(g))
- Type rating endorsement for aircraft requiring type rating (§61.31(a))

> ***Instructor Note:*** *§61.3 is one of the most tested sections on CFI orals. Know the difference between documents the **pilot** must have vs. what the **aircraft** must have. For aircraft documents, see ARROW acronym in Task B. Source: **14 CFR §61.3**.*

Aircraft-Required Documents: ARROW (14 CFR §91.9, 91.203)

Although aircraft documents fall primarily under Task B, CFIs must know them for the complete picture of pre-departure compliance:

- **A** — Airworthiness Certificate (§91.203(a)(1)) — must be displayed in aircraft
- **R** — Registration Certificate (§91.203(a)(2)) — must be current and on board
- **R** — Radio Station License — required for international flights under FCC regulations
- **O** — Operating Limitations/POH/AFM — must be on board and current (§91.9)
- **W** — Weight and Balance data — current for the specific aircraft

English Language Proficiency (AC 60-28B)

Under **14 CFR §61.96(b)(4)** and related sections, pilots must be able to read, speak, write, and understand the English language. ICAO Language Proficiency requirements apply for international operations. **AC 60-28B** details the FAA standard.

Special Situations

- Aircraft with INOP equipment: must comply with MEL or §91.213 before flight
- Operating at night: aircraft must have night equipment per §91.205(c); pilot does not need an additional document but must be night current (§61.57(b))
- Operating IFR: pilot must hold instrument rating, be current (§61.57(c)/(d)), and aircraft must have IFR equipment (§91.205(d))
- Operating in Class A: must hold instrument rating; aircraft must have Mode C transponder

> **KEY RULE** ■ Quick check before every flight: Does the **PILOT** have valid certificate + medical + photo ID + appropriate endorsements? Does the **AIRCRAFT** have ARROW + current maintenance? Is the pilot CURRENT for the planned flight (day/night passengers, IFR)?

5. RISK MANAGEMENT (AI.III.A.R1 & R2)

A WHAT TO TEACH

R1 — Proficiency vs. Currency

Currency is the **legal minimum** — it tells the FAA that a pilot has met the minimum standards to exercise certain privileges. Proficiency is the **actual skill level** needed to operate safely. A pilot can be legally current but dangerously unproficient.

- **Currency example:** A pilot completes 3 night landings on day 89 (one day before the 90-day window expires). They are night current but may not be *proficient* if they haven't flown regularly.
- **Proficiency gap:** Most common after time away from flying — transitions, weather groundings, family obligations. Rust accumulates faster than pilots realize.
- **FAA WINGS Program** — voluntary proficiency program. Completion of WINGS phases satisfies the flight review requirement per §61.56(e). Excellent tool for structured recurrent training.
- **Recurrent training beyond minimums:** Encourage students to seek annual recurrent checks, scenario-based training, and practice in new conditions.

■ ***Risk Note:*** *The NTSB accident database consistently shows that "current" pilots cause fatal accidents. Currency is a floor, not a ceiling. Teach students to hold themselves to a* ***personal minimum*** *standard that exceeds FAA currency minimums. Source: NTSB accident studies;* ***FAA-H-8083-2*** *(Risk Management Handbook).*

CFI's Role in Proficiency Conversations

- CFIs should discuss proficiency standards explicitly during flight reviews and endorsement sessions
- Do not endorse a student whose actual skills do not meet the standard, even if technically they have logged the hours
- Flight reviews are an opportunity to identify and address proficiency gaps, not just check legal boxes

KEY RULE ■ A CFI who signs off a student or endorses a pilot review must genuinely believe the pilot meets the standard. A logbook signature creates a legal record and a moral responsibility. Source: **14 CFR §61.195**; **AC 61-65** (CFI responsibilities).

R2 — Flying Unfamiliar Aircraft / Avionics

One of the most significant accident risk factors is transitioning to an unfamiliar aircraft or cockpit without adequate preparation. This includes transitioning from analog instruments to glass cockpit, from fixed gear to retractable, or from one aircraft manufacturer's avionics suite to another.

- **Checkout requirements:** The FAA does not specify a minimum number of hours for an aircraft checkout beyond the endorsement requirements in §61.31. Insurance policies and flight school SOPs often impose additional requirements — these may be more stringent.
- **Glass cockpit transitions:** Pilots transitioning from analog to glass (e.g., Garmin G1000, Garmin G3X, Avidyne) should receive formal transition training. Automation surprises are a leading cause of glass cockpit accidents.
- **Automation dependency:** Over-reliance on autopilot and GPS can cause pilots to lose basic instrument scan skills. FITS (FAA Industry Training Standards) and scenario-based training address this.
- **System-specific avionics training:** GFC700 autopilot, Garmin GTN navigators, ForeFlight integration — each has unique behaviors that must be understood before flight.

High-Performance and Complex Aircraft Transitions

- High-performance aircraft (>200 HP) require endorsement per §61.31(f) — often involves engine management, mixture control, constant-speed prop operation
- Complex aircraft (retractable gear, flaps, controllable prop) require endorsement per §61.31(e) — GUMP checks, gear-up emergencies, increased landing accidents
- Tailwheel aircraft require endorsement per §61.31(i) — ground handling and crosswind landings differ significantly

■ ***Risk Note:*** *The FAA study 'Introduction to Glass Cockpit Aircraft' found that pilots transitioning without formal training were significantly more likely to experience CFIT and loss-of-control accidents. Encourage students to fly with a CFI in any new aircraft type, regardless of certificate level. Source: FAA Safety Team (FAAST);* ***FAA-H-8083-2*** *Ch. 2.*

6. SKILLS (AI.III.A.S1)

ACS Requirement: The applicant demonstrates how to deliver instruction on at least two of the elements specified in K1 through K4.

What the Evaluator Will Assess

The DPE will present a scenario or ask the applicant to teach a specific knowledge element as if instructing a student. The applicant must demonstrate the ability to explain the concept clearly, answer follow-up questions, and recognize and correct student misunderstandings.

- **Likely topics selected:** Medical certificate classes and expiration, pilot certificate privileges/limitations, or logbook/endorsement requirements — as these are the most common areas tested
- **Delivery technique:** Use the Telling-and-Doing technique — explain the concept, demonstrate it (e.g., show how to read a currency chart), and have the student practice explaining it back
- **Use references:** Have the CFR, AC 61-65, and a pilot logbook available; referencing the actual regulation demonstrates authority and accuracy

Sample Teaching Scenario: Medical Certificates

- Start with the big picture: Why do we need medicals? (Safety, standards, public trust)
- Explain the three classes and what operations each supports
- Walk through expiration: show age 40 cutoff and the downstepping concept for 1st class
- Address BasicMed as an alternative — who qualifies, what are the limitations
- Anticipate student questions: 'What if I take a medication?' — refer to AME or AOPA MedXpress

Instructor Note: *For the oral, the evaluator may interrupt to ask follow-up questions mid-explanation. This is intentional — they are assessing depth of knowledge and instructional adaptability. Pause, acknowledge the question, answer it directly, then return to the lesson.*

Sample Teaching Scenario: Currency vs. Proficiency

- Open with a question: 'What does it mean to be current? Is current the same as safe?'
- Define currency using the regulation (61.56 BFR, 61.57 takeoffs/landings)
- Contrast with proficiency — describe the skills a truly proficient pilot maintains
- Use a real-world example: a pilot who flew 3 landings 88 days ago is 'current' but may not be proficient
- Discuss personal minimums — how to set them, why they matter
- Introduce the WINGS program as a structured alternative to minimum currency

Instructional Techniques to Demonstrate

- **Concrete examples:** Always tie abstract rules to real scenarios
- **Scaffolding:** Build from simple (what is a medical) to complex (downstepping, BasicMed exceptions)
- **Error analysis:** Present common misconceptions and correct them proactively
- **Question framing:** Use open-ended questions to check student understanding, not just yes/no

■ ***Advisory:*** *FAA WINGS Program: Available at* ***faasafety.gov****. Completion of activities and flight proficiency phases satisfies the flight review requirement. Excellent resource to share with students seeking structured recurrency. Encourage all students to enroll.*

KEY RULE ■ On the practical test, the applicant may choose which two K elements to demonstrate. Select two that you are strongest in AND that offer good instructional contrast. Medical certificates (K3) and currency/recordkeeping (K1) are natural pairs with high-yield content.

QUICK REFERENCE: PILOT CERTIFICATE SUMMARY (ALL LEVELS)

Certificate	Min. Age	Medical Req.	Passengers	For Hire?	Night?	IFR?	Key Limitations
Student	16 (14 for glider)	3rd Class or BasicMed (or DL for sport)	None	No	No (solo)	No	Solo only after CFI endorsement; Class B specific training required
Sport	17	Driver's License (if no denial/revocation history)	1	No	No	No	LSA only; ≤10,000 MSL or 2,000 AGL; ≤250 KIAS; no towing
Recreational	17	3rd Class	1	No	No	No	≤50 NM from home airport; single engine ≤180 HP; fixed gear
Private	17	3rd Class or BasicMed	Yes	No (incidental ok)	Yes (w/ currency)	Yes (w/ rating + currency)	Cannot carry for hire; pro-rata expense sharing only
Commercial	18	2nd Class	Yes	Yes	Yes (w/ currency)	Yes (w/ rating + currency)	Instrument rating required for hire at night or XC >50 NM
ATP	23 (21 restricted)	1st Class	Yes	Yes	Yes	Yes (required)	Required for Part 121; restricted ATP limited to SIC role in Part 121
CFI	18	3rd Class or BasicMed (to act as required crewmember)	Yes (as instructor)	Yes (instruction only)	Yes (w/ currency)	No (unless CFII)	Certificate expires 24 months; renewal required

QUICK REFERENCE: MEDICAL CERTIFICATE EXPIRATION SUMMARY

Class	Privileges	Age	Expiration from Date of Exam	CFR Reference
1st Class	ATP operations	<40	12 calendar months (1st class) / 60 months (3rd class)	§61.23(d)(1)(i)
1st Class	ATP operations	40+	6 calendar months (1st) / 12 months (2nd) / 60 months (3rd)	§61.23(d)(1)(ii)
2nd Class	Commercial operations	<40	12 calendar months (2nd class) / 60 months (3rd class)	§61.23(d)(2)(i)
2nd Class	Commercial operations	40+	12 calendar months (all lower class privileges)	§61.23(d)(2)(ii)
3rd Class	Private/Recreational/Student	<40	60 calendar months	§61.23(d)(3)(i)
3rd Class	Private/Recreational/Student	40+	24 calendar months	§61.23(d)(3)(ii)
BasicMed	Private operations only (Part 68 limits)	Any	Physician exam: 48 months; Education course: 24 months	14 CFR Part 68; AC 68-1

Instructor Note: *Medical expiration is calculated in* ***calendar months****, not days. A medical exam taken on January 15 for a 3rd class certificate (age 40+) expires on January 31 two years later — the entire calendar month of January 2 years hence. Source:* ***14 CFR §61.23(d)****. FAA Medical Expiration Calculator is available at* ***medxpress.faa.gov****.*

INSTRUCTOR REFERENCE SUMMARY — WHERE TO FIND IT

Topic	Regulation / Document	Location
Student pilot solo requirements	14 CFR §61.87	Part 61, Subpart C
Student pilot cross-country requirements	14 CFR §61.93	Part 61, Subpart C
Private pilot aeronautical experience	14 CFR §61.109	Part 61, Subpart D
Commercial pilot experience	14 CFR §61.129	Part 61, Subpart F
ATP certificate requirements	14 CFR §61.159	Part 61, Subpart G
Flight instructor certificate requirements	14 CFR §61.183, §61.187	Part 61, Subpart H
CFI certificate renewal	14 CFR §61.197, §61.199	Part 61, Subpart H
Flight review requirements	14 CFR §61.56	Part 61, Subpart A
Recent flight experience (currency)	14 CFR §61.57	Part 61, Subpart A
Logbook requirements	14 CFR §61.51	Part 61, Subpart A
Medical certificate requirements	14 CFR §61.23	Part 61, Subpart A
Medical certificate standards	14 CFR Part 67	Part 67 (separate)
BasicMed requirements	14 CFR Part 68; AC 68-1	Part 68; AOPA and FAA websites
Pilot documents required	14 CFR §61.3	Part 61, Subpart A
Aircraft documents required (ARROW)	14 CFR §91.203, §91.9	Part 91, Subpart C
English language requirement	14 CFR §61.96(b)(4); AC 60-28B	Part 61; Advisory Circular
Endorsement language (standard)	AC 61-65 (current edition)	faa.gov — Advisory Circulars
High-performance endorsement	14 CFR §61.31(f)	Part 61, Subpart A
Complex aircraft endorsement	14 CFR §61.31(e)	Part 61, Subpart A
Tailwheel endorsement	14 CFR §61.31(i)	Part 61, Subpart A
Alcohol / drug restrictions	14 CFR §91.17	Part 91, Subpart B
Medical condition self-grounding	14 CFR §61.53	Part 61, Subpart A
CFI record-keeping requirements	14 CFR §61.189	Part 61, Subpart H
Privileges of private pilot certificate	14 CFR §61.113	Part 61, Subpart D
WINGS proficiency program	faasafety.gov	Online — FAA Safety Team
Risk Management Handbook	FAA-H-8083-2	faa.gov — Handbooks
PHAK — Pilot certification overview	FAA-H-8083-25C, Chapter 1	faa.gov — PHAK

Area III, Task B — Airworthiness Requirements

FAA-S-ACS-25 | CFI Airplane — Ground Lesson

Objective

The applicant demonstrates instructional knowledge of aircraft airworthiness requirements, including required documents, equipment for VFR day/night operations, inoperative equipment procedures under 14 CFR 91.213, Airworthiness Directives, special flight permits, and maintenance record requirements. The applicant can apply this knowledge, manage associated risks, and provide effective instruction to student pilots.

References

- 14 CFR Part 91 — §91.7, 91.9, 91.205, 91.207, 91.213, 91.403, 91.409, 91.417
- 14 CFR Part 39 — Airworthiness Directives
- 14 CFR Part 43 — Maintenance, Preventive Maintenance, Rebuilding
- 14 CFR Part 21 — §21.197 (Special Flight Permits)
- FAA-H-8083-25C (PHAK) — Chapter 8
- POH/AFM — Section 2 (Limitations) and Section 6 (Weight & Balance)

Delivery Format

- Ground lesson — 60–90 minutes
- Bring the actual POH and aircraft logbooks for hands-on reference
- Walk through the 91.213 decision tree with a real scenario

ACS Knowledge Elements (AI.III.B)

Code	Element
AI.III.B.K1	Certificates/documents required to be in the aircraft (ARROWE)
AI.III.B.K2	Airworthiness requirements and how to verify them
AI.III.B.K3	Required instruments and equipment — 14 CFR 91.205
AI.III.B.K4	Inoperative instruments and equipment — 14 CFR 91.213
AI.III.B.K5	Minimum Equipment Lists (MEL) and their use
AI.III.B.K6	Special flight permits — 21.197
AI.III.B.K7	Airworthiness Directives (ADs) — 14 CFR Part 39
AI.III.B.K8	Maintenance record requirements — 14 CFR 91.417

ACS Risk Management

Code	Element
AI.III.B.R1	Effect of inoperative instruments/equipment on flight safety
AI.III.B.R2	Flying with known equipment deficiencies

ACS Skills

Code	Element
AI.III.B.S1	Use checklist/POH to determine airworthiness of the aircraft

> ***Instructor Note:*** *When presenting this lesson, open the actual POH to Section 2 (Limitations). Students who connect the regulation to a physical page they can touch retain it far better than students who only hear an abstract reference number.*

1. Required Documents Onboard — ARROWE (AI.III.B.K1)

A WHAT TO TEACH

Before every flight, certain documents must be onboard the aircraft. The acronym **ARROWE** covers both domestic requirements and the additional document needed for international operations. Operating without required documents violates 14 CFR 91.9.

	Document	Reg. Basis	Key Points
A	Airworthiness Certificate	91.9(b)(1)	Must be displayed in aircraft. No expiration date — valid as long as aircraft is maintained per FAR Part 43 and all ADs are complied with.
R	Registration Certificate	91.9(b)(2)	Must be in the aircraft. Valid 3 years (paper). N-number must match tail number. Digital authorized under specific conditions.
R	Radio Station License (FCC) — International Flights	47 CFR §87.18	Required for any flight outside U.S. airspace or communicating with foreign stations. Issued by FCC (Form 605). Not required for domestic-only ops, but essential for any international or oceanic flight.
O	Operating Limitations / POH or FAA-Approved AFM	91.9(b)(3)	Current FAA-approved POH/AFM must be accessible in flight. Must be aircraft-specific. Section 2 Limitations are legally binding.
W	Weight and Balance Data	91.9(b)(4)	Current, aircraft-specific W&B; reflecting actual configuration. In POH or approved supplement. Must be updated after any modification affecting weight or CG.
E	Equipment List (AFM Equipment List or approved MEL)	91.9 / AC 91-67	POH equipment list identifies installed equipment and certification basis. FAA-approved MEL (if applicable) must be onboard. First reference in the 91.213 inoperative equipment analysis.

Instructor Note: *Instructor Note: Walk to the airplane before the ground lesson and verify each ARROWE item with the student letter by letter. Have them physically find the airworthiness certificate and the FCC radio license themselves. Ask: 'If we flew to the Bahamas tomorrow, what extra document would we need onboard?' — this question reliably surprises students and makes the second R stick. Also ask: 'Where is the equipment list in this POH?' — most students have never opened it, yet it is the first reference in the 91.213 inop analysis.*

1. Airworthiness Certificate — Types, Validity, and PIC Responsibility (AI.III.B.K2)

Two Types of Airworthiness Certificates

An airworthiness certificate is the FAA's declaration that an aircraft meets its type design at the time of issuance. Two primary categories:

Type	Who Gets It	Key Condition
Standard	Normal, utility, acrobatic, commuter, transport category	Maintained per 14 CFR Part 43; all ADs complied with; no unapproved modifications
Special	Experimental, light-sport, primary, restricted, limited, provisional	Additional operating limitations apply; often more restrictive than Standard

Validity: Condition-Based, Not Date-Based

An airworthiness certificate has **no expiration date**. It remains valid as long as:

- Aircraft maintained per 14 CFR Part 43
- All applicable Airworthiness Directives complied with
- No unapproved modifications to the type design
- No major unrepaired damage

KEY RULE ■ 14 CFR 91.7: The PIC is responsible for determining airworthiness prior to each flight. The certificate on the panel doesn't make the aircraft airworthy — the PIC's preflight determination does.

What Makes an Aircraft NOT Airworthy?

The presence of an airworthiness certificate does not guarantee the aircraft is currently airworthy. Teach students these common invalidating conditions:

- **Non-compliant AD:** ADs are legally binding — non-compliance voids airworthiness regardless of certificate status
- **Unapproved modification/repair:** Any type design change without STC or FAA Form 337 approval deviates from the type certificate
- **Overdue inspection:** Annual (or 100-hr for hire) is a legal requirement; an overdue aircraft cannot be flown
- **Known defect found on preflight:** Flying a known unairworthy condition violates 91.7
- **Expired registration:** Operating with expired registration violates 91.9, even if the airworthiness cert is fine

Instructor Note: *Instructor Note: Correct early the common conflation of 'has a certificate' with 'is airworthy right now.' The certificate states compliance at issuance. Every preflight is the PIC's fresh determination — that's why 91.7 exists and why the logbook review matters.*

AV1ATE — Required Inspections to Maintain Airworthiness

	Inspection	Rule	Interval / Requirement
A	Annual Inspection	14 CFR 91.409(a)	Within the preceding 12 calendar months. Required for ALL aircraft operated under 14 CFR Part 91. Any A&P; mechanic with Inspection Authorization (IA) may perform it.
V	VOR Check (IFR only)	14 CFR 91.171	Within the preceding 30 days before IFR flight. Methods: VOT (±4°), ground checkpoint (±4°), airborne checkpoint (±6°), dual VOR check (±4° between receivers). Must be logged with date, place, bearing error, and signature.
1	100-Hour Inspection	14 CFR 91.409(b)	Required only if aircraft is used for hire or flight instruction for hire. Within preceding 100 hours TIS. Any certificated A&P; mechanic may perform it (IA not required). Annual inspection may substitute for the 100-hour.
A	Altimeter / Pitot-Static System	14 CFR 91.411	Within the preceding 24 calendar months. Required for IFR operations only. Must be performed by a certificated repair station or the manufacturer. Pitot-static system integrity tested simultaneously.
T	Transponder	14 CFR 91.413	Within the preceding 24 calendar months. Required for ALL aircraft with transponders, including VFR aircraft. Tested and inspected per Appendix F, Part 43.

E	ELT — Battery & Inspection	14 CFR 91.207	Battery: replace or recharge when 50% of useful life expired (by manufacturer's date) OR after 1 cumulative hour of use (whichever comes first). Inspection: within 12 calendar months of last inspection for proper installation, battery corrosion, operation of controls and crash sensor, and signal adequacy. Testing: only during first 5 minutes of each hour; limit to 3 sweeps maximum. Aircraft may operate without ELT only when ferrying to a repair station for ELT repair (91.207(f)).

Instructor Note: *Instructor Note: Teach AV1ATE by asking the student to find each compliance entry in the aircraft logbooks. Ask: 'When was the last annual? Is the transponder check current? Find the ELT battery date.' Most students have never read the logbooks critically. Note that the VOR check and altimeter/pitot-static are only required for IFR — a common exam trap. The transponder check is required for ALL transponder-equipped aircraft, not just IFR.*

2. Required Instruments and Equipment — 14 CFR 91.205 (AI.III.B.K3)

VFR Day Requirements (91.205(b))

The following instruments and equipment are required for VFR day flight. A common acronym is **ATOMATOFLAMES**:

Letter	Equipment Required
A	Airspeed indicator
T	Tachometer (for each engine)
O	Oil pressure gauge (for each engine using pressure system)
M	Manifold pressure gauge (for each altitude engine)
A	Altimeter
T	Temperature gauge (for each liquid-cooled engine)
O	Oil temperature gauge (for each air-cooled engine)
F	Fuel gauge for each tank
L	Landing gear position indicator (if retractable gear)
A	Anti-collision lights (if certified after 11 Mar 1996)
M	Magnetic compass
E	ELT (Emergency Locator Transmitter)
S	Safety belts / shoulder harnesses (for each occupant)

Instructor Note: *Instructor Note: When teaching ATOMATOFLAMES, don't just recite the list — have the student walk you through the cockpit and point to each item. This ties the regulation to a physical instrument and dramatically improves retention. Clarify that the manifold pressure gauge applies only to altitude engines (turbocharged/fuel-injected).*

Additional Equipment Required for VFR Night (91.205(c))

In addition to all VFR day equipment, the following are required for VFR night. Acronym: **FLAPS**:

Letter	Additional Equipment for Night VFR
F	Fuses — one spare set of each type or three fuses of each type
L	Landing light (if operated for hire)
A	Anti-collision lights (position lights and anti-collision system)
P	Position lights (nav lights — red/green/white)
S	Source of electricity adequate for all required equipment

ELT Requirements (91.207)

The ELT is required by 91.205 and governed by 91.207. Key rules instructors must know:

- ELT batteries must be replaced or recharged after 1 cumulative hour of use, or when 50% of battery life has expired (per manufacturer's date)
- ELT must be tested during the first 5 minutes of each hour — a single sweep of about 3 sweeps is acceptable
- ELT must be installed securely, operating on 406 MHz for newer units
- An aircraft may be operated without an ELT only if it is being ferried to a repair station for ELT repair (91.207(f))

Instructor Note: *Instructor Note: Students often believe FLAPS is a standalone list. Emphasize that night VFR requires ALL day equipment PLUS the FLAPS items — it is additive, not a separate list. Quiz them: 'If your altimeter is inoperative, can you fly at night under VFR?' Answer: No — the altimeter is required for day VFR which underlies night VFR.*

KEY RULE ■ Operating without required equipment is a violation of 91.205 regardless of pilot experience or flight conditions. There is no 'good weather exemption' for missing instruments.

Instructor Note: *Instructor Note: Two common scenarios to walk through with students: (1) Night cross-country — inoperative left nav/position light found on preflight. Can they go? No — position lights are required for VFR night (91.205(c)). Run 91.213 with them to show why. (2) Day VFR — left tank fuel gauge reads empty but tank is full. Gauge is inoperative. 91.205(b) requires a fuel gauge for each tank. The aircraft cannot fly unless the tank is actually empty. Both scenarios are real go/no-go teaching moments — use them.*

3. Inoperative Equipment — 14 CFR 91.213 Decision Process (AI.III.B.K4, K5)

When a pilot discovers inoperative equipment during preflight, **the first question is never 'is it important?' — it is always 'is it required?'** 14 CFR 91.213 provides the legal framework for making that determination. There are two paths depending on whether the aircraft has an FAA-approved Minimum Equipment List (MEL).

Instructor Note: *Instructor Note: 91.213 is one of the regulations students find most confusing and most practically important. A student who internalizes this decision tree will make better go/no-go decisions for their entire career. Take your time here and use a real scenario.*

Path A: Aircraft Has an FAA-Approved MEL

An MEL is an FAA-approved document (AC 91-67) that allows an operator to fly with specific items inoperative under defined conditions. An MEL is based on the Master Minimum Equipment List (MMEL) published by the FAA for that aircraft type.

MEL Rule	Details
FAA-approved only	Self-created lists are NOT MELs — must be specifically approved for that aircraft's registration
Follow procedures exactly	Each inop item has (M) crew procedures and (O) maintenance actions; must be completed before flight
More permissive than 91.213	MEL allows specific inop items that 91.213 alone would prohibit, under defined conditions
Must be onboard	MEL document must be carried in the aircraft when operating under it

Instructor Note: *Instructor Note: Most general aviation training aircraft do NOT have an approved MEL. Without one, you operate exclusively under the 91.213(d) no-MEL procedure. Confirm this with your school's maintenance department.*

Path B: No MEL — The 91.213(d) Decision Test

Without an MEL, 14 CFR 91.213(d) provides a five-question decision process. If the answer to *any* of the first four questions is YES, the aircraft is NOT airworthy and cannot be flown until the equipment is repaired. Only if *all four* are NO may the pilot proceed to deactivate and placard.

Question	Required By	If YES →
1. Is it required by the Type Certificate Data Sheet (TCDS)?	Type design (manufacturer)	NOT airworthy — do not fly
2. Is it required by 14 CFR 91.205 for this operation?	FAR (day/night VFR, IFR)	NOT airworthy for that operation
3. Is it required by an applicable Airworthiness Directive?	14 CFR Part 39	NOT airworthy — do not fly
4. Is it required by the POH/AFM Limitations section?	Manufacturer's approved limitations	NOT airworthy — do not fly
5. If all NO: deactivate or secure INOP, and placard.	91.213(d)(2)	Aircraft is airworthy — may fly

CRITICAL ■ CRITICAL ■ The INOP placard is not optional — it is a legal requirement of 91.213(d)(2)(ii). Without the placard, flying with inoperative equipment is a regulatory violation regardless of whether the equipment was technically required.

4. Airworthiness Directives, Special Flight Permits & Maintenance Records (AI.III.B.K6–K8)

Airworthiness Directives — 14 CFR Part 39 (AI.III.B.K7)

An AD is a legally enforceable regulation to correct an unsafe condition in an aircraft product. Non-compliance makes the aircraft NOT airworthy regardless of recent inspections.

AD Type	Description	Compliance
Emergency AD	Imminent safety threat; effective upon receipt	Before next flight
Immediate Adopted Rule	Bypasses comment period	As specified (often hours TIS)
NPRM / Final Rule	Normal regulatory process	Effective date in AD
Recurring AD	Repeated at specified intervals	Each interval (e.g., 100 hrs)
One-Time AD	Single inspection or modification	Once — then log permanently

Maintenance Records — 14 CFR 91.417 (AI.III.B.K8)

- AD compliance records — retained permanently
- Major alterations and repairs (Form 337) — retained permanently
- Annual/100-hr inspections — retained until next inspection of same type

> ***Instructor Note:*** *Instructor Note: Walk through the aircraft logbooks with the student. Show the annual entry, any AD compliance entries, and 337 forms. Ask: 'How would you find all applicable ADs for this aircraft?' Then show them rgl.faa.gov/ADCMS.*

Special Flight Permits — 14 CFR 21.197 (AI.III.B.K6)

A Special Flight Permit (ferry permit) allows an unairworthy aircraft to fly to a maintenance facility. It is NOT authorization for routine operations.

Authorized Purpose	Example
Fly to base for repairs	Gear malfunction at remote airport — fly to maintenance shop
Deliver new production aircraft	Manufacturer delivers aircraft lacking minor equipment
Evacuate from disaster area	Move aircraft from hurricane-affected airport

Risk Management — R1 & R2

R1 — A legal flight is not always a safe flight. 91.213 answers *can I legally fly?* Risk management asks *should I fly?* Inop comm = legal VFR but no CTAF. Inop pitot heat = legal in VMC but risky near moisture. Train students to evaluate both questions.

R2 — When 91.213 permits flight, the PIC must: log the discrepancy; notify the next PIC; reassess if conditions change; and placard 'INOP' (required by 91.213(d)(2)(ii)).

> ***Instructor Note:*** *Instructor Note: When a student finds a pre-existing INOP placard on preflight, use it: 'What does this mean? Is it safe? Is it legal for our flight today?' Work the 91.213 decision tree together — every PIC makes their own determination.*

> ***Instructor Note:*** *Instructor Note: The most dangerous student is one who knows just enough about 91.213 to convince themselves an inop item is fine without truly working through the analysis. Your job is to install a deliberate, unhurried decision habit — not just an answer for the checkride. Every INOP placard found on preflight is a teaching opportunity: ask who placed it, why, and whether it affects today's flight.*

Area III, Task C — Weather Information

FAA-S-ACS-25 | CFI Airplane — Ground Lesson

Motivation

Weather is the leading cause of fatal general aviation accidents. As a CFI, your ability to teach sound ADM around weather is a life-safety skill. Students who understand *why* hazards form — not just the rules — make better go/no-go decisions throughout their flying careers.

Objective

The applicant demonstrates instructional knowledge of weather information sources, weather products, and meteorological conditions affecting VFR/VMC flight. The applicant obtains a complete weather briefing, identifies at least three K3a–K3l hazards, applies R1–R2 risk management, and makes a defensible go/no-go decision consistent with personal minimums and 14 CFR §91.103.

References

- 14 CFR Part 91 — §91.103 (preflight action), §91.155/157 (VFR minimums)
- FAA-H-8083-25C (PHAK) — Chapters 12 and 13
- FAA-H-8083-28A (Aviation Weather Handbook)
- AIM Chapter 7 — The Safety of Flight
- AC 91-92 — Pilot's Guide to a Preflight Briefing

Materials

- ForeFlight EFB — METARs, TAFs, AIRMETs, SIGMETs, radar, satellite, prog charts, winds aloft
- 1800wxbrief.com — Standard briefing for lesson route (Leidos Flight Service)
- PHAK and AWH for in-lesson reference; whiteboard or tablet for drawing

Delivery Format

- Ground lesson — 90–120 minutes
- Pull up live weather on ForeFlight; use actual or recent METAR/TAF/SIGMET
- Walk through a complete standard briefing on 1800wxbrief.com with the student

> ***Instructor Note:*** *Open ForeFlight to the Weather tab before class and pre-load a route that has interesting weather (or use a saved scenario). Students who interact with real products during instruction retain the material far better than students who only read about them.*

ACS Elements (AI.III.C)

Code	Element
AI.III.C.K1	Weather data sources (NWS, Flight Service, aviationweather.gov)
AI.III.C.K2	Acceptable weather products: departure, en route, arrival
AI.III.C.K2a	a. Airport Observations (METAR/SPECI) and PIREPs
AI.III.C.K2b	b. Surface Analysis Chart, CVA
AI.III.C.K2c	c. Terminal Aerodrome Forecasts (TAF)
AI.III.C.K2d	d. Graphical Forecasts for Aviation (GFA)
AI.III.C.K2e	e. Wind and Temperature Aloft Forecast (FB)
AI.III.C.K2f	f. Convective Outlook (AC)
AI.III.C.K2g	g. AIRMET, SIGMET, Convective SIGMET
AI.III.C.K3	Meteorology applicable to VFR/VMC flight
AI.III.C.K3a	a. Atmospheric composition and stability
AI.III.C.K3b	b. Wind (windshear, mountain wave)
AI.III.C.K3c	c. Temperature and heat exchange
AI.III.C.K3d	d. Moisture and precipitation
AI.III.C.K3e	e. Weather system formation, air masses and fronts
AI.III.C.K3f	f. Clouds
AI.III.C.K3g	g. Turbulence
AI.III.C.K3h	h. Thunderstorms and microbursts
AI.III.C.K3i	i. Icing and freezing level information
AI.III.C.K3j	j. Fog/mist
AI.III.C.K3k	k. Frost
AI.III.C.K3l	l. Obstructions to visibility
AI.III.C.K4	Flight deck digital weather/aeronautical displays
AI.III.C.R1	Go/no-go and continue/divert — personal minimums, icing/turbulence
AI.III.C.R2	Onboard weather limitations and inflight resource use
AI.III.C.S1	Obtain and use an adequate weather briefing
AI.III.C.S2	Analyze ≥3 K3a–K3l conditions using actual weather
AI.III.C.S3	Correlate weather data — make a go/no-go decision

1. WEATHER DATA SOURCES (AI.III.C.K1)

Source	Description	Products
Aviation Weather Center (AWC) aviationweather.gov	FAA/NWS primary online source. Free, continuously updated.	METARs, TAFs, PIREPs, AIRMETs, SIGMETs, GFAs, prog charts
1800wxbrief.com (Leidos Flight Service)	Official FAA-contracted weather briefing. Standard, abbreviated, or outlook briefings. Filing flight plan recommended.	Full weather briefings, NOTAMs, TFRs, winds aloft
DUAT/DUATS	Computer-based direct user access. Self-briefing capability.	Weather, NOTAMs, flight planning
National Weather Service (NWS) weather.gov	Produces aviation forecasts, surface analysis, convective outlooks.	Surface analysis, SPC convective products
In-Flight Resources	122.0 MHz Flight Service, ATC, HIWAS, EFAS (122.0), ADS-B FIS-B	Updated weather, PIREPs, special use airspace

KEY RULE ■ 14 CFR 91.103 — Pilots are required to become familiar with ALL available information pertinent to the flight, including weather. A standard briefing (not abbreviated) is required for any flight outside the local area or into IMC.

2. WEATHER PRODUCTS FOR PREFLIGHT PLANNING (AI.III.C.K2A–K2G)

K2a — Airport Observations (METAR, SPECI) and PIREPs

Field	Example	Meaning
Type/Station/Time	METAR KORD 152253Z	Routine obs, Chicago O'Hare, 15th at 2253Z
Wind	27015G22KT	270° at 15 kts, gusts to 22. VRB = variable
Visibility	10SM	10 statute miles. Fractions = IFR/LIFR
Sky Condition	OVC010	Overcast at 1,000 ft AGL. BKN=5–7 oktas, FEW=1–2
Temp/Dewpoint	18/12	Temp 18°C, dewpoint 12°C. Small spread = fog risk
Altimeter	A2992	29.92 inHg. Set in altimeter to read pressure altitude
Remarks	AO2 SLP013	Automated with precip sensor, sea level pressure

- SPECI — Special observation issued any time conditions change significantly (ceiling drops below 3,000 ft, visibility falls below 3 SM, thunderstorm onset/end, wind shift ≥45° in ≤15 min). AWH Ch. 4
- PIREP (UA/UUA) — Real-time weather from pilots in flight. Most critical source for icing, turbulence, and cloud tops. UUA = urgent PIREP (icing, severe turbulence).
- PIREP format: /OV (location) /TM (time) /FL (flight level) /TP (aircraft) /SK (sky) /WX /TA (temp) /WV (wind) /TB (turbulence) /IC (icing) /RM (remarks)

CRITICAL ■ A METAR only reports surface conditions at the airport. Conditions aloft — especially icing, turbulence, and cloud tops — require PIREPs and upper-air products. Zero PIREPs means lack of information, not absence of hazard.

K2b through K2g — Charts and Advisories

Product	Coverage / Validity	Key Use
Surface Analysis Chart (K2b)	Current; issued every 3 hrs	Pressure systems, fronts, isobars, surface weather. Track frontal movement.
Ceiling & Visibility Analysis (CVA) (K2b)	Current; updated hourly	Graphic depiction of VFR/MVFR/IFR/LIFR ceilings and visibility across CONUS.
Terminal Aerodrome Forecast (TAF) (K2c)	Valid 24–30 hrs; covers 5 SM radius	Official airport forecast. Uses METAR format. FM, TEMPO, BECMG, PROB30/40.
Graphical Forecast for Aviation (GFA) (K2d)	Valid 18 hrs; updated hourly	Replaced FA (Area Forecast). Interactive tool showing clouds, weather, icing, turbulence by altitude and time.
Winds Aloft Forecast (FB) (K2e)	3,000–48,000 ft MSL	Direction/speed and temp at altitude. 9900=calm. Winds >100 kts: add 50° to direction, subtract 100 from speed.
Convective Outlook (AC) (K2f)	Day 1–3	Storm Prediction Center (SPC). Categorizes severe thunderstorm potential: General/Marginal/Slight/Enhanced/Moderate/High.
AIRMET Sierra (WA) (K2g)	Valid 6 hrs	IFR conditions/mountain obscuration (Sierra), turbulence/surface winds >30 kts (Tango), icing/freezing level (Zulu).
SIGMET (WS) (K2g)	Valid 4 hrs	Severe/extreme turbulence, severe icing NOT in TS, widespread dust/sand <3 SM, volcanic ash.
Convective SIGMET (WST) (K2g)	Issued :55 past each hr; valid 2 hrs	Severe/embedded thunderstorms, lines of storms, areas covering ≥40%. Treat as mandatory ground stop for VFR.

CRITICAL ■ Convective SIGMET — Convective SIGMETs should be treated as definitive stop signs for VFR pilots. A thunderstorm forecast along your route is not a ‘maybe’ — it is a mandatory ground stop until the threat clears.

3. METEOROLOGY APPLICABLE TO VFR/VMC FLIGHT (AI.III.C.K3)

CFI Emphasis — Section K3 is the deepest knowledge area in this task. Every hazard — turbulence, icing, fog, thunderstorms — traces back to atmospheric processes. Teach the mechanism, not just the symptom. Students who understand WHY a hazard forms will recognize it in situations the textbook never described.

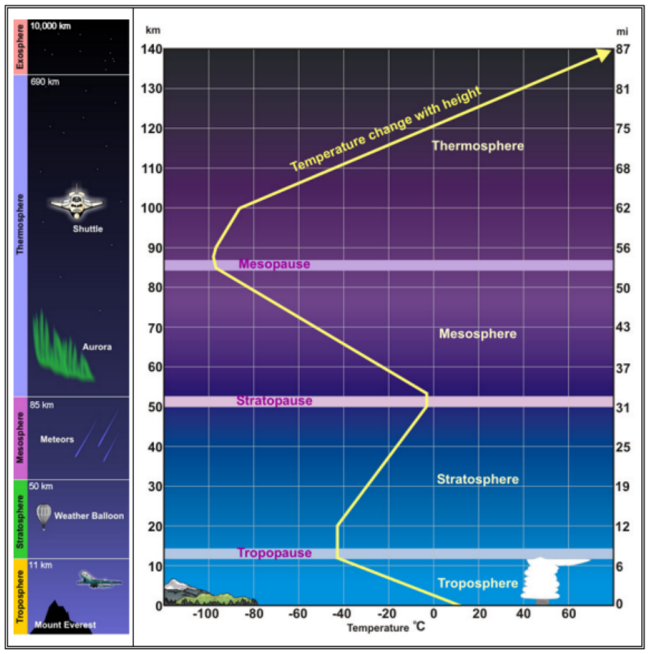
K3a — Atmospheric Composition and Stability

Composition of the Atmosphere

- 78% Nitrogen (N_2), 21% Oxygen (O_2), ~1% Argon and trace gases, plus variable water vapor (0–4%)
- Density decreases with altitude. Standard lapse rate: temperature decreases 2°C (3.5°F) per 1,000 ft in troposphere.
- Troposphere (surface to ~36,000 ft): where all weather occurs. Temperature decreases with altitude. Bounded by tropopause.
- Stratosphere (above tropopause): temperature reversal. Stable, no significant weather. Jet stream near tropopause.

Atmospheric Stability

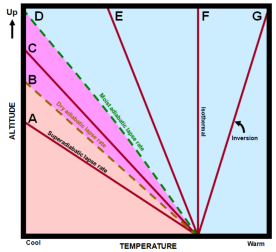
- Stable atmosphere: displaced air parcel returns to original level. Environmental lapse rate (ELR) < dry adiabatic lapse rate (DALR, 3°C/1,000 ft). Produces stratiform clouds, smooth air, steady precipitation, poor surface visibility.
- Unstable atmosphere: displaced air parcel accelerates away from original level. ELR > DALR. Produces cumuliform clouds, rough air, showery precipitation, good surface visibility.
- Dry Adiabatic Lapse Rate (DALR): 3°C per 1,000 ft. Rate at which unsaturated rising air cools.
- Moist Adiabatic Lapse Rate (MALR): ~1.5°C per 1,000 ft (variable). Air cools slower when saturated — latent heat release.
- Temperature Inversion: temperature increases with altitude. Traps pollutants, promotes fog, limits vertical development. Caps convection.



AWH Fig 4-1 — Vertical Structure of the Atmosphere. Note layer boundaries and temperature profiles.

KEY TEST ■ What type of weather is produced by a stable atmosphere vs. an unstable one? Stable = stratus, fog, drizzle, poor visibility. Unstable = cumulus, CB, turbulence, showers.

AWH Fig 13-5 — Stability Types Summary: Absolute Stability, Neutral Stability, Absolute Instability, Conditional Instability



Temperature Sounding	Unsaturated Parcel	Saturated Parcel	Stability Type
A	Unstable	Unstable	Absolute Instability
B	Neutral	Unstable	
C	Stable	Unstable	Conditional Instability
D	Stable	Neutral	
E	Stable	Stable	Lapse — Absolute Stability
F	Stable	Stable	Isothermal — Absolute Stability
G	Stable	Stable	Inversion — Absolute Stability

K3b — Wind: Windshear, Mountain Wave, Factors Affecting Wind

Factors Affecting Surface and Upper-Level Wind

- Pressure Gradient Force (PGF): air flows from high to low pressure perpendicular to isobars. Greater gradient = stronger wind.
- Coriolis Force: deflects wind to the RIGHT in Northern Hemisphere (LEFT in SH). Results in clockwise flow around highs, counterclockwise around lows (Northern Hemisphere).
- Friction: surface friction slows wind and causes it to cross isobars toward lower pressure. Decreases with altitude — at ~2,000 ft AGL, geostrophic wind flows parallel to isobars.
- Local effects: sea/land breeze, valley/mountain breeze, drainage flow, thermal columns. Temperature differences drive local circulation.

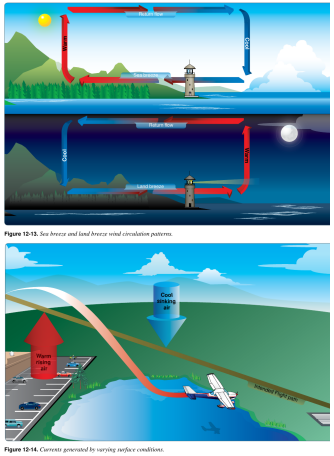


Figure 12-13. *Sea breeze and land breeze wind circulation patterns.*

Figure 12-14. *Currents generated by varying surface conditions.*

PHAK Fig 12-13 — Sea Breeze (day) and Land Breeze (night). Differential heating between land and water drives local circulation reversals.

produce downdrafts of up to 6,000 feet per minute (fpm) — frontal systems.

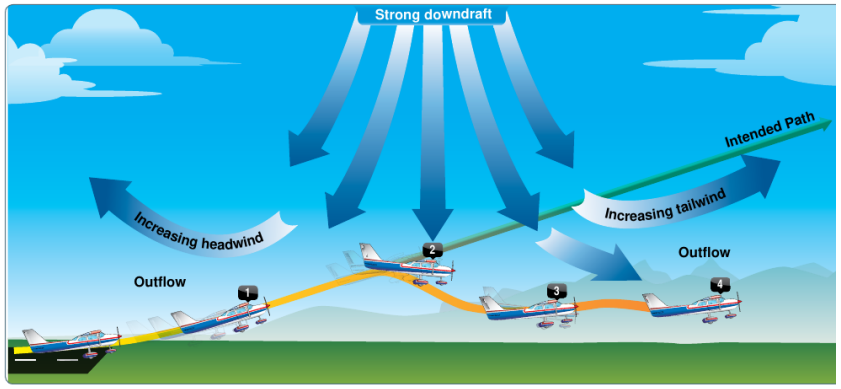


Figure 12-17. *Effects of a microburst wind.*

PHAK Fig 12-14 — Currents generated by varying surface conditions. Rising warm air over land, sinking cool air over water creates the classic sea breeze cell.

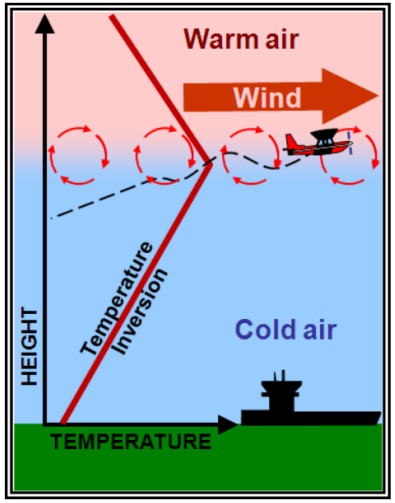
Low-Level Windshear (LLWS)

• Definition: a rapid change in wind speed and/or direction over a short distance. Horizontal LLWS = different wind layers at low altitude. Vertical LLWS = wind change with altitude.

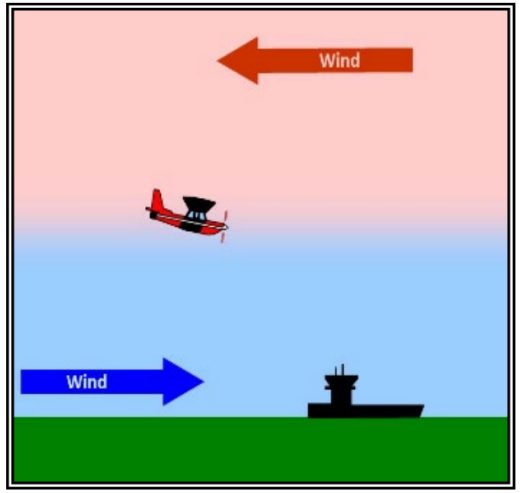
• Causes: frontal boundaries, temperature inversions, thunderstorm outflow, terrain effects. Most dangerous during takeoff and landing (below 2,000 ft AGL).

• Recognition signs: airspeed fluctuations >15 kts, vertical speed changes, stick shaker activation, inability to maintain glidepath.

• Avoidance: PIREPs, LLWS alerts (ATIS), PIREP, ATC reports. If encountered: maximum thrust, pitch to go-around attitude, fly the aircraft out.



AWH Fig 19-6 — Wind Shear Turbulence associated with a Temperature Inversion. Note the sharp wind change at the inversion boundary.



AWH Fig 19-8 — LLWS Example. Aircraft on approach encounters windshear at low altitude — sudden airspeed loss requires immediate full power response.

Mountain Wave Turbulence

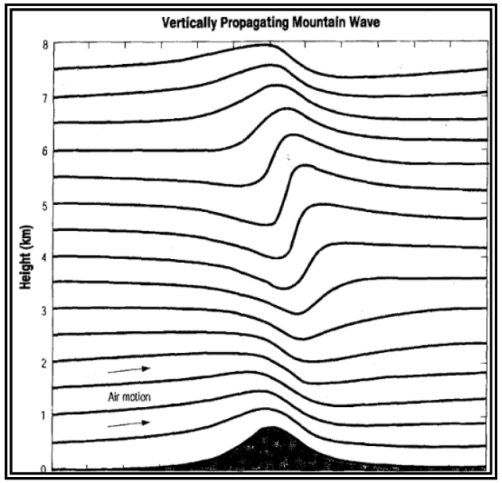
• Triggered when stable air flows over a mountain ridge. Creates a series of standing waves downwind that can extend 100+ miles and up to 60,000 ft.

• Rotor Zone: violent, chaotic turbulence beneath the wave crests, at or below mountain top level. Most severe turbulence associated with mountain waves — can flip aircraft.

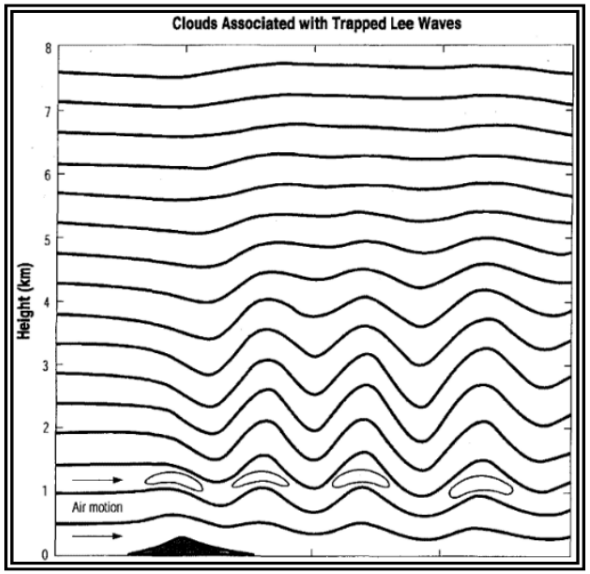
• Visual indicators: lenticular (lens-shaped) clouds cap the crests; rotor clouds mark the turbulent zone beneath; cap cloud over the mountain peak.

• Conditions: wind >25 kts perpendicular to ridge, stable atmosphere, significant ridge height. Arizona/Colorado/Sierra Nevada are particularly active areas.

• Avoidance: cross ridges at 45° angle, add altitude buffer of 50% above mountain height, avoid flying in rotor zone, watch for standing lenticular clouds. AWH Ch. 16.

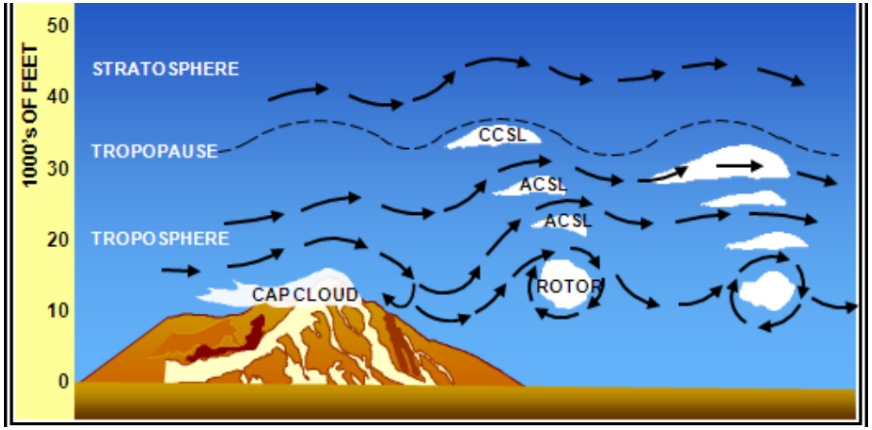


AWH Fig 16-5 — Schematic of a Vertically Propagating Mountain Wave. Note the rotor zone at low levels and wave crests extending aloft.



AWH Fig 16-9 — Clouds Associated with Trapped Lee Waves. Smooth air at altitude but severe turbulence in rotor zone below.

AWH Fig 16-15 — Mountain wave cloud types: cap cloud over peak, lenticular clouds at wave crests, rotor clouds in turbulent zone.



K3c — Temperature and Heat Exchange

How the Atmosphere is Heated

- Solar radiation (insolation): primary energy source. Short-wave radiation passes through atmosphere and heats the Earth's surface. The surface then radiates long-wave (infrared) energy back, warming the lower atmosphere.
- Conduction: direct transfer of heat through contact. Air is a poor conductor — important only in the thin layer immediately above the surface.

• Convection: vertical movement of heat via rising warm air parcels (thermals). Primary mechanism for mixing heat through the troposphere. Drives cumulus development and thunderstorms.

• Advection: horizontal transport of heat (or moisture) by wind. Warm/cold air advection, fog formation.

• Latent heat: energy absorbed or released during phase changes of water. Evaporation absorbs heat (cools air). Condensation releases heat (warms rising air, fuels thunderstorms and reduces the MALR).

Practical Implications for VFR Flight

• Surface heating (afternoon) creates thermals and instability — afternoon convective activity in summer.

• Rapid surface cooling at night (radiation cooling) increases fog and frost risk.

• Temperature/dewpoint spread narrows at night — monitor for fog. When spread ≤3°C, fog is likely.

• Density altitude increases with temperature — critical for takeoff/climb performance. DA = PA + 120 × (OAT – ISA temp).

> ***AWH Reference:*** *The Aviation Weather Handbook Chapter 5 covers heat transfer mechanisms in depth. Temperature inversions occur when surface cooling creates a warmer layer aloft — this cap traps pollutants and fog beneath it, and is a key ingredient for limited visibility conditions at the surface.*

K3d — Moisture and Precipitation

Water Vapor and Humidity

• Relative Humidity (RH): ratio of actual water vapor to maximum possible at that temperature. Warmer air holds more water vapor. RH 100% = saturation.

• Dewpoint: temperature to which air must be cooled at constant pressure and moisture content to reach saturation. Small temp/dewpoint spread = high RH = fog/cloud risk.

• Lifting Condensation Level (LCL): altitude where rising unsaturated air cools to its dewpoint and cloud base forms. Rough estimate: (temp – dewpoint) ÷ 4.4 × 1,000 ft.

Precipitation Types

• Rain: liquid drops >0.5 mm. Forms by collision-coalescence (warm clouds) or ice crystal (Bergeron) process.

• Drizzle: fine drops <0.5 mm, associated with stable air, stratus, and fog.

• Snow: ice crystals, temp below 0°C through full depth. Significant icing and visibility hazard.

• Ice Pellets/Sleet: frozen raindrops. Indicates freezing rain aloft — icing hazard above.

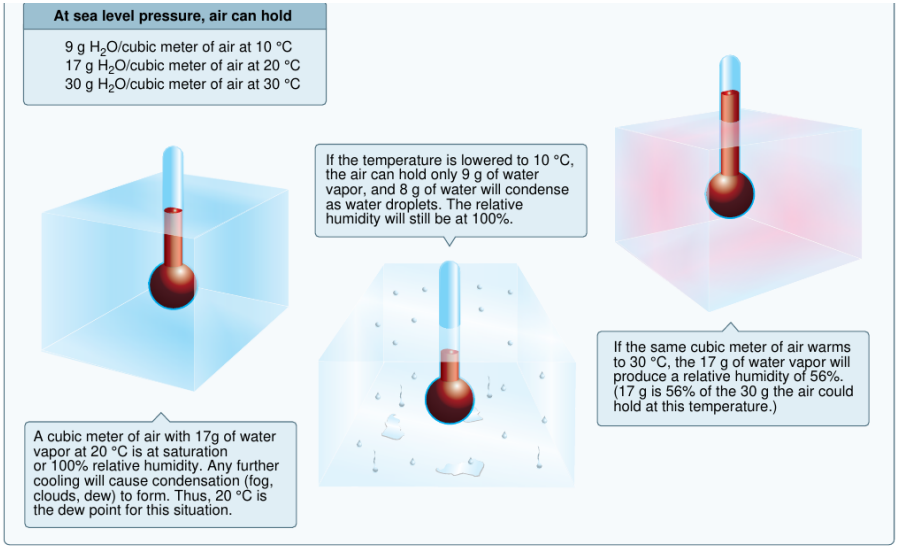


Figure 12-20. *Relationship between relative humidity, temperature, and dewpoint.*

PHAK Fig 12-20 — Relative humidity and dew point. Same volume of air holds more moisture at higher temperatures. At 100% RH, any cooling causes condensation.

K3e — Weather System Formation: Air Masses and Fronts

AWH Fig 11-1 — Air Mass Classification. Source regions and predominant air mass types affecting North America.

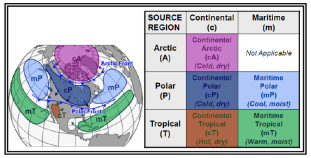


Figure 11-1. Air Mass Classification

11.2.2 Air Mass Modification

As these air masses move around the Earth, they can begin to acquire different attributes. For example, in winter, an arctic air mass (very cold and dry air) can move over the ocean, picking up some warmth and moisture from the warmer ocean and becoming a maritime polar (mP) air mass—one that is still fairly cold but contains moisture. If that same polar air mass moves south from Canada into the southern United States, it will pick up some of the warmth of the ground, but due to lack of moisture, it remains very dry. This is called a continental polar (cP) air mass.

The Gulf Coast states and the eastern third of the country commonly experience the tropical air mass in the summer. Continental tropical (cT) air is dry air pumped north off of the Mexican Plateau. If it becomes stagnant over the Midwest, a drought may result. Maritime tropical (mT) air is air from the tropics that has moved north over cooler water.

A warm, moist air mass moving over a cold surface (see Figure 11-2) produces stable air associated with stratiform clouds, fog, and drizzle.

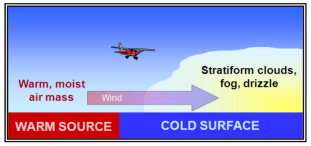


Figure 11-2. Air Mass Modification—Warm, Moist Air Mass Moving Over a Cold Surface

Fronts — Boundaries Between Air Masses

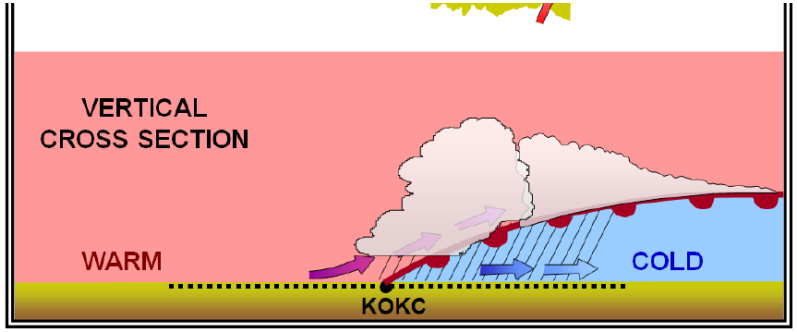


Figure 11-5. Warm Front

AWH — Warm Front cross-section. Gradual slope produces widespread clouds/precip 200–300 nm ahead of surface front. Icing/IFR hazard.

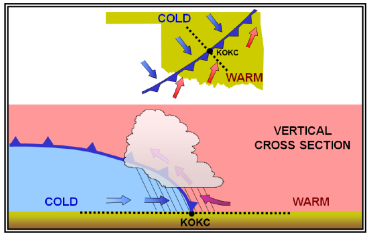


Figure 11-6. Cold Front

11.3.3 Stationary Front

When the forces of two air masses are relatively equal, the boundary or front that separates them remains stationary and influences the local weather for days. This front is called a stationary front. Stationary frontal slope can vary, but clouds and precipitation would still form in the warm rising air along the front (see Figure 11-7). The weather associated with a stationary front is typically a mixture that can be found in both warm and cold fronts.

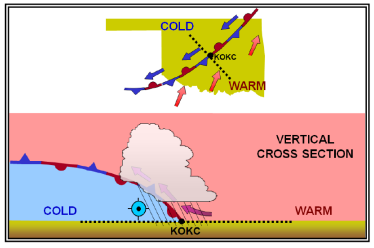


Figure 11-7. Stationary Front

AWH Fig 11-6 — Cold Front cross-section. Steep slope = narrow band of severe weather. Fast-moving cold fronts produce squall lines.

Warm Front (AI.III.C.K3e)

- Warm air advances, overriding retreating cold air at gentle slope (~1:150). Produces widespread stratiform clouds, steady precipitation extending 200–400 nm ahead of surface front.
- Hazards: low ceilings, IFR, freezing rain, icing above 0°C isotherm, embedded CB in warm sector.
- Approach indicators: cirrus → altostratus → nimbostratus → lowering ceilings, steady rain.

Cold Front (AI.III.C.K3e)

- Cold air advances, undercutting warm air at steep slope (~1:50). Narrow but intense. Squall line may precede fast-moving cold front by 50–200 nm.
- Hazards: severe turbulence, strong surface winds, rapid wind shift, sudden CB development.
- Passage indicators: wind shift, pressure rise, temperature drop, improving visibility.

Stationary / Occluded Front

- Stationary: front not moving. Produces persistent IFR, fog, and icing for days.
- Occluded: cold front overtakes warm front. Complex weather — can be warm-type or cold-type occlusion. Generally IFR, icing, precipitation.

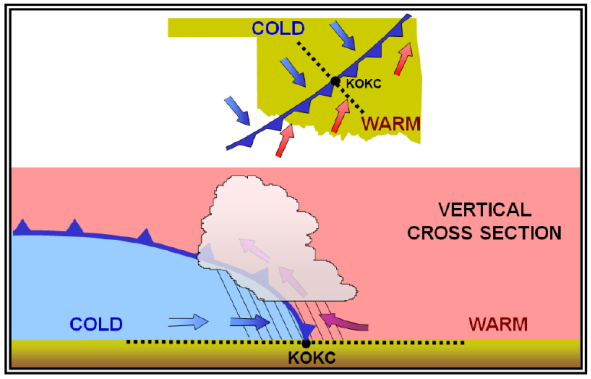


Figure 11-6. Cold Front

AWH Fig 11-6 — Cold Front cross-section. Cold air undercuts warm air at steep slope (~1:50). Narrow, intense weather band with CB development.

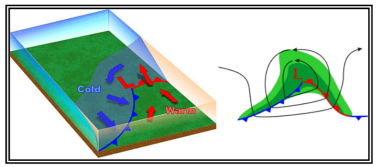


Figure 11-11. Wave Cyclone Model—Stage 3

In the fourth stage, the wave becomes a mature low (see Figure 11-12). The occluded front forms as the cold front overtakes the warm front.

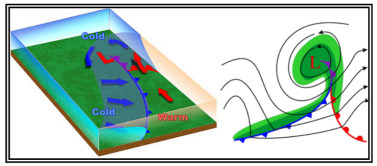
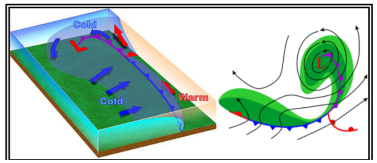


Figure 11-12. Wave Cyclone Model—Stage 4

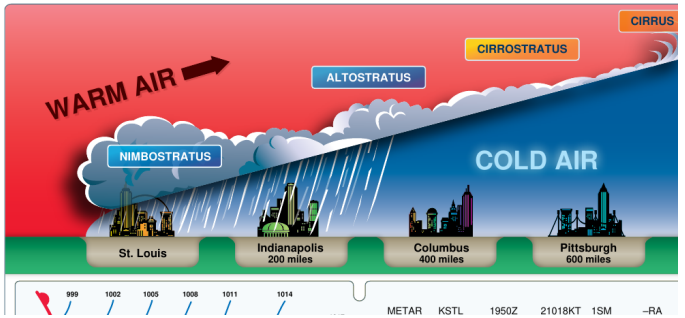
As the cold front continues advancing on the warm front, the occlusion increases and eventually cuts off the supply of warm moist air (see Figure 11-13). This causes the low to gradually dissipate.



AWH Fig 11-11 — Wave Cyclone Model showing frontal development stages. Note how warm and cold fronts form and occlude.

During the passage of a warm front, stratiform clouds are visible and drizzle may be falling. The visibility is generally poor, but improves with variable winds. The temperature rises

to the oncoming warm front, the clouds deepen and beco increasingly stratiform in appearance with a ceiling of 6,(feet. The visibility decreases to six miles in haze with a fall



PHAK — Warm front passage sequence: cirrus ahead → altostratus → nimbostratus at surface front. Cloud base progressively lowers as front approaches.

K3f — Clouds

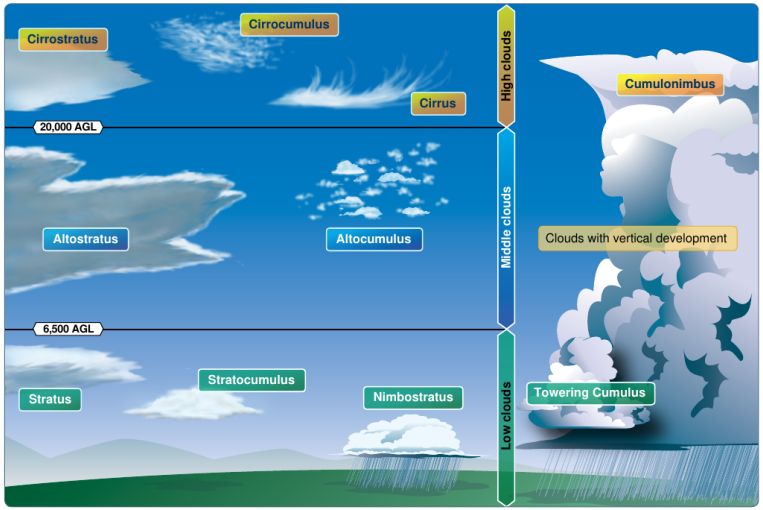


Figure 12-22. *Basic cloud types.*

PHAK Fig 12-18 — Cloud classification by altitude and form: High (cirro-), Middle (alto-), Low (strato-), and Vertical development (cumulo-).

Cloud Family	Types	Altitude (AGL)	VFR Hazard
High clouds	Cirrus, Cirrostratus, Cirrocumulus	Above 20,000 ft	Ice crystals, indicate frontal approach
Middle clouds	Altostratus, Altocumulus	6,500–20,000 ft	Icing, reduced visibility, embedded CB possible
Low clouds	Stratus, Stratocumulus, Nimbostratus	Surface–6,500 ft	IFR, icing, freezing rain (below 0°C)
Vertical development	Cumulus, Cumulonimbus (CB)	Base near surface to tropopause	Turbulence, icing, hail, lightning, microbursts

- VFR cloud clearance minimums (14 CFR 91.155): Below 10,000 ft MSL in Class G airspace: 1 SM visibility, clear of clouds (daytime). In Class E below 10,000 ft MSL: 3 SM, 500 below / 1,000 above / 2,000 horizontal.
- Ceiling = lowest layer that is BKN or OVC. Relevant for VFR minimums and IFR approaches.

Remember ■ Cumulonimbus clouds represent ALL weather hazards simultaneously: extreme turbulence, icing, hail, lightning, microbursts, and tornadoes. A single CB can produce wind gusts exceeding 100 kts. Never fly through or under a CB.

K3g — Turbulence

Types and Causes of Turbulence

• Convective (Thermal) Turbulence: surface heating creates thermals — rising columns of warm air. Intensity increases throughout the day, maximizes in afternoon. Associated with cumulus development.

• Mechanical Turbulence: wind flowing over irregular terrain, buildings, trees. Proportional to wind speed and surface roughness. Rotor turbulence on lee side of ridges.

• Wind Shear Turbulence: abrupt change in wind velocity between layers. Associated with jet stream, frontal boundaries, temperature inversions. CAT (Clear Air Turbulence) occurs without visible indication.

• Wake Turbulence: wingtip vortices from preceding aircraft. Most dangerous during takeoff and landing, in calm/light crosswind conditions. Sink at ~300-500 ft/min, remain near runway edges.

Turbulence Intensity Reporting (PIREP)

• Light: slight bumpiness. No loss of control. Occupants feel slight strain.

• Moderate: changes in altitude/attitude but aircraft remains in positive control. Occupants feel definite strain, unsecured items dislodge.

• Severe: large abrupt changes. Aircraft momentarily out of control. Occupants thrown violently. Structural risk.

• Extreme: aircraft practically impossible to control. Structural damage possible.

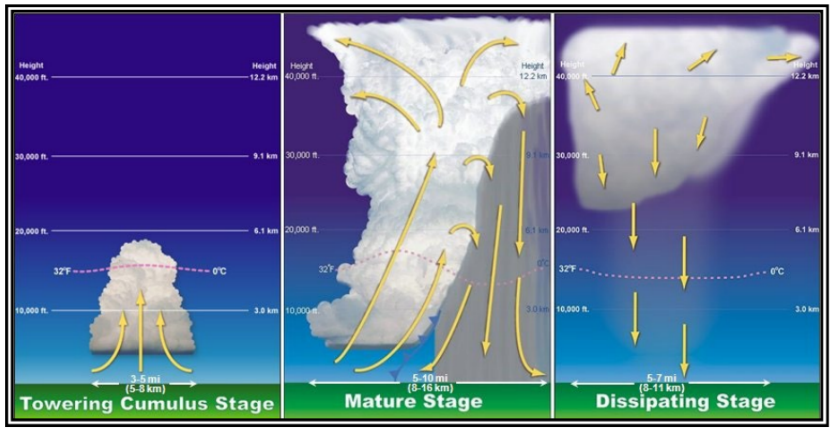
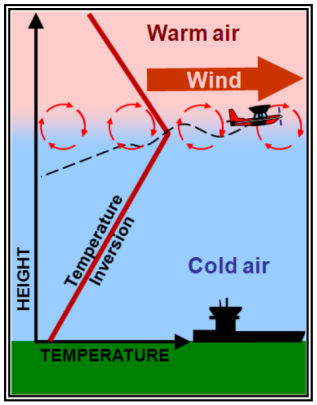


Figure 22-2. Thunderstorm Cell Life Cycle

The cell transitions to the mature stage when precipitation reaches the surface. Precipitation descends

AWH Fig 22-2 — Thunderstorm Cell Life Cycle. Convective turbulence peaks in the mature stage when updrafts and downdrafts coexist. Extreme turbulence inside CB.



AWH Fig 19-6 — Wind Shear Turbulence with temperature inversion. Shear between light surface wind and stronger winds aloft creates turbulence at the inversion boundary.

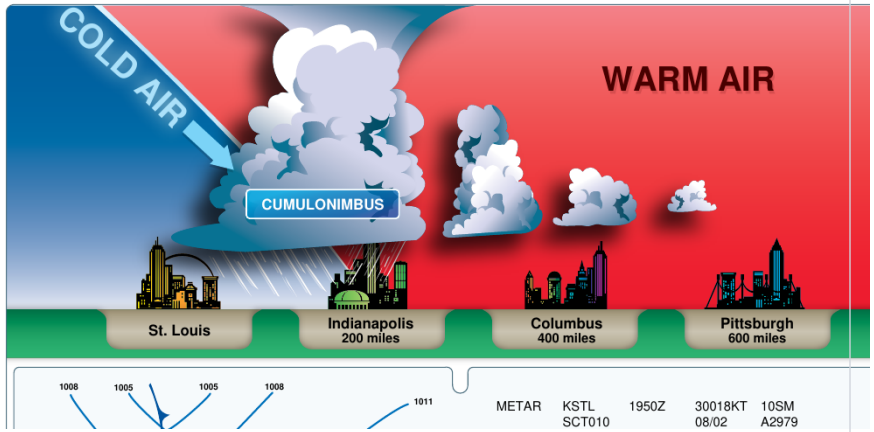


Figure 19-7. Wind Shear Example

AWH Fig 19-7 — Horizontal Wind Shear near jet stream. Speed differential across the jet core creates clear air turbulence (CAT) with no visual warning.

CAT Warning ■ Clear Air Turbulence (CAT) near the jet stream gives NO visual warning. Encounters above FL180 can be severe. Monitor PIREPs, SIGMETs, and turbulence forecasts (GFA) before any cross-country flight at cruise altitude.

K3h — Thunderstorms and Microbursts



PHAK Fig 12-22 — Thunderstorm Cell Life Cycle: Cumulus Stage (strong updrafts), Mature Stage (updrafts + downdrafts, all hazards active), Dissipating Stage (downdrafts dominate).

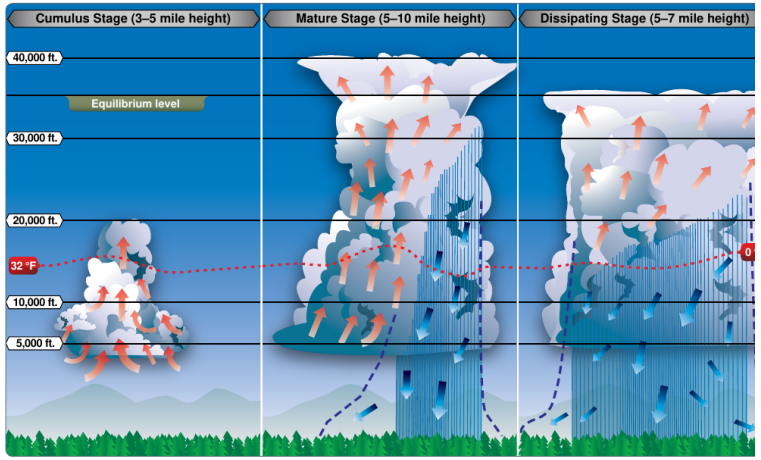


Figure 12-28. *Life cycle of a thunderstorm.*

PHAK Fig 12-23 — Mature Thunderstorm Anatomy: anvil, updraft/downdraft interaction, roll cloud, wind shear zones at multiple levels.

AWH Fig 22-2 — Thunderstorm Cell Life Cycle from the Aviation Weather Handbook. Note the anvil development indicating mature stage and top-level outflow.

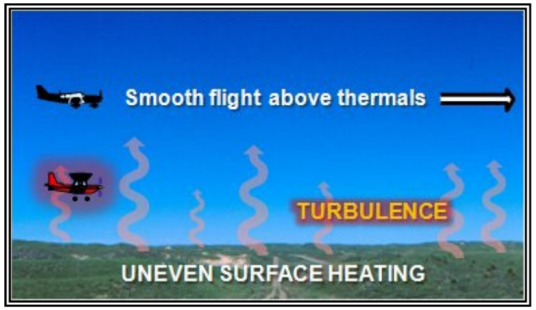


Figure 19-2. Thermals

19.2.1.1 Thunderstorms

Thunderstorm Hazards Summary

- Turbulence: extreme inside CB and in anvil. Clear air turbulence 20 nm from visible storm. Avoid all thunderstorms by ≥20 nm.
- Icing: severe to extreme icing in updraft core and anvil. Supercooled water droplets throughout.
- Hail: can be ejected up to 20 nm ahead of storm at high altitude. Falls through clear air.
- Lightning: strikes can cause temporary blindness, compass deviation, damage to electronics.
- Wind shear: gust front ahead of storm; outflow boundaries create hazardous windshear at low altitude.
- Tornadoes: associated with supercells. Rotating wall cloud is precursor. Highest risk with squall lines.

- Low ceiling/visibility: precipitation core, blowing dust ahead of cold outflow boundary.
- Rapid altimeter changes: large pressure variations across storm. Can create significant altimetry errors.

Microbursts

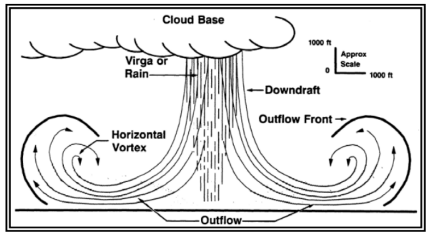


Figure 22-9. Illustration of a Symmetric Microburst

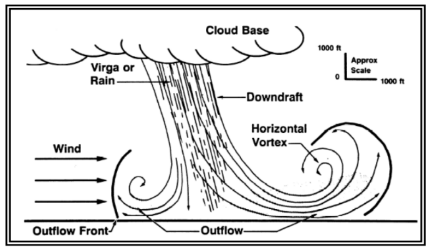


Figure 22-10. Illustration of an Asymmetric Microburst

AWH Fig 22-9/10 — Symmetric and Asymmetric Microburst. Intense localized downdraft spreads outward on all sides — pilot encounters headwind then tailwind in rapid succession.

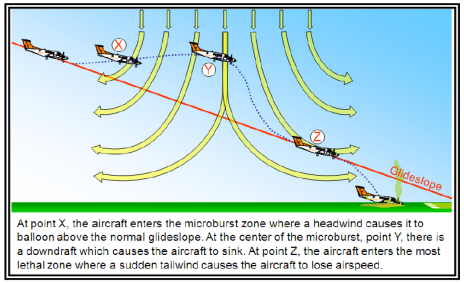


Figure 22-13. Landing in a Microburst

Pilots should be alert for indications of a microburst early in the approach phase, and ready to initiate a missed approach at the first indication. However, it may be impossible to recover from a microburst encounter at low altitude.

Pilots should be aware of asymmetrical microbursts (see Figure 22-10), since a significant airspeed increase may not occur upon entering the outflow or may be much less than the subsequent airspeed loss experienced when exiting the microburst.

It is vital for pilots to recognize that some microbursts cannot be successfully escaped with any known techniques. Some wind shears that are within the performance capability of the aircraft have caused accidents.

22.7.3.1 Encounter During Takeoff—After Lift-Off

In previous accidents studied, the airplane encountered an increasing tailwind shear shortly after lifting off the runway (see Figure 22-14). For the first 5 seconds after lift-off, the takeoff appeared normal, but the

AWH Fig 22-13 — Aircraft encountering microburst on final approach. Performance loss can exceed aircraft climb capability — go-around must be immediate and aggressive.

- Microburst: intense, localized downdraft (≤4 km diameter) that creates a diverging outflow at the surface. Produces headwind/tailwind wind shear sequence during takeoff or landing. Performance loss can exceed 40 kts and 3,000 fpm sink.
- Dry microburst: occurs with little or no surface precipitation. Virga (rain evaporating before surface) is the visual indicator. Common in the Southwest US.
- Wet microburst: shaft of precipitation visible below CB. Easier to detect visually.
- Duration: typically 5–15 minutes at peak intensity. Rarely exceeds 30 minutes.
- Recovery procedure: maximum thrust immediately, set go-around pitch attitude, accept altitude loss — DO NOT reduce thrust to regain airspeed. Fly through the windshear, not against it.

CRITICAL ■ Thunderstorm Avoidance Rule — Never attempt to fly through a thunderstorm. Never fly under a thunderstorm anvil. Maintain ≥20 nm lateral separation from severe or extreme CB. A Convective SIGMET is a mandatory ground stop for VFR pilots. Radar only shows precipitation — it does NOT show turbulence or hail ahead of the precipitation core.

K3i — Icing and Freezing Level Information

Structural Icing — Requirements

- Three requirements: (1) visible moisture (clouds, freezing rain, freezing drizzle), (2) temperature at or below 0°C at the airframe, (3) supercooled liquid water droplets.
- Supercooled water: liquid water below 0°C that freezes on contact with a surface. Most intense between 0°C and –20°C. Nearly non-existent below –40°C.

Types of Structural Icing

- Rime ice: milky, opaque, rough. Small supercooled droplets freeze instantly on contact. Traps air. Less aerodynamic penalty individually, but changes airfoil shape.
- Clear (glaze) ice: clear, hard, transparent. Large droplets spread before freezing. Heavier, harder to remove, more aerodynamically disruptive. Most dangerous type.
- Mixed ice: combination of rime and clear. Most common in practice.

Icing Locations and Forecasts

- Freezing level (0°C isotherm): altitude at which temp = 0°C. Base of icing risk for flight into clouds. Reported in PIREPs, Zulu AIRMET, GFA.
- Icing most intense: frontal zones (warm front especially), cumulonimbus anvils, mountainous terrain, stratocumulus layers.
- Depart immediately if unequipped aircraft enters icing conditions — turn toward warmer air (descend or reverse course). Icing accretes faster than you expect.

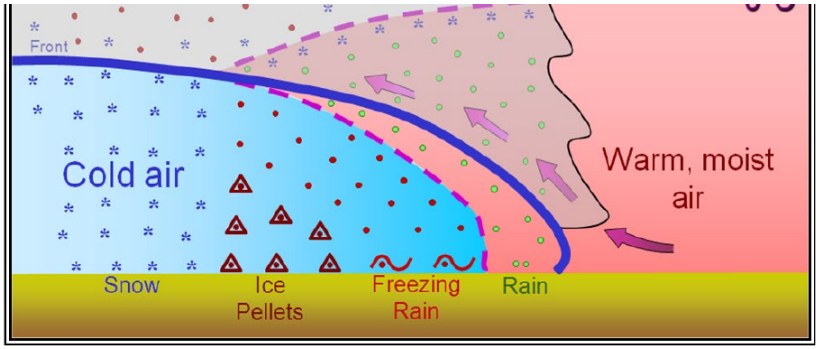


Figure 20-1. Icing with Fronts

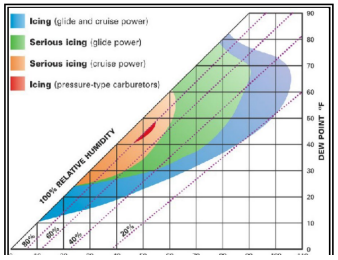
A favored location for severe clear icing is freezing rain and/or freezing drizzle below a front. Rain forms above the frontal surface at temperatures warmer than freezing. Subsequently, it falls through air at

AWH Fig 20-1 — Icing with Fronts. Warm front creates widespread icing above the freezing level with freezing rain/drizzle below. Most hazardous icing zone is just above the frontal surface.

AWH — Carburetor Icing Chart. Carb ice can occur in temperatures as high as 38°C (100°F) with high humidity. Most common during descent with reduced power. Apply carb heat before power reduction.

20.4.1 Carburetor Icing

In an aspirated engine, the carburetion process can lower the temperature of the incoming air by as much as 38 °C (100 °F). If the moisture content is high enough, ice will form on the throttle plate and venturi, shutting off the supply of air to the engine. Even a small amount of carburetor ice will cause power loss and may make the engine run rough. It is possible for carburetor ice to form, even when the skies are clear and the outside temperature is as high as 38 °C (100 °F), if the relative humidity is 50 percent or more. The icing risk does not go away until the humidity falls below roughly 25 percent and/or the OAT drops well below freezing.



Zulu AIRMET ■ Zulu AIRMETs cover moderate icing AND freezing level information. Always check for Zulu AIRMETs before flight in visible moisture below ~10,000 ft MSL. Combination of freezing level information and Zulu coverage gives a three-dimensional picture of icing risk. PIREPs are the only real-time confirmation of icing intensity.

K3j — Fog and Mist

Fog = stratus cloud at the surface, visibility <5/8 SM. Mist = visibility 5/8–6 SM with relative humidity ≥95%. Both require moisture and cooling or mixing to saturation.



Figure 18-2. Radiation Fog

Radiation fog is relatively shallow fog. It may be dense enough to hide the entire sky, or it may conceal

AWH Fig 18-2 — Radiation Fog. Forms on clear, calm nights as ground radiatively cools below the dewpoint. Most dense 1–2 hours after sunrise. Common in valleys.

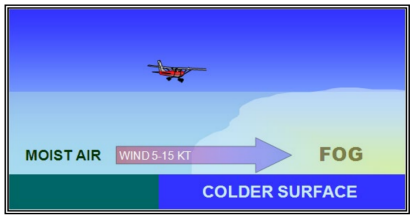


Figure 18-5. Advection Fog Formation



Figure 18-6. Advection Fog

AWH Fig 18-5/6 — Advection Fog. Warm moist air moves over a cooler surface. Common along coastlines and in spring. Unlike radiation fog, advection fog persists with stronger winds.

Type	Mechanism	Conditions	VFR Concern
Radiation fog	Ground cools below dewpoint at night	Clear sky, calm winds, moist air	Rapid post-dawn thickening; clears by mid-morning
Advection fog	Warm moist air over cold surface	Coastal, spring, wind required	Persistent; does NOT require calm winds
Upslope fog	Moist air forced up terrain	Easterly winds on slopes	Can persist all day; obscures terrain
Frontal/precip fog	Evaporation of rain into cold air	Warm front approach	Widespread IFR conditions
Steam fog	Cold air over warm water	Arctic outbreaks, lakes	Low level, patchy, unstable
Ground fog	Thin radiation fog (<20 ft deep)	Clear nights, moist terrain	Runway visibility OK but ATIS may report fog

Fog Risk Indicator ■ When temperature/dewpoint spread is ≤3°C (5°F) with clear skies and calm winds, radiation fog is likely by midnight–dawn. When spread is ≤3°C with marine or moist flow, advection fog is possible regardless of sky condition. Pilots should track the spread throughout the flight day.

K3k — Frost

How Frost Forms

- Frost forms when the surface temperature is at or below 0°C AND at or below the dewpoint. Water vapor deposits directly as ice crystals (deposition/sublimation) — no liquid phase required.
- Conditions: clear sky (maximizes radiational cooling), calm winds, moist air. Common on aircraft parked overnight.

Frost as an Aviation Hazard

- Even a thin, uniform coat of frost on wing surfaces significantly disrupts laminar airflow. Studies show frost can reduce lift by up to 30% and increase stall speed by 5–10%.
- Unlike ice, frost does NOT add significant weight — the hazard is entirely aerodynamic (surface roughness disrupting boundary layer).
- Frost on fuselage or tail may not be visible during walk-around if aircraft is cold — check ALL lifting surfaces.
- Frost on propeller reduces thrust efficiency.

Removal and Legal Requirements

- Clean aircraft concept: 14 CFR 91.527 — no person may take off in an aircraft with frost, ice, or snow adhering to wings, control surfaces, propellers, or stabilizers. There are NO exceptions for 'just a little frost.'
- Removal: de-icing fluid (Type I, II, IV), warm hangar, or wait for surface temp to rise above 0°C.
- Ground de-icing fluid has a finite holdover time — check holdover time tables if precipitation continues after application.

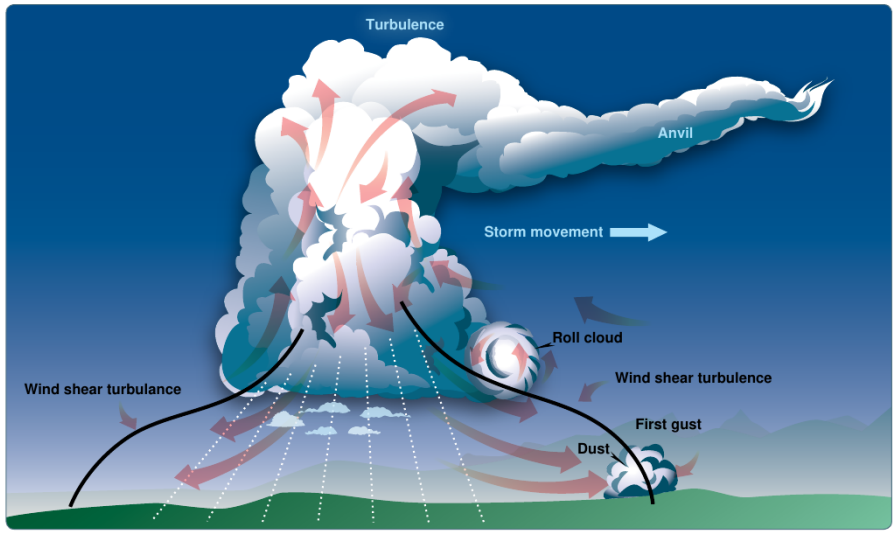


Figure 12-29. *Movement and turbulence of a maturing thunderstorm.*

PHAK Ch.12 — Dew and Frost formation. Note: frost forms when surface temp is at or below 0°C AND at or below dewpoint — direct ice crystal deposition.

CRITICAL ■ Clean Aircraft Concept — 14 CFR 91.527 prohibits takeoff with ANY frost, snow, or ice adhering to lifting surfaces. Frost is not just a nuisance — it is an aerodynamic hazard that can cause the aircraft to fail to fly. When in doubt: de-ice, or don't go.

K3l — Obstructions to Visibility (Smoke, Haze, Volcanic Ash, etc.)

Types of Visibility Obstructions

- Haze: fine dry particles (dust, salt, smoke) suspended in stable air. Reduces slant range visibility, especially looking into sun. Does not involve moisture — present when RH is low. AWH Ch. 18.
- Smoke: combustion products. Wildfire smoke can reduce visibility to near-zero across hundreds of miles. Check NOTAMs and AIRMETs/SIGMETs for smoke advisories. Carbon monoxide risk in cockpit if induction air is contaminated.
- Dust/Sand: raised by strong surface winds (>25 kts). Haboob = large dust storm wall (100+ ft high) associated with thunderstorm outflow. Severe icing and engine damage risk.
- Volcanic Ash: extremely hazardous. Destroys engines (melts in combustion chamber and re-solidifies on turbine blades). Abrades windshields and cockpit surfaces. SIGMET issued for volcanic ash. Even light ash concentrations can cause engine flameout.

- Precipitation: heavy rain, snow, drizzle all reduce visibility. Heavy rain can reduce to near zero. Always obtain current visibility before approach.
- Slant range visibility often worse than reported surface visibility — especially in haze or smoke. Pilot sitting 50 ft above surface looking down at angle sees much less than reported horizontal miles.
- Haze horizon can mask terrain and obstacles. Maintain positional awareness. Do not rely solely on visual navigation in restricted visibility.

Volcanic Ash ■ Do not attempt to fly through volcanic ash clouds under any circumstances, regardless of equipment. Multiple airliners have suffered complete engine failure and near-crashes from volcanic ash. Avoid by at least 150 nm. Relevant SIGMETs issued by Washington VAAC.

4. FLIGHT DECK DIGITAL WEATHER DISPLAYS (AI.III.C.K4)

ADS-B FIS-B (Flight Information Service — Broadcast)

- Free, FAA-provided weather broadcast transmitted through ADS-B ground stations. Received by ADS-B In-equipped aircraft or portable devices (ForeFlight, Stratus, Sentry).
- Products: NEXRAD (base reflectivity), METARs, TAFs, AIRMETs, SIGMETs, NOTAMs, TFRs, winds aloft, PIREPs.
- Critical limitation: NEXRAD data on FIS-B can be 5–20 minutes old. A thunderstorm can travel 2–4 miles in that time. Never use FIS-B NEXRAD to navigate around active convection at close range.

XM/SiriusXM Weather (Subscription)

- Higher update frequency than FIS-B for some products. NEXRAD refresh approximately every 2–5 minutes. More comprehensive product suite.
- Same fundamental limitation: datalink weather is NOT real-time. It represents a snapshot of past conditions.

Onboard Weather Radar (if equipped)

- Aircraft-mounted radar is the only near-real-time weather tool in the cockpit. Detects precipitation, NOT turbulence.
- Attenuation: heavy precipitation can mask stronger cells behind it. Tilt management is critical — check multiple elevation angles.
- Gain setting: Auto gain may hide significant returns. Learn to manually adjust gain.

K4 Key Limitation ■ All cockpit weather displays have latency. FIS-B NEXRAD can be 5–20 minutes old. Subscription services may be 2–5 minutes. This matters enormously near convection. When a cell is 10 nm away and data is 15 minutes old, that cell could be directly overhead. Use datalink weather for strategic planning, NOT for tactical navigation around active storms.

5. RISK MANAGEMENT — GO/NO-GO AND CONTINUE/DIVERT (AI.III.C.R1–R2)

R1 — Making the Go/No-Go Decision

- Personal weather minimums: self-imposed limits above FAA legal minimums. Example: ceiling no lower than 3,000 ft (not 1,000 ft legal), visibility ≥5 SM (not 3 SM legal). Establish and honor them before the flight, not mid-flight.
- Diversion criteria: pre-plan decision points — at what weather conditions will you divert? What is your alternate? Know before departure.
- Continuation bias (get-there-itis): the most common fatal decision. Tendency to continue into deteriorating conditions because you're already in the air. The decision to divert is always available.
- Known icing/turbulence: if forecast or reported icing exists on route and aircraft is not certified, flight should not depart. If encountered unexpectedly, immediately exit the conditions.

R2 — Limitations of Weather Resources

- Onboard weather equipment: radar detects precip only. FIS-B/datalink is delayed. Neither replaces a thorough preflight briefing.
- Aviation weather reports: METARs are point observations — conditions between stations can differ dramatically. TAFs may not capture rapidly changing conditions.
- Inflight resources: PIREPs are the most current source of actual conditions at altitude. Request PIREPs from Flight Watch (122.0). ATC can relay pilot reports.

Condition	VFR Action	Principle
Convective SIGMET on route	DO NOT DEPART — ground stop	No level of mission urgency justifies flight into active convective areas
Reported moderate icing, no de-ice equipment	DO NOT DEPART / DIVERT	Clean aircraft concept; structural icing exceeds aircraft capability
Ceiling dropping to 2,000 ft en route	Evaluate terrain, divert if needed	Maintain 1,000 ft above terrain minimum; consider IFR options
Temp/dewpoint spread ≤3°C at destination	Check for fog forecast; have alternate	Radiation or advection fog may close destination
PIREPs report severe turbulence	Deviate, descend/climb, or delay	Severe turbulence can cause structural damage and loss of control
Volcanic ash SIGMET on route	DO NOT DEPART — re-route	Engine failure from ash is near-certain; no acceptable risk

6. SKILLS ASSESSMENT (AI.III.C.S1–S3)

S1 — Obtain an Adequate Weather Briefing

- S1.1 Access aviationweather.gov or 1800wxbrief.com and obtain a standard weather briefing
- S1.2 Identify and retrieve METARs, TAFs, PIREPs, AIRMETs/SIGMETs, surface analysis, winds aloft
- S1.3 Cross-reference at least two sources for current and forecast conditions
- S1.4 Check for NOTAMs, TFRs, and special use airspace along route

S2 — Analyze Weather Conditions (at least 3 K3a–K3l phenomena)

- S2.1 Identify at least three meteorological phenomena from the K3 list present in the provided weather scenario
- S2.2 Explain the physical mechanism causing each hazard (e.g., 'ice pellets indicate freezing rain aloft because…')
- S2.3 Quantify the risk: severity, likelihood, and whether current aircraft/pilot certification can safely handle it
- S2.4 Describe how each hazard would affect flight — altitude, route, timing considerations

S3 — Go/No-Go Decision

- S3.1 Synthesize weather information and state a clear, justified go/no-go recommendation
- S3.2 Identify specific conditions that would change the decision (e.g., 'I would go if icing AIRMET is cancelled')
- S3.3 Propose contingency plan: alternates, divert points, in-flight weather update sources
- S3.4 Demonstrate understanding that all weather decisions involve uncertainty — use conservative margins

> ***Instructor Note:*** *For the ACS practical test, the applicant must analyze a real or evaluator-provided weather scenario and correlate information to make a go/no-go decision. The applicant must reference at least three K3 conditions. The decision must be defensible, safety-focused, and reflect personal weather minimums above FAA legal minimums. There is no single 'right' answer — the quality of the reasoning is being evaluated.*

Area of Operation IV, Task A

AI.IV.A.K1–K3 · R1 · S1

Preflight Lesson on a Maneuver to be Performed in Flight

ACS REQUIREMENTS — AI.IV.A

OBJECTIVE	KNOWLEDGE (K)	RISK MGMT (R)	SKILL (S)
Demonstrate instructional knowledge of a maneuver selected by the evaluator from Areas VII–XII (ASEL/ASES) and deliver ground instruction using a lesson plan.	**K1** Purpose of the maneuver **K2** Elements and common errors **K3** Desired outcomes and completion standards	**R1** Explain and teach how to identify and manage risks associated with the selected maneuver Task.	**S1** Deliver instruction on the selected maneuver using a lesson plan, teaching methods, and aids as appropriate (incorporates K1–K3).

LESSON DELIVERY FRAMEWORK — THE 5-PHASE PREFLIGHT BRIEFING

LESSON PHASE	TIME	INSTRUCTOR ACTIONS & CONTENT
1 — ATTENTION & MOTIVATION	2–3 min	Open with a compelling hook: a statistic, accident scenario, or question relevant to the maneuver. State the lesson objective: what the student will know and be able to do by the end. Connect the maneuver to a real-world flight scenario.
2 — OVERVIEW (Tell them what you'll tell them)	1–2 min	Briefly outline the lesson structure: purpose → mechanics → common errors → completion standards → risk. Show the student where to find the maneuver in the AFH so they can study independently.
3 — PRESENTATION	8–12 min	K1: Explain the PURPOSE — why we practice it, when it is used in real flight. K2: Walk through the ELEMENTS step by step. Use diagrams, gestures, or a model airplane. Cover all phases (entry, execution, recovery/completion). Teach COMMON ERRORS and their causes. K3: State the COMPLETION STANDARDS exactly as written in the ACS. Describe the desired outcome.
4 — RISK MANAGEMENT	2–3 min	R1: Identify the specific hazards associated with the maneuver (e.g., altitude loss in steep spiral, accelerated stall in chandelles, disorientation in spins). Teach the student to manage risk through awareness, proper technique, and defined abort criteria.
5 — SUMMARY & NEXT STEPS	1–2 min	Review the key points (Tell them what you told them). Confirm the student can state the purpose, elements, and standards. Assign AFH reading chapter/pages. Preview what the in-flight demo will look like.

REQUIRED COMPONENTS OF THE WRITTEN LESSON PLAN

COMPONENT	DESCRIPTION / REQUIREMENT
Lesson Title & ACS Reference	Clearly state the maneuver name, Area/Task code (e.g., AI.VII.A), and applicable ACS references.

COMPONENT	DESCRIPTION / REQUIREMENT
Objective (from ACS)	Write the objective verbatim or paraphrased from the ACS — what the student will know/do.
Purpose of the Maneuver (K1)	One to two sentences: why pilots learn this maneuver and when it is used operationally.
Elements & Technique (K2)	Step-by-step execution: entry conditions, power/attitude, coordination, timing, corrections. Include a brief list of common errors and their probable causes.
Completion Standards (K3)	Exact ACS tolerances (altitude ±, airspeed ±, heading ±, bank angle, etc.). State what 'successful completion' looks like.
Risk Management (R1)	Identify at least two maneuver-specific hazards. Describe the management strategy for each.
Teaching Aids	List what you will use: diagrams, model airplane, whiteboard sketch, AFH figures, etc.
References	Cite the AFH chapter(s) and pages, ACS task code, and any other source material used.

TEACHING GUIDANCE & EXAMINER EXPECTATIONS

EXAMINER EXPECTATIONS

- The evaluator will select the maneuver — you do not choose it. Be prepared for any task from Areas VII–XII.
- Your lesson must be delivered **as if teaching a student**, not as a recitation to the examiner.
- Previously developed lesson plans from your own library **may be used** (ACS note, p. 26).
- The outcome of Area IV is determined **before the flight portion** begins.
- Time is typically 10–20 minutes — stay focused and complete all K/R/S elements.

AFH NAVIGATION TIP

When opening your lesson, show the student *exactly* where the maneuver lives in the AFH. This teaches independent study habits and demonstrates your source knowledge. Point to the chapter title, section heading, and relevant figures.

> ***Instructor Note:*** *The AFH (FAA-H-8083-3C) is the* ***primary reference*** *for all flight maneuvers. Know which chapter covers each maneuver cold — the table on page 2 is your quick-reference guide.*

COMMON ERRORS TO AVOID IN DELIVERY

- Reading directly from the lesson plan without engaging the student
- Skipping the purpose — students lose motivation if they don't understand *why*
- Omitting completion standards — the ACS tolerances are non-negotiable
- Forgetting risk management — R1 is a graded ACS element
- Over-loading the student — cover elements logically, one phase at a time
- Not referencing the AFH — always show where the student can read more

> ■ ***Risk Note:*** *Some maneuvers carry heightened risk during the ground briefing itself — be explicit about altitude minimums, abort criteria, and aircraft configuration requirements so the student enters the flight with accurate expectations.*

KEY RULE ■ Every preflight maneuver lesson MUST cover all three Knowledge elements (K1 Purpose, K2 Elements/Errors, K3 Completion Standards), the Risk Management element (R1), AND the Skill element (S1 — lesson delivery). A lesson plan that omits any element is incomplete regardless of how well the others are presented.

AFH MANEUVER QUICK-REFERENCE — ALL TESTABLE MANEUVERS (ASEL) | AREAS VII – XII

How to use this table: *When the examiner names the maneuver, locate it below to instantly identify the AFH chapter and pages. Open your lesson plan and direct the student to those pages during the briefing. The 'Key Teaching Points' column summarizes what the AFH covers — use it to structure your K1/K2/K3 delivery.*

Area	Task	Maneuver Name	AFH Chapter	AFH Pages	Key Teaching Points
VII	A	**Normal Takeoff and Climb**	**Ch 6**	6-3 – 6-6	Takeoff roll, liftoff, initial climb; common errors
VII	B	**Normal Approach and Landing**	**Ch 9**	9-2 – 9-10	Base leg, final, round out, touchdown, rollout
VII	C	**Soft-Field Takeoff and Climb (ASEL)**	**Ch 6**	6-13 – 6-14	Weight transfer, ground effect use, pitch attitude
VII	D	**Soft-Field Approach and Landing (ASEL)**	**Ch 9**	9-23 – 9-24	Flat approach, nose-high touchdown, power use
VII	E	**Short-Field Takeoff & Max Performance Climb (ASEL)**	**Ch 6**	6-11 – 6-12	Brakes held, rotation at Vr, Vx climb to obstacle
VII	F	**Short-Field Approach and Landing (ASEL)**	**Ch 9**	9-20 – 9-23	Vref approach, steep descent, firm touchdown, braking
VII	M	**Slip to a Landing (ASEL)**	**Ch 9**	9-12 – 9-15	Forward slip technique, altitude loss, rudder use
VII	N	**Go-Around / Rejected Landing**	**Ch 9**	9-10 – 9-12	Power, attitude, configuration sequence
VII	O	**Power-Off 180° Accuracy Approach & Landing (ASEL)**	**Ch 9**	9-24 – 9-27	Key position, glide judgment, touchdown point accuracy
VIII	A	**Straight-and-Level Flight**	**Ch 3**	3-6 – 3-11	Pitch/bank references, trim, common errors
VIII	B	**Level Turns**	**Ch 3**	3-11 – 3-17	Coordinated entry/rollout, bank angle, lead/lag
VIII	C	**Straight Climbs and Climbing Turns**	**Ch 3**	3-17 – 3-20	Vy/Vx, coordinated climbing turns, level-off
VIII	D	**Straight Descents and Descending Turns**	**Ch 3**	3-20 – 3-25	Glide, power-off vs. partial power, level-off
IX	A	**Steep Turns**	**Ch 10**	10-1 – 10-3	45° bank, altitude/airspeed control, rollout timing
IX	B	**Steep Spiral (ASEL)**	**Ch 10**	10-3 – 10-4	Constant radius, airspeed, wind correction, rollout
IX	C	**Chandelles (ASEL)**	**Ch 10**	10-4 – 10-6	180° climbing turn, pitch/bank coordination, completion
IX	D	**Lazy Eights (ASEL)**	**Ch 10**	10-6 – 10-8	Symmetry, airspeed extremes, coordination throughout
IX	E	**Ground Reference Maneuvers**	**Ch 7**	7-1 – 7-13	Rectangular course (7-5), S-turns (7-8), turns around point (7-7)
IX	F	**Eights on Pylons (ASEL)**	**Ch 7**	7-14 – 7-18	Pivotal altitude, line-of-sight reference, wind correction
X	A	**Maneuvering During Slow Flight**	**Ch 5**	5-9 – 5-12	1.3 Vs1, control effectiveness, buffet awareness

Area	Task	Maneuver Name	AFH Chapter	AFH Pages	Key Teaching Points
X	B	**Demonstration of Flight Characteristics at Various Configurations/Airspeeds**	**Ch 5**	5-1 – 5-12	Coordinated flight, AoA, control feel changes
X	C	**Power-Off Stalls**	**Ch 5**	5-17 – 5-18	Approach/landing config, recognition, recovery
X	D	**Power-On Stalls**	**Ch 5**	5-18 – 5-19	Takeoff/departure config, torque effects, recovery
X	E	**Accelerated Stalls**	**Ch 5**	5-19 – 5-20	Elevated load factor, abrupt pitch, recovery
X	F	**Cross-Controlled Stall Demonstration (ASEL)**	**Ch 5**	5-20 – 5-21	Base-to-final scenario, outside slip, snap entry
X	G	**Elevator Trim Stall Demonstration (ASEL)**	**Ch 5**	5-20 – 5-21	Go-around scenario, nose-high trim effect
X	H	**Secondary Stall Demonstration (ASEL)**	**Ch 5**	5-18 – 5-19	Premature back-pressure during recovery
X	I	**Spin Awareness and Spins**	**Ch 5**	5-22 – 5-27	Entry, incipient, developed, recovery phases; PARE
XI	A	**Straight-and-Level Flight (IMC)**	**Ch 18**	18-17 – 18-19	Inadvertent IMC; attitude instrument scan
XI	B	**Constant Airspeed Climbs (IMC)**	**Ch 18**	18-19 – 18-20	Established climb, attitude, power, trim
XI	C	**Constant Airspeed Descents (IMC)**	**Ch 18**	18-19 – 18-21	Controlled descent by reference to instruments only
XI	D	**Turns to Headings (IMC)**	**Ch 18**	18-19	Standard-rate turns, rollout lead, coordination
XI	E	**Recovery from Unusual Flight Attitudes (IMC)**	**Ch 5 / Ch 18**	5-6; 18-18 – 18-22	Nose-high/nose-low recovery, spiral dive awareness
XII	A	**Emergency Descent**	**Ch 18**	18-8 – 18-9	Maximum descent rate, Vne avoidance, clearing turns
XII	B	**Emergency Approach and Landing (Simulated) (ASEL)**	**Ch 9 / Ch 18**	9-28 – 9-30; 18-1 – 18-8	Best glide, terrain selection, forced landing pattern
XII	C	**Systems and Equipment Malfunctions**	**Ch 18**	18-9 – 18-17	In-flight fire, flight control, electrical, pitot-static
XII	D	**Emergency Equipment and Survival Gear**	**Ch 18**	18-22 – 18-23	Ballistic parachute, autoland, survival priorities

Instructor Note: *The Airplane Flying Handbook (FAA-H-8083-3C) is the authoritative source for all flight maneuvers. Page numbers reference the 2023 edition (3C). For Basic Instrument Maneuvers (Area XI), the AFH covers inadvertent IMC procedures in Chapter 18 (pp. 18-17 – 18-22). The Instrument Flying Handbook (FAA-H-8083-15B) provides deeper instrument coverage but Chapter 18 of the AFH is the primary reference for the CFI ACS flight test.*

Area V, Task A — Preflight Assessment

FAA-S-ACS-25 | AI.V.A | CFI Airplane — Ground Lesson

Objective

The applicant demonstrates instructional knowledge of preflight assessment — including pilot self-assessment, aircraft airworthiness determination, the preflight inspection procedure, and environmental factors — and provides effective CFI-level instruction on all elements.

References

- FAA-H-8083-25C (PHAK) — Chapters 2, 8, 9
- FAA-H-8083-2A (Risk Management Handbook) — Chapters 1–3
- FAA-H-8083-3C (AFH) — Chapter 2
- 14 CFR Parts 61, 91 — Pilot currency, aircraft requirements
- POH/AFM — Preflight inspection section

Delivery Format

- Ground lesson with visual diagrams — 25–35 min
- Key frameworks: PAVE, IMSAFE, SPARROW, AV1ATE
- POH walk-through for inspection section reference

ACS Knowledge Elements

Code	Knowledge Element
AI.V.A.K1	Pilot self-assessment
AI.V.A.K2	Determining the airplane is appropriate and airworthy
AI.V.A.K3a–d	Preflight inspection: items, reasons, defects, regulations
AI.V.A.K4	Environmental factors: weather, terrain, route, obstructions

ACS Risk Management

Code	Risk Element
AI.V.A.R1	Pilot (IMSAFE — fitness for flight)
AI.V.A.R2	Aircraft (airworthiness, MEL, inop equipment)
AI.V.A.R3	Environment (weather, airports, airspace, terrain)
AI.V.A.R4	External pressures (get-there-itis, schedule)
AI.V.A.R5	Aviation security concerns

ACS Skills

Code	Skill Element
AI.V.A.S1	Inspect airplane with reference to checklist
AI.V.A.S2	Verify airplane is in condition for safe flight
AI.V.A.S3	Perform self-assessment (IMSAFE)
AI.V.A.S4	Continuously assess environment for safe flight

SECTION 1 — MOTIVATION

The NTSB consistently identifies preflight-related errors — improper fuel verification, failure to remove control locks, undetected structural damage, or a pilot flying despite obvious fatigue — as primary factors in general aviation fatal accidents. In most of these cases, a thorough, disciplined preflight would have identified the hazard before wheels left the ground. Preflight assessment is not a formality; it is the pilot's last opportunity to catch a killer before becoming airborne.

> *"The airplane doesn't care about your schedule. It only cares whether it was checked. The three minutes you save skipping a preflight may cost you the rest of your life."*

SECTION 2 — PAVE: RISK IDENTIFICATION FRAMEWORK (AI.V.A.K1, R1–R4)

The **PAVE checklist** (PHAK Ch. 2, Risk Mgmt. Handbook Ch. 3) gives pilots a structured framework to identify hazards in four categories before every flight. Each letter represents a risk 'bucket.' Teach students to work through all four — a clean score in three does not cancel a red flag in one.



Figure 1 — PAVE Risk Categories | PHAK Fig. 2-7 | FAA-H-8083-2A Fig. 1-2

P — Pilot in Command

- Certificates, ratings, endorsements current?
- Medical certificate valid? (Class 1/2/3 or BasicMed)
- Flight review within 24 calendar months? (14 CFR §61.56)
- Currency: 3 T/O&L; in 90 days for passengers?
- IMSAFE self-check (see Page 3)
- Proficiency with *this specific aircraft* type?

A — Aircraft

- Is this aircraft certified for the planned operation?
- All required inspections current? (Annual, 100-hr, ADs)
- Inoperative equipment — MEL or KOEL reviewed?
- Fuel, oil, and fluid quantities verified?
- Performance: runway, density altitude, weight & CG?

V — enVironment

- Weather: actual vs. forecast, winds, visibility, ceilings
- NOTAMs: runway closures, TFRs, navigation aids
- Terrain: route elevation, obstruction clearance
- Airspace: class, special use, transition requirements
- Destination: airport facilities, lighting, fuel availability
- Night ops: obstacles, lighting, illusions — see PHAK Ch. 17

E — External Pressures

- 'Get-there-itis' — pressure to depart despite hazards
- Passenger or family pressure to continue
- Business or schedule demands on the PIC
- Sunk-cost thinking ('we've already paid for the hotel')

KEY RULE ■ External pressure kills. The PIC is the only authority who can cancel the flight — and must be willing to. Teach students to set **personal minimums** in advance so decisions are made on the ground, not in the air.

CRITICAL ■ R5 — Aviation Security: Pilots must verify the aircraft has not been tampered with, that it is secured when unattended, and that passengers and baggage are known to them. Unauthorized persons near the aircraft or unusual access should be reported immediately.

SECTION 3 — IMSAFE: PILOT SELF-ASSESSMENT (AI.V.A.K1, R1, S3)

The **IMSAFE checklist** (FAA-H-8083-2A Ch. 3, PHAK Ch. 2) is the 'P' element of PAVE broken down into actionable aeromedical factors. Pilots tend to rationalize degraded personal fitness — IMSAFE forces an honest item-by-item review. Teach students that any 'yes' answer is a red flag, not a minor inconvenience.

I	M	S	A	F	E
ILLNESS	**MEDICATION**	**STRESS**	**ALCOHOL**	**FATIGUE**	**EMOTION**
Any symptoms — even mild — can impair judgment and performance. When in doubt, don't fly.	Rx or OTC drugs can cause drowsiness, blurred vision, or impaired reaction time. Check FAA guidance.	Financial, family, or work pressure degrades decision-making. Use the stress check: 'Can I focus 100%?'	8-hour bottle-to-throttle minimum. 0.04% BAC prohibition. 24-hour rule for impairment.	Fatigue is invisible — pilots rarely know how impaired they are. Rest requirement: 8 hrs sleep.	Emotion and Eating. Emotional distress + low blood sugar = poor decisions. Eat before flying.

Figure 2 — IMSAFE Self-Assessment Checklist | FAA-H-8083-2A Fig. 3-3 | PHAK Ch. 2

I — Illness

- ANY symptom — cold, flu, earache, sinus congestion — can cause in-flight disorientation or ear/sinus block on descent.
- Middle ear block at altitude can be debilitating. If you cannot clear your ears on the ground, do not fly.

M — Medication

- FAA prohibits flight while taking any medication that impairs performance. This includes many OTC cold remedies, antihistamines, and sleep aids.
- Pilots must check FAA's 'Do Not Fly' medication list. When in doubt, contact an Aviation Medical Examiner (AME).

S — Stress

- Cognitive stress narrows attention and degrades decision-making. Financial, interpersonal, or professional stress can be as debilitating as physical fatigue.
- Self-test: 'Can I devote 100% of my attention to this flight?'

A — Alcohol

- **8-hour rule** (14 CFR §91.17): No alcohol within 8 hours of acting as PIC.
- **0.04% BAC prohibition**: Blood alcohol at or above 0.04% at any time.
- **24-hour advisory**: Even after 8 hours, residual effects (dehydration, hangover, impaired cognition) may persist. Consider a 24-hour rule.

F — Fatigue

- Fatigue is insidious — pilots cannot accurately assess their own impairment level. Studies show 18 hrs awake ≈ 0.05% BAC impairment.
- Recommend: 8 hours of sleep prior to any flight, with at least a 30-minute quiet rest before a complex or long-distance flight.

E — Emotion / Eating

- *Emotion:* Anger, grief, anxiety, and excitement all impair cockpit resource management and situational awareness.
- *Eating:* Hypoglycemia (low blood sugar) degrades judgment and fine motor control. Always eat before a flight of more than 1 hour.

■ ***Risk Note:*** *Studies show pilots rarely self-identify fatigue or stress as go/no-go factors. Teach students to ask a trusted co-pilot or spouse: 'Am I okay to fly today?' — an outside perspective often catches what the pilot cannot see in themselves.*

KEY RULE ■ IMSAFE is not a checklist to race through — it is a contract with yourself. Teach students that a 'no-go' IMSAFE answer is not a failure; it is the system working correctly. The most dangerous pilot is the one who skips IMSAFE and convinces himself he's fine.

SECTION 4 — AIRCRAFT AIRWORTHINESS & SPARROW REQUIRED DOCUMENTS (AI.V.A.K2, R2)

Before flight, the PIC must determine that the aircraft is **airworthy** — meaning it conforms to its type design and is in condition for safe operation (14 CFR §91.7). This requires verifying that all required documents are on board using the **SPARROW** mnemonic, and that all required inspections are current.

S	P	A	R	R	O	W
SUPPLEMENTS	**POH / AFM**	**AIRWORTHINESS**	**REGISTRATION**	**RADIO LICENSE**	**OPERATING LIMITS**	**WEIGHT & BALANCE**
FAA-approved AFM supplements for installed mods or STC equipment	Pilot's Operating Handbook or FAA-approved AFM on board	Standard = white Special = pink Must be displayed in aircraft	FAA registration certificate 3 years, then renew digitally	Station license required for international operations	Placards, markings, AFM limitations section — all must be current	Current W&B data including any equipment changes or alterations

Figure 3 — SPARROW: Required Documents On Board | 14 CFR §§91.9, 91.203, 91.409

Document Deep Dive

Item	Reg	Key Teaching Point
Supplements	§91.9	FAA-approved supplements for STCs, installed mods, or avionics. If equipment was added, its supplement must be on board and limits observed.
POH/AFM	§91.9	Required for aircraft certificated after March 1, 1979. For older aircraft, approved operating limitations may substitute.
Airworthiness Cert.	§91.203	Must be displayed and legible. Standard = white. Special = pink. Remains valid as long as maintenance is current.
Registration	§91.203	FAA registration certificate. Digital registration is accepted as of 2020. Expires every 3 years — check expiration date.
Radio License	§91.203	FCC station license required for international operations or when operating a radio transmitter. Not required for domestic VFR flights.
Operating Limits	§91.9	Placards, instrument markings, limitations section of AFM. If a placard is missing, the aircraft may not be airworthy.
Weight & Balance	§91.9	Current W&B data including all equipment changes and alterations. Must reflect actual configuration.

Required Inspections (14 CFR §91.409)

Inspection	Interval	Who
Annual Inspection	12 calendar months	FAA-certificated A&P; with IA
100-Hour Inspection	100 flight hours (if operated for hire)	FAA-certificated A&P;
Transponder	24 calendar months	Authorized avionics tech
Altimeter/Pitot-Static	24 calendar months (IFR)	Authorized repair station
ELT Battery	As required by mfr. or 1 hr cumulative use	A&P; or pilot (some types)

Inoperative Equipment (§91.213)

- Use the MEL (if aircraft has one approved) to determine if flight is legal with inop equipment.
- Without MEL: use the KOEL (Kinds of Operations Equipment List) in the POH.
- If the item is required by Type Certificate, §91.205, or an AD — the aircraft is not airworthy until repaired.

CRITICAL ■ The PIC is responsible for airworthiness determination before every flight (14 CFR §91.7). 'The mechanic signed it off' is not a defense — if the PIC observes a defect and departs anyway, they are in violation.

SECTION 5 — AV1ATE PREFLIGHT AUTHORIZATION & INSPECTION PROCEDURE (AI.V.A.K3, S1, S2)

Before departing on any flight, a pilot must confirm legal authorization to fly. The **AV1ATE checklist** is a practical 'go/no-go' framework covering aircraft, weather, currency, documents, performance, and endorsements — all in one sweep.

A	V	1	A	T	E
AIRWORTHINESS	VFR FLIGHT RULES	ONE PILOT REQUIRED	AROW / SPARROW DOCS	TAKEOFF & LANDING	ENDORSE-MENTS
Aircraft airworthy? Maintenance current? Annual, 100-hr, AD compliance	Weather meets VFR minimums? NOTAMs reviewed? Altimeter set?	Certificate current? 3 T/Os & landings (90 days)? Flight review?	All required docs on board? SPARROW complete? MEL if applicable	Performance calcs done? Runway length OK? Density alt considered?	Solo endorsement? X-country endorsement? Logbook current?

Figure 4 — AV1ATE Preflight Authorization Checklist | 14 CFR Parts 61, 91

AV1ATE — Detailed Application

	Element	CFR / Reference	Go / No-Go Check
A	Airworthiness	14 CFR §91.7, §91.203, §91.409	SPARROW documents on board and legible; all required inspections current (annual, 100-hr, ADs); no known unresolved defects
V	VFR Flight Requirements	14 CFR §91.155; PHAK Ch. 2	Weather meets applicable VFR minimums for airspace class; NOTAMs reviewed; ATIS/AWOS obtained; altimeter set
1	One Pilot Required — Currency	14 CFR §61.56, §61.57	Flight review current (within 24 calendar months); 3 takeoffs & landings in 90 days if carrying passengers; night currency if applicable
A	AROW / SPARROW Docs On Board	14 CFR §91.203	All SPARROW items verified on board: Supplements, POH/AFM, Airworthiness cert, Registration, Radio license, Operating limits, W&B
T	Takeoff & Landing Performance	14 CFR §91.103; POH Section 5	Takeoff distance calculated; obstacle clearance verified; density altitude considered; runway length adequate with safety margin
E	Endorsements Current	14 CFR Part 61	Student pilot: solo endorsement, x-country endorsement, category/class endorsements; PPL: logbook current; CFI endorsements valid

Preflight Inspection Sequence (K3a–d)

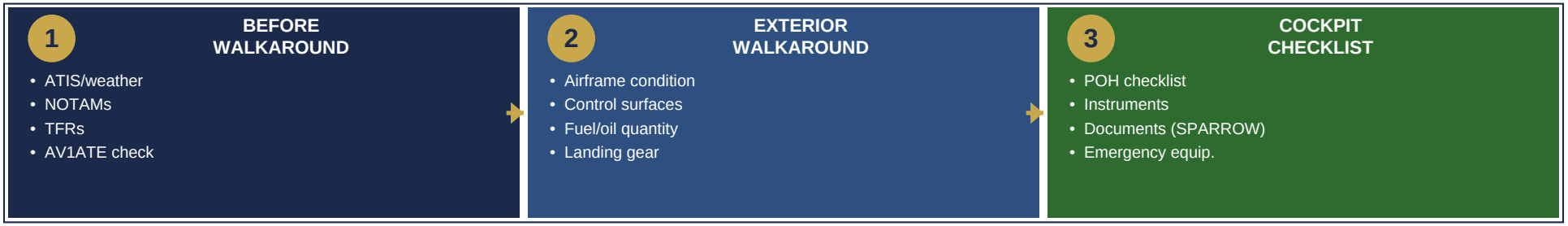


Figure 5 — Three-Stage Preflight Inspection Sequence | POH Section 4

K3b — Why Each Item Is Checked

- Fuel quantity: *Always verify visually* — gauges are only required to be accurate at empty (14 CFR §91.205). Teach students to summon and stick the tanks.
- Oil level: Checked before every flight. Low oil = engine wear; contaminated oil = potential engine failure.
- Flight controls: Full and free movement verified before every takeoff. Gust locks or binding = uncontrollable aircraft.
- Fuel caps: A missing fuel cap can cause fuel starvation in minutes of flight.
- Pitot cover: If left on, airspeed indicator is inoperative. Not subtle — it is a common cause of accidents on training aircraft.

K3c–d — Defect Detection & Regulations

- **Defects vs. wear:** Teach students what is acceptable vs. unairworthy. A scratch on the leading edge is different from a dent. Show examples.
- **Regulatory basis:** §91.7 (PIC responsible for airworthiness), §91.409 (required inspections), §91.205 (required instruments & equipment).
- **POH Section 4** governs the specific inspection sequence — always use the actual checklist, never rely on memory alone.

> ***Instructor Note:*** *Model the walkaround slowly and deliberately. Students learn the pace they are taught. If the instructor rushes, the student rushes — and eventually misses the thing that matters.*

KEY RULE ■ AV1ATE is the go/no-go decision before you ever touch the airplane. SPARROW is confirmed during the cockpit check. The exterior walkaround is governed by the POH checklist — in that order, every flight, without exception.

SECTION 6 — ENVIRONMENTAL FACTORS & RISK MANAGEMENT (AI.V.A.K4, R3–R5)

K4 — Environmental Factors

Factor	What to Assess
Weather	Current conditions, forecast trends, PIREPs, SIGMETs, AIRMETs. Go/no-go based on personal minimums, not legal minimums.
Terrain	Highest terrain on route. Minimum safe altitude (MSA). Density altitude effects on climb performance in mountainous areas.
Route Selection	Alternates available? Fuel stops planned? Off-airport emergency landing areas? Avoid Class A without IFR clearance.
Obstructions	NOTAMs for new towers, cranes, temporary structures. Low-altitude obstructions often appear faster than expected.

R3 — Environment Risk Management

- Check weather: METARs, TAFs, prog charts, SIGMET/AIRMET
- Review NOTAMs for all airports and airspace on route
- Compute density altitude at departure and destination
- Identify divert airports every 30–45 minutes along route
- File a flight plan — it is your best insurance policy

R4 — External Pressure Management

External pressures are the leading cause of continued VFR into IMC and other go/no-go errors. Teach students to recognize and name these pressures so they can resist them:

Pressure Type	Signs	Countermeasure
Destination pressure	Late for event, meeting, wedding	Set decision altitude in advance; file alternate plan
Peer pressure	'Everyone else is flying today'	Pre-brief personal minimums; own your go/no-go
Sunk-cost bias	'We paid for this trip'	Money is replaceable. You are not.
Authority gradient	Instructor/chief pushing departure	PIC authority is absolute — speak up
Get-there-itis	Scud-running, pushing weather	Land early; delay is survivable

■ ***Risk Note:*** *R5 — Security: Brief students to check for tampering, unauthorized fuel additions, foreign objects in the cockpit, or unfamiliar personnel near the aircraft. If something looks wrong, do not fly until it is resolved.*

HOW TO TEACH — SEQUENCING AND TECHNIQUES

Recommended Lesson Sequence

- **Open with PAVE:** 'Before we ever pick up a checklist, we assess four risk buckets...'
- **Drill IMSAFE:** Have the student verbally run through each letter with a personal example
- **Introduce SPARROW:** Walk through the aircraft's actual documents on the ramp
- **AV1ATE gate check:** Use a realistic scenario — is this flight a go or no-go?
- **POH walkaround:** Walk the aircraft using the actual checklist, explaining each item
- **Close with personal minimums:** Have student write their own before next lesson

Common Teaching Errors to Avoid

- Teaching preflight as a 'check the box' exercise — emphasize *why* each item matters
- Skipping IMSAFE because 'the student seems fine' — make it habitual from lesson one
- Treating SPARROW as trivia — missing documents make the flight illegal, period
- Rushing the walkaround — model slow, deliberate, POH-referenced inspection technique
- Failing to address external pressures — this is where most fatal errors originate

> ***Instructor Note:*** *The best teaching tool for external pressures is* ***scenario-based instruction****. Present a realistic scenario: 'Your passenger is getting married tomorrow, weather is marginal, and your boss is waiting. Do you go?' Then let the student decide — and debrief whatever they choose.*

SECTION 7 — SKILLS ASSESSMENT & COMPLETION STANDARDS (AI.V.A.S1–S4)

Skill Demonstration Requirements

#	ACS Skill	Method	Standard
S1	Inspect airplane with checklist	Ramp — actual aircraft + POH	Every item checked in POH sequence; no items skipped
S2	Verify condition for safe flight	Demonstrate defect recognition	Can identify airworthy vs. unairworthy condition
S3	Perform IMSAFE self-assessment	Verbal demonstration	Names all 6 items; applies to realistic scenario
S4	Continuously assess environment	Scenario discussion	Identifies changing conditions and adjusts go/no-go

Completion Standards

- Student correctly identifies all items in the PAVE framework
- Student runs IMSAFE without prompting and applies it to a scenario
- Student identifies all SPARROW documents and their regulatory basis
- Student runs AV1ATE as a go/no-go gate with a realistic scenario
- Student completes walkaround using POH checklist without skipping items

Review Questions

Q	Question	Expected Answer
1	What does PAVE stand for, and what does each category cover?	Pilot, Aircraft, enVironment, External pressures. Each represents a risk category to assess before flight.
2	Run IMSAFE for me. What does each letter mean?	Illness, Medication, Stress, Alcohol, Fatigue, Emotion/Eating. Any 'yes' answer is a potential no-go.
3	What documents must be on board? Use SPARROW.	Supplements, POH/AFM, Airworthiness cert, Registration, Radio license (intl.), Operating limits, Weight & Balance.
4	Walk me through AV1ATE.	Airworthiness, VFR requirements, 1 pilot required (currency), AROW docs, Takeoff/landing perf., Endorsements.
5	The fuel gauges show full. Is that sufficient? Why or why not?	No. Fuel gauges are only required to be accurate at empty (§91.205). Always visually verify fuel quantity.
6	Your passenger really wants to go. Weather is at your personal minimums. What do you do?	Stick to personal minimums. External pressure (passenger desire) does not change the go/no-go calculus. If in doubt, don't.

KEY RULE ■ Every flight begins with a decision — not a checklist. PAVE, IMSAFE, SPARROW, and AV1ATE are decision frameworks, not bureaucratic formalities. A student who understands *why* these tools exist will use them for life. A student who sees them as requirements will abandon them under pressure — exactly when they matter most.

Area V, Task B — Flight Deck Management

FAA-S-ACS-25 | CFI Airplane — Ground Lesson

Objective

The applicant demonstrates instructional knowledge of flight deck management by describing and explaining passenger briefing requirements, appropriate checklist usage, navigation data currency, and securing items and cargo. The applicant can apply that knowledge, manage associated risks, demonstrate appropriate skills, and provide effective instruction.

References

- 14 CFR Part 91 — Preflight and passenger requirements
- AC 120-71 — Standard Operating Procedures and Checklists
- FAA-H-8083-2 (Weight & Balance) — Chapters 1–3
- FAA-H-8083-3 (AFH) — Chapter 2: Ground Operations
- FAA-H-8083-9 (Aviation Instructor's Handbook)
- FAA-H-8083-23 (Seaplane, Skiplane — if applicable)
- FAA-H-8083-25 (PHAK) — Chapter 2: Aeronautical Decision-Making
- POH/AFM — Limitations, Checklists, Equipment Sections

Delivery Format

- Ground lesson with visual aids — 45–60 min
- Reinforce at aircraft before first flight — demonstrate S2 in cockpit
- Evaluate oral delivery of passenger briefing under ACS S2

ACS Knowledge Elements

Code	Element
AI.V.B.K1	Passenger briefing requirements, including operation and required use of safety restraint systems
AI.V.B.K2	Use of appropriate checklists
AI.V.B.K3	Requirements for current and appropriate navigation data
AI.V.B.K4	Securing items and cargo

ACS Risk Management

Code	Element
AI.V.B.R1	Use of systems or equipment, including automation and portable electronic devices
AI.V.B.R2	Inoperative equipment
AI.V.B.R3	Passenger distractions

ACS Skills

Code	Element
AI.V.B.S1	Secure all items in the aircraft
AI.V.B.S2	Conduct appropriate passenger briefing: PIC ID, safety belts, shoulder harnesses, doors, conduct, sterile cockpit, prop avoidance, emergency procedures
AI.V.B.S3	Properly program and manage the aircraft's automation, as applicable
AI.V.B.S4	Appropriately manage risks using ADM, including SRM/CRM

SECTION 2 — MOTIVATION

Flight deck management failures are among the most preventable causes of general aviation accidents. A passenger who is not properly briefed may distract the pilot at a critical moment, interfere with controls, or fail to act correctly during an emergency. An unsecured bag that shifts into the rudder pedals on rotation can render an aircraft uncontrollable. Outdated GPS data used for an approach can lead a pilot confidently into terrain. These are not theoretical risks — they appear repeatedly in NTSB accident reports.

As a CFI, you are teaching your students that the flight deck is a professional environment requiring deliberate preparation and systematic management — before the first engine revolution. The habits formed in primary training will define how your students manage their aircraft for their entire flying career. A student who skips the passenger briefing on lesson five will skip it every time the airplane is full on a cross-country flight. Get it right from the start.

K1 — Passenger Briefing Requirements (AI.V.B.K1)

Per **14 CFR §91.107**, each person on board must be briefed on the use of safety belts and shoulder harnesses. Beyond the regulatory minimum, the FAA expects a comprehensive briefing covering all elements that prepare passengers to act safely during normal and emergency operations. The diagram below summarizes all required briefing elements (AI.V.B.S2).

PIC	✓ BELTS	■ DOORS	✦ STERILE	■ PROP	✎ COMM	✉ EMRG	■ NAV
Pilot in Command	**Safety Belts & Shoulder Harn.**	**Doors & Windows**	**Sterile Cockpit**	**Propeller Avoidance**	**Passenger Conduct**	**Emergency Procedures**	**Nav Data Currency**
Identify yourself as PIC. Passengers may not interfere with controls.	Demonstrate proper adjustment, latching, and release of all restraint systems.	Proper latching procedures. No hands or objects out of aircraft.	No distracting conversation during critical phases: taxi, T/O, landing.	Never walk into propeller arc. Treat prop as always rotating.	No interference with controls or pilot. Follow PIC instructions.	Exit locations, brace position, ELT/radio location, fire extinguisher.	Databases current? Charts, approach plates, Chart Supplements current?

Safety Restraint Systems (§91.107)

- Every occupant must be briefed on proper use of safety belt and shoulder harness
- Demonstrate adjustment, latching, and quick release — don't just tell, show
- Shoulder harness **must be worn** during taxi, T/O, and landing if installed
- Child restraint systems must meet FAA requirements — brief parents accordingly
- Rear seat passengers: seat belt routing often non-obvious — physically check

Propeller Safety (Non-Negotiable)

- Brief every passenger before they exit the aircraft on the ramp
- Teach: 'Treat the propeller as if it's always spinning — because it can be'
- Never walk through the propeller arc — always walk around the tail
- Signal the pilot before approaching the nose of any propeller aircraft

Sterile Cockpit — When It Applies

- Sterile cockpit = no non-essential communication during critical flight phases
- Critical phases: taxi, takeoff roll, climb to cruise, descent, approach, landing
- Passengers must be briefed: wait until level cruise to ask non-emergency questions
- AC 120-71 (airline standard) is the gold standard — apply the principle to GA
- Exception: urgent safety matters — passengers **should** interrupt for emergencies

Emergency Procedures Briefing

- Brief exit door locations and how to open from inside (demo the latch)
- Fire extinguisher location — point to it
- ELT location if visible; tell passengers 'if I'm incapacitated, activate this'
- Brace position for emergency landing — demonstrate
- 'If I say exit, unbuckle and exit immediately — don't look for belongings'

CRITICAL ■ AI.V.B.S2 — The ACS requires CFI applicants to DEMONSTRATE AND SIMULTANEOUSLY EXPLAIN a complete passenger briefing. It is not enough to describe what the briefing contains — the examiner will evaluate the CFI's actual delivery as if conducting a real flight briefing.

K2 — Use of Appropriate Checklists (AI.V.B.K2)

The AFH states: *'Checklists have been the foundation of pilot standardization and flight deck safety for years... Without discipline and dedication to using the appropriate checklists at the appropriate times, the odds are on the side of error.'* There are three accepted methodologies for using checklists in general aviation. A CFI must understand each and teach the appropriate method for each phase of flight.

DO-VERIFY (Flow Check)	CHALLENGE-RESPONSE	READ-DO (Step-by-Step)
Pilot performs flow from memory first, then verifies against published checklist.	One crew member calls item aloud, second member checks and responds verbally.	Pilot reads each item, then performs it before moving to next item.
Faster for routine phases of flight.	Used in multi-crew and complex aircraft.	Best for emergency and abnormal checklists.
Best for experienced pilots with currency.	Ensures verification before each action.	Eliminates memory error completely.
★ Most common in GA	★ Required in airline	★ Required for all

When to Use Which Method

- **Do-Verify (Flow):** Normal operations — preflight inspection, before engine start, before taxi, after landing, shutdown. Builds habit patterns in primary training.
- **Challenge-Response:** Multi-crew operations (e.g., complex aircraft with safety pilot). Encourages verbal verification and cross-checking.
- **Read-Do:** Emergency and abnormal checklists — always. Also appropriate for infrequently performed procedures where memory errors are most likely.

Minimum Checklist Phases (AFH Ch. 1)

- Preflight inspection · Before engine start · Engine start
- Before taxi · Before takeoff · After takeoff · Cruise
- Descent · Before landing · After landing · Engine shutdown & securing

Teaching Checklist Discipline

- The POH/AFM checklist is the **only** approved checklist — do not substitute a 'better' one from a forum or flight school that conflicts with the approved AFM procedures
- Checklists are not 'do lists' — they are **verification** tools. The action must be completed, then checked, not read and then performed (for flow-check method)
- A distracted checklist is as dangerous as no checklist — teach students to complete a checklist before accepting passenger conversation during checklist phases
- Interrupted checklists must be restarted from the beginning — never resume mid-list after a distraction without confirming all prior items

KEY RULE ■ A checklist is a cockpit tool, not a formality. Pilots who skip checklists are not 'experienced' — they are gambling with procedures designed by engineers who knew what could go wrong.

K3 — Navigation Data Currency (AI.V.B.K3)

Using outdated navigation data is not a technicality — it is a safety hazard. Airways change, magnetic variation shifts, obstacle data is updated, and procedures are revised. The pilot is responsible for confirming that all navigation resources are current before flight, whether paper or electronic.

NAVIGATION DATA CURRENCY (AI.V.B.K3) — VFR vs. IFR Requirements

SECTIONAL CHARTS	CHART SUPPLEMENT (A/FD)	GPS DATABASE	APPROACH PLATES (IFR)	NOTAM CHECK
56 days (8 weeks)	56 days (8 weeks)	28 days (IFR req.)	28 days	Pre-flight (each flight)
VFR navigation. New edition every 56 days. Check edition date.	Airport information, frequencies, hours. Same cycle as VFR sectionals.	IFR: must be current for approaches. VFR: current strongly recommended.	Must be current for IFR ops. Paper or EFB — both must be dated.	TFRs, runway closures, navaid outages. Mandatory per 91.103 — every flight.

EFB and Portable GPS Considerations

- Tablet-based EFBs (ForeFlight, Garmin Pilot) require active subscriptions for current data
- Check subscription status before each flight — expired data looks identical to current
- Panel-mounted GPS databases expire on a 28-day AIRAC cycle — verify cycle date
- VFR only: may use out-of-date GPS for situational awareness but NOT navigation to minimums
- IFR: current approved database is required for all instrument approaches — no exceptions

> ***Instructor Note:*** *Teaching tip: Show students how to check database currency on the specific avionics in your training aircraft. Each unit has a different menu path. Know it before the flight — not while holding short on an IFR departure.*

Chart Supplements & TFR Awareness

- **91.103** — Pilot in command must become familiar with ALL available information before a flight
- NOTAM check is legally required every flight — document in flight planning records
- TFRs can be issued with very short notice — check notams.faa.gov or ATIS/D-ATIS
- Chart Supplements (formerly A/FD): airport hours, frequencies, traffic patterns, special notes — check edition date before cross-country planning
- Class B/C/D airspace boundaries can change — always use current sectional edition

CRITICAL ■ Using out-of-date approach plates or GPS data for an instrument approach is a certificate action and a potential criminal violation if it contributes to an accident. Teach this clearly — students must know the difference between 'current' and 'recent.'

K4 — Securing Items and Cargo (AI.V.B.K4 / AI.V.B.S1)

Unsecured items in the cockpit and cabin are a direct safety hazard. Loose objects can slide into control linkages, obstruct rudder pedals, block instrument panels, or become high-velocity projectiles during turbulence or an abrupt maneuver. Weight and balance is also affected by where cargo is placed — an improperly loaded aircraft may exceed CG limits.

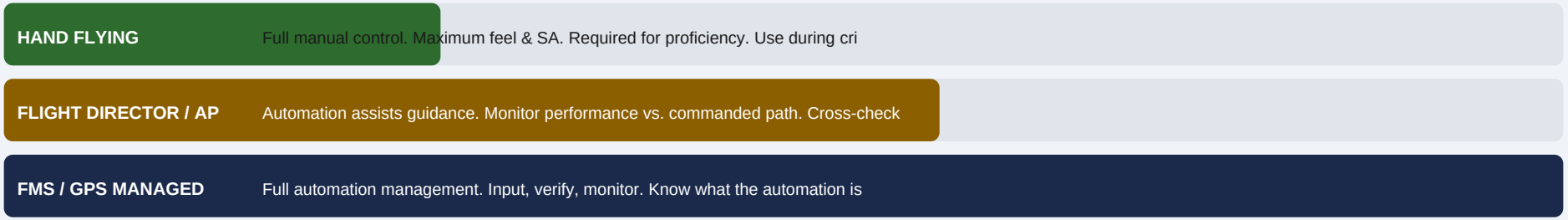
SECURING ITEMS & CARGO — CRITICAL CONSIDERATIONS (AI.V.B.K4 / S1)

BEFORE BOARDING	INSIDE THE AIRCRAFT	WEIGHT & BALANCE IMPACT
Inspect all baggage for sharp, hazardous, or oversize items	Bags under seats or in approved storage areas	Aft-loaded cargo shifts CG aft: reduced pitch authority
Verify nothing can shift against flight controls	No loose items on glareshield, floor, or near rudder pedals	Asymmetric loading causes bank tendency — note in W&B calc
Ensure cargo weight is within W&B limits — compute loading	Headsets, charts, kneepads secured before engine start	Exceeding max baggage weight voids airworthiness — check AFM
Distribute weight evenly;	Passenger items briefed:	Loose items in turbulence

SECTION 3 — RISK MANAGEMENT (AI.V.B.R1 / R2 / R3)

Flight deck management risk extends well beyond the aircraft cockpit — it encompasses every system, every person on board, and every piece of equipment in use. The following three risk elements are the core of the ACS risk management requirements for this task.

AUTOMATION MANAGEMENT — LEVELS OF ENGAGEMENT



R1 — Automation & Portable Electronic Devices

- GPS, autopilot, and avionics are tools — not substitutes for pilot judgment
- 'Automation surprise': the pilot must always know what the automation is doing and be prepared to revert to manual flight in 2–3 seconds
- Portable electronic devices (PEDs): iPads, phones, and EFBs can interfere with some avionics — know your aircraft's avionics manual guidance on PED use
- PED mount placement must not block view of instruments or access to circuit breakers
- Program automation while parked or at cruise — never during critical phases
- **Risk mitigation:** Always brief an 'automation-off' reversion plan before any GPS approach or autopilot-coupled operation

R3 — Passenger Distractions

- Passengers are often the most unpredictable cockpit risk element
- A passenger who grabs the yoke out of panic can override pilot inputs in seconds
- Questions, pointing out window, adjusting vents/heat — all pull attention during busy flight phases
- **Mitigation:** The sterile cockpit briefing is your primary tool — reinforce it before every flight with non-pilot passengers
- Assign the right seat passenger a 'job' during pattern work: watch for traffic. Redirects their energy productively

R2 — Inoperative Equipment (MEL / KOEL)

- If equipment is inoperative, the pilot must determine: is this flight legal and safe?
- Three-step process for inoperative equipment decision:
- 1. Check POH/AFM — is the item required for the intended operation?
- 2. Check the Kind of Operations Equipment List (KOEL) in the POH/AFM
- 3. Reference 14 CFR §91.213 — deferral procedures for non-required equipment
- **MEL:** Master Equipment List (approved deferral program — typically Part 91 turbine or Part 135/121 operations)
- For training aircraft: treat POH equipment list as your MEL — anything listed as required cannot be deferred without the aircraft being grounded
- **Risk:** Inoperative autopilot, GPS, or comm radio changes flight risk profile — this is an ADM decision, not just a legal question

■ ***Risk Note:*** *Document ALL inoperative equipment with a placard marked INOP before flight. Failing to placard inoperative equipment makes the aircraft legally unairworthy regardless of whether the item is actually needed for the flight.*

HOW TO TEACH — ADM / SRM / CRM INTEGRATION (AI.V.B.S4)

Teaching ADM in the Context of Flight Deck Management

- ADM (Aeronautical Decision-Making) is not an abstract concept — it starts on the ramp before the engine starts. Every element of this lesson is an ADM opportunity.
- Use the flight deck management briefing as your classroom: 'Why do we secure loose items? Because the scenario planning for turbulence is an ADM decision.'
- SRM (Single-pilot Resource Management): in single-pilot GA, the pilot manages all resources — passengers, checklists, automation, charts — simultaneously
- Frame checklist use as SA (Situational Awareness) maintenance, not bureaucracy
- 3P Model: Perceive (inop equipment, outdated chart), Process (can I complete this flight safely?), Perform (defer the item, update the database, brief passengers)

CRM for Two-Crew or CFI/Student Operations

- CRM (Crew Resource Management): brief the right seat before flight — student or safety pilot is a crew resource, not a passenger
- Assign callouts: 'Call any traffic you see in the pattern. Call if you notice anything unusual on the instruments.'
- Control transfer protocol: always use the explicit three-step exchange — 'Your controls / I have the controls / Your controls.' Confirm verbally AND visually.
- Never leave authority ambiguous — the AFH documents accidents from unclear handoffs
- A well-briefed student is a resource; an unbriefed student is a liability. The cockpit briefing IS the CRM briefing.

SECTION 4 — SKILLS ASSESSMENT (AI.V.B.S1–S4)

Demonstration & Evaluation Checklist

#	Skill Element	Method / Standard
S1	Secure all items in the aircraft	Physical demo at aircraft — show bag stowage, loose item check, CG consideration — 3 min
S2	Complete passenger briefing (all 8 elements)	Oral delivery to examiner or student — no notes — must include: PIC ID, belts, shoulder harness, doors, conduct, sterile cockpit, prop avoidance, emergency procedures
S3	Program and manage automation	Demo on training aircraft avionics — GPS/FMS entry, autopilot coupling, verify/monitor cycle — 5 min
S4	ADM using SRM/CRM	Oral scenario: inop transponder found in preflight — walk through 91.213 decision, brief crew, note in logbook

ACS Compliance Notes

- S2 is the most commonly failed element — student CFIs recite items but don't demonstrate them physically. Examiner will ask applicant to stand at the aircraft door and deliver the briefing as if to a real passenger.
- S3 scope depends on aircraft — for a C172 with G1000: include COM/NAV setup, direct-to entry, nearest airport page. For steam gauges: discuss GPS MFD if installed.
- S4 is evaluated throughout the oral — examiner is watching for ADM integration into ALL answers, not just the question marked 'ADM.'

Completion Standards

- Applicant demonstrates instructional knowledge of ALL four knowledge elements with no critical errors and only minor deviations that are self-corrected
- Passenger briefing is complete, confident, and delivered in a natural instructional manner — not read from notes during the practical test
- Inoperative equipment decision follows the correct regulatory framework without prompting from the examiner

SECTION 5 — REVIEW QUESTIONS

Q1: A student asks why the passenger briefing needs to include propeller avoidance every single flight. How do you explain it?

A: Propeller accidents on the ramp are almost always fatal and almost always involve someone who 'knew' — but forgot in the moment. The briefing serves as the last checkpoint before the environment becomes lethal. Familiarity breeds complacency; the briefing counters that. Cite real NTSB prop-strike cases to reinforce the point.

Q2: Your GPS database expired 3 days ago. You are flying VFR to a nearby airport you know well. Is this legal and safe? How would you teach this decision?	A: Legal for VFR — the current database is required for IFR approaches, not VFR navigation. However, safety-wise: NOTAMs may have changed, obstacle data may be outdated, and airspace may have been modified. Teach students to use the 3P model: Perceive the risk, Process alternatives (update the database, file VFR flight plan, check NOTAMs via phone), Perform the safest option.
Q3: During preflight, you discover the turn coordinator is inoperative. The planned flight is a local VFR training flight. Can you legally depart?	A: Check the POH/AFM — if the turn coordinator is not listed as required for VFR day flight in the KOEL, you may be able to defer it under 91.213(d) without an MEL. You must placard it INOP, record the deferral, and confirm the failure does not affect airworthiness. The CFI must then assess whether it affects the training objective and student safety — this is an ADM decision beyond the legal minimum.
Q4: You are in the pattern with a student on final when a passenger in the back asks a question. How do you handle it and what do you teach?	A: Sterile cockpit — acknowledge the passenger briefly ('Hold that thought') and maintain focus on approach. After clear of the runway: debrief the student and passenger on sterile cockpit procedure. As CFI, demonstrate the behavior you teach: never sacrifice situational awareness on final for a passenger conversation. Then discuss with student: how would they have handled it as PIC?
Q5: Explain the three-step flight control exchange and why it matters.	A: 'You have the controls' (instructor) → 'I have the controls' (student acknowledges + takes controls) → 'You have the controls' (instructor confirms). The third step is the key — it forces positive confirmation. Per the AFH, accidents have occurred when it was unclear who had the aircraft. Never transfer controls through nods, gestures, or implication.

"The flight deck is the cockpit of a machine that will kill you if you're careless — and a platform that will carry you to beautiful places if you're disciplined. Flight deck management is the difference between those two outcomes. Teach it like it matters, because it does."

Area V, Task C — Engine Starting

FAA-S-ACS-25 | CFI Airplane — Ground Lesson

Objective

The applicant demonstrates instructional knowledge of engine starting procedures by describing and explaining starting techniques under various conditions, use of external power, and engine limitations as they relate to starting. The applicant manages risk associated with propeller safety, external power use, and starting limitations, and demonstrates proper aircraft positioning and checklist completion.

References

- FAA-H-8083-2 (Weight & Balance) — aircraft loading considerations
- FAA-H-8083-3 (AFH) — Chapter 2: Ground Operations and Engine Starting
- FAA-H-8083-9 (Aviation Instructor's Handbook) — teaching techniques
- FAA-H-8083-23 (Seaplane, Skiplane — cold/remote starts, if applicable)
- FAA-H-8083-25 (PHAK) — Chapter 7: Aircraft Systems (fuel, ignition, electrical)
- POH/AFM — Section 4 (Normal Procedures), Section 3 (Emergency Procedures)

Delivery Format

- Ground lesson — 30–45 min; reinforce at aircraft before each start
- At aircraft: demonstrate then have student perform with CFI narrating
- Evaluate simultaneous demo + explanation on oral / practical test

ACS Knowledge Elements

Code	Element
AI.V.C.K1	Starting under various conditions
AI.V.C.K2	Starting the engine(s) by use of external power
AI.V.C.K3	Engine limitations as they relate to starting

ACS Risk Management

Code	Element
AI.V.C.R1	Propeller safety
AI.V.C.R2	Use of external power unit
AI.V.C.R3	Limitations during starting

ACS Skills

Code	Element
AI.V.C.S1	Position the airplane properly considering structures, other aircraft, wind, and the safety of nearby persons and property
AI.V.C.S2	Complete the appropriate checklist(s)

SECTION 1 — MOTIVATION

The engine start is the first powered event of every flight — and the first opportunity for a serious accident. Propeller strikes kill ramp workers and pilots each year because someone cut across the arc without verifying the aircraft was safe. Reversed GPU polarity has destroyed thousands of dollars in avionics in seconds. Engines have seized on takeoff because a pilot advanced power before confirming oil pressure. These are preventable outcomes, and every one of them is rooted in a skipped step or a failure to understand the 'why' behind the checklist.

As a CFI, you will set the standard for how your students start engines for the rest of their flying careers. A student who learns to shout "Clear" and physically scan the arc before every start does it for 10,000 hours. A student who learns to mumble it at the panel does not. Teach the habit, teach the reason, and the behavior follows automatically.

K1 — Starting Under Various Conditions (AI.V.C.K1)

The engine start sequence differs based on engine type (carbureted vs. fuel-injected), ambient temperature, engine temperature, and altitude. A CFI must be able to explain and demonstrate the correct procedure for any condition encountered. The sequence below shows the standard normal start for each fuel delivery system. Steps in **red** are propeller-safety critical; steps in **green** are immediate post-start monitors.

NORMAL ENGINE START SEQUENCE — CARBURETED vs. FUEL INJECTED

CARBURETED ENGINE	FUEL-INJECTED ENGINE
1 Mixture — RICH	1 Mixture — RICH (cold) or IDLE CUTOFF (hot)
2 Carb heat — OFF (cold air)	2 Fuel selector — ON, fullest tank
3 Throttle — OPEN 1/4" (warm) or CLOSED (cold)	3 Boost pump — ON briefly to establish fuel flow
4 Prime as required per POH	4 Throttle — cracked open slightly
5 Master switch — ON	5 Master switch — ON
6 "CLEAR PROP" — shout, look	6 "CLEAR PROP" — shout, look
7 Ignition — START	7 Ignition — START; mixture to RICH at catch
8 Oil pressure — check within 30 sec	8 Oil pressure — check within 30 sec
9 Throttle — reduce to 1,000 RPM idle	9 Boost pump — OFF (monitor fuel flow)

Carbureted Engine — Key Teaching Points

- The primer injects fuel directly into the intake manifold — it is NOT a choke. Over-priming floods the engine with raw fuel that will not ignite properly.
- Throttle position depends on OAT: slightly open in warm conditions helps initial idle; fully closed reduces flood risk in cold starts where heavy priming was used.
- Carb heat MUST be OFF during start — hot air reduces engine efficiency and causes backfire risk when a flooded engine finally catches.
- After start: listen for rough running that indicates carb ice — apply carb heat briefly if suspected, then return to cold air for full power operations.

> ***Instructor Note:*** *Teach students to count primer strokes — POH specifies strokes by temperature range. Guessing results in a flooded engine or a hard start. The POH is the authority, not habit.*

Fuel-Injected Engine — Key Teaching Points

- Fuel-injected engines have no carburetor ice risk but are far more susceptible to **vapor lock** when hot. Fuel in the lines vaporizes and blocks fuel flow to the injectors, requiring the hot-start procedure to purge vapor.
- The boost pump primes the fuel distribution system by pressurizing the fuel manifold — it replaces the manual primer. Observe the fuel flow gauge to confirm priming.
- Hot start (most FI engines): mixture to IDLE CUTOFF, throttle FULL OPEN, crank until engine fires, then smoothly advance mixture to RICH as it catches. This clears vapor from the lines before re-introducing liquid fuel.
- Boost pump OFF after start in most aircraft — it bypasses the engine-driven pump and can cause excessively rich mixture at high fuel pressures.

KEY RULE ■ Always reference the specific aircraft POH for starting procedures. Generic procedures are a starting point for instruction only — POH is the final authority.

K1 (continued) — Special Conditions Matrix

Beyond the standard normal start, CFIs must teach students to recognize and adapt to four common non-standard starting scenarios. Each requires a departure from the normal sequence — understanding the underlying system behavior is what allows pilots to improvise safely when conditions don't match the expected procedure.

SPECIAL STARTING CONDITIONS — RECOGNITION & PROCEDURE (AI.V.C.K1)

COLD WEATHER START	HOT ENGINE / VAPOR LOCK	FLOODED ENGINE	HIGH ALTITUDE START
• Thicker oil = harder crank	• Fuel-injected: vapor lock common	• Excess fuel = will not fire	• Less dense air = leaner mixture needed
• Prime generously per POH	• Boost pump ON briefly	• Mixture — IDLE CUTOFF	• Set mixture leaner than sea level
• Pre-heat if OAT below 20°F	• Throttle — FULL OPEN to clear	• Throttle — FULL OPEN	• Throttle position per POH note
• Battery check (cold reduces capacity)	• Mixture — IDLE CUTOFF at first	• No additional prime/boost pump	• Normal start sequence otherwise
• Throttle — slightly open	• Crank — advance mixture at catch	• Crank to clear raw fuel	• Do not over-prime (lean environment)
• Extended cranking may be needed	• If no start: wait 3–5 min, cool	• Once engine catches: throttle to idle	• Monitor EGT if installed
• Check oil pressure immediately	• Avoid excessive primer (floods FI)	• Advance mixture to RICH smoothly	• Review AFM notes for density altitude
• Warm up at higher RPM per POH	• Follow POH hot-start procedure exactly	• Watch for fire — extinguisher ready	• Battery efficiency unaffected by alt

"A flooded engine is like a flooded carburetor in a lawn mower — if it's already drowning in fuel, adding more fuel won't fix it. You need air first, then fuel. Open throttle, kill the mixture, crank to purge, then reintroduce fuel at ignition."

K2 — Starting by External Power (AI.V.C.K2)

When the aircraft battery is depleted, flat, or weak, an external power unit (GPU — Ground Power Unit) provides the electrical energy needed to start the engine. External starts introduce additional hazards that require explicit briefing: reversed polarity, voltage mismatch, fire risk, and propeller arc violations by GPU operators unfamiliar with aircraft safety zones.

EXTERNAL POWER STARTING — GPU & SAFETY PROCEDURES (AI.V.C.K2 / AI.V.C.R2)

CONNECT PROCEDURE	DISCONNECT PROCEDURE	HAZARDS & LIMITATIONS
1. Verify GPU voltage matches aircraft system (12V or 28V)	1. Reduce to idle RPM after start	FIRE RISK: Sparks at connection — no fuel vapors nearby
2. GPU output OFF before connecting	2. GPU operator: signal pilot / receive signal	POLARITY: Reversed leads can destroy alternator and avionics
3. Connect (+) positive lead to aircraft (+) terminal first	3. GPU output OFF before touching leads	VOLTAGE: 24V GPU on 12V system = immediate damage
4. Connect (–) negative lead to aircraft (–) terminal or airframe ground	4. Disconnect (–) negative lead first	AMPERAGE: Some GPUs spike — verify the aircraft's rated amperage
5. Verify polarity — reverse polarity destroys avionics instantly	5. Disconnect (+) positive lead second	CORD TRIPPING: GPU cables are a ground crew hazard
6. GPU operator stands clear of propeller arc	6. Stow GPU cable clear of propeller and aircraft	ENGINE START: Never crank with GPU cable in propeller arc
7. Turn GPU output ON — proceed with start checklist	7. GPU unit moved away from propeller arc	BATTERY: Check aircraft battery after external start (charge state)
8. After start: GPU output OFF before disconnecting leads	8. Pilot verifies all systems normal before taxi	MEL: If GPU used regularly, check battery health with AMT

Checking the Aircraft's External Power Receptacle

- Most single-engine piston aircraft have a standardized external power receptacle on the firewall or cowling — refer to the POH/AFM Section 8 (Supplements) for location.
- Aircraft external power systems are typically **14V (12V nominal)** or **28V (24V nominal)**. Using the wrong voltage GPU is an immediate avionics hazard.
- Some aircraft (e.g., Cessna 172 with standard equipment) do not have an external power receptacle — confirm before attempting GPU connection.
- Battery main switch: ON before applying external power in most aircraft. The battery acts as a voltage buffer, protecting avionics from GPU voltage spikes.

CRITICAL ■ REVERSED POLARITY is the most common and most destructive GPU error. Always verify (+) to (+) and (–) to (–) before energizing the GPU. One reversed connection can destroy the alternator, avionics bus, and all attached equipment instantly.

Jump-Starting from Another Aircraft

- Aircraft-to-aircraft jump starting is generally NOT recommended by most POH/AFMs.
- If attempted: both aircraft must be on the same voltage system. Both aircraft masters OFF during connection; engines not running on donor aircraft.
- Connection sequence: (+) donor → (+) dead, (–) donor → airframe ground (not the battery negative terminal — avoids spark near battery gases).
- The donor aircraft starter current can damage the receiving aircraft's electrical system if engines are running on the donor during connection.
- **Always defer to the POH:** most manufacturers explicitly prohibit this — if the AFM says 'do not jump start,' do not jump start, period.

Instructor Note: *Teaching point: A weak battery that needs a jump start should be evaluated by an AMT before the next flight. The cause of the dead battery (alternator failure, excessive loads, old battery) may be a more serious airworthiness issue.*

K3 — Engine Limitations During Starting (AI.V.C.K3)

Engine and electrical system limits apply from the first engine revolution. Exceeding starter duty cycles damages the starter motor and can result in an inability to restart. Failure to confirm oil pressure before advancing power can cause bearing failure within seconds. The limits below are the minimum a CFI must be able to explain and teach.

ENGINE LIMITATIONS DURING STARTING (AI.V.C.K3)

STARTER DUTY CYCLE	OIL PRESSURE CHECK	OIL TEMPERATURE	RPM / MANIFOLD PRESS.	ENGINE FIRE
30 sec ON 60 sec REST	**Green within 30 sec**	**Min before takeoff**	**Idle per POH**	**IMMEDIATE SHUTDOWN**
• Do not exceed 30 sec continuous cranking • Starter motor overheats rapidly • 3 attempts max before 15-min cooling • Damage = expensive starter replacement • Follow exact POH starter limits	• If no green arc in 30 sec: SHUTDOWN • Cold weather: may take slightly longer • Low oil pressure = engine seizure risk • Do not advance power without green oil • Check oil qty if pressure fails to rise	• No T/O with oil temp in yellow • Warm up at 1,000 RPM to green arc • Cold wx: allow 5+ min warm-up • Rich mixture helps warm up faster • Below min temp = poor lubrication	• Post-start: reduce to idle ~1,000 RPM • Wait for oil pressure before throttle • Max RPM per POH/AFM spec • MAP limits defined in AFM • High RPM before oil pressure = damage	• Fire in induction system: KEEP CRANKING • Throttle FULL, mixture CUTOFF — draws fir • Fire on cowling: SHUTDOWN + extinguish • Evacuate if fire continues after shutdown • Know difference: induction fire vs. cowl fire

Immediate Post-Start Checks

- Oil pressure: confirm green within 30 seconds of start (cold wx: up to 60 sec). If no green: **shut down immediately**. Do not wait to see if it rises.
- Ammeter / loadmeter: should show positive charge (alternator output) after start. A zero or negative indication means the alternator is not charging.
- Engine instruments in normal range: EGT (if equipped), CHT, fuel flow stable.
- Listen: rough running, misfiring, or unusual vibration — shut down and investigate.
- Throttle to idle (typically 800–1,000 RPM) — allow warm up before taxi.

KEY RULE ■ The 30-second oil pressure rule is not a guideline — it is an absolute limit. Engine bearings run dry in seconds without oil pressure. A new engine is cheaper than a lawsuit from an in-flight engine failure caused by a post-start shortcut.

Engine Starting vs. Engine Fire

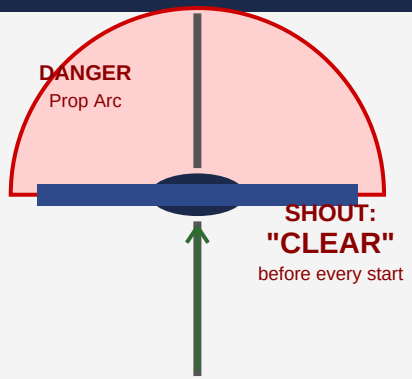
- **Induction fire** (fire in the intake manifold during start): Keep cranking with throttle FULL OPEN, mixture IDLE CUTOFF. The cranking draws the fire into the engine and extinguishes it. This is counterintuitive — drill it verbally before checkride.
- **Engine compartment fire** (flames visible from cowling): Shut down immediately, exit aircraft, use fire extinguisher from upwind. Do not restart.
- Both scenarios require a calm, memory-based response — teach students to distinguish between them before they ever sit in the cockpit.
- After any in-flight or ground fire indication, the aircraft is grounded until an AMT has inspected the induction system and engine compartment.

■ ***Risk Note:*** *Students often panic at an induction backfire and shut down immediately. Drill the induction fire procedure until the response (full throttle, keep cranking) is automatic. Shutting down on an induction fire traps burning fuel in the manifold.*

SECTION 3 — RISK MANAGEMENT (AI.V.C.R1 / R2 / R3)

The three ACS risk management elements for engine starting represent the most common causes of serious ramp incidents. Each must be explicitly taught, not assumed. A CFI who says ‘just don’t go near the prop’ has not met the standard — the standard requires the applicant to explain and teach a complete risk management framework.

PROPELLER SAFETY & AIRCRAFT POSITIONING (AI.V.C.R1 / AI.V.C.S1)



✓ SAFE APPROACH
from the tail or rear quarter

WIND	Position nose into wind when possible — improves cooling, reduces fire risk from flooded-engine starts
STRUCTURES	Point exhaust away from hangars, fuel trucks, and other aircraft. Consider wake from engine start blast
PERSONS	Never start engine with anyone in the propeller arc. Ground crew must be visible to the pilot or clear area
BRAKES	Parking brakes SET before engaging starter. Chocks if available. Verify aircraft will not roll into obstacles
FIRE EXT.	Fire extinguisher accessible (reachable without exiting the seat). Know location before first engine turn

R1 — Propeller Safety (AI.V.C.R1)

- **“Clear Prop” procedure:** Before engaging the starter, the pilot must shout "CLEAR" audibly, wait for acknowledgment or visual confirmation, and physically scan the propeller arc for persons and obstructions. This is not optional.
- The propeller arc extends approximately one blade length in all directions — for most GA aircraft, that is a 5–7 foot radius in front of the aircraft.
- Teach students: the magneto switch is equivalent to a loaded weapon. Grounding a "hot" mag means rotating the engine by hand will fire the ignition. Treat all props as live.
- A hand-propped engine (without a starter) requires the pilot to stay outside the arc until the engine has caught and settled — the person propping must control their footing to avoid stepping into the arc if the engine kicks.
- Passengers and bystanders must be briefed to stay behind the wing at all times on the ramp.

CRITICAL ■ PROPELLER CONTACT IS FATAL. There is no ‘near miss’ with a rotating prop. Teach this with absolute clarity: no amount of hurry justifies skipping the ‘Clear’ call and arc scan.

R2 — Use of External Power Unit (AI.V.C.R2)

- The GPU operator must receive a safety briefing from the pilot or line personnel before connecting: prop arc zone, hot surfaces, connection sequence, and signal protocol.
- Never assume a GPU operator knows aircraft propeller safety. Ground crew from car dealerships, rental companies, or unfamiliar FBOs may have no aviation training.
- The pilot is responsible for verifying polarity before the GPU is energized, even if a qualified line tech is performing the connection.
- Signal protocol: establish a clear ‘go/stop’ signal with the GPU operator before connecting. Many GPU-related accidents occur due to miscommunication during disconnect.

R3 — Limitations During Starting (AI.V.C.R3)

- Starting limitations are binding, not suggestions. The starter duty cycle and oil pressure time limit exist because engineers have tested the failure modes.
- Pressure to depart on time is one of the most common reasons pilots exceed starting limits — schedule pressure is a recognized human factors hazard (HFACS).
- If the engine will not start within limits: troubleshoot on the ramp, not in the air. An engine that is difficult to start may have a deeper airworthiness issue.
- Document any abnormal starting event in the aircraft maintenance log. Future pilots need to know if this aircraft has a chronic starting problem.

SECTION 4 — SKILLS (AI.V.C.S1 / S2)

S1 — Positioning the Aircraft (AI.V.C.S1)

Proper aircraft positioning before engine start is a deliberate safety decision, not simply parking wherever is convenient. Four factors drive positioning:

- **Wind direction:** Position nose into wind when feasible. This improves engine cooling on the initial start, reduces fire risk by blowing fuel vapors away from the aircraft, and prevents exhaust from blowing into the cockpit or hangar.
- **Structures and obstacles:** The propeller blast and exhaust stream extend 30–50 feet behind most GA aircraft. Do not point the tail toward hangars, other aircraft, fuel pumps, or pedestrian areas.
- **Other aircraft:** Wingtip clearance on the ramp, blast from your start does not disturb adjacent aircraft, and taxi path after start is clear.
- **Persons and property:** Visually verify no persons are behind or in front of the aircraft before start. Chock the wheels or confirm brakes are set. Close hangar doors if prop blast could disturb items inside.

> ***Instructor Note:*** *On the practical test, the examiner will observe aircraft positioning and may ask the applicant to explain the choice of heading and location before engine start. This is evaluated under S1 — have a clear, defensible rationale ready.*

S2 — Completing Appropriate Checklists (AI.V.C.S2)

The ACS requires the CFI applicant to complete — and demonstrate simultaneous explanation of — the full engine start checklist. This is not a recitation; it is an instructional performance. Key elements:

- **Before-start checklist:** Fuel quantity verified, fuel selector correct tank, mixture set, magnetos key check, primer in and locked, brakes set, area clear.
- **Engine start checklist:** Follow POH sequence exactly. Demonstrate and narrate each action: what you're doing, why you're doing it, what you're looking for.
- **After-start checklist:** Oil pressure green, ammeter positive, engine instruments in range, avionics power on, lights as required, transponder on standby.
- **Checklist not memorized:** Use the printed POH checklist — do not rely on memory alone for the engine start sequence, especially in training aircraft you fly infrequently.
- **Interrupted checklist protocol:** Any distraction (radio call, passenger, question) requires returning to the top of the current checklist phase after resolution.

CRITICAL ■ On the ACS practical test: AI.V.C.S2 requires simultaneous demonstration and explanation. The CFI applicant must narrate each checklist item in real time as if teaching a student pilot — not complete the checklist and then explain afterward.

K1: Various Conditions — Carb / FI / Cold / Hot / Flooded / Altitude	K2: External Power — Polarity / Voltage / Procedure	K3: Limitations — Starter / Oil Press / Fire	R1: Prop Safety R2: GPU Risk R3: Limits	S1: Positioning S2: Checklist

Lesson Objective

The student performs the full taxi sequence under CFI supervision: conducting the taxi brief in the cockpit, writing down and reading back the ATC clearance, drawing the route on the airport diagram, completing the before-taxi checklist, performing the brake check, and taxiing with a sterile cockpit while correctly identifying signs, markings, and lighting.

Lesson Emphasis

- ★ Taxi brief — performed in cockpit before calling ground
- ★ Write down the clearance — pen on paper, every time
- ★ Draw the route on the airport diagram before releasing brakes
- ★ Brake check — immediately after aircraft begins moving
- ★ Sterile cockpit — no non-essential tasks or conversation while rolling

Lesson References

- AC 91-73 | AIM Ch. 2 & 4-3 | FAA-H-8083-3 Ch. 2 | PHAK Ch. 14
- POH/AFM Section 4 — Before-Taxi Checklist
- Chart Supplement | KSDL Airport Diagram

Completion Standards

- Conducts taxi brief and reads back clearance without CFI prompting
- Draws and traces route on airport diagram before each taxi
- Performs brake check within first 10 feet of movement
- Maintains sterile cockpit; narrates taxiway names and hold-short points
- Identifies all signs and markings without prompting from CFI
- Stops completely and scans before crossing any runway

ACS Knowledge

Code	Element
AI.V.D.K1	Elements of safe taxi operations
AI.V.D.K2	Airport references: Chart Supplement, diagram, NOTAMs
AI.V.D.K3	Taxi instructions/clearances
AI.V.D.K4	Airport markings, signs, and lights
AI.V.D.K5	Visual indicators for wind
AI.V.D.K6	Aircraft lighting
AI.V.D.K7a	Pre-taxi flight deck activities (route planning, Hot Spots)
AI.V.D.K7b	Radio comms — towered & nontowered airports
AI.V.D.K7c	Entering or crossing runways
AI.V.D.K7d	Night taxi operations
AI.V.D.K7e	Low visibility taxi operations

ACS Risk Management

Code	Element
AI.V.D.R1	Activities and distractions
AI.V.D.R2	Confirmation/expectation bias re: taxi instructions
AI.V.D.R3	A taxi route or departure runway change
AI.V.D.R4	Runway incursion

ACS Skills

Code	Element
AI.V.D.S1	Receive and correctly read back clearances
AI.V.D.S2	Use airport diagram; maintain situational awareness
AI.V.D.S3	Position flight controls for existing wind
AI.V.D.S4	Complete the appropriate checklist(s)
AI.V.D.S5	Brake check immediately after aircraft begins moving
AI.V.D.S6	Maintain positive control — direction and speed
AI.V.D.S7	Comply with markings, signals, and ATC instructions
AI.V.D.S8	Position airplane properly relative to hold lines

PHASE 1 — IN THE COCKPIT: THE TAXI BRIEF (BEFORE CALLING GROUND)

Before the student touches the radio, the taxi brief happens in the cockpit with the engine running and parking brake set. This is not a ground school concept — it is a real-time, in-aircraft procedure performed every single flight. CFI demonstrates first, then student takes over.

THE TAXI BRIEF — BEFORE-TAXI FLOW (AI.V.D.K7a | AI.V.D.S1 | AI.V.D.S2)

STEP 1	STEP 2	STEP 3	STEP 4	STEP 5
GET ATIS	**REQUEST CLEARANCE**	**DRAW ROUTE**	**BRIEF COCKPIT**	**STERILE COCKPIT**
• Copy current ATIS on notepad • Note active runway, wx, winds • Note any NOTAMs or closures • Write ATIS letter for readback	• Call ground with ATIS letter • State position & intentions • WRITE DOWN every instruction • Read back the full clearance	• Open airport diagram (EFB/paper) • Trace assigned taxiway route in pen • Circle hold-short points in red • Mark Hot Spots on diagram	• Review route aloud with student • Identify each turn/crossing point • Confirm active runway & hold lines • Silence / set phones per SOP	• Non-essential talk STOPS • No head-down tasks during taxi • Pilot monitors — student narrates • All deviations challenge-response

Writing Down the Clearance — In the Cockpit (AI.V.D.K3 | S1)

The student holds a pen and notepad on their kneeboard before calling ground. When the clearance comes, they write it down in real time — every element. Then they read it back. CFI monitors the readback for accuracy and corrects omissions immediately.

- **What to capture:** Assigned taxiways in order (e.g., “Alpha, Bravo”), hold-short runway, any crossing authorizations, ATIS letter confirmed
- **Shorthand system:** Teach a consistent notation — e.g. “A→B, h/s 03” = taxi Alpha then Bravo, hold short of Runway 03. Student should develop their own consistent system
- **Complete readback:** Student reads back full route AND hold-short point. If ATC corrects them, student writes the correction before releasing brakes
- **Never assume:** If clearance was not heard clearly, student calls: “Scottsdale Ground, N12345, say again taxi instructions”

KEY RULE ■ CFI script: “Every clearance gets written down. If you can’t write it fast enough, say ‘standby’ to ATC before you forget it. A radio call is free.”

Drawing the Route on the Airport Diagram (AI.V.D.S2)

Immediately after writing down the clearance, the student opens the airport diagram on their EFB or kneeboard card. They trace the assigned route with their finger, speaking each taxiway name aloud as they do it. CFI watches to confirm the route matches the clearance.

- **Find current position first:** “We are here — at the ramp on Alpha.” Student points to their parking spot on the diagram
- **Trace the route:** “Alpha north, right turn on Bravo, hold short of Runway 21.” Student moves their finger along each leg as they say it
- **Circle the hold-short point:** Student marks or circles the hold line on the diagram in pen before releasing brakes. Make this a non-negotiable habit
- **Hot Spots:** If KSDL or current airport has published Hot Spots, student identifies them on the diagram and notes the associated caution (e.g., HS 1 = low-visibility risk at Alpha/Bravo)

CRITICAL ■ STERILE COCKPIT — begins now: Once the route is drawn and briefed, non-essential conversation and all head-down tasks stop. Student looks outside. CFI monitors. Student narrates each taxiway and upcoming turn as they approach it.

PHASE 2 — ROLLING: BRAKE CHECK, CHECKLIST & TAXI TECHNIQUE

Before-Taxi Checklist — Then Release Brakes (AI.V.D.S4)

After the taxi brief and before calling ground, the student completes the before-taxi checklist per the POH. This ensures flight controls are free and correct, transponder is set, lights are on, and all instruments are within normal range.

- **Typical Cessna 172 before-taxi items:** Flight controls — free & correct, instruments checked, transponder ALT, lights as required, primer locked, parking brake set, mixture as required for altitude
- **CFI prompt:** "Run your before-taxi checklist before we call ground." Student calls each item aloud. CFI does not read the list for them

Brake Check — First 10 Feet (AI.V.D.S5)

This is non-negotiable. The ACS requires it immediately after the aircraft begins moving. CFI demonstrates on the first flight; student performs it on every subsequent taxi.

- **Sequence:** Release parking brake → add power to break inertia → as soon as the aircraft is rolling, apply both toe brakes firmly → confirm the aircraft decelerates promptly
- **Both sides equal:** Asymmetric braking = hydraulic issue. Stop immediately if one side is weak, soft, or delayed. Do not continue to the runup area
- **CFI call-out:** During demo, say aloud: "Aircraft is rolling — brake check now — firm and equal — brake check complete." Student repeats this call-out on their turns

> ***Instructor Note:*** *If a student forgets the brake check, let them taxi a short distance, then ask: "Did you do your brake check?" Stop. Return to initial roll point. Do it again. Repetition with consequences builds the habit more than verbal reminders alone.*

Flight Controls for Wind — Set Before Rolling (AI.V.D.S3)

Wind check happens during the taxi brief. Student looks at the windsock or ATIS wind before releasing brakes, sets the appropriate aileron deflection, and maintains it throughout the taxi.

- **Headwind component:** Turn yoke INTO the wind. Upwind aileron goes UP. This prevents the upwind wing from being lifted by gusts
- **Tailwind component:** Yoke AWAY from wind (downwind aileron UP), push forward on elevator to protect stabilator from gusts from behind
- **Pure crosswind:** Turn yoke toward wind. If wind shifts, adjust controls
- **Student call-out:** "Wind is from the right at 15 knots — right aileron up, elevator neutral." Say it aloud before releasing brakes

Taxi Speed & Directional Control (AI.V.D.S6)

- **Target speed:** Slow walk — fast enough to be deliberate, slow enough to stop before any intersection or runway hold line
- **Throttle for speed:** Use throttle to maintain taxi speed, not continuous braking. Riding the brakes causes heat buildup and uneven wear
- **Centerline tracking:** Keep nosewheel on the yellow centerline. Wide taxiways can tempt shortcuts — stay on the line
- **Turns:** Slow down before turning. Track the centerline through the turn, not the inside edge of the taxiway

KEY RULE ■ Common student error: taxiing too fast then braking hard before each stop. Correct it early: "Slow down with throttle before you need the brakes."

PHASE 3 — EN ROUTE TAXI: SIGNS, MARKINGS & HOLD LINES

AIRPORT SIGN CATEGORIES — RECOGNITION AT A GLANCE (AI.V.D.K4)

MANDATORY INSTRUCTION	RWY DISTANCE REMAINING	LOCATION SIGNS	DIRECTION SIGNS	DESTINATION SIGNS	INFORMATION SIGNS
26-36 RWY	3	B	A→ ←C	TERM→	121.9 GND
• Red bg / white text • Runway designators • Hold position & ILS critical • NEVER cross w/o clearance • Boundary markers	• Black bg / yellow text • Thousands of feet left • Along runway edge • Counts down to rollout • Go-around decision aid	• Black bg / yellow text • Taxiway you are ON • Non-directional, fixed • Current position ID • Paired with direction sign	• Yellow bg / black text • Intersecting taxiways ahead • Arrows show turn direction • Read before intersection • Plan turn early	• Yellow bg / black text • Runway, FBO, gate direction • Helps with complex routing • Use with airport diagram • Orient before departure	• White bg / black text • Noise abatement, freq info • Airport-specific rules • Review Chart Supplement • Not at every airport

Reading Signs in Real Time (AI.V.D.K4)

- **Mandatory signs (red/white):** Student calls out every red sign before reaching it: “Runway 21-03 hold short sign ahead.” Stop. Look both ways. Confirm clearance
- **Location signs (black/yellow):** Student reads aloud as they pass: “We’re on Bravo.” Builds continuous position awareness
- **Direction signs (yellow/black):** Student reads ahead of intersections: “Alpha is to the left, Charlie to the right.” Pre-plans the turn
- **Hold-short lines:** Two solid + two dashed yellow lines. Stop on the solid side. Student calls: “Hold-short line in sight. Stopping.”

> ***Instructor Note:*** *CFI technique: point to signs slightly before the student reaches them: “What’s that sign?” Student answers before passing it. If they can’t answer, stop. Review. Continue.*

Runway Crossing Procedure (AI.V.D.K7c | S7 | S8)

- **Student calls out:** “Approaching Runway 21 hold-short line.” Slow down, prepare to stop regardless of clearance
- **Complete stop at the line:** Stop before the solid lines. Look LEFT, look RIGHT, look LEFT again. No exceptions, even with a crossing clearance
- **Confirm clearance aloud:** Student says “Cleared to cross Runway 21” before crossing. CFI confirms. Then cross — expeditiously
- **Position relative to hold line (S8):** Nose wheel stops short of the solid lines. No part of the aircraft over the hold-short marking when waiting
- **After crossing:** Student announces: “Clear of Runway 21.” Good habit that confirms the crew is aware they have exited

CRITICAL ■ NEVER cross a runway without a full stop and visual scan — even with ATC clearance. Tower can make mistakes. A landing aircraft cannot stop for you. Look every time.

IN FLIGHT — SITUATIONAL AWARENESS & REAL-TIME DECISION MAKING

Maintaining Position Awareness While Taxiing (AI.V.D.S2)

Once rolling, the student continuously cross-checks their position on the airport diagram against the signs and markings they can see out the window. This is an active skill — not a one-time check before departure.

- **Narrate continuously:** "We're on Alpha heading north, approaching the Bravo intersection." Narration keeps both crew members oriented and flags errors before they become deviations
- **Cross-check the diagram:** Quick glance at EFB/kneeboard card at each taxiway intersection — confirm the turn matches the clearance before turning
- **Orient to runway layout:** Student keeps active runway in mind at all times. "Runway 03 is to our left. Runway 21 threshold is behind us."
- **Unexpected clearance change:** If ATC issues an amended clearance, student calls "Standby", writes it down, updates the diagram, then reads back. Never accept a change from memory alone

KEY RULE ■ Position awareness is NOT just knowing where you are now — it is knowing where you are going next and what you will cross to get there. Anticipate, don't react.

Night & Low Visibility Taxi Operations (AI.V.D.K7d | K7e)

The same procedures apply at night and in low visibility, with heightened attention to lighting cues. Students must understand what the lights mean and use them proactively.

- **Taxiway edge lights (blue):** Mark the edges of the taxiway. Stay between them. If the student can only see one side, they are drifting toward the other edge
- **Taxiway centerline lights (green):** Follow the green line. Alternating green/yellow centerline = approaching a runway hold-short area — prepare to stop
- **Runway edge lights (white/yellow):** White along most of the runway; yellow in the last 2,000 ft. At night, this color shift is a go-around cue if unexpectedly seen during landing rollout
- **Stop bars (red):** Illuminated red lights at hold-short lines — do not cross until ATC confirms they are extinguished. A lit stop bar is a hard stop, regardless of any prior clearance
- **Rotating beacon:** Green/white rotating = airport open. Operating beacon during daylight = IMC conditions or below VFR minimums — check weather before departing

Instructor Note: *At night, slow down even more. External cues are harder to read. Tell students: "If you're not sure where you are, stop. Call ground. There is no penalty for asking."*

COMMON STUDENT ERRORS — WHAT TO WATCH FOR & HOW TO CORRECT

Error	What It Looks Like	CFI Correction
Skips taxi brief	Student goes straight to radio without briefing route or drawing diagram	Stop before calling ground. "Brief me on our taxi route first." Require brief before every call.
Does not write down clearance	Student listens, reads back from memory, misses hold-short point	"Stop. Write it down. Call ground back and confirm the hold-short." Make pen on kneeboard the rule.
Skips brake check	Aircraft starts rolling, student goes straight to turning without testing brakes	Let them roll 10 feet. "Did you check your brakes?" Go back. Start over. Do it right.
Talks during sterile cockpit	Student asks non-essential questions or tries to set avionics while rolling	"We're in the sterile cockpit now — hold that thought until we're clear of the runway."
Blows through hold-short line	Student approaches the runway hold line without slowing or announcing it	Take controls: "Stop." Point to the lines. Explain. Let student taxi back and approach again correctly.

Wrong taxi route	Student takes wrong taxiway — expectation bias from a familiar route	“Stop the aircraft. Where are we on the diagram?” Reorient together. Call ground if needed.
No runway scan before crossing	Student crosses runway without looking both directions	Take controls immediately. Stop. “We look both ways before every crossing — every time.”
Taxi too fast	Student taxis at jogging pace, cannot stop smoothly before intersections	“Slow it down — you want to be able to stop for anything that surprises you.”

POST-FLIGHT DEBRIEF CHECKLIST

Did the student…

- ■ Conduct the taxi brief before calling ground?
- ■ Write down the full clearance?
- ■ Read back clearance including hold-short point?
- ■ Draw and trace the route on the airport diagram?
- ■ Circle the hold-short point(s) on the diagram?
- ■ Complete the before-taxi checklist?
- ■ Perform the brake check within first 10 feet?
- ■ Set flight controls for wind before rolling?
- ■ Maintain sterile cockpit throughout taxi?
- ■ Narrate taxiway names and turns aloud?
- ■ Stop completely before every runway crossing?
- ■ Scan both directions before crossing runway?
- ■ Identify mandatory signs without prompting?
- ■ Stop and hold short of runway on correct side of lines?

Next Lesson / Follow-On Tasks

- If taxi brief not yet automatic: repeat as the first task next flight before any other lesson element
- If route-drawing is shaky: have student pre-draw tonight’s planned taxi route from home using ForeFlight/Garmin Pilot
- If brake check was missed: add it to the student’s personal pre-taxi flow card
- If sterile cockpit was broken: debrief the distraction. Ask: “What were you trying to do, and when should you have done it?”
- If signs were unrecognized: assign PHAK Ch. 14 and AIM Ch. 2 airport sign section for next ground review

KEY RULE ■ Every taxi lesson is also a runway incursion prevention lesson. The habits built here — the brief, the diagram, the brake check, the scan — are the same ones that keep pilots safe at O’Hare and Midway decades from now.

Area V, Task F — Before Takeoff Check

FAA-S-ACS-25 | AI.V.F | CFI Airplane — Flight Lesson

Objective

The applicant demonstrates instructional knowledge of the before takeoff check — explaining the purpose of every checklist item, how to detect malfunctions, and how to ensure the aircraft is in safe operating condition as recommended by the manufacturer — and can manage associated risks and provide effective instruction.

References

- FAA-H-8083-3B (AFH) — Chapter 2
- FAA-H-8083-25C (PHAK) — Chapter 9
- FAA-H-8083-9B (Aviation Instructor's Handbook) — Chapter 9
- Cirrus SR20 POH — Section 4 (Normal Procedures)
- FAA-H-8083-2 (Pilot's Handbook of Aeronautical Knowledge)

Delivery Format

- Flight lesson — cockpit / run-up area — 20–30 min
- Student reads each SR20 checklist item aloud, performs action, verifies result
- Instructor observes, questions, and annotates; never performs items for student
- SR20 POH Section 4 open to Before Takeoff checklist during lesson

ACS Knowledge Elements

Code	Element
AI.V.F.K1	Purpose of before takeoff checklist items, including:
AI.V.F.K1a	a. Reasons for checking each item
AI.V.F.K1b	b. Detecting malfunctions
AI.V.F.K1c	c. Ensuring aircraft is in safe operating condition per manufacturer

ACS Risk Management

Code	Element
AI.V.F.R1	Division of attention while conducting before takeoff checks
AI.V.F.R2	Unexpected runway changes by ATC
AI.V.F.R3	Wake turbulence
AI.V.F.R4	Potential powerplant failure during takeoff or other malfunction

ACS Skills

Code	Element
AI.V.F.S1	Review takeoff performance
AI.V.F.S2	Complete the appropriate checklist(s)
AI.V.F.S3	Position airplane appropriately considering wind and traffic
AI.V.F.S4	Divide attention inside and outside the flight deck
AI.V.F.S5	Verify engine parameters and airplane configuration are suitable

MOTIVATION — WHY THIS IS THE LAST LINE OF DEFENSE

The before takeoff check is the final systematic inspection of the aircraft before the pilot commits to takeoff — the most unforgiving phase of flight. Once the throttle is fully advanced and the aircraft accelerates down the runway, there is no longer the luxury of time to discover that a magneto is dead, the carburetor heat is inoperative, the trim is set for landing, or that the flight controls are restricted. The before takeoff check exists precisely because aircraft have launched with these exact deficiencies and the results have been fatal.

NTSB accident data contains dozens of cases where mechanical malfunctions that would have been immediately detected during a proper run-up were discovered instead at 200 feet AGL with no runway remaining. The before takeoff check is not a formality. It is the last, best opportunity to catch a problem while the airplane is still on the ground and all options remain available. The CFI's responsibility is to instill in every student a deep and unshakeable respect for this checklist — read every item, perform every action, verify every result. No schedule, no external pressure, no perceived urgency justifies rushing or skipping any item.

■ **NO RUSHING** ■ This is a NON-NEGOTIABLE teaching standard: the student reads every item from the printed checklist and performs it before moving on. If anyone creates time pressure, teach the student to say: 'N12345 needs a moment.' The checklist does not get rushed. Ever.

1. Purpose of Checklist Items — Read & Do Method (AI.V.F.K1a)

A WHAT TO TEACH

The Read & Do Discipline

Every checklist must be used in Read & Do fashion: the student reads the item aloud, performs the action, and verifies the result before moving to the next item. Teach this from the very first lesson and enforce it on every subsequent flight. The alternative — doing from memory and then using the checklist to confirm — is not acceptable for the before takeoff check. Memory-only runs miss items, especially under distraction.

KEY RULE ■ The checklist is not a reminder of what you already did. It is the authority that tells you what to do next. Read it first. Then do it. Then verify it.

Positioning for the Run-Up (AI.V.F.S3)

- Taxi to the designated run-up area — never conduct a run-up on the active runway
- Position the aircraft into the wind when possible to maximize engine cooling
- Check for aircraft behind you — prop blast can damage other aircraft
- Set the parking brake firmly before advancing throttle
- Confirm the area is clear in all directions before increasing RPM

Flow + Checklist: The Correct Sequence

Some operators use a Flow (a memory-order scan of the cockpit) followed by the checklist as a verification tool. If your operation uses flows, teach the student both the flow and the checklist — but make clear that the **checklist is the authority**. The flow prevents spending excessive time heads-down; the checklist catches anything the flow missed.

Phase	Purpose
Flow (if used)	Efficient cockpit scan from a memorized sequence — sets up the aircraft quickly
Checklist (always)	Authoritative verification — catches flow errors and omissions
Takeoff Briefing	Confirms abort criteria, engine failure plan, and departure procedure

Instructor Note: *Instructor: Before the student begins the checklist, ask: 'What is your abort speed? What do you do if the engine quits on the runway? What if it quits at 300 feet?' These answers must exist BEFORE the throttle advances. The takeoff briefing is a required part of the before takeoff check — not an optional add-on.*

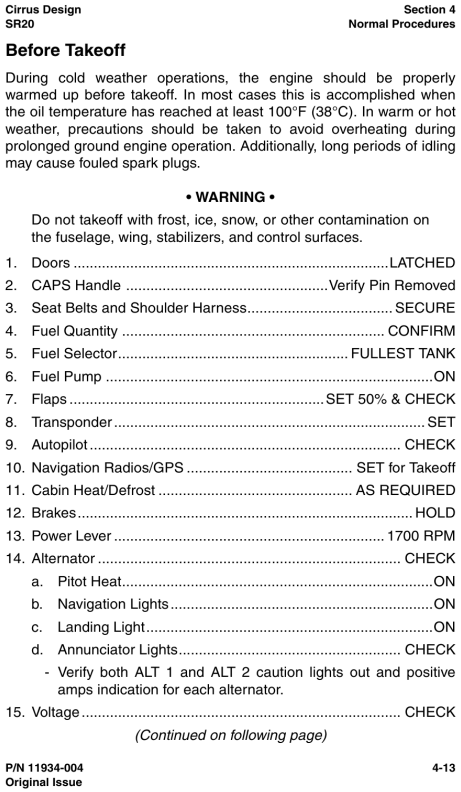
Takeoff Performance Review (AI.V.F.S1)

Before advancing to the runway, the student must confirm the aircraft can safely complete the departure. This is part of the before takeoff check, not a separate event.

Check Item	Verify Against
Density altitude	OAT + pressure altitude — E6B or POH DA table
Takeoff ground roll	POH Section 5 chart for current DA and weight
50-ft obstacle distance	Compare to available runway length — require margin
Abort speed / landmark	State before every takeoff — 'If not at Vr by midfield, abort'

SR20 BEFORE TAKEOFF CHECKLIST — ITEMS 1–15 (AI.V.F.K1A, K1B, K1C)

A WHAT TO TEACH — USE THE ACTUAL SR20 POH CHECKLIST



Cirrus Design
SR20

Section 4
Normal Procedures

Before Takeoff

During cold weather operations, the engine should be properly warmed up before takeoff. In most cases this is accomplished when the oil temperature has reached at least 100°F (38°C). In warm or hot weather, precautions should be taken to avoid overheating during prolonged ground engine operation. Additionally, long periods of idling may cause fouled spark plugs.

• WARNING •

Do not takeoff with frost, ice, snow, or other contamination on the fuselage, wing, stabilizers, and control surfaces.

1. Doors ..... LATCHED
2. CAPS Handle ..... Verify Pin Removed
3. Seat Belts and Shoulder Harness ..... SECURE
4. Fuel Quantity ..... CONFIRM
5. Fuel Selector ..... FULLEST TANK
6. Fuel Pump ..... ON
7. Flaps ..... SET 50% & CHECK
8. Transponder ..... SET
9. Autopilot ..... CHECK
10. Navigation Radios/GPS ..... SET for Takeoff
11. Cabin Heat/Defrost ..... AS REQUIRED
12. Brakes ..... HOLD
13. Power Lever ..... 1700 RPM
14. Alternator ..... CHECK
    a. Pitot Heat ..... ON
    b. Navigation Lights ..... ON
    c. Landing Light ..... ON
    d. Annunciator Lights ..... CHECK
    - Verify both ALT 1 and ALT 2 caution lights out and positive amps indication for each alternator.
15. Voltage ..... CHECK

(Continued on following page)

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Instructor Annotations — Items 1–15

1. Doors — LATCHED

Physical push-out test on each door. An unlatched door post-rotation is disorienting and can affect control authority.

2. CAPS Handle — Verify Pin Removed

Cirrus-specific: the CAPS safety pin prevents accidental parachute deployment during maintenance/storage. Must be removed before flight — green handle must be visible. If the pin is in, the CAPS cannot deploy in an emergency.

3. Seat Belts — SECURE

Belt and shoulder harness — tug to confirm. A loose harness is a secondary injury cause in any sudden stop.

4–5. Fuel Quantity / Fuel Selector

Cross-check gauges against dipstick reading from preflight. Fuel selector on FULLEST TANK — verify by touch AND sight. Wrong selector = fuel starvation on climbout.

6. Fuel Pump — ON

Boost pump on for takeoff. Provides backup fuel pressure during the highest-risk phase of flight.

7. Flaps — SET 50% & CHECK

SR20 normal T/O uses 50% flaps. Verify flap indicator AND check the wing. Confirm it matches the POH — the wrong flap setting means the wrong performance chart was used.

8–11. Transponder / Autopilot / Nav Radios / Cabin

Squawk code confirmed, mode to ALT. Autopilot checked for fault flags. Departure frequency and GPS route loaded. Cabin heat/defrost set before takeoff — not after.

12. Brakes — HOLD

Firm application before advancing power. Verify aircraft does not creep during run-up.

13. Power Lever — 1700 RPM

SR20 run-up power. Confirm on the tachometer — not by feel alone.

14. Alternator — CHECK

Load alternators by turning on pitot heat, nav lights, and landing light. Both ALT 1 and ALT 2 caution lights must be OUT with positive amps shown for each alternator.

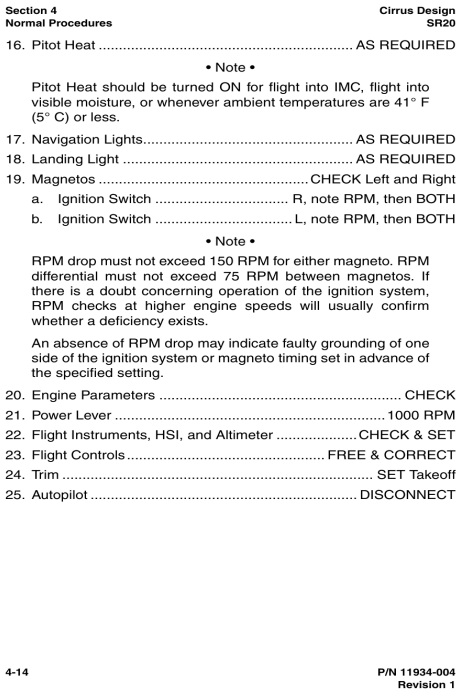
15. Voltage — CHECK

Confirm bus voltage in normal range. Low voltage now = a charging system problem that becomes an in-flight emergency.

> ***Instructor Note:*** *Instructor: Have the student verbalize WHY each item is checked — no silent checkbox-ticking. After this page ask: 'What happens if the CAPS pin stays in?' and 'Why 50% flaps not 0%?' Understanding the purpose is what separates a competent pilot from a button-pusher.*

SR20 BEFORE TAKEOFF CHECKLIST — ITEMS 16–25 (AI.V.F.K1B, K1C) — RUN-UP ITEMS

B ENGINE RUN-UP — THE MOST DIAGNOSTIC ITEMS ON THE CHECKLIST



Section 4 — Normal Procedures — Cirrus Design SR20

16. Pitot Heat ..... AS REQUIRED

• Note •

Pitot Heat should be turned ON for flight into IMC, flight into visible moisture, or whenever ambient temperatures are 41° F (5° C) or less.

17. Navigation Lights..... AS REQUIRED
18. Landing Light ..... AS REQUIRED
19. Magnetos ..... CHECK Left and Right
    a. Ignition Switch ..... R, note RPM, then BOTH
    b. Ignition Switch ..... L, note RPM, then BOTH

• Note •

RPM drop must not exceed 150 RPM for either magneto. RPM differential must not exceed 75 RPM between magnetos. If there is a doubt concerning operation of the ignition system, RPM checks at higher engine speeds will usually confirm whether a deficiency exists.

An absence of RPM drop may indicate faulty grounding of one side of the ignition system or magneto timing set in advance of the specified setting.

20. Engine Parameters ..... CHECK
21. Power Lever ..... 1000 RPM
22. Flight Instruments, HSI, and Altimeter ..... CHECK & SET
23. Flight Controls..... FREE & CORRECT
24. Trim ..... SET Takeoff
25. Autopilot ..... DISCONNECT

4-14 — P/N 11934-004 Revision 1

Instructor Annotations — Items 16–25

16–18. Pitot Heat / Nav Lights / Landing Light — AS REQUIRED

Verified ON during item 14. Now set for actual flight requirements. Pitot heat ON any time IMC or OAT at or below 41°F (5°C).

19. Magnetos — CHECK Left and Right

SR20 limits: max 150 RPM drop per mag; max 75 RPM differential. Switch R → read RPM → BOTH. Switch L → read RPM → BOTH. Student must state exact values. A 0 RPM drop = mag stuck HOT — do not depart.

20. Engine Parameters — CHECK

All gauges in green: oil pressure, oil temp, EGT, CHT. SR20 MFD engine page shows all parameters simultaneously — scan the full display.

21. Power Lever — 1000 RPM

Return to idle. Engine must sustain idle without stumbling. Rough or unstable idle = do not depart.

22. Flight Instruments, HSI, Altimeter — CHECK & SET

AI erect. HSI aligned to compass. Altimeter set to current ATIS/ASOS — verify reads field elevation ±75 ft.

23. Flight Controls — FREE & CORRECT

Full travel all axes. Verify CORRECT deflection: stick right = right aileron up. Crossed controls have caused fatal accidents. Not a formality.

24. Trim — SET Takeoff

SR20 trim to takeoff index on trim wheel. Verify visually AND by feel. Trim set for landing causes uncommanded pitch-up at rotation — potentially unrecoverable.

25. Autopilot — DISCONNECT

Manually disconnect before entering runway. AP engaged at takeoff fights rotation inputs.

CRITICAL ■ Items 19 and 23 are the two most safety-critical items in the run-up. A failed magneto check or restricted flight control that goes undetected will manifest at the worst possible moment — during or immediately after takeoff. Teach the student: there is no acceptable reason to skip or rush these two items.

Instructor Note: *Instructor: During the magneto check, watch for students who switch positions too quickly. Each position must be held 2–3 seconds while the student reads and calls the actual RPM value: 'Right mag, 90 RPM drop — within the 150 RPM SR20 limit.' Vague responses like 'looks good' or 'mags check' are not acceptable. If the drop is outside limits, the airplane does not fly today.*

2. Detecting Malfunctions During the Run-Up (AI.V.F.K1b)

B HOW TO IDENTIFY PROBLEMS BEFORE THEY HAPPEN IN FLIGHT

SR20 Magneto Check — What Each Indication Means

Indication at Run-Up	What It Means	Action
Drop > 150 RPM on one mag	Fouled plug, cracked distributor, point gap issue, or grounding fault on that magneto	Do NOT depart. Taxi back for maintenance.
> 75 RPM differential between mags	Asymmetric combustion — one ignition system significantly weaker than the other	Do NOT depart. Both mags must be within 75 RPM of each other.
No drop on one mag (0 RPM)	Mag NOT grounding off — may be stuck HOT. Engine will not shut down normally with key.	Do NOT depart. Maintenance required immediately.
Rough running on BOTH	Possibly fouled plugs — lean briefly to burn off lead deposits, recheck at higher RPM	If roughness persists: do NOT depart.
Engine quits or stumbles at idle	Idle mixture, carburetor issue, or fuel system fault	Troubleshoot per POH. Do NOT depart.

CRITICAL ■ SR20-specific limits: **150 RPM max drop** per magneto, **75 RPM max differential.** These differ from other aircraft — always verify against the POH for the specific aircraft. Students must state exact numbers, not 'mags look good.'

Other Go / No-Go Malfunction Indicators

Instrument	Abnormal Finding	Do Not Depart If…
Oil Pressure	Below green arc at run-up RPM	Not in green by run-up RPM
Oil Temperature	In red or not yet reached green	Engine not at operating temp
Voltage (Item 15)	Below normal range	Bus voltage out of limits
Alternator Annunciator	ALT 1 or ALT 2 caution light ON	Either alternator showing fault
Flight Controls	Any restriction or wrong deflection	Any abnormality whatsoever
Trim Indicator	Not at takeoff index	Any setting other than specified

Instructor Note: *Instructor: After the run-up, ask the student to state the SR20 magneto RPM limits from memory — then have them identify what the actual drop was and confirm it was within limits. Then ask: 'What would you do if the right mag dropped 180 RPM?' Make the go/no-go decision real, not hypothetical.*

K1c — POH / AFM Is the Only Authority

Every item on the before takeoff check is there because the manufacturer tested, certified, and approved it as necessary for airworthy operation. The POH is not a suggestion. A student who skips items because 'the airplane was fine yesterday' is developing a habit pattern that will eventually produce an accident.

"Would a surgeon skip checklist steps because 'the last hundred surgeries went fine'? The answer — and the consequences — are identical in aviation."

SECTION 3 — RISK MANAGEMENT (AI.V.F.R1–R4)

R1 — Division of Attention During the Check

The before takeoff check requires the student to divide attention between cockpit items and the external environment simultaneously. Aircraft may be taxiing nearby, instructions may be issued over the radio, and the student is heads-down in a checklist. This is a high-risk moment for reduced situational awareness.

Risk Factor	Mitigation
Student fixates on checklist, misses taxiing aircraft	Teach scan discipline: complete a group of items, look up and outside, resume. Never heads-down more than 5–10 sec.
Radio call during run-up	Acknowledge with 'standby,' complete current item, then respond. An incomplete checklist will not wait.
Other aircraft approaching run-up area	Look up before each major section. Parking brake is set but proximity awareness remains the pilot's responsibility.

■ **NO RUSHING** ■ PRESSURE is the #1 cause of rushed before takeoff checks. Teach the student this phrase now: 'N12345, we need a few minutes at the run-up area.' No controller, no passenger, no schedule has ever been worth a missed checklist item. Accidents happen when pilots rush.

R2 — Unexpected Runway Changes by ATC

ATC may assign a different runway after the before takeoff check is partially or fully complete. This requires the student to re-evaluate several checklist items and re-brief the departure.

What Changes	Action Required
Runway length	Re-check takeoff performance — new runway may be significantly shorter
Wind component	Recalculate headwind/crosswind component from new runway heading
Traffic pattern direction	Re-brief departure, pattern, and engine failure abort plan
Departure frequency	Update avionics before taxi — not while rolling
Obstacle considerations	Review new departure path for terrain and obstacles

Instructor Note: *Instructor: After the student completes the run-up, say: 'ATC just changed us to Runway 30 — 2,000 ft shorter, 15-kt tailwind.' Watch the response. Many students will acknowledge and taxi without re-evaluating anything. Stop: 'What five things need to change before we can proceed?' Make re-evaluation a rehearsed habit.*

R3 — Wake Turbulence

Before takeoff is the correct time to identify and plan for wake turbulence. Once airborne, options are limited. Mitigation must start on the ground.

Situation	Risk	Action
Heavy aircraft just departed	Vortices descend and drift laterally	Wait 2 min minimum. Rotate before the heavy aircraft's rotation point.
Heavy aircraft just landed	Vortices settle near touchdown zone, persist 1–3+ min	Land beyond the touchdown point or wait for dissipation.
Light / calm wind	Vortices do not dissipate quickly or drift predictably	Maximum caution — extend wait time. Do not rush for runway.
Crosswind	Upwind vortex may stay on or near the runway	Extra caution — crosswind does not guarantee runway is clear.

R4 — Powerplant Failure During or After Takeoff

The before takeoff check is the last opportunity to catch engine issues before they manifest as failures during the most critical phase of flight.

Failure Scenario	Run-Up Item That Would Have Caught It
Engine failure on the runway	Idle check (item 21) — engine stumbling at idle signals this risk
Magneto failure at rotation	Magneto check (item 19) — failing mag exceeds 150 RPM drop limit
Vacuum-driven instrument failure on departure	Voltage/alternator check (items 15, 14) — bus voltage anomaly is the warning
Loss of directional control on roll	Flight controls (item 23) — restriction or wrong deflection not found at run-up
Autopilot fighting controls at rotation	Autopilot disconnect (item 25) — not disconnected = fights rotation input

CRITICAL ■ The abort briefing is MANDATORY before every departure: 'If we have any malfunction before [abort speed / midpoint landmark], throttle to idle, max braking, remain on runway.' If the student cannot state the abort plan, the aircraft does not move.

SECTION 4 — SKILLS DEMONSTRATION & COMMON ERRORS (AI.V.F.S1–S5)

Skills Assessment Checklist

#	Skill Element	Method
S1	Reviews takeoff performance — states DA, T/O roll, available runway, margin	Oral + calculation before run-up begins
S2	Completes SR20 checklist using Read & Do — no items skipped or reordered	Instructor observes each item; student reads aloud
S3	Positions airplane into wind, clear of other traffic; pre-run-up area scan	Observed during taxi to run-up area
S4	Divides attention: item groups, then scans outside between sections	Instructor times heads-down intervals — target ≤10 sec
S5	States specific run-up values: mag drops within SR20 limits, instruments green	Student verbalizes exact RPM values — not vague assessments

Completion Standards

- Student uses the SR20 POH checklist — not memory — for every before takeoff check
- Student can explain the purpose and go/no-go criteria for every checklist item
- Student states the abort plan before advancing throttle for departure — every flight
- Student does not skip, reorder, or rush any item regardless of any external pressure
- Any abnormal finding is correctly identified and reported — no departure attempted

Common Errors to Identify and Correct

Common Error	How It Manifests	Correction
Running the checklist from memory	Student recites items without referencing the printed SR20 checklist; goes out of order	Stop immediately. 'We use the POH checklist every time. Find item 1 and start over.'
Rushing under external pressure	Student hears other aircraft calling ready and accelerates through remaining items	Stop. 'N12345 needs a few minutes.' Pressure does not justify an incomplete checklist.
Vague magneto check reporting	'Mags good' — no RPM values stated; student unaware of actual drop	Require specifics: 'Right mag, 110 RPM drop, within 150 RPM SR20 limit.' Vague = not checked.
Skipping takeoff performance review	Student starts run-up without computing density altitude or takeoff roll	Before any checklist begins: 'State your density altitude and takeoff distance for today.'
CAPS pin not verbalized	Student touches item 2 and moves on without explaining CAPS function or pin verification	Stop: 'What happens if we depart with the CAPS pin installed? Show me how you verify it's removed.'
Flight control check is perfunctory	Student moves controls slightly without verifying correct deflection or full travel	Demonstrate: full travel on each axis, visual check of correct deflection direction at each surface.
No abort plan briefed	Student calls ready for departure with no stated abort criteria or engine failure plan	'Before we move — what is your abort speed? What if the engine quits at 200 feet?'

SECTION 5 — REVIEW QUESTIONS & INSTRUCTOR ENFORCEMENT NOTES

Review Questions

Q1: What are the SR20 magneto check limits, and what does it mean if one magneto shows a 0 RPM drop?

A: SR20 limits: max 150 RPM drop on either magneto; max 75 RPM differential. A 0 RPM drop means the magneto is not grounding off — it is stuck 'hot.' The engine cannot be shut down normally and this is a serious maintenance hazard. Do not depart.

Q2: You are at the run-up area and feel pressure to hurry. What do you do?

A: Continue the checklist at the correct pace. If on the radio: 'N12345, we need a few minutes.' Pressure — from ATC, passengers, schedule, or other traffic — does not change the standard. No clearance has ever been worth a missed checklist item.

Q3: What is the purpose of item 2 (CAPS Handle — Verify Pin Removed)?

A: The CAPS safety pin is installed during maintenance and storage to prevent accidental parachute deployment. If not removed before flight, the CAPS system cannot deploy in an emergency. The green handle must be visible and the pin absent. This is unique to the SR20/SR22 fleet and must be taught to every Cirrus student.

Q4: ATC changes your runway after the run-up is complete. What re-evaluation steps are required?

A: Re-check takeoff performance for the new runway length, recalculate the wind component, re-brief the abort criteria and engine failure plan for the new departure path, update avionics frequencies and GPS routing if applicable, and review new obstacle considerations. Do not taxi until all re-evaluations are complete.

Instructor Enforcement — Non-Negotiable Standards

Instructor Note: *FIRST LESSON STANDARD: From the very first time a student touches the before takeoff checklist, establish the rule: 'In this airplane, we read every item from the POH, perform it, and verify it before moving on. No exceptions. No shortcuts. No rushing.' Set the standard once and enforce it on every subsequent flight without exception.*

Instructor Note: *TEACHING THE MAGNETO CHECK: Brief the dual-magneto system first — each magneto fires one set of plugs; the check on one mag verifies that system works independently. A dead magneto is completely hidden in BOTH position. That is exactly what the check reveals. Understanding the WHY makes every item mean something.*

Instructor Note: *ABORT PLAN STANDARD: Require students to verbalize the abort plan before every single departure — not just the first few. End every before takeoff check with: 'Abort speed — [Vr minus 10 kts]. Abort point — [midfield landmark]. Engine failure below 500 ft — straight ahead. Proceeding.' Fifteen seconds, every time.*

■ **NO RUSHING** ■ If the student rushes the checklist at any point — even on lesson fifteen — stop the lesson immediately. Do not allow the aircraft to move until the checklist is restarted from the beginning and completed at the correct pace. Rushing is never corrected by debrief alone. It must be stopped in the moment, every time.

Instructor Sign-Off	
Instructor:	_____ Date: _____
Student:	_____ Flight #: _____

Area VI, Task A — Communications, Light Signals & Runway Lighting Systems

FAA-S-ACS-25 | AI.VI.A | CFI Airplane — Flight Lesson

Objective: Student demonstrates correct radio technique, ATC communication, transponder operation, and awareness of runway lighting systems throughout the flight — from engine start to shutdown. CFI evaluates and corrects in real time.

K1 · Radio Frequencies	K2 · Phraseology	K3 · Light Signals	K4 · Transponder	K5 · Lost Comm	K6 · Equip Issues	K7 · Radar	K8 · Runway Status Lights (RWSL)

RADIO COMMUNICATIONS (K1 · K2)

Getting Set Up Before Engine Start (K1)

- Pull ATIS first — tune it, write down the info letter, note altimeter and active runway
- Pre-load ground and tower freqs in COM1/COM2 standby before you need them
- ForeFlight auto-fills freqs by position — confirm before you transmit
- Non-towered: identify CTAF on the sectional and self-announce early

Making the Call — Phraseology (K2)

- **Ground call:** 'Scottsdale Ground, Cirrus 5AB, south ramp, ready to taxi, information Kilo'
- **Tower call:** 'Scottsdale Tower, Cirrus 5AB, holding short 21R, ready for departure'
- **Inbound call:** 'Scottsdale Tower, Cirrus 5AB, 10 miles north, 3,500, inbound full stop'
- Always read back: runway, hold-short, altimeter, and squawk assignments — every time
- Say 'Niner' not 'Nine' — say 'thousand/hundred' for altitude
- Non-towered: announce position and intentions on each leg of the pattern

> ***Instructor Note:*** *If ATC reads back something different from what you expected — say something. 'Verify runway 21R' is always acceptable.*

When Something Goes Wrong with the Radio (K6)

- ATC says 'Someone's blocking the freq' — check your PTT, it may be stuck
- You transmit but get no reply — check volume, squelch, and that you're on the right freq
- Intermittent crackling — loose headset plug or intercom connector
- Total silence after electrical issue — check comm radio circuit breaker

TRANSPONDER, LOST COMM & RADAR (K4 · K5 · K7)

Transponder in the Cockpit (K4)

- During runup: enter squawk code, confirm **ALT** mode is selected before takeoff
- ATC: 'Squawk 4521' → dial in 4-5-2-1, read back 'Squawking 4521, Cirrus 5AB'
- 'Squawk IDENT' → press IDENT once, do not press again unless asked
- Squawk 1200 when VFR with no ATC service; switch back if flight following ends
- Never leave it in SBY airborne — ATC loses your secondary radar return

Radio Goes Quiet — Now What? (K5)

- First: check volume, squelch, freq, headset connections, circuit breaker
- Try guard (121.5 MHz) or FSS (122.2 MHz) — someone may hear you
- Squawk 7600 — ATC radar will see it and adjust spacing for you
- **VFR in the pattern:** stay VFR, enter a left-hand pattern, watch for light gun from tower
- Acknowledge light gun with: wings rock (day) or landing light flash (night)
- **IFR lost comm:** AVE F — fly the highest of Assigned / Vectored / Expected / Filed alt

Declaring an Emergency (R2)

- Low fuel, engine rough, passenger medical — declare early, sort it out later
- 'MAYDAY MAYDAY MAYDAY, Cirrus 5AB, [nature], [position], [souls on board]'
- Squawk 7700 — ATC will clear the airspace and give you priority

CRITICAL ■ Never hesitate to declare. 14 CFR 91.3 gives you full authority. No paperwork penalty for a good-faith emergency.

Radar / Flight Following (K7)

- Request flight following: 'Scottsdale Approach, Cirrus 5AB, request flight following to KPRC'
- Gives you traffic calls, terrain alerts, and a safety net — use it on every XC

ATC LIGHT GUN SIGNALS (K3) — PHAK FIG. 14-42 | USED WHEN RADIO FAILS NEAR A TOWERED AIRPORT

Color and Type of Signal	Movement of Vehicles, Equipment and Personnel	Aircraft on the Ground	Aircraft in Flight
Steady green	Cleared to cross, proceed or go	Cleared for takeoff	Cleared to land
Flashing green	Not applicable	Cleared for taxi	Return for landing (to be followed by steady green at the proper time)
Steady red	Stop	Stop	Give way to other aircraft and continue circling
Flashing red	Clear the taxiway/runway	Taxi clear of the runway in use	Airport unsafe, do not land
Flashing white	Return to starting point on airport	Return to starting point on airport	Not applicable
Alternating red and green	Exercise extreme caution!!!!	Exercise extreme caution!!!!	Exercise extreme caution!!!!

Figure 14-42. *Light gun signals.*

> ***Instructor Note:*** *Scenario: radio dies on downwind at a towered airport. Student should: squawk 7600, enter a normal left-hand pattern, watch the tower cab for a light gun, acknowledge with wings rock (day) or landing light flash (night), and land when given steady green. Tower retains authority.*

RUNWAY STATUS LIGHTING SYSTEMS (K8)

What the Student Will See on the Ramp & Runway

Runway Entrance Lights (REL)

- Red in-pavement lights at the hold-short line on your taxiway
- They're ON → runway is active or occupied → **stop, do not enter**
- They turn off when the runway is clear — but always confirm with ATC

Takeoff Hold Lights (THL)

- Red lights embedded in the runway centerline ahead of you at the departure end
- They illuminate → something is on or crossing your runway → **hold position**
- ATC clearance does NOT override red THL lights — stop and query ATC

Runway Intersection Lights (RIL)

- Red in-pavement lights at a runway-runway crossing
- Warn of traffic on the intersecting runway — treat like a red light

KEY RULE ■ Red Runway Status Lights (RWSL) = stop, regardless of what ATC said. Confirm before proceeding.

COMMON ERRORS & RISK MANAGEMENT (K9 · R1)

What to Watch for and Correct In Flight (K9)

- Student tunes wrong freq → transmits on tower when still with ground → correct immediately
- Steps on another transmission → no response → have student listen, then re-transmit
- Misses a readback → ATC repeats the instruction → debrief: always read back runway and hold-shorts
- Forgets to include aircraft ID on initial call → ATC says 'aircraft calling, say again with ID'
- Leaves transponder in SBY after liftoff → ask student when they last checked their squawk
- Presses IDENT without being asked → rare but happens on initial setup, debrief
- Forgets to get ATIS before calling ground → has to request altimeter from ATC mid-taxi

Risk Management in the Cockpit (R1)

- Head-down on the radio = eyes off the taxiway — make radio calls brief, look up
- Distraction during congested pattern comms → task-prioritize: aviate first, communicate second
- If you didn't understand ATC — say 'Say again' every time. Never guess and go.
- 'Unable' is always an option — if a clearance doesn't work, say so immediately

References

- AIM Chapter 4 — Air Traffic Control
- FAA-H-8083-25C (PHAK) — Chapter 14
- 14 CFR 91.183–91.185 — Lost Comm / Emergency
- 14 CFR 91.215 — Transponder requirements

Area VI, Task B — Traffic Patterns

FAA-S-ACS-25 | AI.VI.B | CFI Airplane — Flight Lesson

Objective: Student demonstrates the ability to fly a proper traffic pattern — maintaining pattern altitude (±100'), airspeed (±10 kts), wind correction, sequencing behind traffic, and correct entry/exit procedures at both towered and non-towered airports.

K1 · Towered/Non-Towered	K2 · Pattern Selection	K3 · Right-of-Way	K4 · ATIS/AWOS	K5 · Common Errors	R1 · Collision	R2 · Situational Awareness	R3 · Wake Turbulence

TRAFFIC PATTERN DIAGRAMS (PHAK FIG. 14-39 & 14-40)

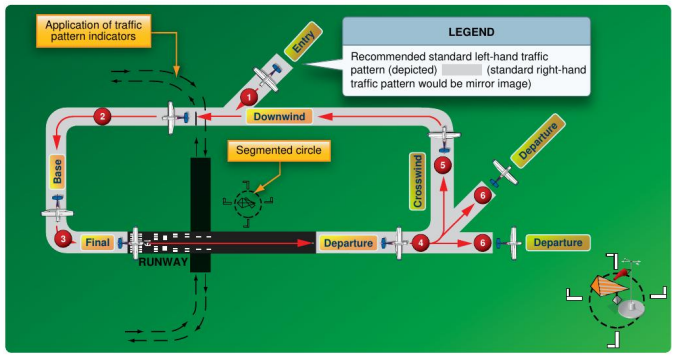


Figure 14-39. *Traffic pattern operations—single runway.*

Fig. 14-39 — Single Runway Traffic Pattern Operations

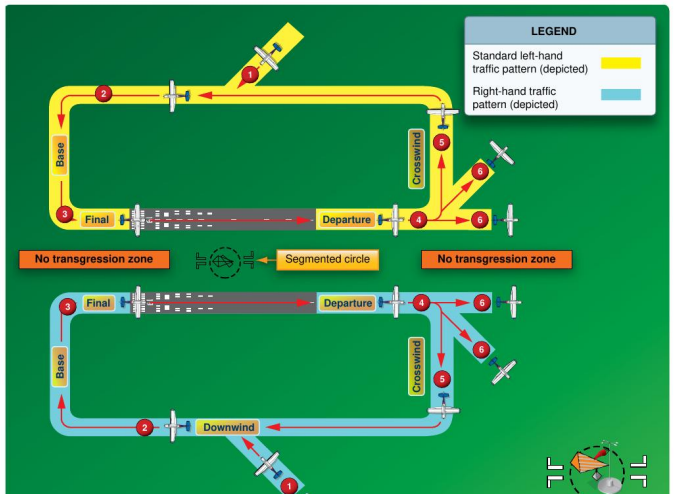


Fig. 14-40 — Parallel Runway Traffic Pattern Operations

SR20 TRAFFIC PATTERN — POWER & AIRSPEED REFERENCE (INSTRUCTOR USE)

LEG	RPM	AIRSPEED	ACTION
Upwind (Climb)	Full Power	Vy / 78 KIAS	Climb straight ahead to 500' AGL, then begin crosswind turn
Crosswind	Full Power	~90 KIAS	Continue climb to TPA listed in A/FD (Chart Supplement) for the airport in use
Downwind	2,300 RPM	~100 KIAS	Level at pattern altitude; parallel runway, ~1/2 mile offset

Abeam Numbers	1,700 RPM	~85 KIAS	Reduce power, Flaps 50%, begin descent ~500 fpm
Base	1,500 RPM	~80 KIAS	Flaps 100%, continue descent, check for conflicting traffic
Final	1,500 RPM	75–80 KIAS	Stabilized approach, on centerline, VASI/PAPI in sight

Instructor Note: *Have the student set 2,300 RPM on downwind to stabilize workload before the abeam point. At abeam the numbers, call out '1,700 RPM, flaps 50%' as a single action — this gives the student a simple anchor to start every descent from. 1,500 RPM on base holds through final.*

PATTERN ENTRY, EXIT & RIGHT-OF-WAY (K2 · K3)

Standard 45° Entry (K2)

- Enter at a 45° angle to the midpoint of the downwind leg, at pattern altitude
- This is the **recommended** method — gives best visibility and separation
- Arrive at pattern altitude **before** entering — do not climb inside the pattern
- Overfly the field at 500' above pattern altitude to determine wind/traffic, then descend and enter

Other Entry Options

- Straight-in: acceptable if you have the field in sight and are monitoring CTAF/tower
- Crosswind entry: enter at the departure end of the runway at pattern altitude
- Parallel runways: enter the downwind for your runway — do not penetrate the final of the adjacent runway

Pattern Exit (K2)

- After liftoff/go-around — continue straight ahead past departure end, then turn crosswind
- Departing the pattern: continue straight out **or** turn 45° in the direction of travel at pattern altitude
- Traffic pattern altitude is 1,000' AGL (recommended) unless otherwise published

Right-of-Way Rules (K3)

- Aircraft on final have right-of-way over aircraft on base or downwind
- Aircraft on base have right-of-way over aircraft on downwind
- Lower aircraft on final has right-of-way — do not cut off another aircraft
- When two aircraft are on final simultaneously — the lower aircraft has priority

Instructor Note: *Make it a habit to pull the A/FD (Chart Supplement) for every new airport before flying there — TPA, pattern direction, noise abatement, and special procedures vary widely from airport to airport and are not always obvious from the sectional.*

TOWERED VS. NON-TOWERED OPERATIONS (K1 · K4)

Towered Airport (K1)

- Get ATIS before calling ground — report information letter in initial call
- ATC will issue pattern entry instructions — follow exactly, read back runway assignments
- Sequence calls: Tower assigns your number in sequence; maintain visual separation
- Extended downwind: ATC may extend you — fly it, report when turning base if asked
- Traffic pattern altitudes and procedures published on airport diagram / Chart Supplement

Non-Towered Airport (K1)

- Monitor CTAF **before** arriving — determine active runway and traffic in pattern
- Use AWOS/ASOS for wind info — then self-announce on CTAF
- Announce: position, intentions, airport name — on every leg (crosswind, downwind, base, final)
- Check for segmented circle and wind indicators to determine pattern direction
- Left-hand patterns are standard unless right-hand is designated in Chart Supplement or by signs

Automated Weather (K4)

- ATIS: pre-recorded, updated hourly or when significant changes occur
- AWOS/ASOS: real-time automated broadcasts — listen on the published freq before entering
- Use ForeFlight to confirm freq before departure — but always verify by listening

CRITICAL ■ Never assume the pattern is empty. Announce your position on **every** leg, every time — even if you hear no one else.

RISK MANAGEMENT (R1 · R2 · R3)

Collision Hazards (R1)

- Scan aggressively on all legs — most mid-airs happen in and around the traffic pattern
- Clear all turns: check in the direction of turn AND behind before rolling in
- On final: check for aircraft overshooting base or on straight-in with no radio calls
- Keep the runway and all pattern legs in sight on every leg

Situational Awareness & Task Prioritization (R2)

- Pattern workload is high — set power and flaps proactively, not reactively
- Aviate first: maintain altitude and airspeed before making radio calls
- If behind or fast — extend downwind; never rush a base-to-final turn
- Disorientation risk: maintain visual contact with the runway on every leg

Windshear & Wake Turbulence (R3)

- Windshear on final: airspeed fluctuation; apply immediate power and go-around if unstable
- Wake turbulence from heavy/large aircraft: stay at or above their glide path on final
- Light aircraft behind jets on final: delay your approach or offset slightly above glidepath
- Wake turbulence settles and drifts downwind — upwind side of runway is safer

KEY RULE ■ If the approach goes unstable — airspeed, glidepath, or alignment — go around. No exceptions.

COMMON ERRORS & CORRECTIONS (K5 · S3-S6)

Altitude & Speed Errors (S5)

- Climbing through pattern altitude on downwind — verify altitude before leveling
- Too fast on downwind: high airspeed delays power reduction and makes sequencing difficult
- Diving on base or final: occurs when student overestimates altitude — use normal descent rate

Wind Correction Errors (S3)

- Drifting on crosswind: crab into the wind to maintain ground track perpendicular to runway
- Downwind blown away from runway in a crosswind: crab toward runway to maintain 1/2-mile offset
- Base overshooting final: turn base sooner in a tailwind; delay in a headwind
- Undershooting final: results in low, fast, unstabilized approach — go around

Traffic & Orientation Errors (S4 · S6)

- Losing sight of the runway on downwind — keep it visible in the side window
- Turning base too early: results in short final, high and fast, unstabilized
- Turning base too late: extends the approach, increases workload, difficult in congested pattern
- Failing to account for other traffic — always check for aircraft on straight-in or extending downwind

References

- PHAK Ch. 14 — Airport Operations (Figs. 14-39, 14-40)
- AIM 4-3-3 — Traffic Pattern Operations
- 14 CFR 91.126–91.127 — Non-Towered Airport Operations
- Chart Supplement — Traffic Pattern Altitude & Direction

Area VII, Task A — Normal Takeoff and Climb

FAA-S-ACS-25 | AI.VII.A | CFI Airplane — Flight Lesson

Objective: Student demonstrates a safe, coordinated normal takeoff and climb — using proper checklist discipline, completing POH performance calculations prior to flight, and selecting the appropriate climb speed (Vx vs. Vy) based on field conditions and obstacles.

K1 · Runway Selection	K2 · Checklist Use	K3 · Vx vs. Vy	K4 · POH Performance	R1 · Engine Failure	R2 · Abort Criteria	R3 · Obstacle Clearance

PRE-TAKEOFF CHECKLIST & TAKEOFF PROCEDURE (K1 · K2)

Before Takeoff — Checklist (K2)

- Run every item in order — no skipping, no working from memory
- Controls free and correct, instruments set, trim for takeoff
- Magneto check: RPM drop within POH limits on each mag
- CAPS handle pin removed — confirm before every departure
- Announce checklist complete before taxiing onto the active runway

Takeoff Roll (K1)

- Check final, announce on CTAF or obtain clearance, taxi onto centerline
- Full power smoothly — instruments in the green before committing
- Track centerline with **rudder pedals**, not brakes
- At **Vr (~70 KIAS)**: smooth back pressure, hold ~10–12° pitch

Climb-Out

- Positive rate → establish Vy (78 KIAS), wings level, ball centered
- Straight ahead to **500’ AGL** before any crosswind turn
- Trim for climb attitude — heads-up scan for traffic

CRITICAL ■ Engine not at full power, abnormal gauges, or unexpected vibration — **abort immediately.** Do not attempt to fly a sick engine.

VX VS. VY / RISK MANAGEMENT / COMMON ERRORS (K3 · K4 · R1–R3)

SPEED	WHAT IT IS	SR20 VALUE	WHEN TO USE
Vx — Best Angle	Greatest altitude gain per unit of distance	**Ref. POH Sec. 5**	Obstacle clearance after takeoff; terrain avoidance; short/obstructed fields. Nose-high, slower — not used past obstacle clearance.
Vy — Best Rate	Greatest altitude gain per unit of time	**78 KIAS**	Normal climb after obstacle clearance; standard departure climb; building the most altitude in the shortest time for cruise.

Engine Failure & Abort (R1 · R2)

- Brief the engine-out plan before every takeoff — altitude, heading, landing area
- Below 500’ AGL: land straight ahead — never attempt to turn back
- Abort speed set: if not near Vr by midfield, abort — throttle idle, brakes firmly
- Rough engine, abnormal gauges, or vibration: abort immediately

Obstacle Clearance & Performance (R3 · K4)

- Calculate takeoff ground roll and obstacle clearance from POH before lining up
- Density altitude is invisible — hot/high/humid days add significant runway requirement
- Use Vx if obstacle clearance is marginal; transition to Vy once clear

Common Errors

- Rushing the checklist or skipping items — enforce challenge-and-response every flight
- Drifting off centerline during roll — smooth rudder, not brakes
- Rotating too early (settles) or over-rotating (slow accel, tail strike risk)
- Chasing airspeed with large pitch inputs — set attitude, trim, then verify
- Using Vy when Vx is required for obstacle clearance
- Turning crosswind before 500’ AGL

Area VII, Task B — Normal Approach and Landing

FAA-S-ACS-25 | AI.VII.B | CFI Airplane — Flight Lesson

Objective: Student demonstrates a safe, stabilized normal approach and landing — using proper energy management and aiming point technique to achieve consistent, accurate touchdowns within –0/+200 feet of the selected aim point, on centerline, with no side drift and at the correct pitch attitude.

K1 · Normal Procedures	K2 · Energy Mgmt	K3 · Wind Effects	K4 · Wind Correction	K5 · Common Errors	R2 · Wind/Shear/Wake	R3 · Go-Around Plan	R5 · Low-Alt Safety	S6–10 · Stabilized/TDZ Accuracy

KNOWLEDGE (K)	RISK MANAGEMENT (R)	SKILLS (S)
K1 Normal & crosswind approach procedures **K2** Stabilized approach — energy management concepts **K3** Wind and atmospheric effects on approach performance **K4** Wind correction techniques on approach and landing **K5** Common errors	**R1** Runway/surface/path/touchdown selection **R2** Crosswind · windshear · tailwind · wake turbulence · surface **R3** Go-around planning · LAHSO awareness **R4** Collision hazards **R5** Low-altitude stall, spin, CFIT **R6** Distractions, task prioritization, situational awareness	**S1–02** Checklist complete · radio calls **S3–05** Correct runway aligned · traffic scan · TDZ aim point **S6–08** Stabilized config/speed/trim · ±5 kt with gust · crosswind **S9–10** Smooth round out/touchdown · within **–0/+200'** of aim point **S11–12** Timely go-around if unstable · analyze/correct errors

APPROACH PHASE SEQUENCE (S1–S9)

PHASE	CONFIGURATION	AIRSPEED	INSTRUCTOR CUES
Downwind (abeam TDZ)	Flaps 50% Power 1,500 RPM	**~100 KIAS**	Establish reference point. Land abeam the TDZ numbers. Set power, deploy partial flaps — confirm trim for the descent.
Base Leg	Flaps 50% (check) Gear down verified	**~90 KIAS**	Monitor glide angle and distance. Correct drift with crab. If the runway moves up in the windshield — you are low. If it moves down — you are high.
Final Approach (>1 mile)	Flaps 100% Full checklist complete	**~85 KIAS (stabilized)**	Lock on the aiming point. Adjust power for glidepath, pitch for airspeed. Aiming spot must appear STATIONARY on the windshield. Stable before 500' AGL.
Short Final (threshold)	Full flaps Trimmed, configured	**~80 KIAS (±5 knots)**	Cross runway threshold at ~50' AGL. Verify no drift. Speed at threshold determines flare height and float — every extra knot adds 50–100 ft of float.
Round Out (Flare)	Power reduces to idle or near-idle	**Decelerate to stall speed**	Gradually raise nose to arrest descent. Eyes shift to far end of runway. Power out smoothly as the airplane descends into ground effect. Hold off with back pressure — do NOT slam the throttle or jerk the nose.
Touchdown	Throttle idle Nose slightly high	**Near VSO**	Mains contact first — within 200' beyond aiming point, on centerline, no side drift. Hold nose off, then lower gently. Never let the nose drop hard.

Instructor Note: *Before each landing, the student should verbalize the aim point and commit to it. An aim point change on short final is a go-around cue, not an adjustment.*

ENERGY MANAGEMENT & AIMING POINT SIGHT PICTURE (K2 · S5–S7)

The Core Principle: Energy = Speed + Altitude

The airplane arrives at the runway with kinetic energy (airspeed) and potential energy (height). Excess energy of either type must dissipate before the wheels touch down. If you arrive fast *or* high, the energy has to go somewhere — and that somewhere is float down the runway.

KEY RULE ■ Power controls glidepath (rate of descent). Pitch controls airspeed. Never swap them.

Aiming Point Technique — The Stationary Target (S5)

Pick a specific, fixed spot on the runway — aim point markers or threshold bars. On a correct approach, that point will appear stationary in the windshield, neither rising nor falling. This is the only reliable visual cue for glidepath.

AIMING POINT RISES in windshield	AIMING POINT STATIONARY in windshield	AIMING POINT DESCENDS in windshield
↑	●	↓
YOU ARE TOO LOW Undershooting	**ON GLIDEPATH Correct angle**	**YOU ARE TOO HIGH Overshooting**
Add power immediately. Small, smooth corrections. Never steepen descent.	Maintain power and attitude. Monitor airspeed ±5 kts. Let it ride.	Reduce power slightly. Do NOT push nose down alone. Aim point will steady.

Power Management on Final (K2 · S6)

- Establish a stabilized descent angle early — the final is not the place to fix big energy problems
- Use **small, smooth throttle inputs** (100–200 RPM) to adjust glidepath — never large chops
- If high: reduce power first, then monitor; if low: add power first, then monitor
- Avoid the tendency to push the nose down when high — this only trades altitude for speed and makes float worse

KEY RULE ■ A fast approach does not equal a safe approach. Every extra 5 knots over VREF adds approximately 100–150 feet of float on landing.

Instructor Note: *Use the PAPI or VASI as a cross-check for the aiming point technique. Two white, two red = on glidepath. If the lights disagree with your sight picture, trust the glidepath and fix the energy with power.*

TOUCHDOWN ACCURACY — ACHIEVING –0 / +200 FEET EVERY TIME (S10)

FLARE AND TOUCHDOWN TECHNIQUE (S9 · S10)

The Round Out (Flare)

- Begin flare when the main gear are approximately 10–15 feet AGL — judge height by peripheral view to the runway edge
- Gradually increase back pressure to **arrest the descent rate** while simultaneously reducing power to idle or near-idle
- Eyes shift to the **far end of the runway** during the flare — this gives depth perception and prevents over-flaring
- Maintain the flare attitude and allow airspeed to bleed to touchdown — the airplane should settle, not be pushed down

The Touchdown

- Mains contact first with a slightly nose-high attitude
- On centerline, with no side drift — crosswind correction maintained to touchdown
- Touchdown within **200 feet beyond** the selected aim point, never short
- After mains contact: hold nose off, then gently lower nose wheel
- Brakes applied smoothly and symmetrically — avoid locking wheels

CRITICAL ■ Never attempt to stretch a short approach — adding back pressure without power trades speed for altitude and risks stall close to the ground. If the aim point is not achievable: go around.

Instructor Note: *The -0/+200 standard means the student should never land short of the aim point and must land within 200 feet beyond it. Consistently long landings (200-400 ft past) indicate excess energy — track this pattern and diagnose the root cause: usually speed, approach angle, or flare timing.*

REDUCING FLOAT — THE INSTRUCTOR'S ENERGY CHECKLIST (K2 · S6–S7)

Root Causes of Excessive Float

Float is not a flare problem — it is an **energy problem**. By the time the airplane is in the flare, it is too late to fix excess energy. Teach students to manage energy on the *approach*, not the landing.

Airspeed at threshold	**VREF ±5 kts**	If +5 or more: go around. Do not try to land fast.
Glidepath at 500' AGL	**On slope, stable**	If unstabilized: go around, not adjustment.
Descent rate on final	**~500 fpm**	If >800 fpm: add power. If <300 fpm: reduce power.
Flap configuration	**Full flaps**	Partial flaps = more float. Use correct config per POH.
Aiming point stable	**Stationary in windshield**	Drifting down = high: reduce power. Drifting up = low: add power.

Power Reduction Timing in the Flare

- Reduce power to idle as the flare begins — not before, not after
- Chopping power on base or early final increases sink rate and risks undershooting
- Carrying power into the flare increases float and delays touchdown
- The correct technique: reduce power **smoothly and progressively** as the nose rises in the flare

KEY RULE ■ Teach the student: land the airplane ON the numbers or within 200 feet past. If it's going to be longer than that — it's a go-around, not a touchdown.

COMMON ERRORS AND INSTRUCTOR CORRECTIONS (K5 · S12)

COMMON ERROR (K5 · S12)	INSTRUCTOR CORRECTION
Flying too fast to the threshold	Every extra 5 kts costs 100+ ft of float. Nail VREF. Correct airspeed control is a prerequisite for landing accuracy.
Chasing glidepath with pitch alone	Power controls glidepath, pitch controls airspeed. Student must learn to separate these inputs. Demonstrate: hold altitude with power, descend with power.
Unstabilized approach below 500' AGL	Call go-around immediately — no exceptions. Teach the habit: if not stabilized by 500' AGL, it's a go-around, every time.
Ballooning in the flare (excess airspeed)	Result of entering flare too fast or too aggressively. Hold flare attitude, let speed bleed — do NOT push forward. If balloon exceeds 10', go around.

Flaring too high / dropping in	Eyes not extended far down the runway. Redirect visual reference to the far end. Teach the student to feel the ground effect cushion, not guess altitude.
Landing short of aim point	Almost always caused by low energy on final. Fix the power management earlier. Use VASI/PAPI or stabilized angle — never try to stretch a glide.
Drifting off centerline at touchdown	Crosswind correction released during flare. Maintain rudder and aileron correction all the way to mains on pavement. Drill this until it is instinct.

RISK MANAGEMENT SUMMARY (R1–R6)

CODE	RISK FACTOR	MITIGATION / INSTRUCTOR TEACHING POINT
R1	Runway/surface/path selection	Brief the landing surface, wind direction, obstacles, and touchdown zone before every approach. Use the longest suitable runway. Confirm ATIS/winds are current.
R2	Crosswind, windshear, tailwind, wake turbulence, surface condition	Check crosswind component vs. demonstrated crosswind limit. Brief windshear NOTAMs. Never accept a tailwind landing unnecessarily. Maintain wake turbulence spacing.
R3	Go-around planning and LAHSO	Before every approach, brief the go-around: when, what power, what pitch, what configuration. If LAHSO is in use, confirm the student understands hold-short point and has accepted or rejected.
R4	Collision hazards	Clear the runway and final approach prior to turning base. Do not cut off an airplane already on final. At uncontrolled fields, call position on CTAF every leg.
R5	Low-altitude stall / spin / CFIT	Overly steep bank on base-to-final is the #1 cause of base-turn stall/spin accidents. Brief the student: bank no more than 30° below 1,000’ AGL. Never skid the turn to final.
R6	Distraction, task saturation, situational awareness	The pattern is one of the highest-workload phases of flight. Ensure the student completes all checklists BEFORE entering the pattern, not during. Sterile cockpit inside the pattern.

Why This Matters: *The landing is the last critical phase of every flight. A consistent, accurate touchdown requires that energy management starts on the downwind leg — not in the flare. Every pilot who learns to keep the aiming spot stationary in the windshield, control airspeed with pitch, and control glidepath with power will land on the numbers, with margin, on every approach. That technique is the foundation of every advanced landing skill that follows: short-field, soft-field, crosswind, and power-off accuracy.*

Objective: Configure per AFM/POH. Transfer weight from gear to wings. Utilize ground effect to accelerate to climb speed. Apply proactive right rudder against amplified left-turning tendencies at full power and high AOA.

POH CONFIGURATION & SOFT-FIELD PROCEDURE (K1 · K2 · K3)

Pre-Takeoff Configuration — Verify per AFM/POH (K1)

- **Flap setting: per POH Section 4** — lowers stall speed and enables earlier liftoff. Set before taxiing onto the soft surface. Confirm on before-takeoff checklist.
- Trim: set per POH. Engine instruments in the green. All checklist items complete.
- **Enter the runway without stopping** — maintaining momentum prevents sinking in.

Weight Transfer During the Takeoff Roll (K2)

- **Apply full aft elevator immediately as power is advanced** — transfers weight from the landing gear to the wings, reducing surface drag and rolling resistance.
- Nosewheel lightens first; hold it *just* above the surface as speed builds. Allow the mains to lift off naturally — **over-rotation** increases drag and risks a tail strike.
- Goal: **fly the weight off the gear aerodynamically** before the aircraft lifts off.

Utilizing Ground Effect — Accelerate Before Climbing (K3)

- At liftoff: **reduce to a level pitch attitude** and remain within one wingspan of the surface. Ground effect reduces induced drag by 30–50%.
- **Accelerate to Vy (or Vx if obstacles)** while in ground effect before initiating climb. Departing too early causes induced drag to spike — the aircraft can settle back.

CRITICAL ■ Aircraft lofts but cannot accelerate — hold altitude in ground effect until Vy. **Premature departure from ground effect is a leading cause of soft-field accidents.**

SPEEDS & CONFIGURATION — REFERENCE AFM/POH (K1)

ITEM	POH REF	TECHNIQUE
Flap Setting	**POH Sec. 4**	Set per POH before taxiing onto soft surface. Lowers stall speed; enables earlier liftoff.
Rotation Speed (Vr)	**POH Sec. 5**	Earlier than normal takeoff. Lift nosewheel as soon as it lightens — do not force or over-rotate.
Best Rate Climb (Vy)	**POH Sec. 5**	Accelerate to Vy in ground effect before climbing. Confirm no abnormal drag or buffet.
Best Angle Climb (Vx)	**POH Sec. 5**	Use when obstacle clearance is required. Accelerate to Vx before departing ground effect.
Flap Retraction	**500+ ft AGL**	Retract incrementally per POH after obstacles cleared and positive climb at Vy established.

LEFT-TURNING TENDENCIES — INCREASED RUDDER USE (K4)

CAUSE	WHY AMPLIFIED AT SOFT-FIELD POWER	CORRECTION
Torque Reaction	Clockwise prop rotation pushes aircraft left. High AOA at liftoff amplifies the effect.	**Right rudder — apply before rotation, increase at liftoff.**
P-Factor (Asymmetric Thrust)	At high AOA, descending blade (right side) produces more thrust — net left yaw.	**Increase right rudder as pitch attitude rises.**
Spiraling Slipstream	Prop wash spirals aft, striking left side of vertical stabilizer at full power.	**Steady right rudder through entire takeoff roll.**
Gyroscopic Precession	Rotating prop acts as gyroscope. Pitch-up during rotation produces left yaw.	**Anticipate — apply right rudder as back pressure is added.**

KEY RULE ■ Right rudder must be **proactive, not reactive.** Brief the student: 'Right rudder goes in with the throttle and increases as the nose pitches up.'

RISK MANAGEMENT & COMMON ERRORS (R1–R3)

- **Assess surface conditions (R3):** mud, ruts, standing water — brief go/no-go criteria.
- **Set abort speed (R1):** not near Vr by midfield → throttle idle, brake firmly.
- Stopping before the roll — aircraft sinks in, loses momentum on soft surface.
- **Premature climb (R2):** departing ground effect before Vy → aircraft settles back.
- Inadequate right rudder — nose yaws left off centerline.
- Retracting flaps below 500’ AGL — airspeed decay and degraded climb rate.

Area VII, Task D — Soft-Field Approach and Landing (ASEL)

FAA-S-ACS-25 • AI.VII.D • CFI Airplane — Flight Lesson

Objective

The applicant demonstrates instructional knowledge of soft-field approach and landing by explaining its purpose, stabilized approach and energy management concepts, atmospheric effects, and wind correction. The applicant demonstrates proper technique — including maintaining full aft elevator throughout the landing roll — while simultaneously providing effective instruction.

References

- AIM; FAA-H-8083-2; FAA-H-8083-3 Ch.9; FAA-H-8083-9; FAA-H-8083-25; POH/AFM

Delivery

- Pre-flight brief 15–20 min; demo then student flies; CFI narrates; debrief back-pressure habit

ACS Knowledge

Code	Element
AI.VII.D.K1	Purpose of and procedures for soft-field approach and landing
AI.VII.D.K2	Stabilized approach, including energy management concepts
AI.VII.D.K3	Effects of atmospheric conditions, including wind, on performance
AI.VII.D.K4	Wind correction techniques on approach and landing
AI.VII.D.K5	Common errors

ACS Risk Management

Code	Element
R1	Runway selection: capability, performance, distance, wind
R2a–e	Crosswind, windshear, tailwind, wake turbulence, surface/condition
R3a–b	Go-around / rejected landing; LAHSO planning
R4–R6	Collision hazards; low-altitude stall/CFIT; task saturation

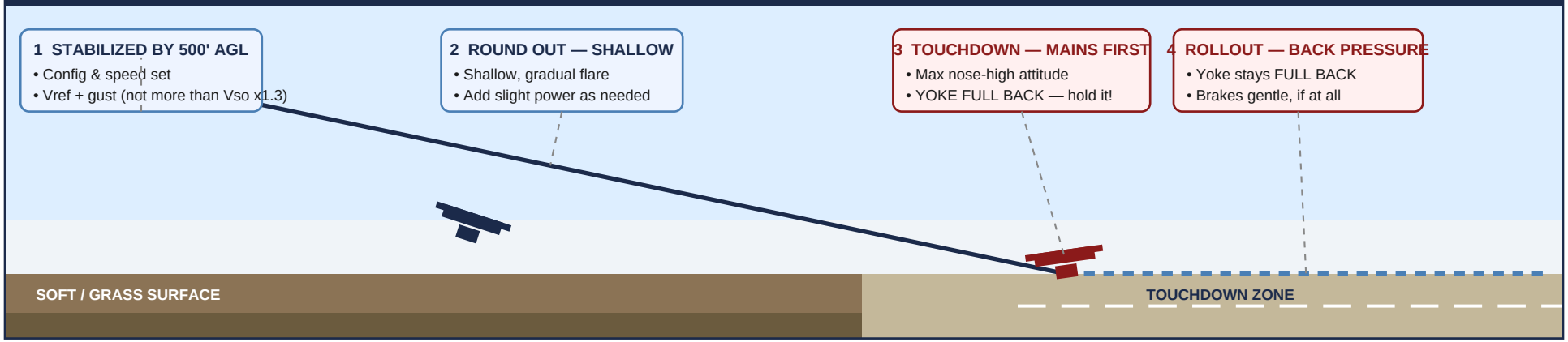
ACS Skills (Key)

Code	Element
S6–S7	Stabilized approach; Vref ±5 kts; proper config and trim
S9–S10	Round out and touchdown at max nose-high attitude; mains first; no drift
S11	Elevator FULL AFT during rollout; exit soft area at taxi speed
S13	Proper flight controls and speed to taxi on soft surface

CRITICAL ■ WHY THIS IS DIFFERENT — On pavement, releasing back pressure after touchdown is harmless. On a soft surface, the nose wheel drops into the surface carrying the full weight of the engine and prop. The #1 soft-field error is relaxing the yoke after the wheel squeak. Every student does it naturally. The CFI's job is to build the habit that overrides it.

TECHNIQUE — APPROACH, LANDING, AND ROLLOUT (K1 / S6–S13)

SOFT-FIELD APPROACH PROFILE — KEY TECHNIQUE POINTS



Step-by-Step Procedure

- **Pattern:** Normal pattern; configure early; stabilized by 500' AGL
- **Final:** Vref (Vso × 1.3) ±5 kts + gust factor; slight power; full flaps per POH
- **Round-out:** Shallow, gradual flare; slight power through flare to cushion descent
- **Touchdown:** Main gear first at highest practical nose-high attitude; minimum sink rate; no side drift; axis aligned with centerline
- **YOKE FULL BACK:** Instant the mains touch — yoke to full aft. HOLD IT. Do not relax, do not move it forward. Maintain through the entire rollout.
- **Rollout:** Power to idle; gentle progressive braking only — hard braking loads the nose wheel; let the surface slow you naturally
- **Exit:** Keep moving at taxi speed until on firm surface; do not stop on soft area

Back Pressure on Rollout (S11)

- **Yoke FULL AFT at touchdown — hold it:** Keeps nose wheel light or off the surface; prevents nose gear digging in; protects propeller clearance throughout the rollout
- **Most common student error:** Instinctively relaxing the yoke after the wheel squeak; nose drops, weight transfers forward, nose wheel contacts soft surface
- **Maintain through braking:** Full aft elevator even while applying brakes; hard braking with a relaxed yoke is the worst combination on soft surfaces
- **Never stop on the soft surface** unless absolutely necessary — exiting requires maintaining taxi speed all the way to firm pavement

Pre-Landing Assessment

- **Surface:** Tire tracks, standing water, color variation — assess before committing
- **Runway:** Longest available; into wind; plan exit route before landing
- **Go-around:** Pre-briefed at the threshold; execute without hesitation if not stabilized, long float, or unexpected surface condition

KEY RULE ■ The landing is not over at touchdown. Full aft elevator until on firm surface and stopped.

COMMON ERRORS (K5) — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — SOFT-FIELD APPROACH AND LANDING (AI.VII.D.K5)

UNSTABILIZED APPROACH

Chasing the glidepath, speed or config changes inside 500' AGL.

- Brief: stabilize by 500' AGL
- Speed: Vref ±5 kts w/ gust
- Power: set, minor adjustments only
- Off-limits: full config change on final
- Go-around if not stabilized

FLARING TOO HIGH/FAST

Aggressive flare drives aircraft onto runway hard; insufficient energy management.

- Shallow, gradual round-out
- Slow to just above stall speed
- Add slight power through flare
- Resist urge to 'plop' onto runway
- Feel for landing, don't force it

RELEASING BACK PRESSURE

The #1 soft-field error. Yoke moves forward after touchdown, loading nose wheel.

- Hold FULL AFT from flare through exit
- Nose wheel must stay light/off surface
- If yoke released: prop/nose strike risk
- Teach 'squeeze and hold' yoke technique
- Do not brake until mains carry weight

BRAKING TOO AGGRESSIVE

Hard braking loads the nose wheel and can cause aircraft to nose-over.

- Gentle, gradual braking only
- Yoke full back reduces nose load
- On soft surface: let rollout slow you
- Exit surface before applying brakes
- Hard braking = nose-over on soft field

STOPPING ON SOFT SURFACE

Allowing the aircraft to slow to taxi speed before exiting the soft area.

- Maintain taxi speed throughout rollout
- Exit to firm surface before slowing
- Once stopped in mud: very hard to move
- Keep slight power to maintain momentum
- Plan exit route before landing

EVALUATION CHECKLIST — SOFT-FIELD APPROACH AND LANDING

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Approach	Stabilized by 500’ AGL	Centerline, glidepath, Vref ±5 kts, config set	Chasing speed/power on final
Flare	Shallow, gradual round-out; slight power	No abrupt pitch changes; controlled energy bleed	Aggressive flare, hard touchdown
Touchdown	Main gear first; max nose-high; no side drift	Highest practical pitch attitude; minimum sink rate	Flat attitude; nose contact on touchdown
CRITICAL	**YOKE FULL AFT at touchdown — HELD through rollout**	**Full aft elevator maintained from touch through exit**	**Releasing back pressure after wheel squeak**
Rollout	Gentle braking; taxi speed to firm surface	No hard braking; does not stop on soft surface	Hard braking; stopping before firm surface
Taxi	Back pressure + speed maintained on surface	Elevator held aft; speed sufficient to prevent sinking	Relaxing controls before reaching firm pavement

KEY RULE ■ ACS S11: ‘Maintain elevator as recommended by manufacturer during rollout and exit the soft area at a speed that would preclude sinking into the surface.’ — Yoke FULL AFT. Not mostly back. Not most of the way. Full aft. Every time.

Area VII, Task E — Short-Field Takeoff and Maximum Performance Climb (ASEL)

FAA-S-ACS-25 • AI.VII.E • CFI Airplane — Flight Lesson

Objective

The applicant demonstrates instructional knowledge of the short-field takeoff and maximum performance climb by explaining procedures, performance data use, and obstacle clearance technique. The applicant demonstrates proper technique — rotating at the POH-specified Vr, maintaining the POH obstacle clearance airspeed until the obstacle is cleared, then transitioning to Vx or Vy — while providing effective simultaneous instruction.

References

- FAA-H-8083-2; FAA-H-8083-3 Ch.5; FAA-H-8083-25 Ch.11; AIM; POH/AFM performance charts

Delivery

- Pre-flight brief: review POH performance charts with actual Vr and obstacle speed; instructor demos narrating all speeds; student flies verbalizing sequence; debrief focused on speed discipline at each transition

ACS Knowledge

Code	Element
AI.VII.E.K1	Purpose and procedures for short-field takeoff and max performance climb
AI.VII.E.K2	Effects of atmospheric conditions, including wind, on takeoff performance
AI.VII.E.K3	POH/AFM performance data: rotation speed and obstacle clearance airspeed
AI.VII.E.K4	Common errors related to short-field takeoff and max performance climb

ACS Risk Management

Code	Element
R1	Runway length, surface, slope, obstacles, and performance requirements
R2a–e	Crosswind, density altitude, tailwind, wake turbulence, surface condition
R3	Rejected takeoff criteria and abort decision point
R4–R6	Wake turbulence; task saturation; collision avoidance scan

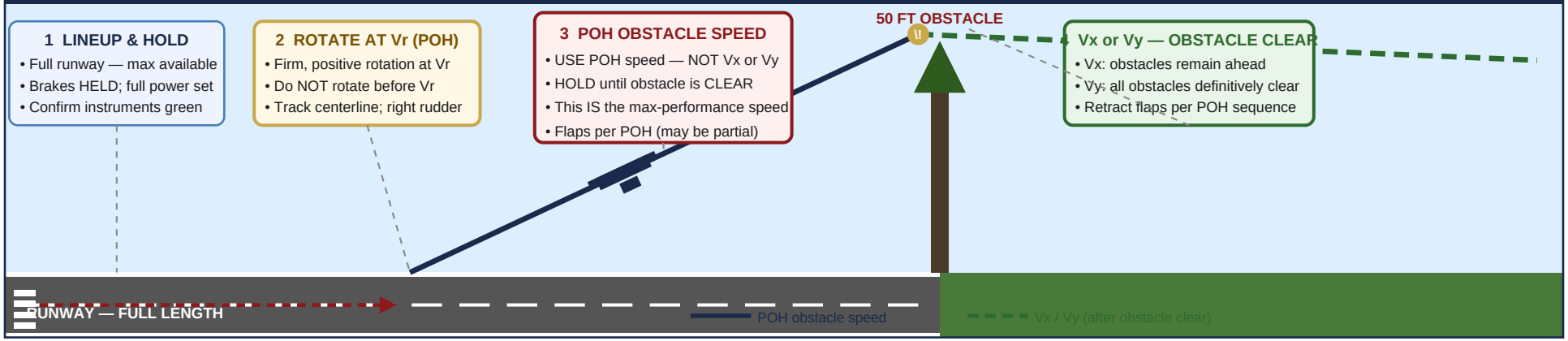
ACS Skills (Key)

Code	Element
S1–S2	Maximum runway used; brakes held with full power before release
S3–S4	Rotate at Vr per POH; positive climb; track centerline (±10°)
S5	Maintain POH obstacle clearance airspeed UNTIL obstacle is cleared
S6	Transition to Vx or Vy after obstacle; ±5 kts; flaps per POH sequence

CRITICAL ■ POH SPEED DISCIPLINE — Rotate at the speed specified in the POH. Immediately establish the POH obstacle clearance airspeed and hold it UNTIL CLEAR OF THE OBSTACLE. Only then transition to Vx (obstacles remain) or Vy (all clear). Students almost universally pitch to Vx or Vy right after liftoff. The sequence is deliberate: Vr → POH obstacle speed → Vx or Vy. Each step is a conscious act — not automatic.

TECHNIQUE — TAKEOFF ROLL, ROTATION, AND SPEED TRANSITIONS (K1 / S1–S6)

SHORT-FIELD TAKEOFF PROFILE — SPEED SEQUENCE AND OBSTACLE CLEARANCE



Step-by-Step Procedure

- **Back-taxi and lineup:** Use the full available runway; taxi to the very end; no intersection takeoffs; set flaps to the POH short-field configuration
- **Brake hold / power-up:** Hold brakes firmly; advance to full power; verify engine instruments in green; note DI heading before releasing
- **Brake release:** Smoothly release brakes; right rudder immediately to counter P-factor and torque; track centerline with rudder, not aileron
- **Rotate at Vr (POH):** Apply firm, deliberate back pressure exactly at the rotation speed specified in the POH — not estimated, not felt; do not allow the aircraft to fly off early or hold it on until it wrenches itself off
- **Establish POH obstacle clearance airspeed:** Immediately after liftoff, pitch to and hold the obstacle clearance airspeed published in the POH. This speed is specifically designed for the obstacle clearance phase and may differ from Vx and Vy
- **Hold until obstacle is cleared:** Maintain POH airspeed and that pitch attitude continuously through obstacle clearance; do NOT transition early; the obstacle — not a timer or gut feeling — is what defines the endpoint
- **Transition to Vx or Vy:** Once the obstacle is positively and definitively cleared, make a deliberate, announced transition: Vx if further obstacles exist, Vy when all are clear; retract flaps incrementally per the POH after positive rate confirmed and obstacle cleared

> ***Instructor Note:*** *Teach students to verbalize the sequence: 'Vr — obstacle speed — obstacle clear — Vy.' Narrating out loud replaces the instinct to pitch immediately to Vy with a disciplined, step-by-step habit.*

Speed Transition Discipline (S5–S6)

- **POH obstacle clearance speed governs** from liftoff through obstacle clearance. It is not Vx, not Vy, and not a blend. The POH publishes this speed because it provides the optimal combination of climb angle, aircraft control, and safety margin during the most critical phase of the departure
- **Vx vs. Vy — know the difference:** Vx gives the best angle of climb — most altitude per horizontal distance — use when obstacles remain ahead after initial clearance; Vy gives the best rate of climb — most altitude per unit time — use when all obstacles are definitively cleared
- **Premature transition costs margin:** Pitching to Vy before the obstacle is cleared reduces climb angle and may bring the aircraft uncomfortably close to or into terrain; even 5 knots of excess speed at the wrong moment changes the geometry significantly
- **Flap retraction sequence:** Confirm positive rate of climb, verify the obstacle is cleared, then retract flaps incrementally per POH; retracting before obstacle clearance reduces available lift; never retract all flaps at once

Performance Chart Briefing (K3)

- **Use the actual POH charts:** Before every short-field departure brief the takeoff distance and obstacle clearance distance from the performance section using actual field elevation, OAT, and weight — never estimated
- **Abort point:** Pre-brief a go/no-go speed and runway marker; if expected speed is not achieved by that point, the takeoff must be rejected; runway behind you is useless and obstacle clearance margin is gone
- **Density altitude effect:** Hot and/or high conditions dramatically increase both takeoff roll and obstacle clearance distance; Vr and obstacle speed are still the same IAS, but the aircraft's ability to achieve climb performance is reduced

KEY RULE ■ Vr → POH obstacle speed (hold until clear) → Vx or Vy. Each arrow is a deliberate, spoken transition — not automatic.

COMMON ERRORS (K4) — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — SHORT-FIELD TAKEOFF AND MAXIMUM PERFORMANCE CLIMB (AI.VII.E.K4)

PREMATURE ROTATION

Pulling back before Vr — aircraft gets airborne in high-drag attitude with reduced climb

- Hold for Vr per POH — no guessing
- Early: high AoA, low speed, poor climb
- May not clear obstacle on short runway
- Teach: eyes on airspeed, rotate on cue
- Late rotation also wrong — wastes runway

WRONG INITIAL CLIMB SPEED

Pitching to Vx or Vy immediately after liftoff instead of the POH-specified obstacle clearance

- POH obstacle speed ≠ Vx or Vy always
- The POH speed is calibrated for clearance
- Wrong speed reduces obstacle margin
- Teach: 'Vr — obstacle speed — then Vx/Vy'
- Student must know the actual POH number

EARLY TRANSITION

Transitioning to Vy before the obstacle is cleared — trades climb angle for climb rate.

- Vy: best rate, NOT best angle
- Pitching to Vy early reduces clearance
- Use Vx if any obstacles remain
- Cue: 'obstacle positively clear — now Vy'
- Transition must be a deliberate choice

PARTIAL RUNWAY USE

Intersection takeoff or failing to back-taxi — POH distances assume maximum runway

- Taxi to runway end — back-taxi if needed
- No intersection takeoffs short-field
- Every foot of runway matters on limits
- Performance charts: full runway assumed
- Pre-taxi: confirm runway assignment

CENTERLINE DEVIATION

Drifting off centerline during roll or initial climb reduces obstacle clearance margin on one side.

- Right rudder from rotation through climb
- P-factor and torque pull left in climb
- Rudder — not aileron — for tracking
- Drift: obstacle margin lost on drift side
- Eyes: airspeed then straight ahead

EVALUATION CHECKLIST — SHORT-FIELD TAKEOFF AND MAXIMUM PERFORMANCE CLIMB

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Lineup	Full runway used; correct flap config; brakes held with full power	Taxi to runway end; no intersection; POH flap setting; brakes held firm	Partial runway; wrong flap config; early brake release
Takeoff Roll	Centerline track; right rudder applied; airspeed cross-check	Heading within ±10°; airspeed confirmed alive; smooth application	Drifting left (P-factor); not monitoring airspeed; abrupt power
Rotation	Rotates at Vr per POH — precise, positive, deliberate	Vr ±2 kts; firm back pressure; no premature or auto liftoff	Premature rotation; aircraft flown off before Vr; late and abrupt
CRITICAL	**CLIMBS AT POH OBSTACLE CLEARANCE SPEED — held until obstacle is positively cleared**	**POH obstacle airspeed ±5 kts; maintained continuously from liftoff through obstacle**	**Transitioning to Vx or Vy before the obstacle is cleared**
Transition	Deliberate, declared transition to Vx or Vy after obstacle clearance	±5 kts of target; student verbalizes transition; flaps retracted per POH	Continuing obstacle speed past clear; wrong speed (Vx vs Vy); all flaps at once
Climb Out	Heading track; engine instruments; collision avoidance scan	±10° heading maintained; instruments in green; no cockpit fixation	Task saturation after rotation; heading drift; fixated on airspeed

KEY RULE ■ ACS S5–S6: Establish and maintain the recommended obstacle clearance airspeed until the obstacle is cleared, then transition to Vx or Vy. The POH speed governs through the obstacle. Vr → POH obstacle speed → Vx or Vy. In that order. Every time.

Area VII, Task F — Short-Field Approach and Landing (ASEL)

FAA-S-ACS-25 • AI.VII.F • CFI Airplane — Flight Lesson

Objective

The applicant demonstrates instructional knowledge of short-field approach and landing by explaining the purpose, stabilized approach and energy management, effects of atmospheric conditions, and wind correction. The applicant demonstrates precise technique — maintaining exactly 1.3 Vso throughout the entire final approach segment, minimizing the flare to prevent float, and touching down within –0 to +100 feet of the aiming point — while providing effective instruction.

References

- AIM; FAA-H-8083-2; FAA-H-8083-3 Ch.9; FAA-H-8083-9; FAA-H-8083-25; POH/AFM

Delivery

- Pre-flight brief 15–20 min; demo then student flies; CFI narrates energy management and aiming point discipline; debrief each rep against the –0/+100 ft standard

ACS Knowledge

Code	Element
AI.VII.F.K1	Purpose of and procedures for short-field approach and landing
AI.VII.F.K2	Stabilized approach, including energy management concepts
AI.VII.F.K3	Effects of atmospheric conditions, including wind, on performance
AI.VII.F.K4	Wind correction techniques on approach and landing
AI.VII.F.K5	Common errors

ACS Risk Management

Code	Element
R1	Runway selection: capability, performance, obstacle clearance, wind
R2a–e	Crosswind, windshear, tailwind, wake turbulence, surface/condition
R3a–b	Go-around / rejected landing decision; LAHSO planning
R4–R6	Collision hazards; low-altitude stall/CFIT; task saturation

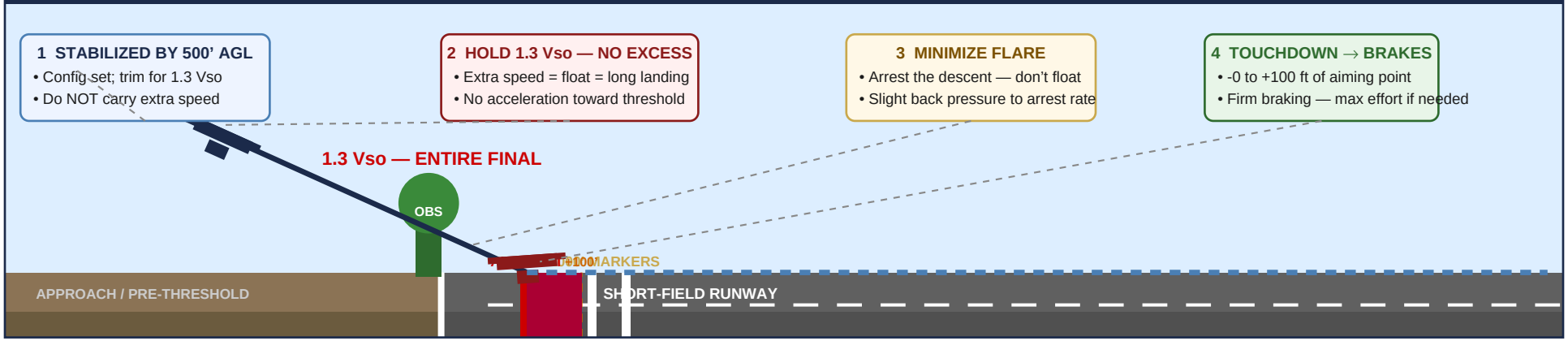
ACS Skills (Key)

Code	Element
S6–S7	Stabilized approach; Vref (1.3 Vso) ±5 kts; proper config and trim
S9–S10	Touch down at or within 100 ft beyond aiming point; no side drift
S11	Apply brakes/controls to stop in shortest distance consistent with safety
S12	Maintain proper crosswind correction and directional control on rollout

CRITICAL ■ SPEED IS THE VARIABLE — Every extra knot above 1.3 Vso on final becomes float, and float becomes runway. Maintain 1.3 Vso from the FAF to the flare — no gust addition unless POH-mandated. Minimize the flare: arrest the descent, don't levitate. Touch down -0 to +100 ft of your aiming point. If using 1000-ft markers, your aiming point is inside those markers, not at them.

TECHNIQUE — APPROACH, LANDING, AND ROLLOUT (K1 / S6–S12)

SHORT-FIELD APPROACH PROFILE — 1.3 Vso THROUGHOUT FINAL / MINIMIZE FLARE



Step-by-Step Procedure

- **Pattern:** Normal pattern; full flaps as published; configure early; trim precisely for 1.3 Vso by base-to-final turn
- **Final:** 1.3 Vso — exactly. This is not 1.3 Vso + 5 or "a little extra for comfort." Trim it in. Every extra knot is float you cannot recover.
- **Aiming point:** Choose a specific, identifiable point before the approach. If using 1000-ft markers, aim inside those markers — not at the numbers, not beyond the markers. Commit to that point.
- **Glidepath control:** Power is primary for glidepath. Pitch holds 1.3 Vso. Do not chase the glidepath with pitch — that changes your speed.
- **Threshold / round-out:** Slight back pressure to arrest the descent rate — do not pull into a prolonged flare. The goal is to stop the descent, not to float down the runway looking for the perfect squeak.
- **Touchdown:** Firm contact at or within 100 ft of the aiming point; main gear first or simultaneous; no side drift; runway axis aligned
- **Rollout:** Immediately apply firm, progressive braking; back pressure to keep nose light; carb heat off; controls for crosswind; shortest stop consistent with safety

Energy Management on Final (K2 / S6–S7)

- **1.3 Vso is both the floor AND the ceiling on final:** You are not managing a range — you are flying a number. Too slow: approach-to-landing stall risk. Too fast: float and overshoot.
- **No gust bump unless POH-mandated:** Some operators add half the gust value; if the POH calls for it, add it — but do not arbitrarily pad your approach speed because the runway is short. That defeats the purpose.
- **Trim, don't fight:** A student who is constantly fighting the controls on short final cannot also be managing the aiming point. Trim for the target speed and let the aircraft fly it.
- **Float = missed approach:** If the aircraft floats past the aiming point with insufficient runway remaining, execute the go-around — do not force it on.

Go-Around Decision

- **Pre-brief the go-around point:** "If I am not on the ground by the 1000-ft markers, I am going around." Commit to this before the approach.
- **Execute without hesitation:** Full power, carb heat off, establish climb attitude, retract flaps incrementally per POH

KEY RULE ■ Maintain 1.3 Vso the entire final segment. Minimize the flare. Touch down –0/+100 ft of the aiming point — inside the 1000-ft markers.

COMMON ERRORS (K5) — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — SHORT-FIELD APPROACH AND LANDING (AI.VII.F.K5)

UNSTABILIZED APPROACH

Speed, power, or config changes inside 500' AGL; chasing the glidepath.

- Stabilize by 500’ AGL: speed, config, power
- 1.3 Vso set and trimmed on final
- No full flap changes on short final
- Glidepath corrections: power primary
- Go-around if not stabilized by 500’

CARRYING EXCESS AIRSPEED

The #1 short-field error. Extra knots become extra float, adding 100-200+ feet.

- 1.3 Vso on final — not 1.3 + 5 kts
- Gust factor adds only as required by POH
- Every extra 5 kts = significant float
- Trim precisely; resist urge to add speed
- If too fast at threshold: go-around

FLARING TOO HIGH / FLOATING

Attempting a normal-style flare with short-field energy bleeds excess runway.

- Arrest the descent — don’t levitate
- Slight back pressure to stop sink rate
- Touch down on the mains; don’t float
- If floating: power off, hold attitude
- Long float = missed aiming point: go-around

LANDING LONG / MISSED AIMING PT

Touching down beyond the -0/+100 ft window; precision and commitment required.

- Identify aiming point before approach
- Inside the 1000-ft markers is your target
- Fly to the numbers — commit to the point
- Power reduction and attitude at threshold
- Long: go-around; short: not acceptable

INADEQUATE BRAKING

Timid braking after touchdown wastes available stopping distance.

- Brake promptly on touchdown — no delay
- Firm progressive braking on both mains
- Max braking if field length requires it
- Hold back pressure to keep nose light
- Carb heat off; full flaps reduce lift

EVALUATION CHECKLIST — SHORT-FIELD APPROACH AND LANDING

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Approach	Stabilized by 500’ AGL	On centerline and glidepath; 1.3 Vso ±5 kts; config set	Late configuration; chasing speed on short final
Final	1.3 Vso maintained entire final segment	Exactly 1.3 Vso — no excess airspeed above ±5 kt tolerance	Padding speed; adding extra “for safety”
Aiming Point	Specific point identified; inside 1000-ft markers	Committed aiming point; not past markers	No defined target; aiming at the numbers or beyond
CRITICAL	**TOUCHDOWN –0 to +100 ft of aiming point; minimal float**	**–0/+100 ft; no prolonged float; mains first; no side drift**	**Floating past aiming point due to excess speed / high flare**
Rollout	Firm, progressive braking immediately after touchdown	Maximum braking consistent with safety; shortest stop	Delayed or timid braking; braking before touchdown
Go-Around	Pre-briefed decision point; executed without hesitation	Go-around if touchdown point missed or float excessive	Forcing the landing on; late go-around decision

KEY RULE ■ ACS S9–S10: Touch down at or within 100 feet beyond the designated touchdown point, with no side drift, and the aircraft’s longitudinal axis aligned with the runway centerline. — 1.3 Vso in, minimal flare, -0/+100 ft. Every time.

Area VII, Task M — Slip to a Landing (ASEL)

FAA-S-ACS-25 • AI.VII.M • CFI Airplane — Flight Lesson

Objective

The applicant demonstrates instructional knowledge of the slip to a landing by explaining its purpose, when to use each type of slip, the effects of atmospheric conditions, and proper crosswind correction technique. The applicant demonstrates the maneuver — including entry, maintenance, and removal at the appropriate moment — while simultaneously providing effective airborne instruction.

References

- AIM; FAA-H-8083-2; FAA-H-8083-3C Ch.9 (Figs. 9-13, 9-14); FAA-H-8083-25; POH/AFM

Delivery

- Pre-flight brief 15–20 min; demo both slip types; student practices each; debrief wing direction, ASI awareness, and forward slip removal timing at flare

ACS Knowledge

Code	Element
AI.VII.M.K1	Purpose of slips and when to use (crosswind, altitude loss, no-flap)
AI.VII.M.K2	Airspeed indicator error in slips — static port blockage by fuselage
AI.VII.M.K3	Effects of atmospheric conditions on approach performance
AI.VII.M.K4	Wind correction techniques — sideslip vs. forward slip distinction
AI.VII.M.K5	Common errors

ACS Risk Management

Code	Element
R1	Runway selection: length, surface, wind direction and velocity
R2a–e	Crosswind, windshear, tailwind, wake turbulence, surface condition
R3a–b	Go-around / rejected landing decision and execution
R4–R6	Collision hazards; stall/spin risk in slip; task saturation on final

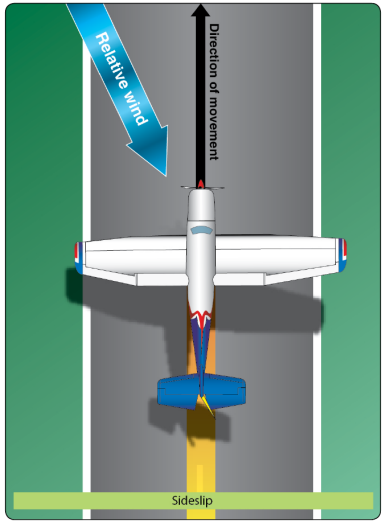
ACS Skills (Key)

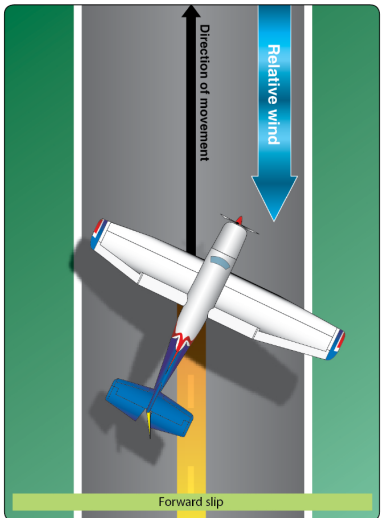
Code	Element
S6	Establish slip at proper altitude; correct entry for the situation
S7	Maintain appropriate airspeed ±10 kts (note ASI may be unreliable)
S8–S9	Track centerline ±1 ft; maintain crosswind correction through touchdown
S10–S11	Remove forward slip at/before roundout; touch down within 400 ft of point

CRITICAL ■ SHOULDER DOWN INTO THE WIND — The most common student error is lowering the wrong wing. Left crosswind: LEFT wing down. Right crosswind: RIGHT wing down. The banked lift component cancels the crosswind drift; opposite rudder keeps the nose on centerline. If the aircraft is still drifting, the wrong wing is down — swap it.

TECHNIQUE — SIDESLIP & FORWARD SLIP: ENTRY, MAINTENANCE, REMOVAL (K1–K4 / S6–S11)

FAA-H-8083-3C — Fig. 9-13: Sideslip (left) | Fig. 9-14: Forward Slip (right)





Step-by-Step Procedure

- **Assess on final:** Determine which tool is needed — too high? Forward slip to bleed altitude. Crosswind? Sideslip to track centerline. Can be combined.
- **Sideslip entry (crosswind):** Lower the UPWIND wing with aileron. Apply OPPOSITE rudder to keep the nose aligned with the runway. Bank and rudder work in opposite directions simultaneously.
- **Forward slip entry (altitude):** Apply aileron in one direction, full opposite rudder to prevent turning. Heading diverges from track — maximum drag bleeds altitude without increasing airspeed.
- **Maintain:** Hold bank and opposite rudder; use pitch attitude reference for airspeed (ASI may under-read); verify centerline track; adjust bank as wind changes on final
- **Forward slip removal:** Return to coordinated flight before or at the roundout — smoothly, not abruptly. Abrupt rollout from a slip causes balloon.
- **Sideslip through touchdown:** Hold the wing-low attitude; upwind main gear contacts first; then lower the downwind main; rudder for rollout directional control

Sideslip vs. Forward Slip — The Core Distinction

- **Sideslip (AFH Fig. 9-13):** Longitudinal axis aligned with runway. Upwind wing low, opposite rudder. Aircraft tracks straight down centerline. The banked lift vector exactly cancels crosswind drift. Hold through touchdown.
- **Forward slip (AFH Fig. 9-14):** Heading diverges from flight path. Aileron one direction, opposite rudder prevents turn. Aircraft moves sideways through the air — maximum drag, steeper descent, constant airspeed. Remove before flare.

Why Shoulder INTO the Wind?

- **Physics:** Banked lift tilts sideways. That sideways component opposes crosswind. Opposite rudder prevents the bank from turning the aircraft. Together: aircraft tracks straight, drift is cancelled.
- **ASI caution (K2):** In a slip, the fuselage may cover the static port. ASI can under-read — actual speed may be higher than indicated. Fly pitch attitude by visual reference; verify with power setting.

KEY RULE ■ Left crosswind → LEFT wing down. Right crosswind → RIGHT wing down. Opposite rudder keeps nose on centerline. Remove forward slip before the flare.

COMMON ERRORS (K5) — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — SLIP TO A LANDING (AI.VII.M.K5)

WRONG WING DOWN	WRONG SLIP FOR THE JOB	CARRYING SLIP THROUGH FLARE	ASI UNRELIABLE	LOSS OF CENTERLINE
Lowering the downwind wing instead of the upwind wing — drift worsens.	*Using a forward slip when a sideslip is needed, or vice versa.*	*Not removing the forward slip before roundout — crooked or wing-low touchdown.*	*Over-relying on airspeed indicator, which may under-read in a slip.*	*Pilot corrects altitude with slip but lets aircraft drift off centerline.*
• Rule: upwind wing DOWN, always	• Sideslip → crosswind correction only	• Forward slip: remove at/before roundout	• Static port can be blocked by fuselage	• Monitor ground track throughout slip
• Left crosswind → left wing down	• Forward slip → altitude loss only	• Sideslip: hold through touchdown	• ASI may read low — actual speed higher	• Sideslip: opposite rudder keeps CL
• Right crosswind → right wing down	• Sideslip: nose stays on runway axis	• Abrupt removal causes ballooning	• Use pitch attitude + power reference	• Forward slip: track is straight
• 'Shoulder into the wind' cue	• Forward slip: nose points offline	• Practice the timing transition	• Know the visual picture for approach	• If drifting: adjust bank/rudder combo
• If drifting: you have wrong wing down	• Teach both; identify situation first	• Upwind main first on sideslip TD	• Check POH for ASI slip limitations	• Never trade CL for altitude fix

EVALUATION CHECKLIST — SLIP TO A LANDING

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Assessment	Identifies correct slip type for the situation	Forward slip = altitude; sideslip = crosswind correction	Defaulting to one slip type for all situations
Entry	Establishes slip smoothly at proper altitude	Coordinated entry; bank and opposite rudder applied correctly	Abrupt entry; wrong wing down; skidding
CRITICAL	**UPWIND wing DOWN — 'shoulder into the wind'**	**Correct wing lowered; nose axis aligned with runway centerline**	**Downwind wing lowered — aircraft drifts downwind**
Maintenance	Holds slip; monitors airspeed via pitch attitude; tracks CL	±10 kts; ±1 ft of centerline; adjusts bank for wind changes	ASI fixation; centerline drift; over/under banking
Removal	Removes forward slip before or at roundout	Smooth rollout to coordinated flight before flare	Slip held through flare — crooked or wing-low touchdown
Touchdown	Upwind main first; no sideways drift; within 400 ft of point	Upwind main contacts first; straight rollout on centerline	Flat touchdown with drift; side load on landing gear

KEY RULE ■ ACS S8–S9: Maintain centerline ±1 ft; hold crosswind correction through touchdown. ACS S10: Remove forward slip at or before roundout. ACS S11: Touch down within 400 ft of designated point. — The right slip, the right wing, removed at the right moment.

Area VII, Task N — Go-Around / Rejected Landing (ASEL)

FAA-S-ACS-25 • AI.VII.N • CFI Airplane — Flight Lesson

Objective

The applicant demonstrates instructional knowledge of the go-around and rejected landing, with emphasis on the factors that contribute to conditions requiring one. The applicant explains and demonstrates procedures — particularly the critical forward yoke pressure required during power application to prevent the elevator trim stall — while providing effective simultaneous instruction.

References

- AIM; FAA-H-8083-2; FAA-H-8083-3 Ch.9; FAA-H-8083-9; FAA-H-8083-25; POH/AFM

Delivery

- Pre-flight brief: cover decision criteria, trim stall mechanics, power-pitch sequence; instructor demos narrating forward yoke application with power; student flies verbalizing each step; debrief emphasizes whether forward pressure was applied simultaneously with power.

ACS Knowledge

Code	Element
AI.VII.N.K1	Purpose of and procedures for go-around or rejected landing
AI.VII.N.K2	Stabilized approach, including energy management concepts
AI.VII.N.K3	Effects of atmospheric conditions, including wind and density altitude
AI.VII.N.K4	Wind correction techniques on takeoff/departure and approach/landing
AI.VII.N.K5	Common errors related to this Task

ACS Risk Management

Code	Element
R1–R2	Delayed recognition and delayed performance of go-around at low altitude
R3–R4	Power application; configuring the airplane
R5–R6	Collision hazards; low altitude maneuvering, stall, spin, CFIT
R7–R9	Task saturation; go-around after LAHSO; runway incursion

ACS Skills (Key)

Code	Element
S3	Timely decision to discontinue the approach to landing
S4	Apply full power immediately; transition to Vx or Vy ±5 kts
S5	Configure after positive rate of climb; flaps per POH incrementally
S6–S9	Offset to side of runway; Vy to safe altitude; track; analyze errors

CRITICAL ■ ELEVATOR TRIM STALL — On approach the airplane is trimmed nose-UP to hold descent pitch. When full power is applied on a go-around, that nose-up trim attempts to pitch the nose aggressively upward. At low altitude and low airspeed, this can exceed the pilot's ability to control and result in an aerodynamic stall with zero recovery altitude. The correct response — FORWARD yoke pressure simultaneously with power — is counter-intuitive. Students instinctively pull back. This must be trained before it matters.

TECHNIQUE — POWER, PITCH CONTROL, AND TRIM STALL PREVENTION (K1 / S3–S9)

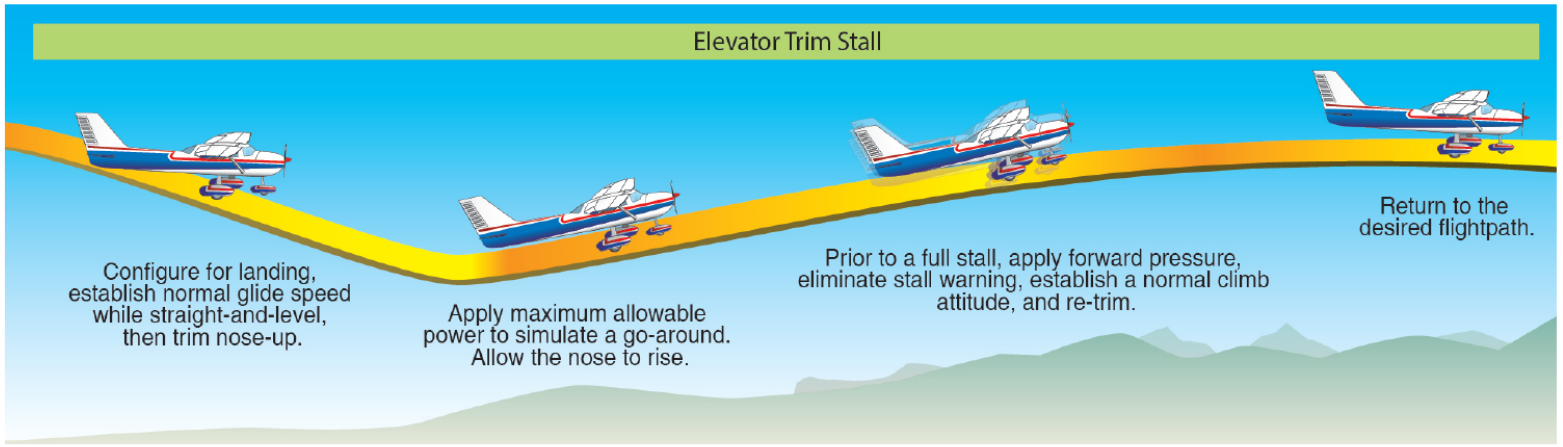


Figure 5-14. *Elevator trim stall.*

Figure 5-14. Elevator trim stall. FAA-H-8083-3, Airplane Flying Handbook (AFH).

Step-by-Step Procedure

- **Decision:** Not stabilized by 500’ AGL, long float, bounce, traffic on runway, or any doubt. Announce: ‘Go-around.’ No penalty for going around.
- **POWER — full, immediately:** Smooth but without hesitation. Carb heat OFF before full power. Confirm engine instruments green.
- **FORWARD YOKE PRESSURE — with power:** Trim is still set nose-up from the approach. Forward pressure comes in the instant power does — not after.
- **Climb attitude:** From the controlled position, smoothly raise the nose to Vx or Vy pitch. Deliberate — not a reaction to trim pulling you up.
- **Positive rate → flaps → retrim → communicate:** Confirm VSI positive; retract flaps incrementally per POH; retrim for Vy; call ATC/CTAF.

Trim Stall — The Physics (K1 / R3)

- **Why it happens:** Approach trim is set nose-up for descent. Full power adds P-factor and slipstream. Both pitch the nose up — together they can overpower the pilot’s ability to hold the nose down.
- **Why it is lethal:** The go-around starts at low altitude near approach speed. An uncontrolled pitch-up bleeds airspeed in seconds with no altitude for recovery.
- **The instinct that kills:** Nose pitches up — pilot pulls back. Wrong. Train the forward-pressure response before the student flies their first go-around.

When to Go Around (K2)

- Unstabilized inside 500’ AGL; long float; bounce or veer
- Traffic, obstacle, or any doubt about the runway

KEY RULE ■ Power IN → Forward pressure simultaneously → Climb attitude from there. Forward pressure is not optional — it prevents the elevator trim stall.

COMMON ERRORS (K5) — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — GO-AROUND / REJECTED LANDING (AI.VII.N.K5)

DELAYED DECISION	ELEVATOR TRIM STALL	IMPROPER FLAP RETRACTION	DRIFTING OVER TRAFFIC	POWER MISMANAGEMENT
Hesitating past the point where a safe go-around is still possible.	*Full power + nose-up trim: nose pitches up uncontrolled; stall at low altitude.*	*Retracting all flaps at once — sudden lift loss drives aircraft back to runway.*	*Failing to offset to the side of the runway — traffic may still be on the surface.*	*Hesitating on power or reducing too early before a stable climb is established.*
• Pre-brief go-around decision criteria	• Trim set nose-up during approach	• Positive rate first — then flaps	• Offset to upwind side of runway	• Full power — no hesitation
• Any doubt at threshold = go-around	• Power + nose-up trim = runaway pitch	• Retract incrementally per POH	• Traffic may still be on runway	• Partial power = reduced climb margin
• Unstabilized approach = go-around	• Forward yoke required with power	• All flaps at once = sudden sink	• Don't overfly the centerline	• Hold power to safe maneuvering alt
• Late go-around = runway overrun risk	• Pulling back makes it worse	• Low-alt sink = ground contact	• Scan for traffic in climb	• Confirm engine instruments green
• No penalty for going around	• Teach: power-in → fwd pressure → climb	• Flap sequence is not optional	• ATC call early — state intentions	• Carb heat OFF before full power

EVALUATION CHECKLIST — GO-AROUND / REJECTED LANDING

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Decision	Timely, declared decision to go-around; announced verbally	Prompt decision; no hesitation past stabilization criteria; verbal callout made	Delayed decision; hoping the approach recovers past the threshold
Power	Full power applied immediately; carb heat OFF before full power	Full throttle smoothly but without hesitation; engine instruments green	Partial power; hesitation; carb heat left ON at full power
CRITICAL	**FORWARD YOKE PRESSURE applied simultaneously with power to counter nose-up trim**	**Forward pressure on yoke the moment power advances; nose does not pitch uncontrolled**	**Pulling back as nose rises from trim — elevator trim stall developing**
Climb Estab.	Deliberate pitch to Vy; positive rate; flaps incrementally per POH; retrim	Vy ±5 kts established; VSI positive before any flap retraction; no all-at-once flap dump	Chasing pitch; retracting all flaps at once at low altitude; sinking toward runway
Climb-out	Offset to side of runway; Vy maintained; traffic scan; ATC call made	Vy ±5 kts; clears runway traffic; heading ±10°; radio call made	Flying directly over runway; task saturation; no ATC call; no retrim

KEY RULE ■ ACS S4: Apply takeoff power immediately and transition to climb pitch attitude for Vx or Vy ±5 kts. The transition starts with FORWARD yoke pressure to neutralize the nose-up trim, then a deliberate pitch to climb attitude. Power in → Forward pressure → Climb attitude. Every time.

Area VII, Task O — Power-Off 180° Accuracy Approach & Landing (ASEL)

FAA-S-ACS-25 • AI.VII.O • CFI Airplane — Flight Lesson

Objective

The applicant demonstrates instructional knowledge of the power-off 180° accuracy approach and landing, with primary emphasis on energy management from the downwind key position to touchdown. The applicant explains and demonstrates procedures — particularly the discipline of managing energy high and bleeding it off with flaps and slips rather than stretching the glide — while providing effective simultaneous instruction. ACS tolerance: touchdown within 200 feet **beyond** (not short of) the specified point.

References

- AIM; FAA-H-8083-2; FAA-H-8083-3 Ch.9 (Fig. 9-27); FAA-H-8083-9; FAA-H-8083-25; POH/AFM

Delivery

- Pre-flight brief: energy budget concept, key positions, flap/slip tools, the '200 feet long is fine, short is fail' rule. Instructor demos narrating throttle placement, key position altitude, base turn timing, and flap/slip deployment. Student flies verbalizing energy state at each key position. Debrief focuses on whether energy was managed high-to-low or student attempted to stretch.

ACS Knowledge

Code	Element
AI.VII.O.K1	Purpose of and procedures for proper 180° accuracy approach and landing
AI.VII.O.K2	Stabilized approach, including energy management concepts
AI.VII.O.K3	Effects of atmospheric conditions, including wind, on approach and landing
AI.VII.O.K4	Wind correction techniques on approach and landing
AI.VII.O.K5	Common errors related to this Task

ACS Risk Management

Code	Element
R1	Runway/surface selection based on performance, capability, and available distance
R2a–e	Crosswind, windshear, tailwind, wake turbulence, landing surface condition
R3a–b	Planning for go-around and rejected landing; LAHSO
R4–R5	Collision hazards; low altitude maneuvering, stall, spin, CFIT
R6–R7	Distractions, task saturation; forward slip ops (fuel, tail stall, airspeed)

ACS Skills (Key)

Code	Element
S3–S4	Plan flightpath to landing area; select touchdown point; configure airplane
S5	Position on downwind leg parallel to runway; establish key position altitude
S6–S7	Configure airplane; correlate crosswind with slip direction as required
S8	Touch down within 200 ft BEYOND (not short of) specified point; no drift; aligned
S9	Analyze and correct common errors related to this Task

CRITICAL ■ ENERGY MANAGEMENT — NEVER SHORT. From throttle-to-idle at the downwind key position, the pilot has a fixed energy budget. The ACS standard is within 200 feet BEYOND the target — landing short is an immediate unsatisfactory. Examiners strongly prefer a student who floats 200 feet past the mark over one who touches down 10 feet short. Train the student to manage energy HIGH and use flaps and forward slips to bleed off excess. A stretched glide at pattern altitude risks an unrecoverable stall. Energy discipline is the entire lesson.

TECHNIQUE — ENERGY MANAGEMENT FROM DOWNWIND KEY POSITION TO TOUCHDOWN (K1–K4 / S3–S8)

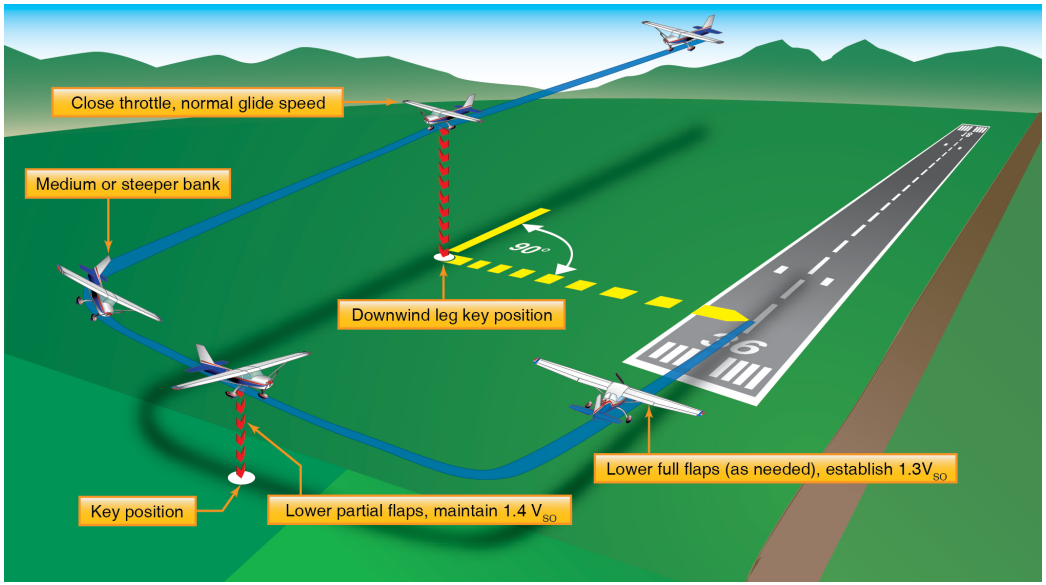


Figure 9-27. 180° power-off approach. FAA-H-8083-3C, Airplane Flying Handbook (AFH), p. 9-26.

Step-by-Step Procedure

- **Downwind key position:** Throttle to idle abeam the touchdown point; decelerate to 1.4 V_{SO}. Note altitude — your energy budget. Low key position = go-around consideration immediately.
- **Downwind → base turn:** Medium or slightly steeper coordinated bank. Headwind shortens glide; tailwind lengthens. Extend partial flaps on base as needed.
- **Base key position:** Arrive at altitude mirroring a 90° power-off key position. If significantly low — go around immediately. Never stretch to the runway.
- **Final:** 1.3 V_{SO} coordinated. Use flaps and forward slip to manage excess altitude. Deploy flaps late — they are your altitude eraser. Retain some tool until glidepath is confirmed.
- **Flare and touchdown:** Smooth flare to normal landing attitude. Within 200 ft BEYOND the mark. Short of mark = immediate unsatisfactory.

Energy Management — The Core Skill (K2)

- **Energy budget:** At throttle-closure the pilot has fixed potential + kinetic energy. 'Too much' is solvable with flaps and slips. 'Too little' — go around.
- **Bleed energy (if high):** Extend flaps to steepen descent. Forward slip = more sink, no airspeed gain. S-turns on base if significantly high. These are the correct tools.
- **Never do (if low):** Raise nose to stretch. Mush at slow speed. Skid turns. All three bleed energy without range gain and risk a stall at pattern altitude.

Wind Effects (K3–K4)

- Headwind on final: steeper approach, less float — plan to arrive slightly high
- Tailwind on base/final: shallower angle, more float — deploy slip/flaps earlier
- Adjust key position altitude and base turn timing for wind conditions each approach

KEY RULE ■ Manage energy HIGH — use flaps and slips to land long. NEVER stretch the glide. 200 ft BEYOND = pass. ~50 ft SHORT = immediate fail.

Instructor Note: *Teach this maneuver in the airplane the student will fly on the checkride. Each model behaves differently — glide ratio, flap authority, and energy bleed-off vary significantly. The SR20 carries energy very differently than a PA-28 or C172. Know your airplane's key position altitudes and glide characteristics cold before teaching, and brief the student on how those numbers change with weight and density altitude.*

COMMON ERRORS (K5) — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — POWER-OFF 180° ACCURACY APPROACH (AI.VII.O.K5)

DOWNWIND TOO FAR OUT

Flying the downwind leg too far from the runway — forces a long flat approach, undershoots the

- Stay 1/2–3/4 nm from runway
- Too far = glide doesn't reach
- Tempts pilot to stretch glide
- Mushing = stall at pattern alt
- NEVER sacrifice airspeed for distance

STRETCHING THE GLIDE

Raising the nose to extend glide distance — trades kinetic energy for nothing, leads to stall.

- Best glide speed = max range
- Above best glide = drag, not range
- Nose high + slow = stall setup
- ~50 ft short = immediate fail
- Go around early — no penalty

POOR BASE LEG POSITION

Turning base too early (overshoot) or too late (undershoot) — disrupts the energy budget for

- Turn base abeam key position
- Too early — too high on final
- Too late — undershoots, stretch glide
- Use flaps to manage overshoot
- S-turns on base if high

SKIDDING TURNS

Using rudder to skid turns in an attempt to extend glide — ineffective and dangerous at low

- Skid increases drag AND sink rate
- Does NOT extend glide distance
- Cross-controlled stall risk
- Use coordinated turns only
- Slip (intentional) to lose altitude

PREMATURE FLAP EXTENSION

Extending full flaps too early — steepens glide prematurely, leaving no tool to correct an

- Hold flaps until final assured
- Partial flaps on base as needed
- Full flaps only when on glidepath
- Flaps are your altitude eraser
- Once extended, glide shortens

EVALUATION CHECKLIST — POWER-OFF 180° ACCURACY APPROACH AND LANDING

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Downwind Key	Throttle closed abeam touchdown point; glide speed established (1.4 Vso); altitude noted	Idle power established promptly; airspeed at manufacturer's glide speed or 1.4 Vso; altitude appropriate for airplane type (typically 1,000 ft AGL or less)	Forgetting to note key position altitude; improper deceleration; too far from runway on downwind
Base Turn	Coordinated medium-to-steep bank turn to base; partial flaps as needed; base key position altitude	Coordinated turn; no skidding; arrives at base key position with energy margin in hand	Skidding turn to stretch glide; turning base too early or too late; premature full flap extension
CRITICAL	**ENERGY MANAGEMENT — Arrive high, bleed with flaps/slips. NEVER stretch the glide when low.**	**Student verbalizes energy state continuously. If low at base key position — GO AROUND. Examiners accept 200 ft long. ~50 ft short = immediate fail.**	**Raising nose to stretch glide when low; holding flaps in reserve when high instead of deploying; skidding turns**
Final Approach	Stabilized final at 1.3 Vso; forward slip or flap deployment used to manage excess altitude; glidepath to threshold	Airspeed 1.3 Vso ±5 kts; coordinated; glidepath adjusted with flaps/slip only — not throttle	Fixating on the spot and slow-flying; applying throttle to adjust; failing to slip when high on final
Touchdown	Proper pitch attitude; within 200 ft BEYOND specified point; no side drift; aligned with centerline	ACS S8: touchdown within 200 ft BEYOND (not short of) specified point; proper attitude; no drift; longitudinal axis aligned	Touching down short of mark (~50 ft short = immediate fail); floating without slip correction; landing in a crab or drift

KEY RULE ■ ACS S8: Touch down at proper pitch attitude, within 200 feet BEYOND or on the specified point, with no side drift, and with the airplane's longitudinal axis aligned with the runway centerline. Energy management is the lesson. Manage high — bleed with flaps and slips. Go around if low. Never stretch. ~50 ft short of the mark = immediate unsatisfactory.

Area VIII, Task A — Straight-and-Level Flight (ASEL)

FAA-S-ACS-25 • AI.VIII.A • CFI Airplane — Flight Lesson

Objective

The applicant demonstrates instructional knowledge of straight-and-level flight by explaining its purpose, visual reference techniques, integrated flight instruction concepts, and the pitch-power-trim relationship. The applicant demonstrates and simultaneously explains proper technique — establishing and maintaining heading and altitude using outside visual references as the primary control method with instruments as a cross-check — while providing effective instruction and correcting common student errors.

References

- AIM; FAA-H-8083-2; FAA-H-8083-3 Ch.3 (Figs. 3-6, 3-8, 3-9); FAA-H-8083-9; FAA-H-8083-25; POH/AFM

Delivery

- Pre-flight brief 10–15 min: visual references, integrated flight concept, pitch+power+trim relationship. Instructor demonstrates narrating nose reference, 90% outside rule, trim use. Student flies while verbalizing reference points. CFI watches for instrument fixation. Debrief: was the student looking outside or chasing needles?

ACS Knowledge

Code	Element
AI.VIII.A.K1	Purpose of and procedures for proper straight-and-level flight
AI.VIII.A.K2	Flight control and trim use
AI.VIII.A.K3	The pilot's visual references when performing the maneuver
AI.VIII.A.K4	Integrated flight instruction
AI.VIII.A.K5	Common errors related to this Task

ACS Risk Management

Code	Element
R1	Distractions, task prioritization, loss of situational awareness, or disorientation
R2	Collision hazards

ACS Skills

Code	Element
S1	Establish and maintain straight-and-level flight
S2	Analyze and correct common errors related to this Task

ACS Tolerances (Maintain Throughout)

Parameter	Tolerance
Heading	±10° of assigned heading
Altitude	±100 ft of assigned altitude
Airspeed	±10 kts of assigned airspeed
Coordination	Coordinated flight — ball centered

CRITICAL ■ PITCH + POWER = PERFORMANCE — This is the single most important concept in all of basic flight training. Pitch attitude controls altitude: nose on the horizon reference → level flight. Power controls airspeed: set cruise RPM and the airplane will settle at cruise speed. Set the power, find the nose reference, trim off the pressure — the airplane holds itself. A student who truly internalizes this relationship stops chasing needles and starts flying the airplane. Drive this concept home on the very first lesson and repeat it every flight thereafter.

TECHNIQUE — VISUAL REFERENCES, INTEGRATED FLIGHT & TRIM (K1–K4 / S1–S2)

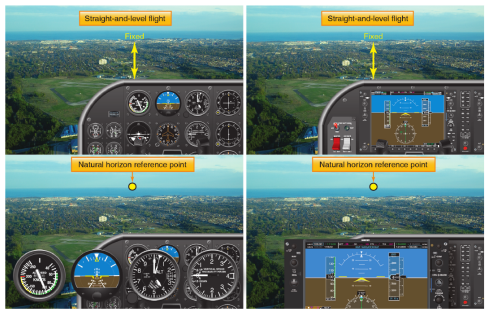


Figure 3-6. *Nose reference for straight-and-level flight.*

Fig. 3-6 — Nose reference for straight-and-level flight

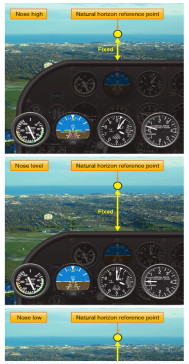


Fig. 3-8 — Nose reference for level flight (high/level/low)



Fig. 3-9 — Elevator trim nulls constant control pressure

Step-by-Step Procedure

- **Setup:** Clear the area; establish cruise altitude; set cruise RPM (per POH/AFM); let airspeed stabilize before starting the maneuver
- **Pitch reference (Fig. 3-6):** Fix a point on the cowling against the natural horizon — this is your pitch control. Keep it there. Adjust with elevator.
- **Bank reference:** Both wingtips equally above/below the natural horizon. Coordinated aileron + rudder for all bank corrections. Never rudder-only.
- **Trim (Fig. 3-9):** Attitude stable → trim rudder first, then elevator to remove all control pressure. Airplane should hold attitude hands-off.
- **Cross-check:** Quick 10% instrument scan — confirm altitude, heading, airspeed; then immediately back outside. Never correct while looking inside.
- **Deviations:** Detect outside first. Smooth, proportional correction to the horizon reference. Re-trim. Repeat. Do not chase the instruments.

Visual Reference & Integrated Flight (K3–K4)

- **Fig. 3-6/3-8 — Nose reference:** A cowling point fixed to the horizon is the pitch control. Establish it seated and in normal posture on the ground. Dry-erase mark works for early lessons. This reference is always on the horizon.
- **Bank reference:** Wingtips are primary for bank — small deviations invisible at the nose are obvious at the wingtip. Both wings equally above/below horizon = wings level.
- **Fig. 3-9 — Trim:** Trim relieves pressure; it does not fly the airplane. Attitude first, then trim out the force. A properly trimmed airplane requires zero sustained input from the pilot.

Instructor Note: *90% OUTSIDE — Students must look outside 90% of the time. The natural horizon gives attitude information 10× larger than any instrument. Use instruments only to validate, never to control. If fixation persists, cover the AI and force the student to use outside references exclusively. Corrections made while looking inside are always late, always over-controlled.*

CRITICAL ■ PITCH + POWER = PERFORMANCE — Power controls airspeed; pitch controls altitude. At cruise RPM, find the nose reference, trim, and the airplane holds itself. Higher RPM = less back pressure required = easier to hold S&L.; Lower RPM = more back pressure, more drift. Set power FIRST, then find the attitude, then trim.

COMMON ERRORS (K5) — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — STRAIGHT-AND-LEVEL FLIGHT (AI.VIII.A.K5)

INSTRUMENT FIXATION

Staring inside at the AI/altimeter instead of flying the natural horizon. Leads to over-correction and

- 90% attention MUST be outside
- Instruments validate, not control
- Cover AI if fixation persists
- Horizon gives 10× larger reference
- Look out first, check in, look out

POOR VISUAL REFERENCE

Using only the nose reference for bank — small deviations go unnoticed. Wingtips are the

- Both wingtips equally above horizon
- Nose reference for pitch only
- Wingtips catch small bank deviations
- Pre-select reference point on ground
- Dry-erase marker on cowling if needed

OVER-CONTROLLING

Palm grip on controls kills sensitivity. Mechanical pushes/pulls instead of light finger pressure

- Fingertips only on yoke/stick
- Heels on floor, ball of foot on pedals
- Smooth, measured pressure inputs
- Let airplane stabilize after input
- Trim, don't fight the airplane

TRIM NEGLECT

Flying with sustained back pressure instead of trimming. Fatiguing, causes heading/altitude drift

- Trim after attitude is established
- Pressure off = airplane holds attitude
- Rudder trim first, then elevator
- Aileron trim last if available
- Properly trimmed = good pilot skill

NEGLECTING OUTSIDE SCAN

Fixating on one direction (usually left due to seat position). Misses traffic, terrain, weather, and

- Scan all quadrants continuously
- Traffic, terrain, weather awareness
- Left-seat bias causes left heading drift
- Deliberate scan pattern required
- SA is the #1 safety task in VFR

EVALUATION CHECKLIST — STRAIGHT-AND-LEVEL FLIGHT

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Pitch Control	Nose reference fixed to natural horizon; level pitch maintained throughout	±100 ft; reference point stable on horizon; corrections to horizon, not altimeter	Chasing the altimeter; reference drifts; pitch input while looking inside
Bank Control	Both wingtips equal on horizon; coordinated aileron + rudder corrections	±10° heading; inclinometer ball centered; no sustained rudder-only inputs	One wing low with opposite rudder; skidding; correcting heading with feet only
CRITICAL	**90% attention OUTSIDE — instruments used to validate only, not to control**	**Student corrects to natural horizon reference; glances instruments to confirm; no corrections made while looking inside the flight deck**	**Fixating on AI or altimeter; making corrections while looking inside; chasing needles instead of referencing the natural horizon**
Trim	Control pressures fully trimmed out; airplane holds attitude without pilot force	Hands/feet off → heading and altitude maintained; no drift or oscillation	Sustained back pressure instead of trimming; over-trimming; flying with trim
Deviations	Deviations caught early outside; smooth proportional correction applied	Returns to ±10° heading and ±100 ft promptly; no over-correction or oscillation	Late detection (was inside); abrupt over-correction; chasing instruments afterward

KEY RULE ■ ACS S1: Establish and maintain straight-and-level flight — heading ±10°, altitude ±100 ft, airspeed ±10 kts, coordinated. The natural horizon is the primary reference; instruments confirm. PITCH sets altitude. POWER sets airspeed. TRIM holds both. 90% of the pilot's attention belongs outside the flight deck — always.

Area VIII, Task B — Level Turns (ASEL)

FAA-S-ACS-25 • AI.VIII.B • CFI Airplane — Flight Lesson

Objective

The applicant demonstrates instructional knowledge of level turns by explaining the purpose, technique, and visual references required to perform coordinated turns while maintaining altitude. The applicant demonstrates and simultaneously explains the entry, maintenance, and rollout of level turns to specified headings — using outside visual references as the primary control method — while identifying and correcting common student errors including altitude loss, poor coordination, and instrument fixation.

References

- FAA-S-ACS-25; FAA-H-8083-3 Ch.3 (Figs. 3-10, 3-11, 3-12, 3-17, 3-18); FAA-H-8083-25; POH/AFM

Delivery

- Pre-flight brief 10–15 min: vertical/horizontal lift components, coordination, rollout lead rule. Instructor demonstrates: entry with back pressure callout, coordinated rudder, visual references, rollout lead. Student flies and verbalizes back pressure application and target heading count-down. CFI watches for altitude loss, instrument fixation, and uncoordinated rudder. Debrief: was the student feeling the turn or chasing instruments?

ACS Knowledge

Code	Element
AI.VIII.B.K1	Purpose of and procedures for level turns
AI.VIII.B.K2	Visual references for bank angle and pitch attitude in a turn
AI.VIII.B.K3	Coordinated use of flight controls (adverse yaw / rudder role)
AI.VIII.B.K4	Common errors related to this Task

ACS Risk Management

Code	Element
R1	Distractions, task prioritization, loss of situational awareness, or disorientation
R2	Collision hazards — clearing turns required prior to all practice maneuvers

ACS Skills

Code	Element
S1	Perform level turns to headings — shallow, medium, and steep
S2	Analyze and correct common errors related to this Task

ACS Tolerances (Maintain Throughout Turn)

Parameter	Tolerance
Bank Angle	±5° of desired bank angle
Altitude	±100 ft of assigned altitude
Rollout Heading	Within 10° of desired heading
Coordination	Ball centered — coordinated flight throughout

CRITICAL ■ BACK PRESSURE IN TURNS — When the airplane banks, lift splits into vertical and horizontal components. Only the vertical component supports the aircraft's weight. As bank angle increases, vertical lift decreases — the pilot MUST increase back pressure to compensate or the airplane will descend. A student who does not feel and apply this back pressure will lose altitude every time they turn. This is the single most important concept in level turns. Drive it home on entry, reinforce it at 15°, 30°, and 45° bank.

TECHNIQUE — ENTRY, BACK PRESSURE, COORDINATION & ROLLOUT (K1–K3 / S1–S2)



Fig. 3-10 — Cockpit view: level turn to the left — nose tracks the horizon, wingtip shows bank angle

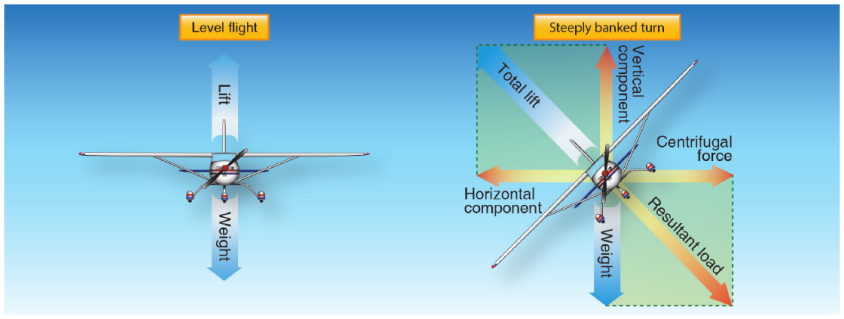


Fig. 3-11 — Banked lift: vertical + horizontal components; back pressure restores vertical lift

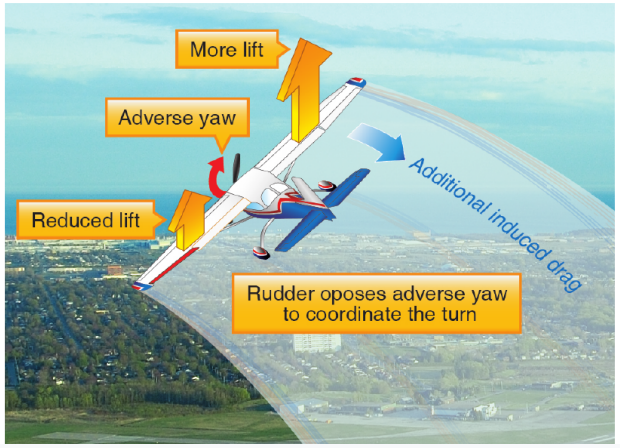


Fig. 3-12 — Adverse yaw: rudder input coordinates the turn entry

Step-by-Step Procedure

- **1. Clear the area:** Two 90° (or one 180°) clearing turns. Verify altitude, airspeed, and traffic before beginning.
- **2. Select rollout target:** Pick heading on DI or a ground reference. Pre-select desired bank (shallow ≤20°, medium 20–45°).
- **3. Roll entry [Fig. 3-12]:** Coordinated aileron + rudder toward the turn. Rudder offsets adverse yaw. Smooth roll to desired bank.
- **4. Add back pressure [Fig. 3-11]:** Simultaneously increase elevator back pressure as bank increases. More bank = more back pressure. Feel it.
- **5. Maintain [Fig. 3-10]:** Hold bank + back pressure. Nose tracks horizon during turn. Brief instrument glance to confirm — then back outside.
- **6. Lead rollout:** Begin rollout ½ bank angle before target heading (30° bank → start 15° early). Coordinated opposite aileron + rudder.
- **7. Release back pressure:** Progressively release as wings come level. Wings-level at target heading. Re-trim as needed.

Visual References & Technique Notes (K2–K3)

- **Fig. 3-10 — Cockpit view:** Bank angle is visible as the lowered wingtip against the horizon. The nose tracks along the horizon. Feel the need for back pressure; do not hunt altitude on the altimeter.
- **Fig. 3-11 — Lift components:** Banking splits lift into vertical and horizontal. Only the vertical component supports weight. More bank = less vertical lift = MORE back pressure required. No exceptions.
- **Fig. 3-12 — Adverse yaw:** Rising wing generates more induced drag, yawing the nose against the turn. Coordinated rudder on entry offsets this. Ball must stay centered — felt in the seat before the ball moves.

> ***Instructor Note:*** *90% OUTSIDE / DETECT BY FEEL — Slips, skids, pitch drops, and over-bank are all detectable outside and by feel before any instrument confirms them. Train the student to sense and correct visually — NOT by chasing needles. If fixation persists: cover the AI and altimeter. Make them fly by feel and horizon reference. Instrument cross-check validates; it does not drive the turn.*

VISUAL REFERENCES, ERRORS & EVALUATION (K2 / K4 / S1–S2)

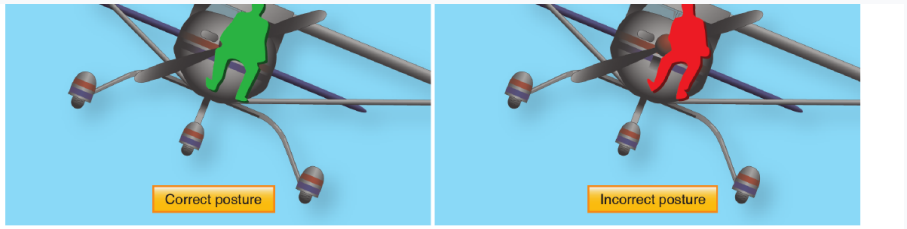


Fig. 3-17 — Correct vs. incorrect pilot seating posture — improper posture creates a false bank reference.

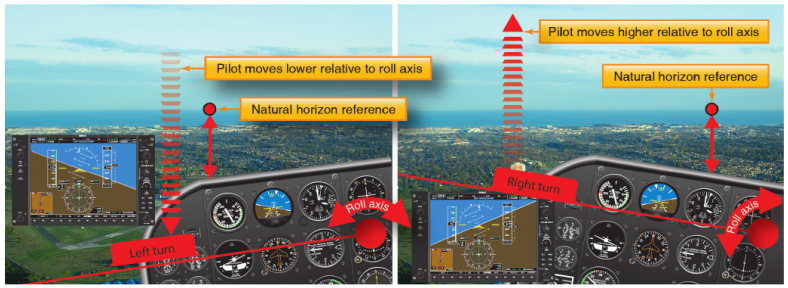


Fig. 3-18 — Parallax error — eye position relative to the roll axis shifts the apparent horizon reference.

CFI NOTE ■ *Fig. 3-17: A student leaning or slumped perceives the horizon at an angle and chases a "bank" that is actually their own body position. Fig. 3-18: Parallax shifts the apparent nose reference depending on eye height relative to the roll axis. Ensure the student sits erect with a consistent seat position on every flight — establish it on the ground.*

COMMON ERRORS (K4) — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — LEVEL TURNS (AI.VIII.B.K4)

LOSING ALTITUDE	INSTRUMENT FIXATION	POOR COORDINATION	OVER/UNDER BANK	LATE/EARLY ROLLOUT
Failing to increase back pressure as bank is established. The vertical lift component	*Staring at the attitude indicator or altimeter instead of the natural horizon. Corrections are*	*Skidding or slipping through turns due to improper rudder use. Rudder must coordinate*	*Establishing incorrect bank angle and not correcting to desired. Student often over-banks*	*Rolling out too late (overshooting heading) or too early (undershooting). Rollout must be led by*
• Back pressure = reduced vertical lift	• 90% attention MUST be outside	• Ball must stay centered throughout	• Pre-select visual bank reference	• Lead rollout = ½ bank angle
• Increase pitch as bank increases	• Bank angle visible from cockpit view	• Lead aileron with coordinated rudder	• Lowered wing tip = bank angle visual	• 20° bank: start rollout 10° early
• More bank = more back pressure needed	• Horizon shows pitch deviation instantly	• Slip/skid felt in seat and seen outside	• Roll rate smooth — not rushed	• 30° bank: start rollout 15° early
• Student must feel the need, not read it	• AI/Alt validates — does not control	• Adverse yaw worst at entry/rollout	• Cross-check AI briefly to confirm bank	• Track target heading on DI

EVALUATION CHECKLIST — LEVEL TURNS

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Clearing Turns	180° or two 90° clearing turns completed before maneuver; traffic scan verbal	Area clear; student verbalizes scan; no turns without clearing first	Skipping the clearing turns; mechanical check without actual scan
Entry & Co ordination	Coordinated aileron + rudder input on entry; ball centered; smooth roll rate	Ball centered; no noticeable slip or skid; roll smooth and deliberate	Leading with rudder only; skidding entry; abrupt roll inputs

CRITICAL	**Back pressure increases with bank — altitude ±100 ft maintained throughout turn**	**±100 ft by feel and outside reference; back pressure proportional to bank; no altitude hunting on instruments**	**No back pressure added; altitude lost; chasing altimeter instead of feeling/seeing the nose drop**
Bank & Rollout	Bank ±5°; outside reference primary; rollout led by ½ bank angle; coordinated; wings-level at target	±5° bank held; ±10° rollout heading; ball centered; outside reference primary throughout	Over-banking; AI fixation; late rollout; overshooting heading; back pressure released too abruptly

KEY RULE ■ ACS S1: Perform level turns to headings — bank ±5°, altitude ±100 ft, rollout within ±10°, coordinated. BACK PRESSURE must increase with bank angle to compensate for reduced vertical lift. 90% attention outside — detect pitch, bank, and coordination errors by visual reference and feel, not by instrument fixation.

Area VIII, Task C — Straight Climbs & Climbing Turns (ASEL)

FAA-S-ACS-25 • AI.VIII.C • CFI Airplane — Flight Lesson

Objective

The applicant demonstrates instructional knowledge of straight climbs and climbing turns by explaining the purpose, technique, and visual references for each climb configuration (Vx, Vy, and normal/cruise climb). The applicant demonstrates and simultaneously explains entry, maintenance, and level-off technique — using outside visual references as the primary control method and trim as the primary airspeed management tool — while identifying and correcting common student errors including airspeed fixation, shallow pitch attitude, over-banking, and uncoordinated climbing turns.

References

- FAA-S-ACS-25; FAA-H-8083-3 Ch.3 (Fig. 3-21); FAA-H-8083-25; POH/AFM

Delivery

- Pre-flight brief 10–15 min: define Vx, Vy, normal climb per AFH; Fig. 3-21 cockpit nose reference; trim use vs. airspeed chasing; overbank/coordination risk in climbing turns. Instructor demonstrates straight climb with trim callout, then climbing turn at ≤20° bank. Student flies and verbalizes trim application and coordination. CFI watches for airspeed fixation, steep bank, and skidding turns. Debrief: did the student trim or chase the needle?

ACS Knowledge

Code	Element
AI.VIII.C.K1	Purpose of and procedures for straight climbs and climbing turns
AI.VIII.C.K2	Visual references for pitch attitude and bank angle during a climb
AI.VIII.C.K3	Trim use to establish and maintain climb airspeed
AI.VIII.C.K4	Common errors related to this Task

ACS Risk Management

Code	Element
R1	Distractions, task prioritization, loss of situational awareness, or disorientation
R2	Collision hazards — clearing turns required before all practice maneuvers
R3	Low airspeed / high AOA — stall/spin risk in uncoordinated climbing turns

ACS Skills

Code	Element
S1	Perform straight climbs and climbing turns to headings
S2	Analyze and correct common errors related to this Task

ACS Tolerances (Maintain Throughout)

Parameter	Tolerance
Airspeed	±10 kts of target climb airspeed
Heading (straight climb)	±10° of assigned heading
Bank angle (climbing turn)	±5° of desired bank angle
Rollout heading	Within ±10° of desired heading
Coordination	Ball centered throughout

Instructor Note: *CLIMB SPEED DEFINITIONS (AFH) — Brief all three before every climb lesson. Vx (Best Angle of Climb): maximum altitude gained per horizontal distance — used to clear obstacles; nose highest, airspeed lowest of the three. Vy (Best Rate of Climb): maximum altitude gained per unit of time — used for normal climb to cruise altitude; slightly lower pitch than Vx, slightly higher airspeed. Normal (Cruise) Climb: airspeed higher than Vy — provides better engine cooling, improved forward visibility, and reduced nose-high attitude at a modest sacrifice in climb rate. Preferred for long climbs in training aircraft. All speeds defined in the POH/AFM.*

CRITICAL ■ TRIM IS THE AIRSPEED CONTROL — The single most common error in climbs is fixating on the airspeed indicator and constantly pumping the elevator to chase it. Teach the student: establish the climb attitude visually (nose above horizon per Fig. 3-21), then TRIM until the yoke is free of pressure. The airspeed will stabilize. Once trimmed, hands off the elevator. Monitor outside. Cross-check the airspeed to validate — not to control. A student who trims correctly will fly a stable, coordinated, efficient climb. A student who chases the ASI will oscillate the entire way to altitude.

TECHNIQUE — STRAIGHT CLIMB & CLIMBING TURN ENTRY, TRIM & LEVEL-OFF (K1–K3 / S1–S2)

Visual Reference — Fig. 3-21 (K2)



Figure 3-21. *Climb indications.*

Fig. 3-21 — Climb indications: nose above the natural horizon (left: conventional; right: glass cockpit). Pitch attitude to the horizon is the primary reference; instruments cross-check climb performance.

- **Nose above horizon:** The climb attitude places the nose above the natural horizon. The exact height depends on climb speed: Vx = nose highest; normal climb = lowest of the three. Establish visually, then cross-check VSI and ASI — the horizon reference comes first, always.
- **Shallow bank in climbs:** Keep climbing turns ≤20°. Steeper banks reduce vertical lift and increase stall risk at the already-high AOA of a climb. Ball must stay centered — a skidding climbing turn is the setup for an incipient spin.

Step-by-Step Procedure

- **1. Clear the area:** Two 90° (or one 180°) clearing turns. Check traffic above and below. Brief climb speed (Vx / Vy / normal) before entry.
- **2. Set climb power:** Full throttle (or per POH/AFM). Mixture and carb heat per POH. Monitor CHT/EGT and oil pressure.
- **3. Establish pitch attitude [Fig. 3-21]:** Raise the nose to the climb reference above the horizon. Vx = steepest pitch; normal climb = shallowest.
- **4. TRIM to airspeed:** Once airspeed approaches target, trim elevator until yoke is pressure-free. Do NOT chase the ASI with elevator inputs. Airspeed stabilizes. Leave the attitude alone.
- **5. Monitor and maintain:** Hold heading with coordinated rudder. Quick instrument scan: VSI, airspeed, heading — then back outside. 90% outside.
- **6. Climbing turn entry:** Shallow bank (≤20°), coordinated aileron + rudder. Ball centered. Maintain trim. Nose stays above horizon throughout.
- **7. Lead the level-off:** At ~10% of climb rate before target altitude (e.g., 50 ft early at 500 fpm), lower nose, reduce power to cruise, re-trim.

Instructor Note: *TRIM — PREVENT AIRSPEED FIXATION: After establishing the climb attitude, direct the student to trim until the yoke requires zero pressure, then take their hand off the yoke and look outside. The airspeed will hold itself. If the student starts hunting the ASI, cover it and force them to fly the attitude. Trim is correct technique — not a crutch.*

■ ***Risk Note:*** *OVERBANKING + UNCOORDINATED CLIMBING TURN — A steep bank in a climbing turn is dangerous for two compounding reasons: (1) it reduces the vertical lift component at a moment when the airplane needs every bit of lift to climb; (2) if the turn is also skidding — ball deflected outward — the airplane is at high AOA with yaw applied: the textbook incipient spin entry. Keep bank ≤20°. Keep the ball centered. Emphasize this on every climbing turn. There are no second chances close to the ground.*

COMMON ERRORS (K4) — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — STRAIGHT CLIMBS & CLIMBING TURNS (AI.VIII.C.K4)

AIRSPEED FIXATION	SHALLOW PITCH ATTITUDE	OVER-BANKING IN CLIMB	UNCOORDINATED CLIMBING TURN	LATE LEVEL-OFF
Chasing the airspeed indicator with elevator inputs instead of establishing pitch attitude and	*Insufficient nose-high attitude results in a reduced climb rate and lower-than-desired*	*Excessive bank in a climbing turn reduces climb performance and demands more back pressure*	*A skidding climbing turn combines high AOA with yaw — the classic incipient spin entry. This*	*Failing to lead the level-off results in busting the target altitude. Begin transition 10% of climb rate*
• Establish nose-high attitude FIRST	• Pre-brief the nose reference above horizon	• Bank ≤20° in any climbing turn	• Skid = high AOA + yaw = spin risk	• Lead level-off by 10% of climb rate
• Trim until yoke is pressure-free	• Fig. 3-21 shows correct nose position	• More bank = less vertical lift	• Ball centered throughout the turn	• 500 fpm → start level-off at altitude –50 ft
• Airspeed stabilizes on its own	• Verify with VSI — adequate climb rate?	• High AOA + steep bank = stall risk	• Apply rudder to stop any yaw	• Reduce back pressure as nose lowers
• Do NOT hunt the airspeed needle	• Set full climb power FIRST	• Shallow bank preserves climb rate	• Outside scan for coordination	• Adjust power to cruise setting
• Attitude + trim = stable climb	• Pitch attitude + power = climb performance	• CFI must correct immediately	• Never allow a skidding climb	• Re-trim for level flight

EVALUATION CHECKLIST — STRAIGHT CLIMBS & CLIMBING TURNS

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Climb Setup	Clearing turns completed; climb speed briefed (Vx/Vy/normal); full climb power set; mixture/carb heat per POH	Area clear; correct power and configuration per POH; verbal brief of climb speed before entry	Skipping the clearing turns; wrong climb speed; forgetting carb heat in cruise-to-climb transition
Pitch & Fig. 3-21	Nose raised to correct climb attitude above natural horizon per Fig. 3-21; attitude established visually before instrument cross-check	Nose position matches target climb speed; VSI positive; airspeed within ±10 kts after trim	Insufficient nose-up attitude; chasing VSI or ASI to set pitch; pitch reference established by instruments instead of horizon
CRITICAL	**Trim used to establish and hold climb airspeed — NOT elevator chasing. Student trims until pressure-free, then monitors outside.**	**Yoke pressure-free after trim; airspeed stable within ±10 kts; student not continuously adjusting elevator; 90% attention outside after trim set**	**Continuous elevator pumping to chase ASI; never trims; oscillating pitch throughout the climb; looking inside the whole time**
Climbing Turn	Bank ≤20°; coordinated entry; ball centered; climb attitude maintained; rollout within ±10° of target heading	±5° bank; ball centered throughout; airspeed within ±10 kts; rollout within ±10°; no altitude or airspeed bust	Over-banking (>20°); skidding turn (ball out); pitch drops on turn entry; late rollout; airspeed decay ignored
Level-Off	Level-off led by ~10% of climb rate; nose lowered to cruise attitude; power reduced to cruise; re-trimmed for level flight	Target altitude ±100 ft; smooth transition with no over-shoot; cruise power set; trimmed hands-off level flight established	Busting target altitude; abrupt nose pushover; forgetting to reduce power; not re-trimming — continuing to hold back pressure in level flight

KEY RULE ■ ACS S1: Perform straight climbs and climbing turns — airspeed ±10 kts, heading ±10°, bank ±5°, rollout within ±10°, coordinated throughout. TRIM establishes and holds climb airspeed — never chase the ASI. Climbing turns: bank ≤20°, ball centered always. A skidding climbing turn at high AOA is the most dangerous error in basic airwork — address it immediately every time.

Area VIII, Task D — Straight Descents & Descending Turns (ASEL)

FAA-S-ACS-25 • AI.VIII.D • CFI Airplane — Flight Lesson

Objective

The applicant demonstrates instructional knowledge of straight descents and descending turns by explaining the purpose, technique, and visual references for each descent type (partial power, minimum safe airspeed at 1.3 V_{SO}, and emergency descent). The applicant demonstrates and simultaneously explains entry, maintenance, and level-off technique — using outside visual references as the primary control method and instruments for cross-check only — while identifying and correcting common student errors per AFH Ch. 3 (Fig. 3-22, pp. 3-21–3-24).

References

- FAA-S-ACS-25; FAA-H-8083-3 Ch.3 (Fig. 3-22, pp. 3-21–3-24); FAA-H-8083-25; POH/AFM

Delivery

- Pre-flight brief 10–15 min: define all three descent types; show Fig. 3-22 (nose below horizon visual reference); brief RPM + pitch combination for 500 fpm in this airplane; define 1.3 V_{SO} and its checkride significance; brief emergency descent configuration per POH/AFM. Instructor demonstrates each type while narrating attitude, power, and trim. Student flies and verbalizes visual reference. Debrief: Did the student fly the attitude or chase the instruments? Were control inputs coordinated in descending turns?

ACS Knowledge

Code	Element
AI.VIII.D.K1	Purpose of and procedures for straight descents and descending turns
AI.VIII.D.K2	Flight control and trim use
AI.VIII.D.K3	The pilot's visual references when performing the maneuver
AI.VIII.D.K4	Integrated flight instruction
AI.VIII.D.K5	Common errors related to this Task

ACS Risk Management

Code	Element
AI.VIII.D.R1	Distractions, task prioritization, loss of situational awareness, or disorientation
AI.VIII.D.R2	Collision hazards

ACS Skills

Code	Element
AI.VIII.D.S1	Establish, maintain, and level off from straight descents and descending turns
AI.VIII.D.S2	Analyze and correct common errors related to this Task

Instructor Note: *THREE DESCENT TYPES TO BRIEF AND PRACTICE: (1) Partial Power (cruise/en route) — partial throttle, target ~500 fpm, specific RPM + pitch varies per airplane. (2) Min Safe Airspeed — 1.3 VSO, nose-high, power-assisted; this IS the short-field approach speed — checkride task. (3) Emergency Descent — specific POH/AFM config (idle, prop fwd, gear out, flaps retracted); target airspeed per POH/AFM (typically the beginning of the yellow arc); tested on nearly every practical test.*

CRITICAL ■ VISUAL TASK — Descents are established and maintained by outside visual reference to the horizon. The nose drops below the horizon (Fig. 3-22). Instruments are used to CROSS-CHECK performance, not to set pitch attitude. 1.3 VSO is the descent at minimum safe airspeed target and the short-field landing approach speed — a commonly failed checkride task; train the student to hold it precisely and recognize the mushing cue before it becomes a stall. Emergency descent appears on nearly every practical test — configuration, airspeed, and bank angle per POH/AFM must be memorized and immediately executable.

TECHNIQUE — DESCENT ENTRY, ATTITUDE CONTROL & LEVEL-OFF (K1–K4 / S1–S2)

Visual Reference — Fig. 3-22 (K2)



Fig. 3-22 — Descent indications: nose below the natural horizon (left: conventional; right: glass cockpit). Outside visual reference is the primary control; instruments cross-check descent performance. FAA-H-8083-3C, Ch. 3, p. 3-21.

- **Nose below horizon:** The descent attitude places the cowling below the natural horizon. The exact position depends on descent type: deeper pitch for steeper/faster descents. Establish the visual picture first — then verify with VSI and airspeed as a cross-check, not the other way around.
- **Descending turns:** Keep bank ≤30°. Reduced control forces in a power-off descent catch students off-guard — less rudder is needed. The nose must be lowered on entry to prevent airspeed decay. Ball centered throughout.

Instructor Note: *RPM + PITCH ATTITUDE — For the partial power descent, there is a specific RPM range and pitch attitude combination that will produce the desired airspeed and approximately 500 fpm rate of descent. This combination is NOT universal — it varies by airplane type, weight, and density altitude. Before teaching, establish and brief the correct RPM setting and nose position for your specific training aircraft. Once set, the pilot should trim hands-off and cross-check VSI for the target rate. Do not continuously adjust power or pitch to chase the VSI.*

Step-by-Step Procedure

- **1. Clear the area:** Two 90° clearing turns. Check for traffic above and below. Verbalize the descent type being performed (partial power, min safe airspeed, or emergency).
- **2. Partial power descent entry:** Reduce throttle to the briefed RPM setting; lower nose to the visual pitch attitude for the desired airspeed. Trim hands-off. Cross-check VSI for ~500 fpm. Carb heat per POH.
- **3. Min safe airspeed descent (1.3 VSO):** Reduce airspeed to 1.3 VSO — a nose-high, power-assisted configuration. Set power sufficient to prevent mushing or excessive sink rate. This is the short-field approach configuration. Any airspeed below 1.3 VSO risks a full stall with power — dangerous at low altitude.
- **4. Emergency descent:** Per POH/AFM — power to idle, propeller control full forward, landing gear extended (if retractable), flaps retracted; roll into a 30–45° bank turn to increase drag and rate of descent; establish and hold the POH/AFM emergency descent airspeed. Maintain vigilance for terrain and traffic.
- **5. Descending turns:** Shallow to medium bank (≤30°). Lower nose on entry to prevent airspeed decay. Ball centered. Maintain trim. Rollout leads heading by bank angle ÷2 degrees (e.g., 30° bank → lead by 15°).
- **6. Level-off:** Lead the level-off by ~10% of descent rate (e.g., 100 ft early at 1,000 fpm). Add power to cruise setting; smoothly raise nose to level attitude; re-trim. Release any back-pressure held during a descending turn to avoid a pitch-up on recovery.

KEY RULE ■ Establish descent attitude VISUALLY (nose below horizon, Fig. 3-22), then TRIM to airspeed. Instruments cross-check only. Set RPM + pitch for 500 fpm — brief this combination per airplane before every lesson.

■ ***Risk Note:*** *MINIMUM SAFE AIRSPEED (1.3 VSO) — SHORT-FIELD APPROACH SPEED: This is the same airspeed used for short-field landings and is a commonly failed checkride task. The airplane is in a high-AOA, power-dependent condition. If the student allows airspeed to decay below 1.3 VSO while mushing — especially if uncoordinated — the aircraft can enter an accelerated stall near the ground with full power applied, leaving no recovery altitude. Train the student to recognize the buffet onset and the sound/feel of impending stall at this configuration. EMERGENCY DESCENT: The target airspeed is specified in the POH/AFM and is typically the beginning of the yellow arc (caution range) on the airspeed indicator — brief this per the actual training aircraft before the first attempt. Configuration errors (wrong gear/flap position) and wrong airspeed are the most common practical test failures. Require the student to verbalize the full POH procedure from memory before executing.*

COMMON ERRORS (K5) — AFH P. 3-24 — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — STRAIGHT DESCENTS & DESCENDING TURNS (AI.VIII.D.K5 | AFH p. 3-24)

CHASING THE AIRSPEED INDICATOR	STRETCHING THE GLIDE	SKIDDING/SLIPPING GLIDING TURNS	PITCH BY INSTRUMENTS ONLY	PITCH CONTROL ERRORS
Unable to stabilize the descent — pilot continually hunts the ASI with elevator instead of	*Applying back-elevator pressure to extend glide range when low. This increases drag, bleeds*	*Skidding or slipping during descending turns — often from overuse of rudder. Reduced control*	*Student attempts to establish and maintain the descent solely by reference to flight instruments*	*Failure to lower pitch during gliding turn entry (airspeed drops), inadequate back pressure on*
• Set nose-low attitude visually FIRST	• Back-pressure = steeper descent angle	• Control forces lighter without power	• Nose below horizon is the reference	• Lower nose on gliding turn entry
• Trim until yoke is pressure-free	• Does NOT extend glide distance	• Less rudder needed vs. powered turns	• Fig. 3-22: learn the visual picture	• Glide entry: back-pressure then pitch
• Airspeed stabilizes on its own	• Increases drag and sink rate	• Skid = yaw + high AOA = stall risk	• Instruments are for cross-check only	• Slow to glide speed BEFORE pitch down

EVALUATION CHECKLIST — STRAIGHT DESCENTS & DESCENDING TURNS

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Descent Setup	Clearing turns complete; descent type verbalized (partial power / min safe airspeed / emergency); carb heat/mixture per POH; appropriate airspeed established before pitch change	Area clear; correct power/config per POH; student verbalizes which descent type; airspeed slowed to appropriate range before nose lowered	Skipping clearing turns; lowering nose before slowing to descent speed (overly steep entry); forgetting carb heat in descent; wrong configuration for descent type
Visual Attitude	Nose positioned below natural horizon per Fig. 3-22; pitch attitude established visually; VSI and airspeed used for cross-check only; trim set for hands-off	Nose below horizon established without chasing instruments; VSI showing ~500 fpm (partial power); airspeed within ±10 kts; yoke pressure-free after trim	Chasing ASI with elevator; establishing pitch by instruments only; inability to sense airspeed changes by sound and feel; never trimming
CRITICAL	**1.3 VSO held precisely (min safe airspeed = short-field approach speed); Emergency descent: correct POH/AFM config + POH airspeed (yellow arc start) executed immediately from memory**	**1.3 VSO ±5 kts; no mushing; no stall buffet; Emergency: correct config; POH/AFM airspeed held; both tasks on nearly every checkride**	**Airspeed below 1.3 VSO + mushing = stall risk; wrong emergency descent config; wrong airspeed (brief POH speed per airplane); student cannot execute emergency procedure from memory**
Descending Turns	Bank ≤30°; coordinated; nose lowered on entry; ball centered; constant bank maintained; rollout within ±10°; back-pressure released on recovery	±5° bank; ball centered; airspeed ±10 kts; rollout within ±10° of heading	Not lowering nose on entry (airspeed decays); skidding turns; excessive rudder from powered-flight habits; cross-controlling near ground
Level-Off	Level-off led by 10% of descent rate; power to cruise; nose raised; re-trimmed; altitude bust avoided	Target altitude ±100 ft; smooth transition; cruise power set; trimmed hands-off level flight established	Busting altitude; abrupt pitch change; forgetting to add power; not re-trimming; back-pressure from turn carried into level-off

KEY RULE ■ ACS S1: Perform straight descents and descending turns — airspeed ±10 kts, heading ±10°, bank ±5°, rollout within ±10°, coordinated throughout. This is a VISUAL task — nose below horizon (Fig. 3-22) is the reference; instruments cross-check only. 1.3 VSO = short-field approach speed = commonly failed checkride task. Emergency descent: configuration and airspeed per POH/AFM (typically start of yellow arc) — must be immediate and from memory.

Area IX, Task A — Steep Turns (ASEL)

FAA-S-ACS-25 • AI.IX.A • CFI Airplane — Flight Lesson

Objective

The applicant demonstrates instructional knowledge of steep turns by explaining the purpose, aerodynamics, and technique for 360° turns at approximately 50° of bank. The applicant demonstrates and simultaneously explains entry, maintenance, and rollout technique — using outside visual reference (nose AND wing on the horizon) as the primary control method and instruments for cross-check only — while identifying and correcting common errors per AFH Ch.10, pp. 10-1–10-2.

References

- FAA-S-ACS-25; FAA-H-8083-3 Ch.10 (Fig. 10-1, pp. 10-1–10-2); FAA-H-8083-25; POH/AFM

Delivery

- Ground brief 10–15 min: explain load factor, overbanking tendency, and visual reference technique using Fig. 10-1; brief airplane-specific entry speed (V_A), power addition, and trim technique. Instructor demonstrates left then right 360° while narrating nose + wing position on the horizon. Student flies both directions and verbalizes visual references throughout. Debrief: Were eyes outside? Bank held? Altitude within ±100 ft?

ACS Knowledge

Code	Element
AI.IX.A.K1	Purpose of and procedures for steep turns
AI.IX.A.K2	Pilot sensations and control forces
AI.IX.A.K3	Aerodynamics: coordinated flight, overbanking, V_A and weight, load factor, accel. stalls, rate/radius of turn
AI.IX.A.K4	Common errors related to this Task

ACS Risk Management

Code	Element
AI.IX.A.R1	Division of attention between aircraft control and orientation
AI.IX.A.R2	Collision hazards
AI.IX.A.R3	Low altitude maneuvering: stall, spin, or CFIT
AI.IX.A.R4	Distractions, task prioritization, loss of situational awareness, or disorientation
AI.IX.A.R5	Uncoordinated flight

ACS Skills

Code	Element
AI.IX.A.S1	Clear the area
AI.IX.A.S2	Establish manufacturer's recommended airspeed (or ≤ V_A)
AI.IX.A.S3	Roll into coordinated 360° steep turn at approximately 50° bank
AI.IX.A.S4	Perform the Task in the opposite direction
AI.IX.A.S5	Maintain entry altitude ±100 ft, airspeed ±10 kts, bank ±5°, roll out on entry heading ±10°
AI.IX.A.S6	Analyze and correct common errors related to this Task

Instructor Note: *BRIEF ON THE GROUND BEFORE FLIGHT: Confirm entry speed for today's gross weight (V_A changes with weight — lighter = lower V_A). Brief the RPM/MAP increase used on entry in this specific airplane to hold airspeed in the turn. If trim will be used, remind the student it must be fully removed on rollout or a pitch-up results. Show Fig. 10-1 and describe where the wing tip meets the horizon at 50° bank in this aircraft — students must know the visual picture before they attempt it.*

CRITICAL ■ VISUAL TASK — Use BOTH nose AND wing tip position relative to the horizon as primary pitch and bank reference. A pilot who watches only the nose will lose altitude; a pilot fixated on instruments cannot hold bank and heading. Eyes outside 90% of the time. OVERBANKING: hold deliberate opposite aileron to maintain 50° — the airplane will roll further without it. ADD POWER on entry — failure to add power causes simultaneous altitude and airspeed loss.

TECHNIQUE — ENTRY, BANK MAINTENANCE & ROLLOUT (K1–K4 / S1–S6)

Visual Reference — Fig. 10-1 (K2, K3)

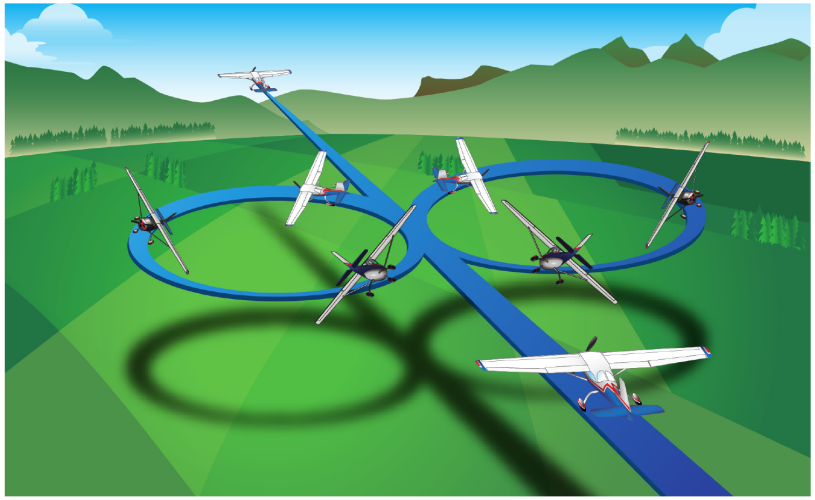


Fig. 10-1 — Steep turns: single and multiple 360° turns at 45°–60° bank. The pilot maintains orientation to outside ground references throughout. FAA-H-8083-3C, Ch. 10, p. 10-1.

- **Nose AND wing on the horizon:** At 50° bank, the nose traces well above the horizon. Watch both nose position (pitch) and the low wing tip (bank) relative to the horizon simultaneously. Do not chase instruments — establish the picture outside first, then cross-check.
- **Overbanking tendency (K3b):** Past ~30° of bank the outer wing accelerates and generates more lift, rolling the airplane further into the bank. Apply deliberate opposite aileron to hold 50°. Load factor at 50° ≈ 1.56g; at 60° = 2.0g. Above 60° approaches structural limits.

Instructor Note: *AIRPLANE-SPECIFIC — Entry speed, power increment, and trim technique vary by aircraft. Establish the correct V_A for today's weight, determine the RPM/MAP that holds airspeed in the turn, and decide whether trim will be used. Demonstrate the correct visual picture in this specific airplane before the student attempts the maneuver unsupported.*

Step-by-Step Procedure

- **1. Clear the area:** Two 90° clearing turns. Verify traffic above, below, and in the turn direction. Select a prominent horizon reference for rollout heading. Announce entry heading.
- **2. Set entry speed:** Slow to manufacturer's recommended speed or ≤ V_A for today's gross weight before beginning the bank.
- **3. Roll to 50° bank:** Smooth coordinated aileron and rudder. As bank passes ~30°, simultaneously increase back pressure and add power (briefed increment per airplane). Establish 50° (±5°) bank.
- **4. Hold bank and altitude:** Apply opposite aileron against overbanking tendency. Reference nose AND wing tip on the horizon for pitch and bank. Ball centered throughout. Trim if aircraft/instructor technique permits.
- **5. Nose-low recovery:** Minor deviation — elevator only, bank held. Significant nose-low — reduce bank FIRST then raise nose. Pulling elevator in a steep bank steepens the bank, it does NOT raise the nose.
- **6. Rollout:** Lead by ½ bank angle before entry heading (50° bank → lead 25°). Simultaneously reduce back pressure and power. Remove trim if used. Roll wings level on entry heading ±10°.
- **7. Opposite direction:** Establish entry speed and roll into 360° in the opposite direction using the same technique. Same power, same visual picture.

KEY RULE ■ Hold 50° bank with OPPOSITE AILERON. Add POWER on entry (per airplane). Reference NOSE + WING on the horizon — not the altimeter. Lead rollout by ½ bank angle (≈25°). Nose-low recovery: reduce bank first, THEN pull.

COMMON ERRORS (K4) — AFH P. 10-2 — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — STEEP TURNS (AI.IX.A.K4 | AFH p. 10-2)

ALTITUDE LOSS / GAIN	INSTRUMENT FIXATION	BANK ANGLE CREEP	POWER & TRIM ERRORS	ROLLOUT ERRORS
Most common steep turn failure. Nose drops causing rapid altitude loss, or student	*Student watches altimeter or VSI to control pitch instead of using outside visual reference.*	*Overbanking tendency causes bank to steepen past target. Student fails to hold opposite*	*Failure to add power on entry causes altitude and airspeed loss simultaneously. Forgetting to*	*Starting rollout too early or too late; failing to stop on entry heading; not reducing back*
• Nose AND wing tip on horizon = primary fix • Minor deviation: elevator only, hold bank • Significant nose-low: reduce bank FIRST	• Nose + wing tip on horizon = primary ref • Horizon tells you everything — look outside • AFH: 'Observe nose AND wings vs. horizon'	• Overbanking = deliberate opposite aileron needed • Hold ~50° (±5°) bank with aileron pressure	• Add power on entry — brief amount per airplane • Steep bank = increased induced drag	• Lead rollout by ½ bank angle (50° → 25° early) • Reduce back pressure as bank shallows

EVALUATION CHECKLIST — STEEP TURNS

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Setup & Entry	Two 90° clearing turns; entry speed ≤ V_A for gross weight; horizon reference selected; smooth coordinated roll-in to 50° with simultaneous back pressure and power addition	Clearing turns complete; entry speed ≤ V_A; smooth coordinated entry; power added before airspeed decays; 50° (±5°) bank established	Skipping clearing turns; exceeding V_A; rolling in without back pressure (immediate altitude loss); forgetting power; uncoordinated entry
CRITICAL	**Altitude ±100 ft throughout 360° in BOTH directions; bank 50° ±5° with opposite aileron against overbanking; visual reference used (nose AND wing on horizon); ball centered; airspeed ±10 kts; eyes outside 90%**	**Altitude ±100 ft; bank 50° ±5°; airspeed ±10 kts; ball centered; outside visual reference primary (not instruments)**	**Altitude loss/gain (most common); instrument fixation instead of outside reference; bank creep past 60° (overbanking not corrected); skidding or slipping; pulling elevator when nose-low in steep bank (spirals steeper)**
Rollout & Opposite Dir.	Rollout led by ½ bank angle before entry heading (50° → lead 25°); back pressure and power reduced simultaneously; trim removed if used; smooth transition to opposite direction; same entry technique re-applied	Rollout on entry heading ±10°; smooth coordinated rollout; power reduced as bank decreases; no significant altitude deviation on direction change	Rollout too early or too late; forgetting to reduce power (pitch-up); trim not removed; heading bust >10°; losing altitude through direction change
Error ID & Correction	Student verbalizes cause and correction for all K4 errors (AFH p. 10-2); instructor demonstrates an error in flight and student identifies and corrects	All 13 AFH errors named with cause and fix; in-flight correction applied promptly and smoothly without over-correcting	Unable to articulate error causes; over-corrects (chases altimeter); does not return eyes outside after instrument cross-check

KEY RULE ■ ACS S5: Entry altitude ±100 ft, airspeed ±10 kts, bank ±5°, roll out on entry heading ±10° — in BOTH directions. VISUAL task: nose AND wing on the horizon are primary; instruments cross-check only. Add power on entry; hold opposite aileron against overbanking; lead rollout by ½ bank angle (~25°).

Area IX, Task B — Steep Spiral (ASEL)

FAA-S-ACS-25 • AI.IX.B • CFI Airplane — Flight Lesson

Objective

The applicant demonstrates instructional knowledge of steep spirals by explaining the purpose, procedures, and aerodynamics of a gliding spiral of at least three 360° turns at a bank not exceeding 60°, maintaining a constant radius over a ground reference with wind-drift correction. The applicant explains the relationship to emergency landing procedures and demonstrates the maneuver while continuously scanning for traffic and using outside visual references as primary control. The maneuver concludes no lower than 1,500 ft AGL (ACS S6).

References

- FAA-S-ACS-25 AI.IX.B; FAA-H-8083-3 Ch.10 (Fig. 10-2, pp. 10-3–10-4); FAA-H-8083-25; POH/AFM

Delivery

- Ground brief 10–15 min: explain constant-radius concept, wind-correction technique, and relationship to power-off 180° landing. Show Fig. 10-2. Compute entry/rollout altitudes (entry ≥4,500–5,000 ft AGL; rollout ≥1,500 AGL). Demonstrate entry, three turns with narrated wind corrections, and rollout on heading. Student flies with verbal narration. Debrief: radius constant? Bank varied for wind? Eyes outside? Rolled out on heading?

ACS Knowledge

Code	Element
AI.IX.B.K1	Purpose of and procedures for a proper steep spiral
AI.IX.B.K2	Relationship to emergency landing procedures
AI.IX.B.K3	Maintaining a constant radius about a point
AI.IX.B.K4	Effects of wind on ground track and relation to ground reference
AI.IX.B.K5	Common errors related to this Task

ACS Risk Management

Code	Element
AI.IX.B.R1	Division of attention between aircraft control and orientation
AI.IX.B.R2	Collision hazards
AI.IX.B.R3	Low altitude maneuvering: stall, spin, or CFIT
AI.IX.B.R4	Distractions, task prioritization, loss of situational awareness, or disorientation
AI.IX.B.R5	Uncoordinated flight
AI.IX.B.R6	Effects of wind
AI.IX.B.R7	Airframe or airspeed limitations

ACS Skills

Code	Element
AI.IX.B.S1	Clear the area
AI.IX.B.S2	Select an altitude sufficient to continue through ≥3 turns of 360°
AI.IX.B.S3	Maintain steep spiral ≤60° bank; constant radius about reference
AI.IX.B.S4	Apply wind-drift correction; bank ≤60° at steepest point
AI.IX.B.S5	Divide attention: airplane control, traffic avoidance, ground track
AI.IX.B.S6	Airspeed ±10 kts; roll out on heading ±10°; complete ≥1,500 ft AGL
AI.IX.B.S7	Analyze and correct common errors related to this Task

Instructor Note: *WIND PICTURE BEFORE ENTRY — The steep spiral is specifically designed to set up a power-off 180° accuracy approach and landing. Before entry, positively identify wind direction and determine which heading will be upwind at rollout. This is not a coincidence — the whole point is to arrive wings-level on the upwind side of the runway at the right altitude for an immediate power-off approach. Steepen bank on downwind legs; shallow on upwind. A student who cannot identify wind direction on the ground cannot fly this maneuver successfully in the air.*

CRITICAL ■ CLEAR THE AREA — This maneuver descends approximately 3,000 feet. You MUST clear for traffic above, below, and in the entire spiral path before entry. Failure to clear is an immediate checkride failure (ACS S1). COMPLETE NO LOWER THAN 1,500 FT AGL — Know your field elevation and compute the rollout altitude before you start. Running the maneuver to the ground is the other most common checkride bust (ACS S6). VISUAL REFERENCES AND TRAFFIC SCAN ARE VITAL — Eyes outside throughout all three turns. Use the ground reference and horizon as primary inputs; instruments are a cross-check only.

TECHNIQUE — ENTRY, WIND CORRECTION, CONSTANT RADIUS & ROLLOUT (K1–K5 / S1–S7)

Wind Correction — Fig. 10-2 (K3, K4)

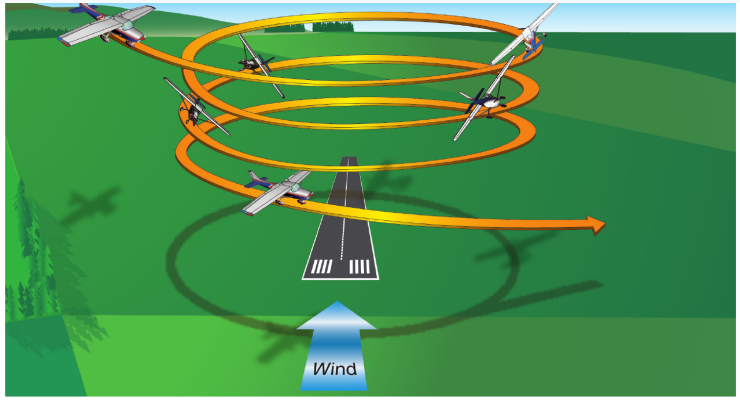


Figure 10-2. *Steep spiral.*

10-3

Fig. 10-2 — Steep spiral: at least three 360° turns at idle power, maintaining a constant radius over a reference point. Bank steepens on downwind, shallows on upwind. Complete no lower than 1,500 ft AGL. FAA-H-8083-3C, Ch. 10, p. 10-3.

- **Constant radius = variable bank:** Steepen bank downwind (wind pushes radius out); shallow upwind (wind pulls radius in). Same principle as turns around a point — but at a gliding descent. Continuously adjust bank to keep the reference at a fixed visual angle.
- **Airspeed management (K1, R7):** Bank changes shift pitch — steepening drops the nose slightly, shallowing raises it. Anticipate with back pressure as bank steepens. Advance throttle 2–3 sec periodically to prevent engine cooling and spark plug fouling at prolonged idle.

> ***Instructor Note:*** *AIRPLANE-SPECIFIC — Confirm glide speed for today's weight before flight. Brief carb heat before closing throttle on entry. Demonstrate the visual picture of the reference point before student attempts unsupported.*

Step-by-Step Procedure

- **1. Clear the area:** Two 90° clearing turns — check traffic above, below, and throughout the full spiral path. Verify entry altitude allows ≥3 turns completing ≥1,500 ft AGL (≈4,500–5,000 ft AGL recommended). Identify reference point; note wind direction.
- **2. Set entry config:** Reduce to idle; apply carb heat if equipped. Establish glide speed before beginning bank. Note entry heading — also the rollout heading.
- **3. Roll into spiral:** Smooth coordinated roll to initial bank over reference point. Immediately begin wind correction — steepen downwind, shallow upwind. Bank ≤60° always.
- **4. Fly three turns:** Continuously vary bank for constant radius. Scan traffic every turn — all altitudes. Ground reference + horizon = primary control inputs. Note altitude lost per revolution. Announce altitude each turn.
- **5. Monitor altitude:** Advance throttle 2–3 sec periodically to prevent engine cooling. DO NOT descend below 1,500 ft AGL. Plan rollout altitude before starting.
- **6. Rollout:** On entry heading or briefed object — smooth coordinated roll to wings level while restoring cruise power. Roll out within ±10° (ACS S6). Transition to normal cruise.

KEY RULE ■ Steepen bank DOWNWIND, shallow UPWIND — constant radius = variable bank. Complete ≥1,500 ft AGL. Eyes outside: reference + traffic every turn. Airspeed ±10 kts throughout. Rollout on entry heading ±10°.

COMMON ERRORS (K5) — AFH PP. 10-3–10-4 — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — STEEP SPIRAL (AI.IX.B.K5 | AFH pp. 10-3–10-4)

AREA CLEARING & ALTITUDE	WIND CORRECTION & RADIUS CONTROL	AIRSPEED CONTROL	TRAFFIC SCAN & VISUAL REF	ENTRY / ROLLOUT ERRORS
Failure to properly clear for traffic before entry and failure to monitor altitude loss. Descending	*Failure to vary bank angle for wind results in an oval ground track instead of a constant radius*	*Airspeed fluctuates as bank angle changes with wind correction. Student must anticipate pitch*	*Students go heads-down chasing airspeed or instruments and lose traffic awareness. Visual*	*Poor entry airspeed setup, abrupt bank establishment, failure to roll out on the briefed*
• Clear thoroughly: above, below, in spiral path • Know MSL entry altitude AND field elevation AGL	• Steepen bank downwind, shallow upwind • Radius set by distance from reference point • Bank not to exceed 60° at any point (ACS	• Glide speed established BEFORE beginning bank • Pitch up slightly when steepening bank	• Eyes outside for ground track and traffic • Use reference point and horizon, not instruments	• Establish glide speed BEFORE rolling in • Smooth coordinated roll to bank angle • Note entry heading and reference object

EVALUATION CHECKLIST — STEEP SPIRAL

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Setup & Entry	Two 90° clearing turns; entry altitude sufficient for ≥3 full turns completing ≥1,500 ft AGL; glide speed set before bank; carb heat ON; reference point selected; wind direction noted	Clearing turns complete; entry altitude confirms ≥1,500 AGL at rollout; glide speed established BEFORE bank; carb heat ON; wind direction briefed	Skipping area clearing (automatic failure); entry altitude too low; bank before glide speed set; forgetting carb heat; no wind awareness
CRITICAL	**Three complete 360° turns at constant radius; bank varies for wind (steepens downwind, shallows upwind); bank ≤60°; airspeed ±10 kts; traffic scan maintained; eyes outside as primary reference; complete NO LOWER than 1,500 ft AGL**	**Constant radius — variable bank for wind; bank ≤60°; airspeed ±10 kts; ≥3 full 360° turns; complete ≥1,500 ft AGL (ACS S3, S4, S5, S6)**	**Oval track (no wind correction); exceeding 60° bank; airspeed loss through bank changes; below 1,500 ft AGL (automatic failure); instrument fixation; failure to scan traffic**
Rollout & Recovery	Rollout on entry heading or briefed reference; smooth coordinated roll to wings level; power restored; airspeed maintained; no bust below 1,500 ft AGL	Rollout on entry heading ±10° (ACS S6); smooth coordinated transition; power restored; airspeed ±10 kts through rollout	Wrong heading rollout; abrupt rollout; forgetting power; heading bust >10°; descending through 1,500 AGL during rollout
Error ID & Correction	Verbalizes cause and correction for all K5 errors (AFH pp. 10-3–10-4); identifies wind effect on ground track; corrects in-flight demonstration	All AFH errors with cause and fix; wind correction principle articulated (downwind = steeper, upwind = shallower); in-flight corrections smooth and prompt	Cannot explain wind correction; over-corrects bank causing radius oscillation; does not recognize instrument fixation as error

KEY RULE ■ ACS S3/S4/S6: ≥3 full 360° turns; constant radius (variable bank for wind); bank ≤60°; airspeed ±10 kts; roll out on entry heading ±10°; complete no lower than 1,500 ft AGL. This maneuver directly sets up the power-off 180° — wind awareness and visual scanning are the foundation of every turn.

Area IX, Task C — Chandelle (ASEL)

FAA-S-ACS-25 • AI.IX.C • CFI Airplane — Flight Lesson

Objective

The applicant demonstrates instructional knowledge of chandelles by explaining the purpose, aerodynamics, and two-phase procedure of a maximum performance 180° climbing turn beginning from straight-and-level flight and concluding wings-level just above power-on stall speed. The applicant demonstrates the maneuver while simultaneously explaining technique, completing at or above 1,500 ft AGL.

References

- FAA-S-ACS-25 AI.IX.C; FAA-H-8083-3C Ch.10 (Fig. 10-3, pp. 10-4–10-5); POH/AFM

Delivery

- Ground brief 10–15 min: brief canyon scenario (see MAX PERFORMANCE note below), show Fig. 10-3, explain two phases. Confirm VA and max-performance RPM setting. Compute entry altitude (complete at or above 1,500 AGL). Demonstrate with narration; student calls out “90°” and “180°” during practice. Debrief: Was pitch truly locked in Phase 2? Did it finish just above stall?

> ***Instructor Note:*** *BEFORE FLIGHT: Brief VA for today’s weight (VA decreases lighter). In fixed-pitch aircraft, brief max RPM without exceeding limits. Student must verbalize phase transitions during demonstration.*

KNOWLEDGE	
AI.IX.C.K1	Purpose of and procedures for chandelles
AI.IX.C.K2	Aerodynamics: (a) coordinated flight; (b) overbanking; (c) maneuvering speed and weight effects; (d) accelerated stalls
AI.IX.C.K3	Airplane configuration for maximum performance climb
AI.IX.C.K4	Proper pitch control for continuously decreasing airspeed
AI.IX.C.K5	Common errors related to this Task
RISK MANAGEMENT	
AI.IX.C.R1	Division of attention between aircraft control and orientation
AI.IX.C.R2	Collision hazards
AI.IX.C.R3	Low altitude maneuvering: stall, spin, or CFIT
AI.IX.C.R4	Distractions, task prioritization, situational awareness, or disorientation
AI.IX.C.R5	Uncoordinated flight
AI.IX.C.R6	Energy management
AI.IX.C.R7	Rate and radius of turn with confined area operations
SKILLS	
AI.IX.C.S1	Clear the area
AI.IX.C.S2	Select altitude: maneuver no lower than 1,500 ft AGL
AI.IX.C.S3–4	Establish entry config (flaps UP) at VA; roll to ~30° bank
AI.IX.C.S5	Apply full power + pitch; constant bank, decreasing airspeed to 90°
AI.IX.C.S6–7	Constant-rate rollout 90°–180°; maintain pitch; wings level at 180°±10° just above stall
AI.IX.C.S8	Resume straight-and-level with minimum altitude loss
AI.IX.C.S9	Analyze and correct common errors related to this Task

■ ***MAX PERFORMANCE:*** *CANYON SCENARIO — Brief this before every chandelle flight: “We’ve flown into a box canyon. Terrain ahead is rising and we cannot continue straight. The chandelle is our escape. We need to turn 180° while gaining the absolute maximum altitude possible — that means FULL THROTTLE from the moment we roll in. Not ‘a lot’ of power: MAXIMUM power. Every foot of altitude gained in that turn is the margin between clearing the terrain and hitting it.” This framing makes students understand WHY full throttle matters — not just as a test requirement.*

CRITICAL ■ FULL THROTTLE = MAX PERFORMANCE — Apply full throttle at entry and hold it throughout. PHASE 1 (0–90°): Roll to 30° bank; simultaneously apply full power and continuously increase pitch so maximum pitch-up attitude is reached at the 90° point. Bank held constant. PHASE 2 (90–180°): Pitch LOCKED at the 90° attitude — begin constant-rate rollout to wings level. Any pitch change in Phase 2 is a failure: increase = stall; decrease = wasted performance. Complete at 180° ±10°, airspeed just above power-on stall (ACS S7). Complete at or above 1,500 AGL.

TECHNIQUE — TWO-PHASE MAXIMUM PERFORMANCE CLIMB | AFH FIG. 10-3 (K1–K4 / S1–S9)

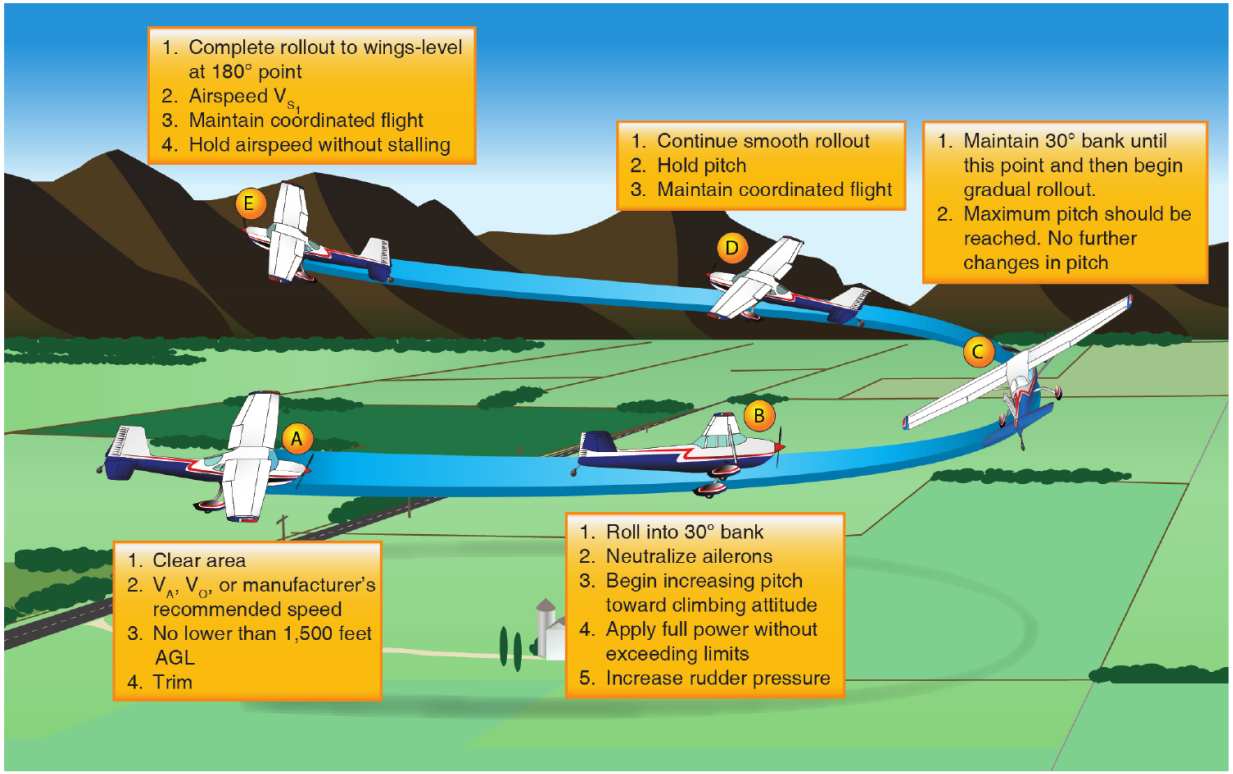


Figure 10-3. Chandelle. FAA-H-8083-3C, Airplane Flying Handbook, Ch. 10, p. 10-4. Published by the Federal Aviation Administration.

A — ENTRY	B — PHASE 1 0°–90°	C — 90° POINT LOCK PITCH	D — PHASE 2 90°–180°	E — 180° COMPLETE
Entry config; full throttle	*Constant bank; pitch continuously rising*	*Max pitch locked — rollout begins NOW*	*Constant pitch; constant-rate rollout*	*Wings level; just above power-on stall*
• Roll to 30° bank; neutralize ailerons	• 30° bank fixed — not steeper, not shallower	• Lock pitch — CRITICAL: no changes from here	• Pitch CONSTANT — use aileron for overbanking	• Wings level at 180° ±10° (ACS S7)
• FULL THROTTLE simultaneously with pitch-up	• Pitch attitude smoothly and continuously up	• Begin constant-rate bank rollout immediately	• Constant rate rollout — not rushed	• Airspeed: just above power-on stall speed
• Right rudder starts here; complete at or above 1,500 AGL	• Right rudder increases; max pitch at 90°	• Right rudder pressure is now greatest	• Left chandelle: max right rudder; near stall	• Hold nose-high; recover to cruise (S8)

KEY RULE ■ PHASE 1 (0–90°): Full throttle at entry; roll to 30° bank; pitch continuously UP at constant rate; right rudder builds; bank held constant. PHASE 2 (90–180°): Pitch LOCKED at 90° attitude; constant-rate rollout; right rudder greatest (left chandelle). Wings level at 180° ±10°, just above power-on stall. Minimum altitude loss on recovery.

PROCEDURE, COMMON ERRORS & EVALUATION — CHANDELLE (K1–K5 / S1–S9)

Step-by-Step Procedure

- **1. Clear the area (S1):** Two 90° clearing turns above, below, and in turn path. Confirm entry altitude allows completion at or above 1,500 AGL. Flaps UP, gear UP.
- **2. Entry (S2, S3):** Establish VA (or mfr. rec.) in S&L; or shallow dive. Brief direction of turn.
- **3. Phase 1 entry (S4, S5):** Roll to 30° bank; neutralize ailerons; simultaneously apply FULL THROTTLE and begin smooth continuous pitch-up. Right rudder progressively increases. Bank held at exactly 30°.
- **4. 90° point — Lock pitch (S6):** Maximum pitch reached — hold it. Begin constant-rate rollout immediately. Right rudder now at greatest pressure.
- **5. Phase 2 rollout (S6):** Pitch constant; constant-rate bank rollout. Airspeed approaching power-on stall. Aileron counters overbanking tendency.
- **6. 180° completion (S7, S8):** Wings level at 180° ±10°; just above power-on stall; hold nose-high momentarily; reduce pitch; restore cruise.

Technique Notes

- **Full throttle (K3, R6):** Fixed-pitch: max RPM within limits. Constant-speed: cruise/climb power. Do not reduce power mid-maneuver. This is the energy source for max altitude.
- **Overbanking tendency (K2b):** As airspeed decreases in Phase 2, the tendency to steepen the bank increases. Use aileron to hold the rollout rate constant.
- **Pitch discipline (K4):** The pitch rate during Phase 1 must be calibrated so maximum pitch arrives exactly at 90°. Practice the rate — not just the endpoint.
- **Accelerated stall risk (K2d):** Pulling excessive back pressure at high bank angles can produce an accelerated stall before the 90° point. Brief VA for the day.

KEY RULE ■ Full throttle from entry. Phase 1: 30° bank constant, pitch continuously UP. Phase 2: pitch LOCKED, constant-rate rollout. Complete: wings level 180° ±10°, just above power-on stall.

COMMON ERRORS (K5) — AFH P. 10-5

COMMON ERRORS — CHANDELLE (AI.IX.C.K5 | AFH p. 10-5)

BANK ANGLE CONTROL	PITCH MANAGEMENT	PHASE TRANSITION	RUDDER & COORDINATION	TRAFFIC & VISUAL REF
Too shallow = stall early. Too steep = fails max performance. Bank must be exactly 30° through	*Max pitch must be reached at the 90° point — no earlier, no later. Any pitch change in Phase 2*	*Rollout starts late or early from the 90° point. Wings must be level exactly at 180°. Constant*	*Right rudder progressively increases as airspeed decreases. Greatest demand during*	*Instrument fixation during Phase 2 when airspeed is near stall. Clear area on entry and*
• Too shallow (< 30°): stall before 180°	• Max pitch set exactly at 90° point (S5)	• Rollout begins at exact 90° point (S6)	• Right rudder builds from entry forward	• Two 90° clearing turns before entry (S1)
• Too steep (> 30°): insufficient alt gain	• Pitch too low: finishes above stall speed	• Constant rate — not rushed, not slow	• Max right rudder: left chandelle rollout	• Scan at 90° point before Phase 2
• Bank increasing after entry: wrong	• Pitch too high: stall before 180° (K2d)	• Wings level at 180° ±10° (ACS S7)	• Right chandelle: reduce right rudder	• Eyes outside — visual attitude reference

EVALUATION CHECKLIST — CHANDELLE

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Setup	Two 90° clearing turns; complete at or above 1,500 AGL; flaps UP, gear UP; VA set	Clears above/below/in path; VA before bank; config correct; altitude verified	Skips clearing; >VA entry; flaps out; no altitude check
CRITICAL	**FULL THROTTLE at entry; 30° bank held through Phase 1; pitch continuously increasing to max at 90°; Phase 2 pitch LOCKED; constant-rate rollout; progressive right rudder. Wings level 180° ±10° just above power-on stall (S4–S7).**	**Bank 30° ±5°; max pitch at 90°; pitch constant Phase 2; wings level 180° ±10°; just above power-on stall; coordinated**	**Bank wrong; pitch changes in Phase 2; rollout off-timing; airspeed well above stall; stall before 180°; not coordinated**
Recovery & Error ID	Hold nose-high at 180°; smooth pitch-down to cruise (S8); verbalizes K5 errors with cause and fix	Minimum altitude loss; smooth coordinated recovery; all AFH errors explained (K1–K5)	Abrupt pitch-down; altitude loss; cannot explain Phase 2 pitch lock; unaware of overbanking tendency

KEY RULE ■ ACS S4–S7: 30° bank; FULL THROTTLE; max pitch at 90°; pitch LOCKED Phase 2; wings level 180° ±10° just above power-on stall. MAX PERFORMANCE — the canyon demands it.

Area IX, Task D — Lazy Eights (ASEL)

FAA-S-ACS-25 • AI.IX.D • CFI Airplane — Flight Lesson

Objective

The applicant demonstrates instructional knowledge of the lazy eight by explaining its purpose as the only standard maneuver in which flight control pressures are constantly changing throughout execution. The maneuver develops mastery of the aircraft's aerodynamics and energy management across a continuously varying range of airspeeds, bank angles, and pitch attitudes. The applicant demonstrates symmetrical lazy eights using AFH Figure 10-4 reference points — completing at or above 1,500 ft AGL — while simultaneously providing effective flight instruction.

References

• FAA-S-ACS-25 AI.IX.D; FAA-H-8083-3C Ch.10 (Fig. 10-4, pp. 10-6–10-7); POH/AFM

Delivery

• Ground brief 10–15 min: explain the figure-8 pencil concept (see note below), show Fig. 10-4, explain all five key positions and what must be true at each. Confirm VA for today's weight. Compute entry altitude (complete at or above 1,500 AGL). Demonstrate with narration; student calls out "45°", "90°", "135°", "180°" during practice. Debrief: Was altitude and airspeed matched at the 180° point? Was the maneuver symmetric?

> ***Instructor Note:*** *BEFORE FLIGHT: Brief VA for today's weight (VA decreases at lighter weights). Pre-select three prominent reference points at 45°, 90°, and 135° on the natural horizon before beginning. Without these references the maneuver cannot be flown correctly. Student must verbalize each position during demonstration.*

KNOWLEDGE	
AI.IX.D.K1	Purpose of and procedures for lazy eights
AI.IX.D.K2	Aerodynamics: (a) coordinated flight; (b) overbanking tendency; (c) maneuvering speed and weight effects; (d) accelerated stalls
AI.IX.D.K3	Proper coordination across constantly changing airspeeds and attitudes
AI.IX.D.K4	Energy management: symmetrical altitude gain/loss across each 180° segment
AI.IX.D.K5	Common errors related to this Task
RISK MANAGEMENT	
AI.IX.D.R1	Division of attention between aircraft control and orientation
AI.IX.D.R2	Collision hazards
AI.IX.D.R3	Low altitude maneuvering: stall, spin, or CFIT
AI.IX.D.R4	Distractions, task prioritization, situational awareness, or disorientation
AI.IX.D.R5	Uncoordinated flight
AI.IX.D.R6	Energy management
AI.IX.D.R7	Rate and radius of turn
SKILLS	
AI.IX.D.S1	Clear the area
AI.IX.D.S2	Select altitude: maneuver no lower than 1,500 ft AGL
AI.IX.D.S3	Establish entry config (flaps UP) at VA or mfr. recommended speed
AI.IX.D.S4–5	45° point: max pitch-up; bank ~15° increasing
AI.IX.D.S6	90° point: max bank ~30°; pitch through level; min airspeed 5–10 kts above stall
AI.IX.D.S7	135° point: lowest pitch; bank ~15° decreasing; airspeed increasing
AI.IX.D.S8	180° point: wings level; same altitude and airspeed as entry
AI.IX.D.S9	Perform symmetrically; analyze and correct common errors

■ ***ENERGY & AERODYNAMICS:*** *PENCIL ON THE HORIZON — Brief this before every lazy eights flight: "Imagine a pencil lying flat on its side on the natural horizon. If you traced the path your wingtip traces through the sky from a pilot's-eye view, it would draw a sideways figure-8. The maneuver is named for this shape. The nose traces a lazy, continuous arc — always moving, never holding. There is no phase where anything is constant: bank, pitch, airspeed, and rudder pressure are ALL changing simultaneously, every moment of the maneuver. Mastery of lazy eights means mastery of the airplane." This framing helps students understand WHY this is the most demanding coordination maneuver.*

CRITICAL ■ SYMMETRY IS THE STANDARD — At each 180° completion point, the airplane must return to entry altitude (±100 ft ACS) and entry airspeed (±10 kts ACS). The altitude GAINED in the climb must EXACTLY equal the altitude LOST in the descent. Five reference positions govern the maneuver: 45° = max pitch-up (~15° bank, increasing); 90° = max bank (~30°), pitch through level, minimum airspeed (5–10 kts above stall); 135° = lowest pitch-down (~15° bank, decreasing); 180° = wings level, entry altitude and airspeed restored. Power and bank must be balanced so that energy gained equals energy lost across each loop. See AFH Figure 10-4.

TECHNIQUE — FIVE KEY POSITIONS | AFH FIG. 10-4 (K1–K4 / S1–S9)

climb; the second 90° is a descent. *[Figure 10-4]*

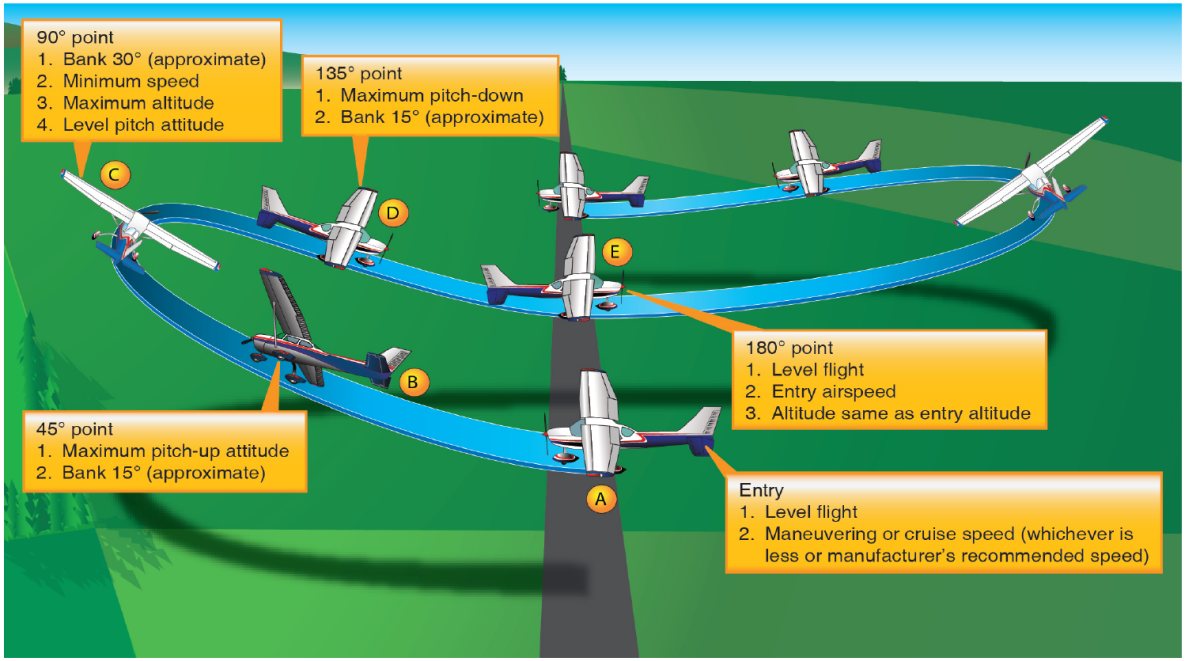


Figure 10-4. *Lazy eight.*

The previous description of a lazy eight and *figure 10-4* describe how a lazy eight looks from outside the flight deck and describes it as two 180° turns with altitude changes. How does it look from the pilot's perspective? Think of the longitudinal axis of the airplane

Figure 10-4. Lazy eight. FAA-H-8083-3C, Airplane Flying Handbook, Ch. 10, p. 10-6. Published by the Federal Aviation Administration.

ENTRY	45° POINT MAX PITCH-UP	90° POINT MAX BANK / MIN SPEED	135° POINT LOWEST PITCH	180° POINT LEVEL FLIGHT
S&L; flight; configure for entry	*Highest nose-up attitude; bank ~15° increasing*	*Pitch through level; max bank ~30°; min airspeed*	*Lowest nose-down attitude; bank ~15° decreasing*	*Wings level; entry altitude & airspeed; reverse*
• Flaps UP; establish VA or mfr. rec. speed	• MAX pitch-up reached HERE (S4–5)	• MAX bank ~30°; pitch through LEVEL (S6)	• LOWEST pitch attitude HERE (S7)	• Wings level; pitch level (S8)
• Pre-select 45°/90°/135° horizon refs	• Bank ~15° and slowly increasing	• Min airspeed: 5–10 kts above stall	• Bank ~15° decreasing; speed increasing	• Entry alt ±100 ft; entry speed ±10 kts
• Power set; begin gradual climbing turn	• Airspeed decreasing — add right rudder	• Peak right rudder; begin rollout	• Reduce right rudder; pitch rising back	• Reverse direction — begin second half

KEY RULE ■ 45°: max pitch-up, bank ~15° increasing, airspeed decreasing — add right rudder. 90°: max bank ~30°, pitch through level, minimum airspeed, max right rudder. 135°: lowest pitch, bank ~15° decreasing, airspeed increasing — reduce right rudder. 180°: wings level, entry altitude ±100 ft, entry airspeed ±10 kts. Reverse and repeat.

PROCEDURE, COMMON ERRORS & EVALUATION — LAZY EIGHTS (K1–K5 / S1–S9)

Step-by-Step Procedure

- **1. Clear & configure (S1–3):** Two 90° clearing turns above, below, in turn path. Flaps UP. Pre-select 45°/90°/135° horizon refs. Establish VA in level flight.
- **2. Entry (S4):** Begin gradual climbing turn with a slow rate of roll — so max pitch-up arrives at the 45° reference, not before it.
- **3. 45° point (S5):** Max pitch-up; bank ~15° increasing. Airspeed decreasing — add right rudder progressively for P-factor and adverse yaw.
- **4. 90° point (S6):** Max bank ~30°; pitch through level; min airspeed (5–10 kts above stall); peak right rudder. Begin rollout; pitch descending.
- **5. 135° point (S7):** Lowest pitch; bank ~15° decreasing; airspeed increasing — reduce right rudder. Pitch now rising back toward level.
- **6. 180° (S8):** Wings level; pitch level; airspeed and altitude match entry (±10 kts / ±100 ft). Immediately reverse for the second half.

Technique Notes

- **Always changing (K3):** Unlike any other maneuver, bank, pitch, and rudder are ALL changing simultaneously, every moment. Students who try to hold anything produce a rough, asymmetric result.
- **Energy symmetry (K4, R6):** Altitude gained in the climb must equal altitude lost. Consistent altitude gain at 180° = too much power or too shallow bank. Altitude loss = insufficient power or too steep bank.
- **Rudder (K3, R5):** Right rudder builds to peak at the 90° point, then reduces as airspeed returns. Rolling right at low airspeed + high power = greatest right rudder demand. Ball centered throughout.
- **Visual only (K1, R1):** Fly to preselected 45°/90°/135° horizon references. Instruments = cross-check only. Heads-down students lose timing and symmetry together.

KEY RULE ■ Lazy eight: pitch, bank, and rudder are ALWAYS changing. Symmetry = entry altitude ±100 ft and airspeed ±10 kts at each 180°.

COMMON ERRORS (K5) — AFH P. 10-7

COMMON ERRORS — LAZY EIGHTS (AI.IX.D.K5 | AFH p. 10-7)

ASYMMETRY ACROSS 180°	WRONG REFERENCE POINTS	PITCH FALLS THROUGH HORIZON	RUDDER MISMANAGEMENT	INSTRUMENT FIXATION
Altitude or airspeed at each 180° point does not match entry — the maneuver is not symmetrical.	*Pilot fails to preselect 45°/90°/135° horizon references — maneuver becomes reactive, not*	*At the 90° point, pilot allows pitch to drop rapidly through level — nose hunts, not a smooth arc.*	*Right rudder pressure not continuously adjusted — ball not centered as airspeed and bank*	*Pilot chases the airspeed indicator or altimeter instead of flying by outside visual reference.*
• Match entry altitude ±100 ft (ACS)	• Select 3 reference points before entry	• Lazy eight is a continuous smooth arc	• Right rudder INCREASES as speed drops	• All reference is VISUAL (K3, R1)

EVALUATION CHECKLIST — LAZY EIGHTS

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Setup	Two 90° clearing turns; at or above 1,500 AGL; flaps UP; VA set; 45°/90°/135° reference points pre-selected on horizon	Clears above/below/in path; VA before entry; altitude verified; three reference points named before maneuver begins	Skips clearing; >VA entry; no reference points selected; no altitude check
CRITICAL	**AFH Fig. 10-4 — 45°: max pitch-up, bank ~15° increasing. 90°: max bank ~30°, pitch through level, min airspeed (5–10 kts above stall). 135°: lowest pitch, bank ~15° decreasing. 180°: wings level, entry alt ±100 ft, entry speed ±10 kts. Coordinated throughout.**	**Bank ±10° at each key point; altitude ±100 ft at 180°; airspeed ±10 kts at 180°; ball centered; smooth continuous arc**	**Altitude not restored at 180°; pitch falls rapidly at 90°; incorrect bank at key points; ball not centered; rough controls**
Coordination, Energy & Error ID	Right rudder progressively applied and released; ball centered throughout; altitude gain = altitude loss across each 180°; verbalizes all 13 AFH common errors (K1–K5) with cause and correction	Ball centered at all positions; altitude ±100 ft / airspeed ±10 kts at 180°; smooth coordinated recovery; all AFH errors identified	Skidding at 90° (rudder); altitude consistently gained or lost (power/bank); rough controls; instrument fixation; cannot explain asymmetry causes

KEY RULE ■ ACS S4–S9: Symmetrical lazy eights — entry altitude and airspeed restored at each 180° point (±100 ft / ±10 kts). Five positions govern the arc: 45° max pitch-up | 90° max bank / min speed | 135° lowest pitch | 180° level entry. Controls are ALWAYS changing. This maneuver demonstrates mastery of the aircraft's aerodynamics and energy management.

Area IX, Task E — Ground Reference Maneuvers (ASEL)

FAA-S-ACS-25 • AI.IX.E • CFI Airplane — Flight Lesson

Objective

The applicant demonstrates instructional knowledge of ground reference maneuvers by explaining the purpose and procedures for the rectangular course, S-turns, and turns around a point. The applicant explains how wind affects the ground track and the required bank angle changes, and demonstrates each maneuver at 600–1,000 ft AGL while simultaneously providing effective flight instruction, maintaining altitude ±100 ft and airspeed ±10 kts throughout.

References

- FAA-S-ACS-25 AI.IX.E; FAA-H-8083-3C Ch.7 (Figs. 7-4, 7-5, 7-6); POH/AFM

Delivery

- Ground brief 10–15 min: explain wind effect on groundspeed and bank using the “downwind = faster = steeper” rule. Show Figs. 7-4, 7-5, 7-6. Identify wind direction before flight and ask student to predict which maneuver leg will require the steepest bank. Demonstrate each maneuver with narration. Debrief: Was the ground track constant? Did bank vary with groundspeed?

> ***Instructor Note:*** *BEFORE FLIGHT: Determine and brief wind direction and velocity. Ask: “Which leg/half will be downwind? Upwind? What bank do you expect to use on each?” This activates awareness before the maneuver begins. Students who cannot answer this correctly are not ready to fly it. Ensure a strong ground reference is pre-selected and visible from both sides of the aircraft.*

KNOWLEDGE	
AI.IX.E.K1	Purpose of and procedures for ground reference maneuvers
AI.IX.E.K2	Effects of wind on ground track and relation to a ground reference
AI.IX.E.K3	Effects of bank angle and groundspeed on rate and radius of turn
AI.IX.E.K4	Relationship of rectangular course to airport traffic pattern
AI.IX.E.K5	Common errors related to this Task
RISK MANAGEMENT	
AI.IX.E.R1	Division of attention between aircraft control and orientation
AI.IX.E.R2	Collision hazards
AI.IX.E.R3	Low altitude maneuvering: stall, spin, or CFIT
AI.IX.E.R4	Distractions, task prioritization, situational awareness, or disorientation
AI.IX.E.R5	Uncoordinated flight
SKILLS	
AI.IX.E.S1	Clear the area
AI.IX.E.S2	Select a suitable ground reference area, line, or point
AI.IX.E.S3a	Rectangular course: enter 45° to downwind, 600–1,000 ft AGL
AI.IX.E.S3b	S-turns: enter perpendicular to reference line, 600–1,000 ft AGL
AI.IX.E.S3c	Turns around a point: enter at appropriate distance, 600–1,000 ft AGL
AI.IX.E.S4	Apply wind-drift correction to maintain constant ground track or constant radius
AI.IX.E.S5	S-turns: reverse over reference line; Turns around point: complete in specified direction
AI.IX.E.S6	Divide attention between aircraft control, traffic avoidance, and ground track; maintain coordinated flight
AI.IX.E.S7	Maintain altitude ±100 ft; maintain airspeed ±10 kts
AI.IX.E.S8	Analyze and correct common errors related to this Task

■ ***CORE CONCEPT:*** *All three ground reference maneuvers share a single governing principle: GROUNDSPEED CHANGES CONTINUOUSLY as the aircraft flies relative to the wind. Downwind = fastest groundspeed = STEEPEST bank required to hold constant radius or distance. Upwind = slowest groundspeed = SHALLOWEST bank required. A student flying constant bank in a crosswind will ALWAYS produce a distorted ground track. Teach them to watch the reference and continuously ADJUST bank to chase the correct track — this is not a formula, it is a visual skill developed through practice.*

CRITICAL ■ EVALUATOR SELECTS AT LEAST ONE maneuver to demonstrate (ACS note). Prepare all three: rectangular course (K4 — directly relates to traffic pattern), S-turns (mirrors the real-world crosswind turn problem), turns around a point (360° constant-radius — the most demanding for wind correction). ACS standard: 600–1,000 ft AGL; altitude ±100 ft; airspeed ±10 kts. Entry: Rectangular 45° to downwind; S-turns perpendicular to reference line; Turns around a point from upwind side at appropriate distance.

MANEUVER 1 — RECTANGULAR COURSE | AFH FIG. 7-4 (K1, K2, K3, K4 / S1–S4, S6–S8)

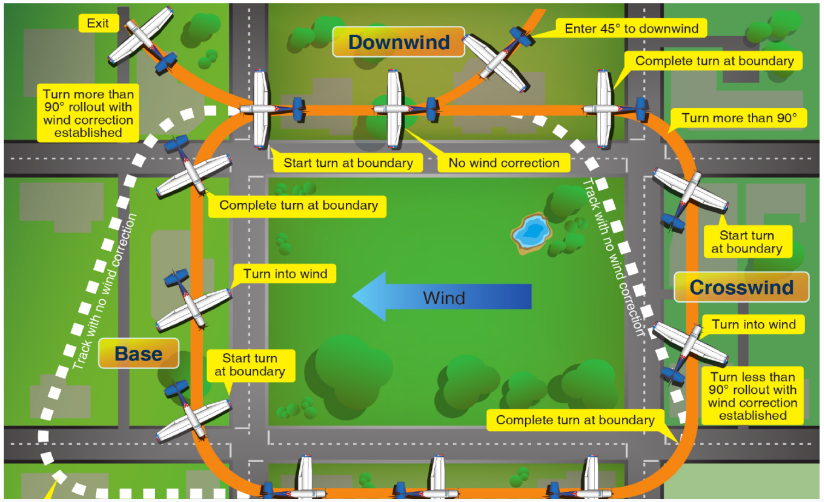


Fig. 7-4. Rectangular course. FAA-H-8083-3C Ch.7.

KEY RULE ■ Steeper bank at downwind corners (faster GS), shallower at upwind corners (slower GS). Crab on straight legs. Entry 45° to downwind. Alt ±100 ft; spd ±10 kts.

Procedure (S1–S4, S6–S8)

- **1. Setup (S1–3a):** Clearing turns; select square/rect field with defined boundaries. Note wind direction. Enter 45° to downwind corner, 600–1,000 ft AGL.
- **2. Downwind leg:** Fly parallel to boundary. Groundspeed highest here. STEEPER bank at downwind corners (>90° turn) — begin turn AT boundary.
- **3. Crosswind legs:** Crab INTO wind to track parallel/perpendicular. Without crab the airplane drifts off the rectangular path.
- **4. Upwind leg:** Groundspeed slowest. SHALLOWER bank at upwind corners (<90° turn). Crab maintains track parallel to boundary.
- **5. Maintain (S4, S6–8):** Alt ±100 ft, spd ±10 kts. Adjust bank each corner. Verbalize K4: this IS the traffic pattern.

Technique Notes

- **Corner bank (K3):** Four corners — four DIFFERENT bank angles. Steeper downwind (fast GS), shallower upwind (slow GS). No single bank fits all corners.
- **Traffic pattern (K4):** Rectangular course IS the traffic pattern. Downwind = fastest GS; base-to-final = slowest, shallowest turn. Brief this connection.
- **Entry (S3a):** 45° to downwind corner mirrors the 45° traffic pattern entry. Not arbitrary — it creates proper spacing from the start.

Instructor Note: *INSTRUCTOR: After the first downwind corner, ask the student: "Was that bank angle the same as you'll use on the upwind corner?" If they say yes, the corners are wrong. Tight downwind corners and gentle upwind corners are the visual signature of a well-flown course — identical to what a well-flown traffic pattern looks like.*

MANEUVER 2 — S-TURNS ACROSS A ROAD | AFH FIG. 7-6 (K1, K2, K3 / S1–3B, S4–8)

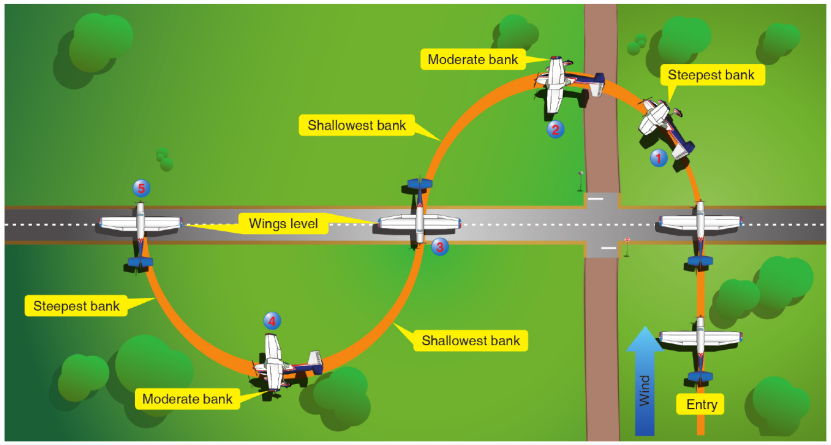


Fig. 7-6. S-turns across a road. FAA-H-8083-3C Ch.7.

KEY RULE ■ 1st semicircle downwind = enter STEEP, shallow to wings-level at road. 2nd semicircle upwind = enter SHALLOW, steepen to wings-level at road. Reversal EXACTLY over reference line. Equal circles = correct. Alt ±100 ft.

Procedure (S1–3b, S4–8)

- **1. Setup (S1–3b):** Clearing turns; select straight road/line. Enter PERPENDICULAR to road from upwind side, 600–1,000 ft AGL. First circle = downwind.
- **2. 1st semicircle — downwind (S4):** Cross road wings-level, immediately roll STEEP — GS is highest. Bank PROGRESSIVELY SHALLOWS toward upwind. Wings level as road is crossed again.
- **3. Reversal (S5):** Reverse DIRECTLY over the reference line — not before, not after. Wings level = reversal signal.
- **4. 2nd semicircle — upwind (S4):** Roll SHALLOW — GS is lowest. Bank PROGRESSIVELY STEEPENS toward downwind. Wings level at road.
- **5. Maintain (S6–8):** Equal-sized circles; road bisects both. Alt ±100 ft, spd ±10 kts. Debrief entry bank and reversal timing.

Technique Notes

- **Bank always changes (K3):** Neither semicircle has a constant bank. Steep-to-shallow downwind; shallow-to-steep upwind. Constant bank = unequal circles.
- **Entry bank is everything (K3):** Wrong entry bank cannot be corrected mid-circle. Teach students to think “downwind = steep entry, upwind = shallow entry” before rolling in.
- **Visual check (K2):** Both circles must be the same size, road bisects both. If one is larger, the entry bank on that side was wrong.

Instructor Note: *INSTRUCTOR: Before entry, ask: “Which side of the road are we crossing onto — downwind or upwind? What bank will you use?” A student who hesitates does not understand the concept yet. In strong winds the visual difference between the two entry banks is dramatic. If both entries look the same, the student is not correcting.*

MANEUVER 3 — TURNS AROUND A POINT | AFH FIG. 7-5 (K1, K2, K3 / S1–3C, S4–8)

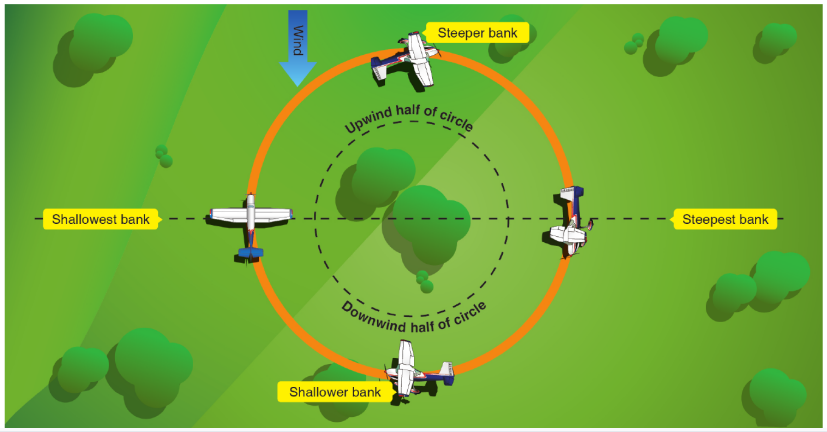


Fig. 7-5. Turns around a point. FAA-H-8083-3C Ch.7.

KEY RULE ■ Bank CONSTANTLY CHANGES throughout 360°. Steepest = wind directly behind; shallowest = wind directly ahead. Reference point fixed at wingtip. Crab applied continuously. Alt ±100 ft; spd ±10 kts.

Procedure (S1–3c, S4–8)

- **1. Setup (S1–3c):** Clearing turns; select prominent isolated reference (intersection, tree, corner). Enter from UPWIND side, ¼–½ mi radius, 600–1,000 ft AGL.
- **2. Entry (S4):** Roll into moderate bank. Reference point fixes at wingtip position. Low-wing: reference on lowered wing. Bank changes immediately.
- **3. Downwind half (S4):** GS increases — STEEPEN bank progressively. Steepest bank directly downwind. Add wind correction angle (crab) throughout.
- **4. Upwind half (S4):** GS decreases — SHALLOW bank progressively. Shallowest bank directly upwind. Continue crab to hold constant radius.
- **5. Complete & reverse (S5):** Complete 360° (or more). Reversal if requested by evaluator. Debrief: was radius constant? Was reference fixed?
- **6. Maintain (S6–8):** Alt ±100 ft, spd ±10 kts. Do NOT exceed 45° bank. If 45° insufficient: reference is too close, re-enter.

Technique Notes

- **Continuous bank change (K3):** Most demanding of the three maneuvers. Unlike rectangular corners, bank never holds constant — it is always in transition. Students who sense this for the first time often freeze.
- **Reference discipline (K2):** Point moves toward nose = too shallow (drifting out). Point moves toward tail = too steep (pulling in). The reference IS the bank indicator. Brief: “watch the point, move the bank.”
- **Crab + bank together (K2):** Constant-radius tracking requires BOTH varying bank AND varying crab. Students who only adjust bank will still drift.

Instructor Note: *INSTRUCTOR: The most common error is BREAKING VISUAL CONTACT with the reference. Once they look away, they cannot judge drift. Brief: “The reference is your only bank angle information. If it moves, you correct it. Do not look inside.” In gusty conditions bank adjustments will feel jerky — this is normal. Teach smooth corrections, not impulsive ones.*

WIND EFFECTS INSTRUCTOR GUIDE — WHERE STUDENTS STRUGGLE (K2, K3) | ALL THREE MANEUVERS

The visual differences caused by wind are the primary challenge of this task. Students who do not understand **why** the bank changes will not be able to **see** when their correction is wrong. Use this page as a briefing reference before flight, and as a debrief checklist after. The three-column table below shows exactly what changes, what the student sees, and what the most common error looks like for each maneuver.

RECTANGULAR COURSE	S-TURNS	TURNS AROUND A POINT
DOWNWIND LEG (faster groundspeed)	**DOWNWIND SEMICIRCLE (faster GS)**	**DOWNWIND HALF (steeper bank required)**
• Groundspeed fastest — drift toward field boundary • Steeper bank at downwind corner turns (>90° turn) • Crab heading INTO wind to track parallel to boundary • No wind correction needed on downwind leg itself	• Enter with STEEP bank — GS is highest at entry • Bank progressively SHALLOWS as heading turns into wind • Wings level directly over the reference line • First semicircle always looks wider than second	• Steepest bank abeam point with wind directly behind • Bank decreases continuously through crosswind to upwind • Wind correction angle (crab) applied throughout • Constant bank = circle drifts downwind of reference
UPWIND LEG (slower groundspeed)	**UPWIND SEMICIRCLE (slower GS)**	**UPWIND HALF (shallower bank required)**
• Groundspeed slowest — drift away from field boundary • Shallower bank at upwind corner turns (<90° turn) • Crab heading INTO wind to track parallel to boundary • Base-to-final turn: shallow and slow into the wind	• Enter with SHALLOW bank — GS is lowest at entry • Bank progressively STEEPENS as heading turns downwind • Wings level directly over the reference line • Reversal point MUST be exactly over the reference line	• Shallowest bank abeam point with wind directly ahead • Bank increases continuously through crosswind to downwind • Reference point must remain at constant wingtip position • If point moves inward → steepen bank; outward → shallow
VISUAL CUE FOR STUDENTS	**VISUAL CUE FOR STUDENTS**	**VISUAL CUE FOR STUDENTS**
• Downwind: field boundary moves TOWARD you → too much drift • Upwind: field boundary moves AWAY from you → drifting out • Crosswind: horizon reference tilted → crab angle needed • Corners: tight turn downwind, gradual turn upwind	• Both semicircles should be equal in size when done correctly • Downwind circle looks wider/flatter; upwind looks taller/narrower • Road should bisect each circle exactly in half • Entry bank sets the tone — correct it before completing the circle	• Reference point should stay at a FIXED wingtip reference • Point drifting inward → bank too shallow, add bank • Point drifting outward → bank too steep, reduce bank • The point dictates bank; wind dictates when bank changes
COMMON STUDENT ERROR	**COMMON STUDENT ERROR**	**COMMON STUDENT ERROR**
■ **Flies constant bank at ALL corners → produces an oval, not a rectangle** ■ **Starts turns too late on downwind → overshoots boundary** ■ **Forgets to crab on straight legs → drifts off parallel track**	■ **Enters both semicircles with same bank → unequal circles** ■ **Reverses turn BEFORE or AFTER the line → offset semicircles** ■ **Flies the entry heading instead of banking immediately**	■ **Holds constant bank throughout → circle drifts downwind** ■ **Looks AWAY from reference point to check instruments** ■ **Yaws toward point when it drifts instead of banking more**

■■ ***TEACH THIS FIRST:*** *Before demonstrating any ground reference maneuver, ask: "If the wind is from the west and we're flying a left rectangular course around that field — which leg are we on when groundspeed is fastest?" The student who can answer this understands the core concept. The student who cannot should not attempt the maneuver until they can. Ground reference maneuvers are a VISUAL task — students must be able to SEE drift, recognize the bank needed, and apply it continuously without instrument reference. If they are looking inside the cockpit, the maneuver has already failed.*

COMMON ERRORS (K5) — AFH CH.7 | EVALUATION CHECKLIST — ALL THREE MANEUVERS

COMMON ERRORS — GROUND REFERENCE MANEUVERS (AI.IX.E.K5 | AFH Ch.7)

NO WIND CORRECTION	ALTITUDE DRIFT	REFERENCE LOST	WRONG ENTRY POINT	UNCOORDINATED CORNERS
Student flies constant bank throughout all maneuvers, ignoring groundspeed changes • RECT: oval pattern, not rectangle • S-TURNS: unequal semicircles	*Student fixates on the ground reference and allows altitude to creep up or down during the* • Split attention: ground + altitude • Trim before entering maneuver	*Student loses sight of the ground reference (road, field, point) and cannot re-establish the* • Select PROMINENT reference only • Pre-brief reference before entry	*Student enters at wrong angle, wrong altitude, or wrong distance — making the maneuver setup* • RECT: enter 45° to downwind (S3a) • S-TURNS: enter perpendicular (S3b)	*Student skids through corners (especially downwind where bank is steeper) — ball not* • Steeper bank → more right rudder req. • Monitor ball throughout all turns

EVALUATION CHECKLIST — GROUND REFERENCE MANEUVERS (S1–S8)

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Setup (all)	Two 90° clearing turns; altitude 600–1,000 ft AGL; wind direction briefed; prominent reference pre-selected and visible from both sides of aircraft	Clears above/below/in turn path; altitude in range (S3); reference identified and visible; student can state which leg/half will require steepest bank	Skips clearing turns; reference too small or ambiguous; altitude below 600 AGL; no wind direction awareness before beginning
CRITICAL	**Wind-drift correction applied continuously: steeper bank downwind (faster GS), shallower bank upwind (slower GS). Crab applied on straight legs. Ground track is constant-radius or parallel to boundary throughout. Bank VARIES — not held constant. S-turns: reversal exactly over reference line.**	**Constant radius or parallel boundary track maintained (S4); bank visibly varies with groundspeed; crab applied on straight legs; reversal at reference line (S5); altitude ±100 ft; airspeed ±10 kts (S7); coordinated flight**	**Constant bank throughout (no wind correction); oval track or drifting circle; no crab on straight legs; S-turn reversal early/late; altitude exceedance; fixating on instruments instead of ground reference**
Rectangular Course	Downwind corners: steeper bank (>90° turn). Upwind corners: shallower bank (<90° turn). Crosswind legs: crab heading into wind. Turn begins AT boundary, not past it. Entry 45° to downwind leg.	Four distinct bank angles at corners (two steeper, two shallower); parallel boundary tracks on all four legs; corners start at boundary; entry at 45° to downwind (S3a); identifies traffic pattern relationship (K4)	Same bank at all corners; turns past boundary (late entry); no crab on straight legs; cannot relate maneuver to traffic pattern
S-Turns	1st semicircle (downwind): enter steep, shallow to wings-level at road. 2nd semicircle (upwind): enter shallow, steepen to wings-level at road. Reversal directly over reference line. Both circles equal in size.	Equal semicircles (same radius both sides); road bisects each circle; reversal at reference line (S5); entry bank visibly different for each circle; smooth bank transitions throughout	Identical entry bank both circles; reversal before/after line; unequal circle sizes; abrupt bank changes at reversal; loses reference line
Turns Around a Point	Bank changes continuously throughout 360°; steepest bank with wind directly behind, shallowest with wind directly ahead. Reference point remains at fixed wingtip position. Completes turns in direction specified by evaluator (S5).	Constant-radius circular track; bank clearly steeper on downwind half; reference point at consistent lateral position; no drift of circle across ground; coordinated throughout; altitude ±100 ft; airspeed ±10 kts (S7)	Constant bank → circle drifts downwind; reference point moves (inside/outside); yaws toward point instead of banking; breaks visual contact with reference; exceeds 45° bank (too close to reference)

KEY RULE ■ ACS AI.IX.E — All three maneuvers: 600–1,000 ft AGL; altitude ±100 ft; airspeed ±10 kts. CORE RULE: groundspeed varies with wind direction → bank must vary continuously. Downwind = fastest GS = steepest bank. Upwind = slowest GS = shallowest bank. Rectangular course = traffic pattern training. S-turns = reversal at reference. Turns around a point = constant-radius 360° with continuously changing bank.

Area IX, Task F — Eights on Pylons (ASEL, ASES)

FAA-S-ACS-25 • AI.IX.F • CFI Airplane — Flight Lesson | Required: Commercial ACS & CFI ACS

Objective

The applicant demonstrates instructional knowledge of eights on pylons by explaining the purpose, procedures, and aerodynamics of the maneuver — including pivotal altitude and how groundspeed variations due to wind continuously affect it. The applicant selects appropriate pylons, determines pivotal altitude, enters at maneuvering speed, and maintains the line-of-sight reference on the pylon using altitude (not bank or rudder), while simultaneously providing clear and effective flight instruction.

References

- FAA-S-ACS-25 AI.IX.F; FAA-H-8083-3C Ch.7 (Figs. 7-10 through 7-14); POH/AFM (VA, cruise power)

Delivery

- Ground brief 15–20 min: explain pivotal altitude formula ($GS^2 \div 15$), show Figs. 7-11, 7-12, 7-13. Ask student: “If reference line moves rearward, what do you do?” (Answer: DESCEND.) Compute pivotal altitude for the estimated cruise groundspeed. Show Fig 7-10 for maneuver shape. Demonstrate with full narration. Then have student fly while narrating aloud — CFI checkride requires talk-through.

> ***Instructor Note:*** *BEFORE FLIGHT: Have the student compute pivotal altitude for estimated groundspeed at cruise power (upwind and downwind). Brief the pylon selection criteria: same elevation, prominent, 3–5 seconds of straight-and-level flight between turns. Emphasize: “This maneuver is controlled with ALTITUDE. If the reference moves, the correction is always power and pitch — never rudder alone.”*

KNOWLEDGE	
AI.IX.F.K1	Purpose of and procedures for eights on pylons
AI.IX.F.K2	Aerodynamics: coordinated and uncoordinated flight
AI.IX.F.K3	Pivotal altitude and factors that affect it
AI.IX.F.K4	Effect of wind on ground track
AI.IX.F.K5	Phases of the maneuver from entry to recovery
AI.IX.F.K6	Common errors related to this Task
RISK MANAGEMENT	
AI.IX.F.R1	Division of attention between aircraft control and orientation
AI.IX.F.R2	Collision hazards
AI.IX.F.R3	Low altitude maneuvering: stall, spin, or CFIT
AI.IX.F.R4	Distractions, task prioritization, situational awareness, or disorientation
AI.IX.F.R5	Uncoordinated flight
AI.IX.F.R6	Energy management
AI.IX.F.R7	Emergency landing considerations
SKILLS	
AI.IX.F.S1	Clear the area
AI.IX.F.S2	Determine the approximate pivotal altitude
AI.IX.F.S3	Select suitable pylons with straight-and-level flight between them
AI.IX.F.S4	Enter in correct direction and position; appropriate altitude and airspeed
AI.IX.F.S5	Establish correct bank angle for conditions, not to exceed 40°
AI.IX.F.S6	Smooth continuous corrections to keep line-of-sight on pylon
AI.IX.F.S7	Divide attention between airplane control and outside visual references
AI.IX.F.S8	Maintain pylon position using appropriate pivotal altitude; avoid slips/skids
AI.IX.F.S9	Analyze and correct common errors related to this Task

■ ***CORE CONCEPT:*** *Eights on pylons is the only ground-reference maneuver where the pilot does NOT correct drift with bank or crab. Instead, the airplane is flown to a specific ALTITUDE — the pivotal altitude — at which the line-of-sight from the pilot’s eye to the wingtip tip stays parallel to the lateral axis, effectively “pinning” the pylon in place. The bank angle chosen sets the radius of turn but does NOT alter the pivotal altitude. Wind continuously changes groundspeed, so pivotal altitude continuously changes: downwind = higher GS = fly HIGHER; upwind = lower GS = fly LOWER. Every correction in this maneuver is a power/pitch (altitude) correction.*

CRITICAL ■ This task is REQUIRED for both the Commercial Pilot ACS and the CFI ACS (AI.IX.F). Prepare to DEMONSTRATE the maneuver to ACS standard AND to teach/talk through it simultaneously. On the CFI checkride, the evaluator will expect a verbal explanation of pivotal altitude, the formula, and the correction technique as the maneuver is flown. On the commercial checkride, bank is limited to 40° max (S5). Evaluator may select which pylon to orbit and which direction. Maintain pivotal altitude throughout; avoid slips/skids (S8).

PIVOTAL ALTITUDE — THE CORE CONCEPT | AFH FIGS. 7-10, 7-11, 7-12 (K3, S2)

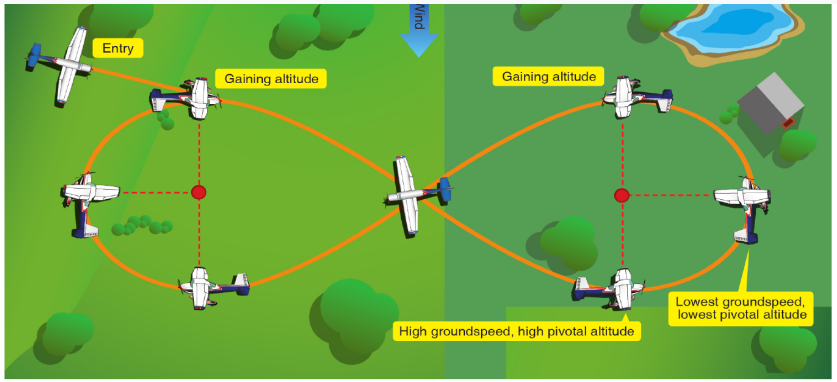


Figure 7-10. *Eights on pylons.*

Fig. 7-10. Eights on pylons overview. FAA-H-8083-3C Ch.7.

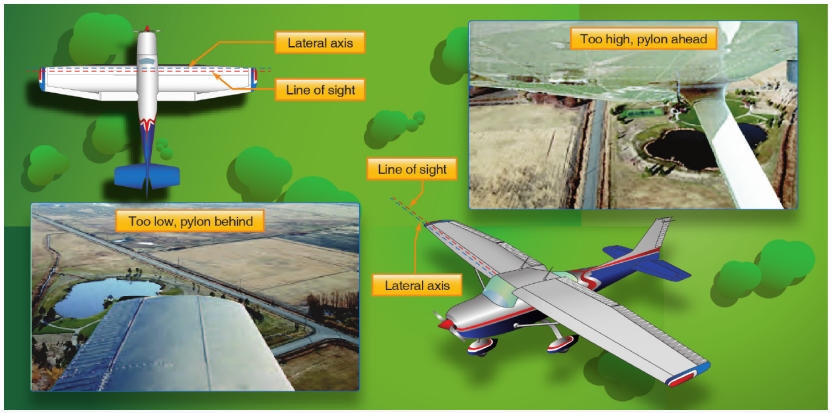


Fig. 7-11. Line of sight from pilot's eye to wingtip. FAA-H-8083-3C Ch.7.

KEY RULE ■ The line-of-sight from pilot's eye to wingtip must stay parallel to the lateral axis. At pivotal altitude this happens automatically. Above it: line moves rearward. Below it: line moves forward. Correct with altitude, never with rudder alone.

PIVOTAL ALTITUDE FORMULA

$GS^2 \div 15$ (groundspeed in knots, result in ft AGL above pylon MSL) $GS^2 \div 11.3$ (groundspeed in MPH)

Example: 100 kts → $100^2 \div 15$ = **667 ft AGL** above pylon elevation | Add pylon's MSL elevation to get target altimeter reading

Groundspeed		Approximate Pivotal Altitude
Knots	MPH	
87	100	670
91	105	735
96	110	810
100	115	885
104	120	960
109	125	1050
113	130	1130

Figure 7-12. *Speed versus pivotal altitude.*

Fig. 7-12. Speed vs. pivotal altitude. FAA-H-8083-3C Ch.7.

■ ***EFB NOTE:*** *STUDENT: Save Fig. 7-12 (above) to your EFB right now. Before every eights-on-pylons flight, look up your expected cruise groundspeed and read the approximate pivotal altitude directly from the table. Add the pylon's MSL elevation to get your target altimeter reading. This is your primary preflight planning tool for this maneuver.*

Pivotal Altitude: What Changes It

- **Groundspeed increases (downwind):** pivotal altitude INCREASES — fly higher
- **Groundspeed decreases (upwind):** pivotal altitude DECREASES — fly lower
- **Bank angle:** has NO effect on pivotal altitude (bank only changes turn radius)
- **Pylon elevation:** add MSL elevation of pylon to AGL pivotal altitude
- **Density altitude:** affects TAS/GS — use groundspeed, not indicated airspeed

LINE-OF-SIGHT CORRECTION | AFH FIG. 7-13 | ENTRY TO RECOVERY PROCEDURE (K5, S1–S9)

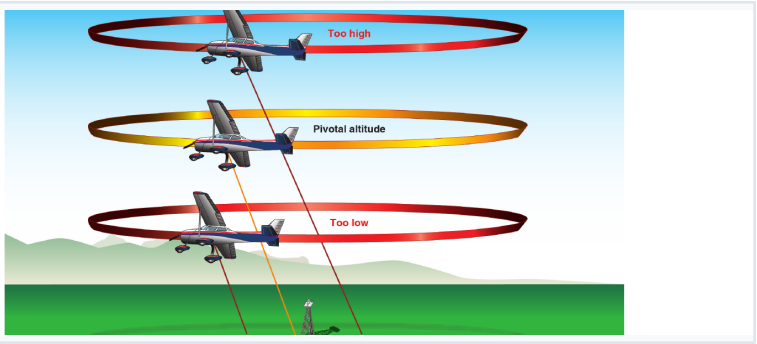


Fig. 7-13. Effect of different altitudes on line of sight. Too high → reference drifts rearward (descend). Too low → drifts forward (climb). Pivotal altitude → locked on pylon. FAA-H-8083-3C Ch.7.

KEY RULE ■ Reference drifts REARWARD → you are TOO HIGH → DESCEND. Reference drifts FORWARD → you are TOO LOW → CLIMB. At pivotal altitude the reference is locked. Every correction is power/pitch, not bank or rudder. This is the only maneuver controlled entirely by altitude.

Technique Notes (K3, K4, S6, S8)

- **Entry (K5):** Approach downwind pylon diagonally, descending to pivotal alt at VA. Roll in as pylon comes abeam. Narrate: “Descending to [X] ft MSL — that’s my pivotal altitude for this groundspeed.”
- **Correction call (S6, S8):** “Reference moving rearward — I’m too high. Reducing power slightly, descending to re-capture the pylon.” Never: “I’ll use rudder to push it back.”
- **Wind effect (K4):** Downwind turn = highest GS = highest pivotal alt. Upwind turn = lowest GS = lowest pivotal alt. Transition between pylons is where you climb or descend to the new pivotal altitude.
- **Bank angle (K2, S5):** Sets radius only. Steeper = tighter radius. Shallower = wider radius. Bank never changes pivotal altitude. Max 40°.

Procedure (S1–S9)

- **1. Preflight (S2–3):** Compute pivotal altitude: $GS^2 \div 15$. Add pylon MSL elevation to get altimeter target. Select two prominent pylons at same elevation with 3–5 sec straight-and-level flight between them.
- **2. Clear the area (S1):** Two 90° clearing turns. Check for traffic above, below, and in the turn direction. Confirm altitude, airspeed, config.
- **3. Entry (S4):** Approach downwind pylon on a diagonal, descending to pivotal altitude. Enter at VA. Roll into bank as pylon comes abeam wingtip.
- **4. Pylon 1 — downwind (S5–8):** Bank ≤40°. Lock line-of-sight on pylon. GS is highest here — fly at highest pivotal altitude. Correct altitude (power/pitch) when reference drifts. Coordinated throughout.
- **5. Straight-and-level (S3):** Roll out smoothly toward second pylon. 3–5 sec of level flight. Adjust altitude downward slightly for upwind pivotal altitude — GS will be lower on the next turn.
- **6. Pylon 2 — upwind (S5–8):** GS is lowest — slightly lower pivotal altitude. Roll in as pylon comes abeam. Lock reference. Altitude corrections as needed. Coordinated. Repeat as desired.
- **7. Recovery (S4, S9):** Roll wings level on a cardinal heading. Resume cruise altitude and power. Debrief: was reference locked? Did altitude vary between pylons? Were all corrections altitude-based?

CRITICAL ■ If the student instinctively yaws or banks toward the pylon when it drifts, STOP the maneuver and return to ground briefing. This is a conceptual failure, not a technique error. The student must internalize: “Reference moves → altitude correction, not bank.” Show Fig. 7-13 again before the next attempt.

BANK ANGLE VS. PIVOTAL ALTITUDE | AFH FIG. 7-14 | CFI TEACHING GUIDE (K2, K3, K4)

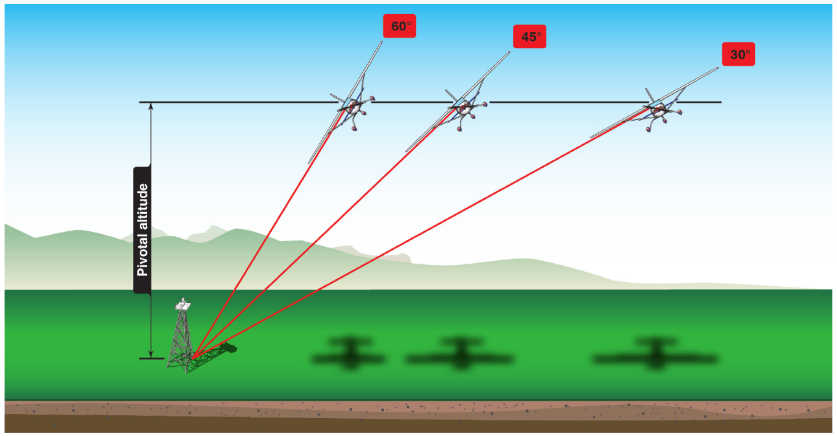


Figure 7-14. *Bank angle versus pivotal altitude.*

Fig. 7-14. Bank angle vs. pivotal altitude. All three bank angles orbit the same pylon at the same pivotal altitude. Bank changes radius, not altitude. FAA-H-8083-3C Ch.7.

KEY RULE ■ All three airplanes in Fig. 7-14 are at the SAME pivotal altitude despite different bank angles. Steeper bank = tighter radius = closer to pylon. Shallower bank = wider radius = farther from pylon. The pivotal altitude is a function of GROUNDSPEED ONLY — not bank. Brief this figure before every student's first attempt.

Ground Brief Sequence for CFI

- **Step 1:** Show Fig. 7-13 — "Reference moving back means you're too high. Reference moving forward means you're too low."
- **Step 2:** Show Fig. 7-12 table, compute pivotal altitude together. Ask student to add pylon MSL elevation to get altimeter target.
- **Step 3:** Show Fig. 7-14 — "Bank angle doesn't change anything about pivotal altitude. It only changes your radius."
- **Step 4:** Show Fig. 7-10 — brief entry point, straight-and-level segment, and why we enter on a downwind diagonal.
- **Step 5:** Ask student: "If the wind is from the west, which pylon turn will require a higher pivotal altitude?" (Downwind/eastbound turn.)

CFI Talk-Through Script (Demonstrate)

As you fly, narrate each phase out loud. This is exactly what the CFI evaluator expects to hear during the checkride. Customize to your airplane's numbers.

- **Pre-entry:** "I'm setting up on the downwind side. My groundspeed is approximately [X] kts, so pivotal altitude is about [$X^2 \div 15$] feet AGL, which puts my altimeter at [Y] ft MSL. I'm at maneuvering speed, VA, and descending to pivotal altitude now."
- **Rolling in:** "As the pylon comes abeam my wingtip, I'm rolling into a [X]° bank — keeping it under 40°. My reference is the wingtip-to-pylon line of sight, and right now it looks — locked. The pylon is pivoting under my wingtip. I'm not using rudder to steer toward it — the altitude is doing the work."
- **Correction:** "The reference just drifted slightly rearward — that tells me I'm a little too high. I'm adding a touch of forward pressure and reducing power slightly to descend 20–30 feet. There — reference is locked again."
- **Straight-and-level:** "Rolling out now. I have about 4 seconds to the next pylon. This is upwind, so my groundspeed will be lower — I'm descending slightly to the lower pivotal altitude for this turn. Adjusting power to hold VA."
- **Second pylon:** "Rolling in on the upwind pylon. Bank is the same, but I'm a little lower. Reference is locking in. The pylon appears fixed under my wingtip."

Debrief Checklist

- Did the reference line stay locked on the pylon, or did it drift forward/backward?
- Did altitude vary between the two pylons (downwind = higher, upwind = lower)?
- Was bank within 40°? Was flight coordinated throughout (S5, S8)?
- When the reference drifted, was the correction altitude-based or rudder-based?
- Did the student successfully narrate the maneuver during the second attempt?

COMMON ERRORS (K6) — AFH CH.7 | EVALUATION CHECKLIST (S1–S9)

COMMON ERRORS — EIGHTS ON PYLONS (AI.IX.F.K6 | AFH Ch.7)

CHASING PYLON WITH RUDDER/BANK	WRONG PIVOTAL ALTITUDE	ALTITUDE NOT ADJUSTED FOR WIND	UNCOORDINATED FLIGHT	POOR PYLON SELECTION
Student tries to yaw or bank toward the pylon instead of correcting altitude. This is the most	*Student computed or estimated incorrect pivotal altitude. Either enters at wrong height or fails to*	*Student holds constant altitude throughout both turns. Wind changes GS continuously — pivotal*	*Student slips or skids around the pylon. Especially common when entering steep banks*	*Student selects pylons too close together (no straight-and-level flight between), at different*
• Reference line moving back → DESCEND	• Compute before flight: GS² ÷ 15	• Downwind = higher GS = FLY HIGHER	• R5: uncoordinated flight is a risk item	• S3: straight-and-level flight between pylons
• Reference line moving fwd → CLIMB	• Add pylon MSL elevation (not just AGL)	• Upwind = lower GS = FLY LOWER	• Monitor ball throughout both turns	• Pylons should be at same elevation

EVALUATION CHECKLIST — EIGHTS ON PYLONS (AI.IX.F.S1–S9)

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Setup (S1–3)	Two 90° clearing turns; pivotal altitude computed (GS² ÷ 15 + pylon MSL); two suitable pylons selected at same elevation with sufficient straight-and-level flight between them; enters at maneuvering speed (VA)	Clears above/below/in turn direction; pivotal altitude calculated and stated (S2); pylons identified and at same elevation (S3); enters at VA from downwind diagonal (S4)	Skips clearing turns; fails to compute pivotal altitude before entry; pylons at different elevations or too close together; enters at incorrect airspeed or position
CRITICAL	**Line-of-sight reference from pilot's eye to wingtip stays locked on the pylon throughout both turns. When reference drifts, correction is ALTITUDE (power/pitch), not rudder or bank. Pivotal altitude varies between pylons: higher on downwind turn (higher GS), lower on upwind turn (lower GS). Flight is coordinated throughout (S8). Bank not to exceed 40° (S5). No slips or skids.**	**Reference line remains on or very near pylon continuously (S6, S8); altitude corrections observed (power and pitch changes) when reference drifts; flight coordinated, ball centered (S7, S8); bank ≤40° (S5); altitude lower on upwind pylon, higher on downwind pylon (K3, K4)**	**Chasing pylon with rudder instead of altitude; holding constant altitude throughout both turns (no wind-GS compensation); reference drifting uncorrected; slipping or skidding (ball deflected); bank exceeding 40°; looking inside at altimeter instead of outside at reference**
Pylon 1 (Downwind, S4–8)	Enters from downwind diagonal at pivotal altitude and VA. Rolls into bank as pylon comes abeam wingtip. Maintains reference with altitude corrections. GS is highest on this turn — pivotal altitude is at its highest.	Entry diagonal from downwind; rolls in with pylon abeam (not ahead/behind); reference locks within 90° of entry; altitude corrections visible when needed; bank ≤40°; coordinated throughout	Enters crosswind instead of diagonal; rolls in late (pylon already past); no altitude adjustment when reference drifts; uses opposite rudder to push reference back to pylon
Straight & Level (S3)	Rolls out smoothly toward second pylon. Adjusts power and pitch to reach upwind pivotal altitude (slightly lower) before rolling into second turn. 3–5 seconds of wings-level flight between pylons.	Rolls out on correct heading toward second pylon; altitude adjustment visible between pylons; airspeed maintained near VA; coordinated rollout	Climbs or dives abruptly during transition; arrives at second pylon at wrong altitude; no altitude adjustment between turns despite groundspeed change
Pylon 2 (Upwind, S4–8)	Rolls in at slightly lower pivotal altitude (lower GS on upwind leg). Maintains reference with altitude corrections. Same bank angle as first turn. Completes full turn and rolls out smoothly on exit heading.	Lower pivotal altitude observed vs. first pylon; reference locks on pylon; same bank angle used; altitude corrections applied when reference drifts; smooth rollout on completion; coordinated throughout (S7–8)	Holds same altitude as downwind pylon (no groundspeed compensation); reference drifts rearward and student does not correct; uncoordinated flight on rollout; forgets to scan for traffic during second turn

KEY RULE ■ ACS AI.IX.F — Pivotal altitude = GS² ÷ 15 (knots) + pylon MSL elevation. CORRECTION IS ALTITUDE, not bank or rudder. Reference line moves rearward → DESCEND. Reference line moves forward → CLIMB. Bank ≤40°; no slips or skids. Downwind turn = higher GS = higher pivotal altitude. Upwind turn = lower GS = lower pivotal altitude. Save Fig. 7-12 to EFB for preflight planning. Required on both Commercial and CFI ACS.

Area X, Task A — Maneuvering During Slow Flight (ASEL)

FAA-S-ACS-25 • AI.X.A • CFI Airplane — Flight Lesson

Objective

The applicant demonstrates instructional knowledge of maneuvering during slow flight by explaining purpose, aerodynamics, and technique for maintaining flight at airspeeds just above the stall warning in various configurations. The applicant demonstrates and simultaneously explains coordinated straight-and-level flight, turns, climbs, and descents — managing AOA, power, trim, and rudder — while identifying and correcting common errors per AFH Ch.5, pp. 5-9–12.

References

- FAA-S-ACS-25; FAA-H-8083-3C Ch.5 (Fig. 5-7, pp. 5-9–12); FAA-H-8083-25; AC 61-67; POH/AFM

Delivery

- Ground brief 10–15 min: cover backside-of-power-curve, AOA-airspeed relationship, and config-change effects using Fig. 5-7. Brief target airspeed (+5/-0 kts) and right rudder. Instructor demonstrates straight-and-level, turns, climbs, descents narrating every input. Student flies and verbalizes. Debrief: Clearing done? AOA anticipated? Altitude ±50 ft? Airspeed above target?

ACS Knowledge

Code	Element
AI.X.A.K1	Purpose of and procedures for proper slow flight
AI.X.A.K2	Aerodynamics: AOA, airspeed, load factor, power setting, weight/CG, attitude, and yaw effects in various configurations
AI.X.A.K3	Common errors related to this Task

ACS Risk Management

Code	Element
AI.X.A.R1	Inadvertent slow flight and flight with a stall warning — could lead to LOC
AI.X.A.R2	Range and limitations of stall warning indicators (buffet, stall horn, etc.)
AI.X.A.R3	Uncoordinated flight
AI.X.A.R4	Environmental elements on performance (turbulence, microbursts, high density altitude)
AI.X.A.R5	Collision hazards
AI.X.A.R6	Distractions, task prioritization, loss of situational awareness, or disorientation

ACS Skills

Code	Element
AI.X.A.S1	Clear the area
AI.X.A.S2	Select entry altitude ≥ 1,500 ft AGL (ASEL/ASES) or 3,000 ft AGL (AMEL/AMES)
AI.X.A.S3	Establish and maintain airspeed at which any increase in AOA, load factor, or reduction in power would result in a stall warning
AI.X.A.S4	Accomplish coordinated straight-and-level, turns, climbs, and descents without a stall warning
AI.X.A.S5	Maintain altitude ±50 ft; heading ±10°; airspeed +5/-0 kts; bank ±5°
AI.X.A.S6	Analyze and correct common errors related to this Task

CRITICAL ■ CLEAR THE AREA — Two 90° clearing turns before every entry, no exceptions. Slow flight = low airspeed + heads-down instrument attention = elevated collision risk. GROUND BRIEF: Show Fig. 5-7; establish target speed (VSO+5–10 kts, landing config); brief +5/-0 kt ACS tolerance (below target = stall warning = task failure); sequence: power back → pitch up → configure incrementally → trim → maneuver. ANTICIPATE AOA CHANGES — Every time you dirty the aircraft (flaps/gear) or reduce RPM/MP, the AOA shifts. Apply back pressure or power BEFORE the stall horn sounds. Failure to anticipate is the #1 teaching error in slow flight.

TECHNIQUE — ENTRY, CONFIGURATION, MANEUVERING & RECOVERY (K1–K3 / S1–S6)

Flight Regime — Fig. 5-7 (K1, K2)



Figure 5-7. *Slow flight—low airspeed, high angle of attack, high power, and constant altitude.*

Fig. 5-7 — Slow flight: low airspeed, high angle of attack, high power setting, and constant altitude. FAA-H-8083-3C, Ch. 5, p. 5-11.

- **Backside of the power curve (K2):** In slow flight below L/D_{MAX}, pitch controls airspeed and power controls altitude — the reverse of cruise flight. A pitch increase slows the airplane; a power increase raises altitude without significantly changing speed. Students accustomed to cruise logic will initially do this backwards.
- **AOA and configuration (K2):** Each incremental flap extension and gear extension increases AOA at a given airspeed. As RPM or MP is reduced, the stall margin shrinks. The pilot must ANTICIPATE each change and apply compensating pitch or power BEFORE the stall warning activates. AFH: 'A pilot should anticipate the changes to the AOA as the landing gear and flaps are retracted.'

Instructor Note: *AIRPLANE-SPECIFIC — Target slow flight speed varies by aircraft and configuration. In the Cessna 172, landing config (full flaps) slow flight is typically flown around 50–55 KIAS. Determine the actual stall warning onset speed in today's weight and configuration, then add 5–10 knots for the target. Demonstrate the right rudder amount needed at full power — it surprises students every time.*

Step-by-Step Procedure

- **1. Clear the area:** Two 90° clearing turns. Verify traffic above, below, left, and right. Announce entry. Select altitude ≥1,500 ft AGL. Do not skip this step.
- **2. Reduce power:** From cruise, smoothly reduce throttle (RPM or MP) to approximately 1,500 RPM or per POH guidance for slow flight entry. Simultaneously increase back pressure to hold altitude as airspeed decays. Trim throughout.
- **3. Configure (anticipate AOA changes):** As airspeed slows to gear extension speed, extend gear if applicable. Add flaps in increments per POH. With EACH configuration change, ANTICIPATE the increase in AOA and apply appropriate back pressure and/or power to hold altitude. Do not wait for the stall horn.
- **4. Establish target airspeed:** Adjust power to hold altitude at target slow flight speed (VSO+5–10 kts or per POH). Right rudder to keep ball centered. Trim to relieve control pressure.
- **5. Maneuver:** Perform coordinated straight-and-level, medium-banked turns (≈20°), climbs (add power — more right rudder), and descents (reduce power — adjust pitch). Maintain altitude ±50 ft, airspeed +5/-0 kts, heading ±10°. Respond immediately to any stall warning.
- **6. Recovery:** Add power smoothly. As airspeed increases, apply forward pressure to reduce AOA. ANTICIPATE flap retraction changes: retract flaps incrementally and hold altitude. Return to cruise configuration and trim.

KEY RULE ■ PITCH controls airspeed; POWER controls altitude in slow flight. ANTICIPATE AOA changes with every config change and every RPM/MP reduction — do not wait for the stall warning. RIGHT RUDDER increases with power. Airspeed tolerance is +5/-0 kts — going below target = task failure.

COMMON ERRORS (K3) — AFH P. 5-12 — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — MANEUVERING DURING SLOW FLIGHT (AI.X.A.K3 | AFH p. 5-12)

FAILURE TO CLEAR AREA	AOA NOT ANTICIPATED	INADEQUATE BACK PRESSURE	RUDDER & COORDINATION	POWER MANAGEMENT
Skipping clearing turns before entering slow flight. Student becomes fixated on airspeed and	*Student fails to anticipate AOA changes as flaps/gear are extended or retracted, or as*	*As power is reduced during entry, student fails to increase back-elevator pressure to maintain*	*At high power and high AOA, P-factor, torque, and slipstream create strong left-yaw. Failure to*	*Inadequate power management: too little power causes altitude loss; too much causes climb*
• Two 90° clearing turns — every time, no exceptions	• Each notch of flap increases AOA at same speed	• Power reduction = immediate back pressure needed	• Right rudder increases with power AND AOA • Ball centered throughout all configurations	• Power = altitude in slow flight (not pitch) • Large power inputs cause disproportionate

EVALUATION CHECKLIST — MANEUVERING DURING SLOW FLIGHT

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Setup & Entry	Two 90° clearing turns; altitude ≥1,500 ft AGL; power reduced with simultaneous back pressure; trim throughout; gear/flaps extended incrementally with AOA anticipated at each step	Clearing turns complete; ≥1,500 ft AGL; no stall warning during config; target airspeed +5/-0 kts established	Skipping clearing turns; stall warning on entry (AOA not anticipated); excessive pitch up → climb then rapid airspeed decay
CRITICAL	**Altitude ±50 ft, airspeed +5/-0 kts, heading ±10°, bank ±5° throughout S&L;, turns, climbs, descents — NO stall warning; ball centered; trim used; stall warning responded to immediately**	**Altitude ±50 ft; airspeed +5/-0 kts (no stall warning); heading ±10°; bank ±5°; ball centered**	**Stall warning activated (most common bust); altitude >50 ft deviation; airspeed below target; uncoordinated flight; instrument fixation**
Config Changes	Each flap/gear extension/retraction anticipated; back pressure or power applied BEFORE stall warning; no altitude loss or stall warning through any configuration change	No stall warning during any config change; altitude ±50 ft through entire sequence; airspeed +5/-0 kts	Stall warning on flap extension; altitude loss on flap retraction; abrupt flap changes causing pitch oscillation
Recovery & Error ID	Power added smoothly; forward pressure to reduce AOA; flaps retracted incrementally; altitude maintained through recovery; return to cruise; student verbalizes cause and fix for all K3 errors	No stall warning during recovery; altitude held through config cleanup; all K3 errors named with cause and correction	Abrupt power → pitch-up; full flap retraction at once (altitude loss); failure to trim; cannot explain why stall warning activated

KEY RULE ■ ACS S5: Altitude ±50 ft, heading ±10°, airspeed +5/-0 kts (NOT ±5 kts), bank ±5°. PITCH = airspeed; POWER = altitude. CLEAR THE AREA before every entry — two 90° turns, no exceptions. ANTICIPATE AOA changes with every configuration change and RPM/MP reduction — never wait for the stall warning.

Area X, Task B — Flight at Different Airspeeds and Configurations (ASEL)

FAA-S-ACS-25 • AI.X.B • CFI Airplane — Flight Lesson

Objective

The applicant demonstrates instructional knowledge of how airspeed and configuration changes affect aircraft performance by flying a four-phase sequence — full flaps at Vref, two-flap setting (+10 kts), one-flap setting (+10 kts), then clean cruise — while narrating the aerodynamic cause-and-effect of each transition, maintaining attitude, altitude, and an active traffic scan throughout.

References

- FAA-S-ACS-25; FAA-H-8083-3C Ch.5; FAA-H-8083-25; POH/AFM

Delivery

- Brief the four phases, expected airspeeds, and narration expectations on the ground. CFI demonstrates first — narrating at every transition. Student flies second, verbalizing throughout. Debrief: Was each phase trimmed? Altitude held? Scan maintained? Explanation clear and accurate?

ACS Knowledge

Code	Element
AI.X.B.K1	Purpose of and procedures for flight at different airspeeds and configurations
AI.X.B.K2	Aerodynamic effects of changing airspeed and configuration: drag, lift, power required, attitude, and trim changes
AI.X.B.K3	Common errors related to this Task

ACS Risk Management

Code	Element
AI.X.B.R1	Inadvertent entry into parameters that could lead to loss of control
AI.X.B.R2	Impact of distractions, task prioritization, or fixation during multi-task demonstration
AI.X.B.R3	Collision hazards — traffic scan required throughout all phases
AI.X.B.R4	Environmental factors: density altitude, turbulence, and their effect on performance

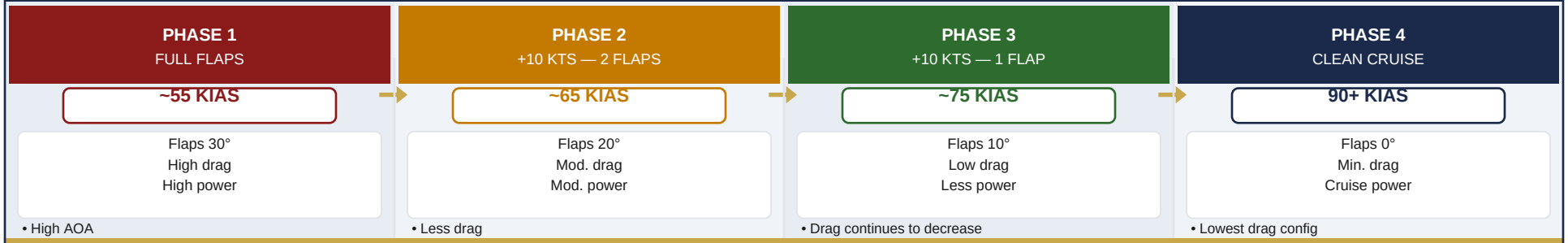
ACS Skills

Code	Element
AI.X.B.S1	Clear the area before the demonstration
AI.X.B.S2	Select entry altitude ≥ 1,500 ft AGL
AI.X.B.S3	Establish and maintain each airspeed and configuration combination
AI.X.B.S4	Narrate the aerodynamic effects at each phase transition
AI.X.B.S5	Maintain altitude ±100 ft, heading ±10° throughout all phases
AI.X.B.S6	Analyze and correct common errors

CRITICAL ■ NARRATE WHILE YOU FLY — This task is an add-on to slow flight. The examiner is listening for cause-and-effect: why does power increase going from Phase 4 to Phase 1? Why does pitch attitude change with each flap notch? Why does trim change? Silence = no evidence of instructional knowledge. Brief students: ‘At every config change, I will explain what just changed and why.’ ALSO: Altitude and traffic scan must be maintained throughout — this is NOT a heads-down exercise.

TECHNIQUE — FOUR-PHASE DEMONSTRATION SEQUENCE (K1–K3 / S1–S6)

DEMONSTRATION SEQUENCE — CONFIG & AIRSPEED PROGRESSION (AI.X.B)



NARRATE AT EACH PHASE: Explain what is changing and WHY — drag, lift, power required, attitude, trim

Step-by-Step Procedure

- **Setup:** Clear area (two 90° clearing turns). Select ≥1,500 ft AGL. Brief the sequence and narration expectations.
- **Phase 1 — Full Flaps:** Slow to Vref (Vso × 1.3, full flaps per POH). Establish stabilized flight. Trim for hands-off. Announce: 'Phase 1 — full flaps.' Narrate: drag, power required, pitch attitude, proximity to stall.
- **Phase 2 — 2 Flaps (+10 kts):** Retract to second-notch flap setting. Accelerate +10 kts. Re-establish level flight. Trim. Narrate: flap drag reduction, power reduction, pitch attitude change, trim shift.
- **Phase 3 — 1 Flap (+10 kts):** Retract to first-notch flap setting. Accelerate another +10 kts. Re-establish. Trim. Narrate: continued drag reduction, power further reduced, nose lower, further trim change.
- **Phase 4 — Clean Cruise:** Retract all flaps. Accelerate to cruise. Trim. Narrate: minimum drag configuration, lowest power required for level flight, normal cruise attitude restored.
- **Throughout all phases:** Maintain altitude ±100 ft; heading ±10°. Scan for traffic between each transition. Do not rush — stabilize and trim each phase.

What to Narrate — Each Phase

- **Drag:** 'Flaps create induced and parasite drag. Full flaps = maximum drag, requires the most power to maintain altitude. Each notch I retract, drag decreases.'
- **Power:** 'As drag decreases with each retraction, I reduce power to stay level. By cruise, I need significantly less power than in Phase 1.'
- **Pitch attitude:** 'Flaps increase lift at a given speed, allowing a lower pitch attitude. As I retract flaps, lift decreases — I must raise pitch slightly or accelerate.'
- **Trim:** 'Each config and speed change shifts the pitch moment. I must retrim after every transition — the airplane should fly hands-off before I move to the next phase.'
- **Traffic scan:** 'Between each phase I look up, scan the horizon, clear left and right. I never sacrifice situational awareness for airspeed management.'

KEY RULE ■ ATTITUDE + TRIM first, then verify airspeed. Stabilize and trim hands-off at each phase before transitioning. Narrate cause-and-effect at every change — drag, power, pitch, trim. Traffic scan between every transition.

COMMON ERRORS (K3) — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — FLIGHT AT DIFFERENT AIRSPEEDS AND CONFIGURATIONS (AI.X.B.K3)

FAILURE TO NARRATE	CHASING AIRSPEED	ALTITUDE DEVIATION	TRAFFIC SCAN NEGLECTED	NOT TRIMMED EACH PHASE
Flying the sequence correctly but staying silent. Examiner cannot evaluate instructional	*Fixating on the airspeed indicator instead of establishing attitude and trim. Results in*	*Losing or gaining altitude during config changes. Config change shifts pitch moment, student*	*Student becomes heads-down during airspeed/config transitions. This is a multi-task*	*Moving to the next phase without trimming for hands-off flight. Holding control pressure forces*
• Verbalize at every config change • Explain: drag, power, attitude, trim	• Attitude first, then verify airspeed • Trim for hands-off each phase	• Expect pitch change with each flap notch • Apply pressure before altitude deviates	• Scan outside between every transition • Clear before each config change	• Trim after every config & speed change • Verify: hands-off for 3-5 seconds

EVALUATION CHECKLIST — FLIGHT AT DIFFERENT AIRSPEEDS AND CONFIGURATIONS

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Setup & Entry	Two 90° clearing turns; ≥1,500 ft AGL; sequence briefed; entry established	Clearing complete; altitude set; student briefed on narration expectations	Skipping clearing turns; no brief before starting sequence
Phase 1 Full Flaps	Stabilized at Vref; trimmed hands-off; narrates drag/power/attitude	Level flight ±100 ft; airspeed per POH; trimmed; verbal explanation provided	Silent flying; not trimmed; altitude deviation on flap extension
Phases 2 & 3 Flap Retractions	Each retraction accompanied by power/pitch adjustment; re-trimmed; effect explained verbally; traffic scan between phases	±100 ft altitude; ±10° heading; airspeed +10/-0 kts; trimmed each phase	Ballooning on flap retraction; altitude loss; no narration; skipping trim
CRITICAL	**NARRATE AT EVERY TRANSITION — explain drag, power, pitch attitude, and trim change at each of the four phases while simultaneously maintaining attitude and scanning for traffic**	**Clear, accurate verbal cause-and-effect at each phase; altitude ±100 ft throughout**	**Flying silently; fixating on instruments; narrating without maintaining altitude**
Phase 4 Clean Cruise	Clean config achieved; cruise speed established; trimmed; summary narration of full sequence completed	Cruise config; altitude ±100 ft; heading ±10°; trimmed; summary provided	Forgetting to summarize; rushing cleanup; not re-trimming

KEY RULE ■ ACS S3–S5: Establish and maintain each airspeed/config combination; altitude ±100 ft, heading ±10°. ACS S4: Narrate aerodynamic effects at every transition — drag, lift, power required, pitch attitude, trim. Trim for hands-off at each phase. Traffic scan is required throughout — this is a multi-task demonstration.

Area X, Task C — Power-Off Stalls (ASEL)

FAA-S-ACS-25 • AI.X.C • CFI Airplane — Flight Lesson

Objective

The applicant demonstrates instructional knowledge of power-off stalls by explaining the purpose, aerodynamics, and technique for configuring the airplane in a landing configuration, establishing a stabilized descent per POH/AFM, transitioning to a stall attitude, and executing the proper recovery sequence. The applicant explains the direct connection between this maneuver and go-around procedures, and demonstrates while simultaneously explaining coordinated flight, recovery sequencing, and common error identification per AFH Ch.5, p. 5-17.

References

- FAA-S-ACS-25; FAA-H-8083-3C Ch.5 (Fig. 5-11, p. 5-17); AC 61-67; FAA-H-8083-25; POH/AFM

Delivery

- Ground brief 10–15 min: cover AOA and approach-to-stall aerodynamics, POH/AFM entry sequence, and recovery procedure using Fig. 5-11. Emphasize: this stall simulates an inadvertent approach stall — the recovery IS the go-around. Brief the go-around connection explicitly. Instructor demonstrates, narrating every step. Student flies and verbalizes. Debrief: Was a stabilized descent established first? Proper sequencing? Recovery AOA first?

ACS Knowledge

Code	Element
AI.X.C.K1–K2	Purpose and procedures; aerodynamics of stall — AOA, airspeed, load factor, power, weight/CG, attitude, yaw
AI.X.C.K3–K4	Stall characteristics by design; recognition by sight/sound/feel; factors leading to power-off stall and prevention
AI.X.C.K5–K6	Fundamentals of stall recovery; common errors related to this Task

ACS Risk Management

Code	Element
AI.X.C.R1	Factors and situations leading to inadvertent power-off stall, spin, and LOC-I
AI.X.C.R2–R3	Range and limitations of stall warning indicators; stall warnings during normal operations
AI.X.C.R4–R5	Stall recovery procedure (AOA before power); secondary, accelerated, and cross-control stalls
AI.X.C.R6	Environmental elements on performance (turbulence, microbursts, high density altitude)
AI.X.C.R7–R8	Collision hazards; distractions, task prioritization, loss of SA, and disorientation

ACS Skills

Code	Element
AI.X.C.S1–S2	Clear the area; select entry altitude ≥1,500 ft AGL (ASEL/ASES)
AI.X.C.S3–S4	Configure in approach/landing config per evaluator; establish a stabilized descent; coordinated throughout
AI.X.C.S5–S6	Transition smoothly from approach attitude to stall pitch; maintain heading ±10° or bank ≤20° ±5°
AI.X.C.S7–S8	Acknowledge stall cues (buffet/horn); recover at first indication or full stall as directed by evaluator
AI.X.C.S9–11	Configure per POH/AFM; accelerate to Vx/Vy; return to altitude/heading/airspeed; correct common errors

CRITICAL ■ GO-AROUND CONNECTION — This stall simulates an inadvertent approach-to-landing stall. Teach students from day one: power-off stall recovery = go-around procedure. ESTABLISH THE DESCENT FIRST — Students must take their time: configure per POH/AFM (carb heat, throttle idle, gear, flaps in sequence), pitch down to approach attitude, let airspeed stabilize at approach speed, then SMOOTHLY raise the nose to induce the stall. DO NOT rush from cruise to stall pitch. AFH p. 5-17: ‘pitch down to normal approach attitude to maintain that airspeed’ BEFORE raising the nose. RECOVERY: Pitch forward to reduce AOA — power comes in almost simultaneously (attitude leads, power follows immediately). Level wings with coordinated rudder. Reconfigure per POH/AFM.

TECHNIQUE — ENTRY, DESCENT, STALL & RECOVERY — FIG. 5-11 (K1–K5 / S1–S11)

Power-Off Stall Sequence — Fig. 5-11 (K1, K2, K5)

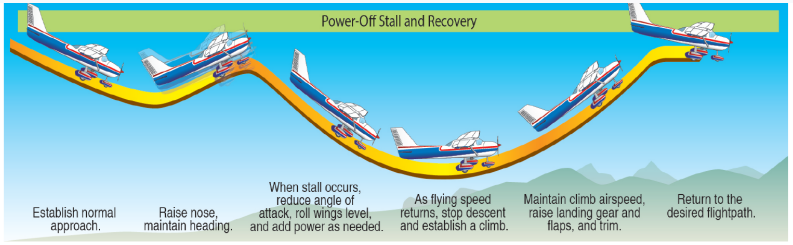


Figure 5-11. *Power-off stall and recovery.*

Fig. 5-11 — Power-off stall and recovery: establish normal approach, raise nose to stall, recover with forward elevator, wings level, power, reconfigure. FAA-H-8083-3C, Ch. 5, p. 5-17.

> ***Instructor Note:*** *GO-AROUND CONNECTION — Brief before every rep: 'This stall simulates an inadvertent approach stall. The recovery IS the go-around.' Reinforce after each recovery: 'That was your go-around — fly it exactly like that.'*

- **Establish descent first (S3–S4):** Follow full POH/AFM sequence: carb heat, throttle idle, gear, then flaps incrementally. Pitch DOWN to approach attitude; stabilize at approach speed; trim. Only after glide is stable should nose be raised. AFH: 'pitch to approach attitude to maintain airspeed' — THEN induce stall.
- **Aerodynamics (K2, K3):** Back pressure raises AOA toward critical angle. Stall horn/buffet = first cue. In turning stalls (base-to-final), uncoordinated flight stalls the inner wing first — potential spin precursor. Ball centered always.

Step-by-Step Procedure (S1–S11)

- **1. Clear the area:** Two 90° clearing turns. Check above, below, left, right. Announce entry. Select altitude ≥1,500 ft AGL (ASEL).
- **2. Configure per POH/AFM:** Carb heat (if applicable) → throttle idle → gear (if applicable) → flaps in landing config increments. Take your time — follow the sequence in order, do not shortcut.
- **3. Establish stabilized descent (S4):** Pitch DOWN to approach attitude. Let airspeed stabilize at Vref/approach speed. Trim. Ball centered. Verify the glide is stable BEFORE raising the nose.
- **4. Transition to stall (S5–S6):** Smoothly and progressively raise the nose from approach attitude. No snatching. Maintain heading ±10° (or bank ≤20° ±5°). Hold coordinated flight until stall warning or full stall as directed.
- **5. Recognize cues (S7):** Stall horn, buffet, mushy controls, reduced airflow sound. Verbalize: 'Stall — initiating recovery.'
- **6. Recover per POH/AFM (S8–S9):** (1) Pitch forward to reduce AOA below critical — eliminate stall warning. (2) Power comes in almost simultaneously — attitude leads, power follows immediately. (3) Level wings with coordinated aileron + rudder; right rudder for torque/P-factor. (4) Retract flaps/gear incrementally per POH. Accelerate to Vx or Vy.
- **7. Return (S10):** Climb to altitude; return to heading; trim for cruise.

KEY RULE ■ SEQUENCE: POH/AFM config → Stabilized descent → Smooth pitch up. RECOVERY: Pitch forward (AOA) — power almost simultaneously; attitude leads, power follows immediately. Wings level → Reconfigure per POH. This recovery IS the go-around — teach it that way every time.

COMMON ERRORS (K6) — AFH P. 5-21 — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — POWER-OFF STALLS (AI.X.C.K6 | AFH p. 5-21)

FAILURE TO CLEAR AREA	NOT ESTABLISHED ON DESCENT	IMPROPER RECOVERY SEQ.	UNCOORDINATED FLIGHT	ABRUPT CONTROL INPUTS
Skipping clearing turns before entry. Low-airspeed, nose-high attitude during stall	*Student rushes from cruise directly to stall pitch without getting established on a stabilized*	*Pilot adds power or levels wings BEFORE reducing AOA. Pulling back elevator while*	*Ball not centered during entry or recovery. Skidding turn from base to final is the most*	*Snatching elevator back to induce stall too aggressively. High airspeed + abrupt elevator =*
• Two 90° clearing turns — every time • Check above, below, left, right	• Configure per POH/AFM sequencing • Establish normal approach attitude & speed	• Pitch forward (AOA) — power almost simultaneously	• Ball centered throughout entire maneuver • Right rudder as power is added in recovery	• Smooth, progressive pitch increase to stall • Do not snatch elevator at cruise speed

EVALUATION CHECKLIST — POWER-OFF STALLS

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Setup & Clearing	Two 90° clearing turns; altitude ≥1,500 ft AGL; entry altitude and plan verbalized; traffic checked above, below, left, right before every entry	Clearing turns complete; ≥1,500 ft AGL; verbal intent announced; traffic scan confirmed	Skipping clearing turns; entering too low; not verbalizing entry intent
Config & Descent (S3–S4)	POH/AFM sequence followed: carb heat, throttle idle, gear, flaps in order; pitches DOWN to approach attitude; approach speed stabilized; descent established and trimmed BEFORE raising nose	Stabilized descent at approach speed prior to stall entry; all config steps completed per POH; ball centered throughout	Rushing from cruise directly to stall pitch; skipping POH sequencing; not establishing approach attitude first; flaps deployed out of order
CRITICAL	**STALL ENTRY — Smooth, progressive pitch increase from approach attitude; coordinated flight maintained (ball centered); heading ±10° (straight) or bank ≤20° ±5° (turning) until stall warning or full stall as directed; stall cues acknowledged verbally**	**Coordinated throughout; heading ±10° or bank ≤20° ±5°; stall warning or full stall achieved as specified; cues verbalized**	**Abrupt elevator input (accelerated stall risk); uncoordinated flight (spin risk); recovery before stall cue activated; heading deviation >10°; failure to verbalize**
Recovery Sequence	Recovery executed in proper sequence per POH/AFM: pitch forward to reduce AOA — power almost simultaneously (attitude leads); wings level; right rudder as needed; flaps/gear retracted incrementally; student verbalizes each step; no secondary stall	AOA reduced before power added; no secondary stall; altitude loss minimized; no uncoordinated flight during recovery	Adding power before reducing AOA (secondary stall risk); abrupt full flap retraction (altitude loss); uncoordinated recovery; failure to verbalize sequence
Go-Around Connection	Student can articulate that power-off stall recovery IS the go-around procedure; configures to Vx/Vy per POH after recovery; returns to specified altitude/heading; all K6 errors identified with cause and correction	Recovery completes as proper go-around; accelerates to Vx or Vy; altitude/heading/airspeed returned to specified; all K6 errors verbalized	Fails to connect recovery to go-around scenario; cannot identify common errors; returns to cruise without proper reconfiguration

KEY RULE ■ ACS S4: Establish a STABILIZED DESCENT first — POH/AFM sequence, approach attitude, approach speed. ACS S5: Transition SMOOTHLY from approach attitude to stall pitch — no abrupt inputs. ACS S8–S9: RECOVERY — Pitch forward to reduce AOA; power comes in almost simultaneously (attitude leads, power follows immediately). Wings level with coordinated rudder. Reconfigure per POH. This recovery IS the go-around — teach it that way every single time.

Area X, Task D — Power-On Stalls (ASEL)

FAA-S-ACS-25 • AI.X.D • CFI Airplane — Flight Lesson

Objective

The applicant demonstrates instructional knowledge of power-on stalls by explaining the purpose, aerodynamics, and technique for establishing a takeoff or departure configuration at no less than 65% power, transitioning smoothly to the stall attitude, and executing the proper recovery sequence. The applicant explains the critical relationship between uncoordinated flight and spin entry at the departure stall, demonstrates progressively increasing right rudder to counteract left-turning tendencies throughout the entry, and teaches students to recognize the stall by feel — not by the stall warning horn — per AFH Ch.5, Fig. 5-12, p. 5-20.

References

- FAA-S-ACS-25; FAA-H-8083-3C Ch.5 (Fig. 5-12, p. 5-20); AC 61-67; FAA-H-8083-25; POH/AFM

Delivery

- Ground brief 10–15 min: cover departure stall aerodynamics, left-turning tendencies at full power (P-factor, torque, slipstream, gyroscopic precession), the cross-control spin scenario, and recovery using Fig. 5-12. BRIEF THE SPIN SCENARIO before the first rep: ‘An uncoordinated departure stall at low altitude is how pilots spin into the ground.’ Instructor demonstrates with full narration of rudder inputs. Student flies and verbalizes. Debrief: Was ball centered? Did right rudder anticipate or chase? What was the first cue felt before the horn?

ACS Knowledge

Code	Element
AI.X.D.K1–K2	Purpose and procedures; aerodynamics of stall — AOA, airspeed, load factor, power, weight/CG, attitude, yaw effects (especially at high power)
AI.X.D.K3–K4	Stall characteristics by design; recognition by sight/sound/feel; factors leading to power-on stall (departure scenario) and prevention
AI.X.D.K5–K6	Fundamentals of stall recovery; common errors related to this Task

ACS Risk Management

Code	Element
AI.X.D.R1	Factors and situations leading to inadvertent power-on stall, spin, and LOC-I (esp. departure/climbing turns)
AI.X.D.R2–R3	Range and limitations of stall warning indicators; do not rely on horn alone — feel is primary
AI.X.D.R4–R5	Stall recovery procedure; secondary, accelerated, elevator trim, and cross-control stalls
AI.X.D.R6	Environmental elements on performance (turbulence, microbursts, high density altitude)
AI.X.D.R7–R8	Collision hazards (nose blocks view on entry); distractions, task prioritization, loss of SA

ACS Skills

Code	Element
AI.X.D.S1–S2	Clear the area; select entry altitude ≥1,500 ft AGL (ASEL/ASES)
AI.X.D.S3–S4	Establish takeoff/departure/cruise config per evaluator; set power ≥65%; coordinated throughout
AI.X.D.S5–S6	Transition smoothly to stall pitch; maintain heading ±10° or bank ≤20° ±10°
AI.X.D.S7–S8	Acknowledge stall cues (buffet/horn/feel); recover at first indication or full stall as directed
AI.X.D.S9–11	Configure per POH/AFM; accelerate to Vx/Vy; return to altitude/heading/airspeed; correct errors

CRITICAL ■ THREE NON-NEGOTIABLES FOR POWER-ON STALLS — (1) UNCOORDINATED FLIGHT = SPIN ENTRY: A skidding climbing turn into a departure stall is one of the most fatal accident patterns in general aviation. Brief the scenario every time: ‘Ball out of center + stall at low altitude = we spin into the ground.’ Ball centered is life safety, not technique. (2) ANTICIPATE RUDDER — DON’T CHASE IT: As power is applied and the nose rises, left-turning tendencies (P-factor, torque, slipstream, gyroscopic precession) increase continuously. Right rudder must increase PROGRESSIVELY from the moment of power application. Brief: ‘right foot follows the nose up.’ Students who wait for the yaw are already behind. (3) FEEL THE STALL — NOT THE HORN: Power-on stalls break more abruptly than power-off. Train students to feel mushy elevator, sluggish aileron response, and airframe buffet BEFORE the horn. The horn confirms what the hands should already know.

TECHNIQUE — ENTRY, CLIMB, STALL & RECOVERY — FIG. 5-12 (K1–K5 / S1–S11)

Power-On Stall Sequence — Fig. 5-12 (K1, K2, K5)

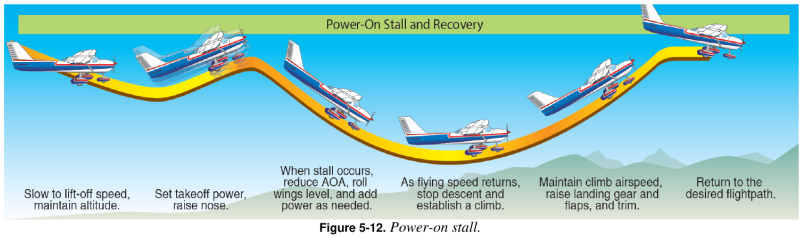


Figure 5-12. *Power-on stall.*

Fig. 5-12 — Power-on stall and recovery: slow to lift-off speed, set takeoff power, raise nose to stall, recover with forward elevator + wings level. Anticipate right rudder throughout. FAA-H-8083-3C, Ch. 5, p. 5-20.

■ ***SPIN RISK:*** *Brief before EVERY rep: 'An uncoordinated departure stall is how we spin into terrain. The ball tells us if we're about to. If you feel the ball moving right, add right rudder NOW — before it goes further.' Stall + skid = inner wing drops, spin begins. There is no safe altitude for this error on departure.*

■ ***ANTICIPATE RUDDER:*** *Right rudder increases from the moment power is applied. It must continue increasing as pitch rises. P-factor peaks as pitch angle grows. Torque never stops. Cue: 'right foot follows the nose up.' If nose yaws left, you're already behind.*

● ***FEEL THE STALL:*** *Train recognition by feel, not by horn. Cues in order: (1) elevator feels mushy and less responsive; (2) aileron effectiveness drops; (3) airframe buffet begins; (4) stall horn confirms. Students who wait for the horn receive the full break. Ask after every rep: 'What was the first thing you FELT?'*

Step-by-Step Procedure (S1–S11)

- **1. Clear the area:** Two 90° clearing turns. Check above (nose blocks view on entry), below, left, right. Announce entry. Altitude ≥1,500 ft AGL (ASEL).
- **2. Configure (S3–S4):** Establish takeoff or departure configuration per evaluator and POH/AFM. Reduce airspeed to lift-off or slow-flight speed while maintaining altitude. Set power to ≥65% (takeoff power for departure stall). Retractable gear: normally in takeoff config; practice with gear up per evaluator.
- **3. Set pitch attitude (S5):** Smoothly and progressively raise the nose from the established climb attitude. No abrupt inputs. As pitch increases, simultaneously increase right rudder to counteract P-factor, torque, and slipstream. Right foot follows the nose up.
- **4. Maintain coordinated flight (S6):** Ball centered throughout. Maintain heading ±10° (straight) or bank ≤20° ±10° (turning). Continue right rudder input as pitch increases. Do not allow nose to yaw left. Do not allow bank to steepen unintentionally.
- **5. Recognize cues — feel first (S7):** Feel: mushy elevator, sluggish aileron, airframe buffet. Verbalize: 'Stall cue — initiating recovery.' Stall horn confirms — do not wait for it as primary cue.
- **6. Recover (S8–S9):** (1) Pitch forward to reduce AOA below critical angle — eliminate stall warning. (2) Level wings with coordinated aileron + rudder. (3) Power is already at climb setting — confirm. (4) Retract flaps/gear incrementally per POH. Accelerate to Vx or Vy.
- **7. Return (S10):** Climb to altitude; return to heading; trim for cruise.

KEY RULE ■ ENTRY: ≥65% power → slow to lift-off speed → smooth pitch up. RIGHT RUDDER increases progressively as pitch rises — anticipate, never chase. FEEL the mushy controls and buffet — do not wait for the horn. RECOVERY: Pitch forward (AOA) + wings level simultaneously; power already in. Ball centered throughout — uncoordinated departure stall = spin entry.

COMMON ERRORS (K6) — AFH P. 5-21 — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — POWER-ON STALLS (AI.X.D.K6 | AFH p. 5-21)

FAILURE TO CLEAR AREA	UNCOORDINATED FLIGHT / SPIN	INSUFFICIENT RIGHT RUDDER	WAITING FOR STALL HORN	IMPROPER RECOVERY SEQ.
Skipping clearing turns before entry. Nose-high, full-power attitude = extreme blind spot above	*Ball out of center during stall entry or recovery. Skidding climbing turn = crossed controls at high*	*Student fails to anticipate increasing left-turning tendency as power rises and nose pitches up.*	*Student fixates on stall horn for recognition cue instead of developing feel. Power-on stalls break*	*Student levels wings or holds back pressure before reducing AOA. At full power, holding pitch*

EVALUATION CHECKLIST — POWER-ON STALLS

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Setup & Clearing	Two 90° clearing turns; altitude ≥1,500 ft AGL; entry altitude and plan verbalized; traffic checked above (nose-high = blind spot), below, left, right before every entry	Clearing turns complete; ≥1,500 ft AGL; verbal intent announced; traffic scan confirmed	Skipping clearing turns; entering too low; not verbalizing entry intent; not checking above nose
Config & Power (S3–S4)	Establishes takeoff/departure config per evaluator and POH/AFM; reduces to lift-off speed before entry; sets power ≥65%; ball centered from power application forward	Correct config per evaluator; power ≥65%; airspeed at lift-off or slow-flight speed; ball centered at power application	Wrong configuration; insufficient power; entry from cruise speed without reducing first; ball not centered before entry begins
CRITICAL	**COORDINATED FLIGHT + RUDDER ANTICIPATION — Ball centered throughout; right rudder applied progressively from power application, increasing as pitch rises; no yaw left at any point; uncoordinated stall = spin; student verbalizes rudder inputs**	**Ball centered throughout; right rudder applied before yaw begins (anticipation, not reaction); no left yaw during entry; student verbalizes 'right rudder increasing'**	**Ball deflected (skid or slip); waiting for yaw before applying rudder; neutral feet on entry; failure to verbalize rudder corrections**
Stall Recognition	Student identifies stall approach by feel BEFORE relying on horn: mushy elevator, sluggish aileron, airframe buffet; acknowledges cues verbally; horn confirms — does not use horn as primary cue; recognizes more abrupt break characteristic of power-on stall	Stall cue verbalized at or before horn activation; student identifies at least one felt cue (mushy controls, buffet) prior to horn; recovery initiated at first indication or full stall as directed	Waiting for horn as only recognition cue; no verbal acknowledgment of felt cues; surprised by abrupt break; recovery initiated too late due to horn dependence
Recovery Sequence	Pitch forward (reduce AOA) + wings level simultaneously with coordinated rudder; power at climb setting, confirm; retract flaps/gear per POH; accelerate to Vx/Vy; no secondary stall; student verbalizes each step	AOA reduced at initiation; wings leveled with coordinated rudder; no secondary stall; altitude loss minimized; accelerates to Vx/Vy; steps verbalized	Pulling back after break; leveling wings before reducing AOA; uncoordinated recovery (spin risk); failure to confirm power; secondary stall

KEY RULE ■ S3–S4: ≥65% power; coordinated throughout — uncoordinated departure stall = spin. ANTICIPATE RIGHT RUDDER: right foot follows the nose up from power application. FEEL THE STALL: mushy elevator + buffet first — do not wait for the horn. S8–S9: Pitch forward + wings level simultaneously; power already in. Accelerate to Vx/Vy.

Area X, Task E — Accelerated Stalls (ASEL)

FAA-S-ACS-25 • AI.X.E • CFI Airplane — Flight Lesson

Objective

The applicant demonstrates instructional knowledge of accelerated stalls by explaining the aerodynamics of load factor, bank angle, and stall speed (PHAK Figs. 5-52, 5-53, 5-54), and by demonstrating that an aircraft can be stalled at **any airspeed** when a sufficiently high AOA is imposed through elevator back pressure in a banked turn. The applicant briefs CG location and its effect on required back pressure, verifies entry airspeed is at or below VA, establishes a 45° coordinated bank, applies smooth and progressive back pressure until the impending stall, and executes the proper recovery sequence. The applicant repeats the maneuver at **multiple power settings** to reinforce that power setting does not prevent a stall.

References

• FAA-S-ACS-25; FAA-H-8083-25C Ch.5 (Figs. 5-52, 5-53, 5-54, pp. 5-34–35); FAA-H-8083-3C Ch.5; AC 61-67; POH/AFM

Delivery

• Ground brief 10–15 min: Review PHAK Figs. 5-52, 5-53, 5-54 with student — trace the bank angle → load factor → stall speed increase chain. Brief CG location for the day's flight and its effect on elevator sensitivity. Verify VA for current gross weight and confirm entry speed plan. Brief: 'This maneuver proves the airplane can stall at any airspeed — at cruise, at pattern speed, at any power setting.' Instructor demonstrates at power-off, then student flies at power-off, cruise power, and approach power to feel the point. Debrief: Did the stall speed surprise the student? What changed between power settings? What stayed the same?

ACS Knowledge

Code	Element
AI.X.E.K1–K2	Purpose and procedures; aerodynamics of accelerated stalls — AOA, airspeed, load factor, power setting, weight/CG, attitude, yaw effects in banked flight
AI.X.E.K3–K4	Stall characteristics by design; recognition of impending and full stall by sight/sound/feel; factors leading to accelerated stall and preventive actions
AI.X.E.K5–K6	Fundamentals of stall recovery; common errors related to this Task

ACS Risk Management

Code	Element
AI.X.E.R1	Factors and situations leading to inadvertent accelerated stall, spin, and LOC-I (esp. steep turns, base-to-final, pull-ups)
AI.X.E.R2–R3	Range and limitations of stall warning indicators; stall warnings during normal operations
AI.X.E.R4–R5	Stall recovery procedure; secondary stalls, cross-control stalls, and spins
AI.X.E.R6	Environmental elements on performance (turbulence, microbursts, high density altitude — all reduce margin to stall)
AI.X.E.R7–R8	Collision hazards (nose blocks view in banked attitude); distractions, task prioritization, loss of SA

ACS Skills

Code	Element
AI.X.E.S1–S2	Clear the area; select entry altitude ≥3,000 ft AGL
AI.X.E.S3–S4	Establish config per evaluator; set power appropriate for config; airspeed ≤ VA
AI.X.E.S5–S6	Establish/maintain coordinated 45° bank; increase back pressure smoothly until impending stall; acknowledge first cue
AI.X.E.S7–S8	Execute stall recovery per POH/FM; configure per manufacturer; accelerate to Vx/Vy
AI.X.E.S9–10	Return to altitude/heading/airspeed specified by evaluator; analyze and correct common errors

CRITICAL ■ THIS MANEUVER EXISTS TO PROVE ONE THING: AN AIRCRAFT CAN STALL AT ANY AIRSPEED. Stall is a function of AOA — never airspeed alone. In a 45° bank, load factor = 1.41 Gs and stall speed increases ~19%. At 60° bank, stall speed is 41% higher than wings-level. Have the student perform this at POWER-OFF, CRUISE POWER, and APPROACH POWER to break the mental model that speed equals safety. GROUND BRIEF REQUIREMENTS: (1) Review PHAK Figs. 5-52, 5-53, 5-54 — trace bank angle → G-load → stall speed increase. (2) Brief CG location for the day — aft CG = less back pressure needed, stall arrives earlier than expected. (3) Confirm VA for current gross weight — VA DECREASES as weight decreases. Entry must be at or below VA. RECOVERY: AOA first (forward elevator) → level wings with coordinated rudder → confirm power → accelerate to Vx/Vy.

TECHNIQUE — LOAD FACTOR, BANK ANGLE & STALL SPEED — PHAK FIGS. 5-52, 5-53, 5-54 (K2 / S4–S7)

Bank Angle → Load Factor → Stall Speed (K2)

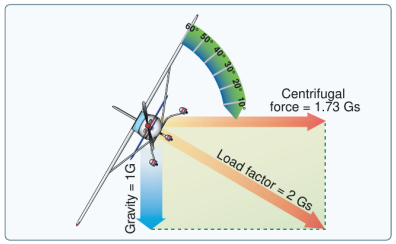
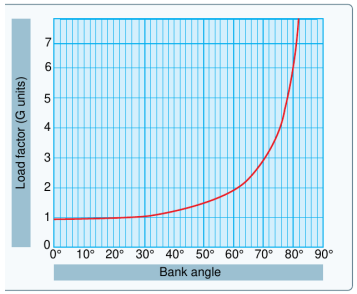


Figure 5-52. *Two forces cause load factor during turns.*

5-34



ıure 5-53. *Angle of bank changes load factor in level flight.*

Fig. 5-52 — Two forces cause load factor: centrifugal + weight. At 60° bank: 2 Gs. PHAK p. 5-34.

Fig. 5-53 — Bank angle vs. load factor. 45°=1.41G, 60°=2G, 80°=5.76G. PHAK p. 5-34.

★ ***KEY CONCEPT:*** *ANY AIRSPEED CAN STALL. At 45° bank: load factor = 1.41 Gs, stall speed ×1.19. At 60°: stall speed ×1.41 over wings-level. Have student perform reps at power-off, cruise power, and approach power — the stall arrives the same way every time regardless of throttle setting. The throttle changes the altitude loss during recovery, not the stall mechanism.*

■ ***CG EFFECT:*** *Brief CG before every flight. AFT CG: center of lift is closer to center of gravity — less back pressure required to reach critical AOA. Stall arrives quicker and more abruptly than expected. Students with aft CG must not be surprised. FORWARD CG: more back pressure required, airplane more stable — stall cues are more gradual. Both conditions require the same recovery sequence.*

■ ***VA LIMIT:*** *Entry must be at or below VA (design maneuvering speed). VA is found in the POH/AFM. CRITICAL: VA DECREASES as airplane gross weight decreases — a lightly loaded airplane has a lower VA than a heavy one. Above VA, the combination of elevator back pressure + high load factor can impose structural loads beyond the aircraft's design limits. Set airspeed, verify VA, then apply back pressure.*

Step-by-Step Procedure (S1–S10)

- **1. Clear the area (S1–S2):** Two 90° clearing turns. Check above, below, left, right. Entry altitude ≥3,000 ft AGL. Announce entry intent. Check airspeed is at or below VA for current weight.
- **2. Configure (S3–S4):** Establish configuration as specified by evaluator (typically clean cruise or slow flight config). Set power appropriate for config. Verify airspeed ≤ VA — consult POH for current gross weight VA.
- **3. Establish 45° bank (S5):** Roll smoothly into a coordinated 45° banked turn. Maintain altitude — add slight back pressure as bank is established. Use outside visual reference to hold bank. Ball centered throughout.
- **4. Apply back pressure (S5):** With bank established at 45°, smoothly and progressively increase elevator back pressure. Maintain coordinated flight. Hold bank angle — do not allow it to creep. Continue applying back pressure until impending stall cues are felt.
- **5. Recognize impending stall (S6):** Feel: buffet / airframe shudder. Horn or stall light. Sluggish elevator. Acknowledge verbally: 'Stall cue — initiating recovery.' Do not wait for the full break if demonstrating impending stall. If demonstrating full stall, continue to full break.
- **6. Recover (S7–S8):** (1) Pitch forward to reduce AOA — release back pressure immediately. (2) Level wings with coordinated aileron and rudder. (3) Set power per POH/AFM as appropriate. (4) Configure per manufacturer: retract flaps/gear incrementally. (5) Accelerate to Vx or Vy. Minimize altitude loss.
- **7. Power setting variation (Instructor emphasis):** After initial demonstration at power-off, repeat at cruise power and approach power. Brief student: 'Same 45° bank, same back pressure — did power prevent the stall?' Student discovers: power setting changes altitude loss during recovery, but does NOT prevent the stall. AOA is the only variable that matters.
- **8. Return (S9):** Climb to entry altitude; return to heading; trim for cruise. Re-clear area before each additional rep.

KEY RULE ■ S4: Entry at or below VA — VA decreases as weight decreases. S5: 45° bank + progressive back pressure = impending stall at any airspeed. VARY POWER SETTINGS: power-off, cruise, approach — same stall, different recovery energy. S7: AOA first (forward elevator) → wings level (coordinated) → power → Vx/Vy. Ball centered throughout — banked accelerated stall + skid = spin entry.

LOAD FACTOR & STALL SPEED — PHAK FIG. 5-54 — ANY AIRCRAFT CAN STALL AT ANY AIRSPEED

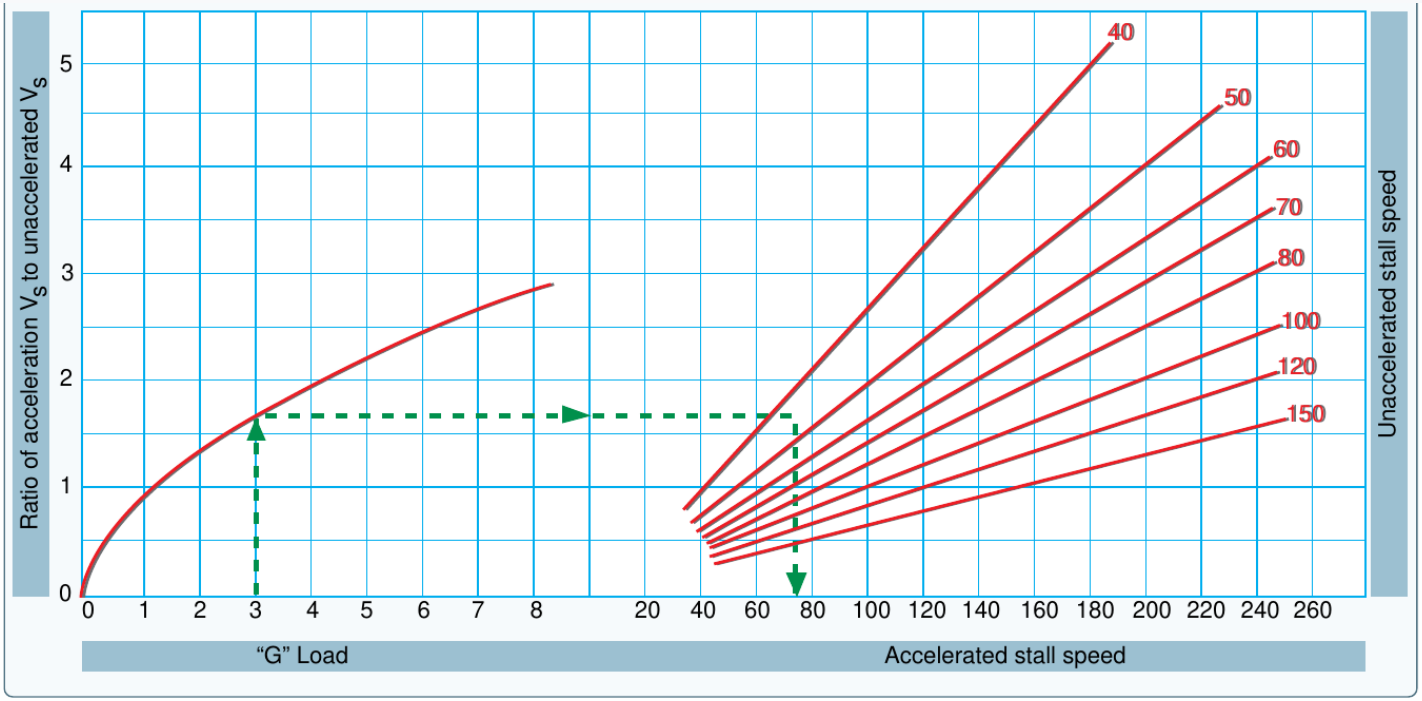


Figure 5-54. *Load factor changes stall speed.*

Fig. 5-54 — Load factor changes stall speed. Left graph: G-load vs. ratio of accelerated to unaccelerated stall speed. Right graph: unaccelerated stall speed (right axis, knots) vs. accelerated stall speed (bottom axis). An aircraft with a 50-kt stall speed can be stalled at 100 kts by imposing 4 Gs. FAA-H-8083-25C, Ch.5, p. 5-35.

COMMON ERRORS (K6) — PHAK PP. 5-34–35 — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — ACCELERATED STALLS (AI.X.E.K6 | PHAK pp. 5-34–5-35)

EXCEEDING VA / WRONG AIRSPEED	THINKING AIRSPEED = SAFETY	AFT CG / BANK ANGLE CREEP	UNCOORDINATED ENTRY / SPIN RISK	IMPROPER RECOVERY SEQ.
Attempting the maneuver above design maneuvering speed or failing to verify VA for	*Student believes flying fast prevents stalls. This is the exact misconception this maneuver*	*With aft CG, less back pressure is needed to reach critical AOA — stall arrives faster than*	*Student applies back pressure while allowing rudder to go neutral or skidding the turn. An*	*Student rolls wings level before reducing AOA, or pulls back after the break, creating a*

EVALUATION CHECKLIST — ACCELERATED STALLS

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR

Setup & Clearing	Two 90° clearing turns; altitude ≥3,000 ft AGL; entry altitude verbalized; airspeed at or below VA for current gross weight verified and stated aloud; traffic scanned above, below, left, right; CG and config briefed	Clearing turns complete; ≥3,000 ft AGL; VA confirmed for current weight; verbal intent announced; traffic scan confirmed	Skipping clearing turns; entering too low; not confirming VA for current gross weight; not verbalizing entry intent or config
CRITICAL	**ENTRY BELOW VA — Airspeed confirmed at or below VA before applying back pressure. VA for current gross weight verified from POH — NOT the placard speed if lighter. Student states VA value, confirms indicated airspeed, then proceeds. Above VA with elevator back pressure at high G = potential structural overload.**	**VA verified and stated (not assumed); indicated airspeed at or below VA at entry; no application of back pressure above VA; student understands VA decreases with weight**	**Using placard VA for a lighter airplane; applying back pressure before checking airspeed; assuming cruise speed is safe for this maneuver; not briefing VA on the ground**
45° Bank & Coordination	Smooth roll to 45° coordinated bank; bank held at 45° throughout back pressure application; ball centered; no bank creep above 45°; outside visual reference used; back pressure applied smoothly and progressively, not abruptly	Bank angle 45° ±5°; ball centered; no skid or slip during entry or back pressure; back pressure smooth (not abrupt jab)	Bank creeping above 45° (increases G unpredictably); ball displaced (skid = spin risk at stall); abrupt back pressure application
Stall Recognition	Student acknowledges stall cues at impending stall: buffet, stall horn, sluggish elevator. Verbalizes cue: 'Stall cue — initiating recovery.' At multiple power settings: student confirms same stall cues appear regardless of throttle; articulates that power setting did not prevent the stall	Stall cue verbalized at or before full break; recovery initiated at first indication; student identifies same cues at each power setting; verbalizes: 'power doesn't prevent the stall'	Waiting for full break rather than impending; no verbalization of cues; student surprised that cruise power still stalled; fixating on airspeed indicator instead of feel
Recovery Sequence	AOA first (forward elevator, release back pressure); wings level simultaneously with coordinated rudder; power set per POH; configure per manufacturer; accelerate to Vx or Vy; no secondary stall; return to altitude/heading/airspeed	AOA reduced at first indication; wings leveled with coordinated rudder; no secondary stall; altitude loss minimized; accelerates to Vx/Vy; all steps verbalized	Pulling back after forward elevator; leveling wings before reducing AOA; uncoordinated recovery (spin risk); secondary stall from premature pitch up

KEY RULE ■ S2: Entry ≥3,000 ft AGL. S4: At or below VA — VA decreases with weight, always verify. S5: 45° coordinated bank + progressive back pressure — airplane WILL stall regardless of airspeed or power. VARY POWER SETTINGS to prove this point. CG aft = earlier stall than expected. S7: AOA first → wings level (coordinated) → power → Vx/Vy. Banked stall + skid = spin entry.

Area X, Task F — Cross-Controlled Stall Demonstration (ASEL, ASES)

FAA-S-ACS-25 • AI.X.F • CFI Airplane — Flight Lesson | Demonstration Only

Objective

The applicant demonstrates instructional knowledge of cross-controlled stalls by explaining the aerodynamics of uncoordinated flight on stall behavior, the base-to-final overshoot scenario, and the critical role of simultaneous rudder release when applying opposite aileron. The applicant configures the airplane (gear down, throttle idle), establishes a gliding turn with excess inside rudder and opposite aileron held, applies back elevator until the stall occurs, and demonstrates the correct recovery sequence. The applicant also explains why this stall is deadly at 500' AGL and can occur to a 'good' student who correctly recognizes an overbank but fails to simultaneously remove rudder pressure.

References

- FAA-H-8083-3C p. 5-20 (Cross-Control Stall); FAA-S-ACS-25 AI.X.F; AC 61-67; FAA-H-8083-25C; FAA-H-8083-2; FAA-H-8083-9; POH/AFM

Delivery

- Pre-flight brief 10 min: walk through the base-to-final overshoot scenario, explain the physics of the inside wing stalling first, and brief why opposite aileron without rudder reduction is the 'good student' error. Instructor demonstrates full stall version at 3,000+ ft AGL; student then demonstrates entry and impending-stall recovery. Debrief: what happened to bank angle at the break? Where was the ball?

ACS Knowledge

Code	Element
AI.X.F.K1–K2	Aerodynamics of cross-controlled stalls; flight situations where unintentional cross-controlled stalls may occur (base-to-final overshoot, skidding turn)
AI.X.F.K3–K4	Recognition of cross-controlled stalls (sharp break, nose pitch-down, sudden bank change); entry procedure and minimum entry altitude (3,000 ft AGL)
AI.X.F.K5–K6	Recovery procedure (AOA → rudder → wings level → power); common errors related to this Task

ACS Risk Management

Code	Element
AI.X.F.R1	Stall recovery procedure — AOA reduction is always Step 1; no exceptions
AI.X.F.R2	Environmental elements on performance (turbulence, microbursts, high density altitude — all reduce stall margin)
AI.X.F.R3	Collision hazards — clear area before entry; nose blocks view in banked turn
AI.X.F.R4	Aircraft limitations — no flaps during this maneuver; spin-approved aircraft required for full spin demo
AI.X.F.R5	Distractions, task prioritization, loss of SA, or disorientation during skidding turn

ACS Skills

Code	Element
AI.X.F.S1–S2	Clear the area; entry altitude ≥3,000 ft AGL
AI.X.F.S3–S4	Configure: gear down, throttle closed; establish normal glide airspeed and trim
AI.X.F.S5	Roll into medium-banked turn; apply excess inside rudder; hold bank constant with opposite aileron; increase back elevator to prevent nose drop
AI.X.F.S6–S7	Acknowledge stall cues; recover at first indication or full stall as specified by evaluator
AI.X.F.S8–S9	Describe and demonstrate conditions leading to cross-controlled stall; analyze and correct common errors

CRITICAL ■ THE 'GOOD STUDENT' SCENARIO — Base-to-final, student overshoots centerline. They are aware. They feel the overbank and correctly apply OPPOSITE AILERON to reduce it. What they do NOT do is simultaneously remove inside (bottom) rudder pressure. The airplane is now in a cross-controlled SLIP at 500' AGL: aileron rolling one way, rudder yawing the other, elevator raising AOA. The inside wing — already slower and generating less lift — has its AOA increased further by the down-deflected aileron. It stalls first. The nose pitches sharply down. Bank angle increases rapidly. At 500' AGL, this is unsurvivable. The fix is not more aileron — it is RELEASING RUDDER. AFH (p. 5-20): 'The safest action for an overshoot is to perform a go-around.' RECOVERY: Forward elevator (AOA) → remove excess rudder → wings level → power.

TECHNIQUE — ENTRY, STALL SETUP, AND RECOVERY (K1–K5 / S3–S8)

Step-by-Step Procedure (S1–S9)

- **1. Clear the area (S1–S2):** Two 90° clearing turns. Traffic scan above, below, left, right. Entry altitude ≥3,000 ft AGL — recovery may require significant altitude if spin occurs. Announce intent.
- **2. Configure and establish glide (S3–S4):** Gear down (if applicable). Close throttle. DO NOT extend flaps — flaps reduce the airplane's G-load limit. Hold altitude as airspeed decreases to normal glide speed. Trim for stabilized glide. Retrim nose-up as needed.
- **3. Roll into medium-banked turn (S5):** Establish a realistic base-to-final bank (15–30°). Simulate the overshoot by holding the turn past the extended centerline.
- **4. Apply cross-control inputs (S5):** Smoothly apply **excess inside (bottom) rudder** to yaw the nose further into the turn. Simultaneously apply **opposite aileron** to hold bank angle constant. Add **back elevator** to prevent the nose from dropping. Progressively increase all three until the stall occurs.
- **5. Recognize stall cues (S6):** Buffet or airframe shudder. Stall horn/light. Sluggish elevator. The nose may suddenly pitch sharply downward and the bank may increase rapidly. Verbalize: 'Stall — initiating recovery.'
- **6. Recover (S7):** (1) **Release back elevator immediately** — reduce AOA. (2) **Remove excess rudder** — stop the yaw/skid. (3) **Level wings** with coordinated aileron and rudder. (4) **Add power** as needed. Return to desired flightpath. Minimize altitude loss throughout.
- **7. Debrief (S8–S9):** Discuss what happened to bank angle and nose attitude at the break. Was the ball centered? What did the student feel in the seat? Ask: 'What did the airplane want to do?' Reinforce: this exact scenario causes fatal accidents on base-to-final every year.

The Aerodynamics (K1–K2 — AFH p. 5-20)

- **Inside wing vs. outside wing:** In any banked turn, the inside (lower) wing moves through the air more slowly than the outside wing and generates less lift. The difference in lift tends to steepen the bank. The pilot adds opposite (top) aileron to hold bank — this deflects the aileron DOWN on the inside wing, raising that wing's AOA further, moving it closer to stall.
- **The skid effect:** Excess inside rudder yaws the nose toward the turn. This is a skid. In a skid, the low wing has even less relative airflow. Combined with the down aileron, the inside wing's AOA approaches critical while the outside wing is still flying. One wing stalls; the other doesn't — the result is a sharp, sudden roll in the direction of the stalled inside wing.
- **The elevator completes the trap:** As the nose drops and bank steepens, the pilot's instinct is to pull back on the elevator. This raises total AOA and pushes the inside wing past critical AOA immediately. The AFH describes this as: 'The nose may pitch down, the bank angle may suddenly change, and the airplane may continue to roll to an inverted orientation.'

Why Go-Around is the Right Answer

- The AFH (p. 5-20) is direct: **'The safest action for an overshoot is to perform a go-around.'** At 500' AGL, the pilot has no margin to correct a cross-control stall. The bank angle at the break is typically greater than 45°, the nose is pointed at the ground, and recovery requires altitude. Brief this before every pattern entry: if you overshoot, go around — do not increase bank, do not add rudder.

■ ***WARNING:*** *NO FLAPS during this demonstration. Flaps reduce the airplane's structural G-load limit. If the stall occurs abruptly and the nose pitches down hard, a recovery pull could exceed flap structural limits. Also, entry must be at or above 3,000 ft AGL — this stall can degrade into a spin with NO warning.*

KEY RULE ■ The fix is not more aileron — it is releasing rudder. A student who adds opposite aileron without removing inside rudder has not solved the problem. BOTH inputs must be corrected simultaneously. At 500' AGL, this is a fatal distinction.

KEY RULE ■ S2: Entry ≥3,000 ft AGL — no exceptions. S3: NO FLAPS. S5: Excess inside rudder + opposite aileron + back elevator — inside wing stalls first, breaks hard, can roll inverted. RECOVERY: AOA first (forward elevator) → release rudder → wings level (coordinated) → power. THE LESSON: Opposite aileron without releasing rudder does not fix a cross-control condition. At 500' AGL, the correct answer is always GO-AROUND — not more bank, not more rudder.

COMMON ERRORS (K6) — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — CROSS-CONTROLLED STALL (AI.X.F.K6 | AFH p. 5-20)

AILERON WITHOUT REDUCING RUDDER	OVERBANKING / LATE BASE TURN	PULLING BACK ELEVATOR (AOA ↑)	IMPROPER RECOVERY ORDER	ENTERING TOO LOW / NO CLEARING TURNS
The 'good student' error. Student sees overbank, applies opposite aileron —	*Student fails to identify tailwind on base leg. Higher groundspeed means the aircraft tracks*	*Natural reaction when nose drops or bank increases: pull back on elevator. This raises*	*Student releases rudder and levels wings BEFORE reducing AOA. Leveling wings first*	*Cross-controlled stall is performed at minimum 3,000 ft AGL. Below this altitude there is no*

EVALUATION CHECKLIST — CROSS-CONTROLLED STALL DEMONSTRATION

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Setup & Clearing	Two 90° clearing turns; entry altitude ≥3,000 ft AGL stated aloud; traffic scan above, below, left, right; intent verbalized; gear down and throttle to idle; NO flaps; glide speed established and trimmed	≥3,000 ft AGL; clearing turns complete; throttle idle; no flaps; glide speed stabilized; verbal intent and altitude announced	Skipping clearing turns; entering too low; extending flaps; not verbalizing altitude or intent; not trimming for glide before entry
Entry & Cross-Control Setup	Smooth roll to medium bank (15–30°); excess inside rudder applied; bank held constant with opposite aileron; back elevator added to prevent nose from lowering; all three inputs increased progressively until stall occurs or impending stall cue felt	Medium bank established; coordinated application of rudder, opposite aileron, back elevator; stall occurs with cross-control inputs present; no abrupt or jerky control movements	Insufficient rudder (stall won't develop); releasing aileron or rudder before stall; applying full cross-control abruptly; allowing bank to change significantly before stall
CRITICAL	**RECOVERY SEQUENCE: (1) Forward elevator FIRST — reduce AOA immediately. (2) Remove excess rudder. (3) Level wings with coordinated control. (4) Add power. Verbalize each step. No leveling wings before AOA is reduced. No secondary stall. Minimize altitude loss.**	**Forward elevator at first stall indication; excess rudder removed (not just aileron); wings leveled with coordinated inputs; power added; no secondary stall; all steps verbalized in order**	**Leveling wings before reducing AOA; releasing aileron but NOT rudder (cross-control remains); pulling back after forward elevator (secondary stall); adding power before stall warning is gone**
Debrief & Teaching	Applicant can describe what happened to bank angle, nose attitude, and ball position at the stall. Can explain the inside-wing AOA physics. Explains why opposite aileron without rudder release does not fix the condition. States the go-around is always the correct answer on base-to-final overshoot.	Physics of inside-wing stall explained correctly; can articulate the 'good student' error; states minimum entry altitude; correctly identifies go-around as the answer	Unable to explain inside vs. outside wing AOA; describes aileron as the fix without mentioning rudder; cannot state entry altitude requirement; does not connect maneuver to real accident scenario

Area X, Task G — Elevator Trim Stall Demonstration (ASEL, ASES)

FAA-S-ACS-25 • AI.X.G • CFI Airplane — Flight Lesson | Demonstration Only

Objective

The applicant demonstrates instructional knowledge of elevator trim stalls by explaining the aerodynamics of trim effects during go-around power application, the specific flight scenarios where elevator trim stalls may occur, recognition cues, and the recovery procedure. The applicant configures the airplane for a simulated landing approach (flaps, gear, nose-up trim set), advances power smoothly to simulate a go-around, allows the nose to rise toward an impending stall, and recovers with forward elevator. The applicant then demonstrates the complete go-around: reducing AOA, trimming to relieve control forces, retracting flaps and gear per POH, and returning to desired flightpath. The applicant also explains why this stall is relevant at every certificate level and how to prevent it on every real-world go-around.

References

- FAA-H-8083-3C p. 5-21, Fig. 5-14 (Elevator Trim Stall); FAA-S-ACS-25 AI.X.G; AC 61-67; FAA-H-8083-25C; FAA-H-8083-2; FAA-H-8083-9; POH/AFM

Delivery

- Pre-flight brief 10 min: walk through the go-around scenario using AFH Fig. 5-14. Explain the physics: nose-up trim + propwash = double pitch-up force. Instructor demonstrates smooth power application vs. abrupt. Student demonstrates entry, impending-stall recognition, and recovery. Emphasize: this same scenario repeats on every go-around for the rest of their flying career.

ACS Knowledge

Code	Element
AI.X.G.K1–K2	Aerodynamics of elevator trim stalls; flight situations where elevator trim stalls may occur (go-around from approach, simulated forced landing, takeoff with approach trim set)
AI.X.G.K3–K4	Recognition of elevator trim stalls (rapid pitch-up past climb attitude, stall warning onset, sluggish controls); entry procedure and minimum entry altitude (3,000 ft AGL)
AI.X.G.K5–K6	Recovery procedure (forward elevator → trim → complete go-around); common errors related to this Task

ACS Risk Management

Code	Element
AI.X.G.R1	Stall recovery procedure — AOA reduction is always Step 1; forward elevator before trimming
AI.X.G.R2	Environmental effects on performance (turbulence, high density altitude reduce stall margin and increase severity of power-induced pitch-up)
AI.X.G.R3	Collision hazards — clear area before entry; nose blocks view during high-pitch-attitude entry
AI.X.G.R4	Aircraft limitations — verify POH/AFM go-around procedure; observe VFE during flap retraction
AI.X.G.R5	Distractions, task prioritization, loss of SA during go-around (ATC, traffic, gear warning horn)

ACS Skills

Code	Element
AI.X.G.S1–S2	Clear the area; entry altitude ≥3,000 ft AGL
AI.X.G.S3–S4	Configure for landing (flaps, gear); establish normal glide airspeed; TRIM NOSE-UP for approach glide
AI.X.G.S5	Advance throttle smoothly to max allowable power as in a go-around; hold heading; ANTICIPATE pitch-up
AI.X.G.S6–S7	Acknowledge stall cues at first indication; recover (forward elevator); do not allow full stall unless directed
AI.X.G.S8–S10	Adjust trim to relieve control forces; return to desired flightpath; complete go-around; correct common errors

CRITICAL ■ TEACH AT ALL LEVELS: Private • Instrument • Commercial — Every go-around begins with the airplane configured for landing and trimmed nose-up. The moment full power is applied, propwash over the stabilizer amplifies the nose-up trim force. Without immediate forward elevator, the nose rises rapidly past climb attitude and the airplane approaches a stall. AFH (p. 5-21): 'It is imperative to avoid the occurrence of an elevator trim stall during an actual go-around.' RECOVERY: Forward elevator (reduce AOA) → trim nose-down to relieve forces → complete go-around per POH.

■ TEACH AT ALL CERTIFICATE LEVELS — This maneuver occurs on EVERY go-around ■

PRIVATE	INSTRUMENT	COMMERCIAL
Every touch-and-go and balked landing. Nose-up trim is set for every approach. Go-around power applied. Trim stall risk is present on Lesson 1 through checkride.	Every missed approach from ILS/RNAV/VOR. At DA/MDA, full power is applied with full approach config and nose-up trim. The trim stall is an IFR go-around risk.	Every rejected landing and precision approach. Commercial ACS requires demonstrating go-arounds under pressure. Trim management is a commercial-level skill standard.

TECHNIQUE — ENTRY, GO-AROUND SETUP, AND RECOVERY (K1–K5 / S3–S9)

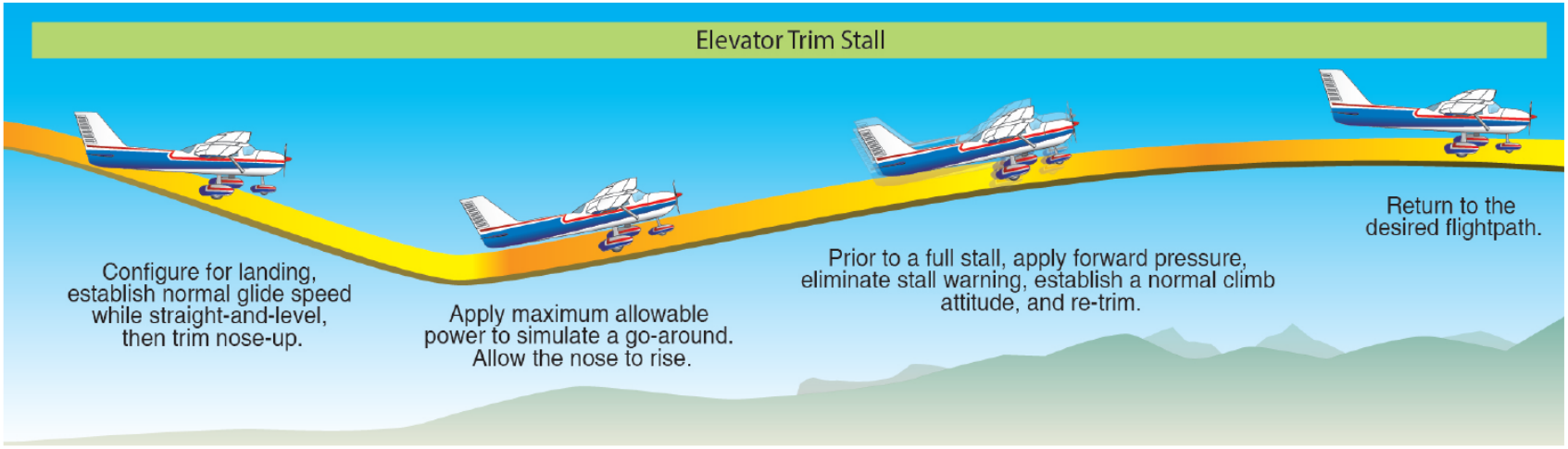


Figure 5-14. *Elevator trim stall.*

AFH Figure 5-14. Elevator trim stall — FAA-H-8083-3C p. 5-21

Step-by-Step Procedure (S1–S10)

- **1. Clear the area (S1–S2):** Two 90° clearing turns. Traffic scan above, below, left, right. State entry altitude aloud (≥3,000 ft AGL). This task develops significant pitch-up; allow altitude margin.
- **2. Configure for landing approach (S3):** Reduce power to idle. Extend gear (if retractable). Extend flaps to one-half or full per POH. Maintain altitude as airspeed decreases to normal approach glide speed.
- **3. Establish glide and trim nose-up (S4):** Establish stabilized glide at normal approach airspeed. **Trim nose-up for hands-off approach glide.** Confirm airplane is trimmed and settled before power application. This trim setting is the source of the trim stall.
- **4. Apply go-around power smoothly (S5):** Advance throttle **smoothly** to maximum allowable power, as you would in a real go-around. Do NOT slam the throttle. Simultaneously apply right rudder to counter P-factor/torque. **Anticipate the nose-up pitch immediately.**
- **5. Allow nose to rise (impending stall entry):** With inadequate forward elevator, the nose pitches up sharply past the normal climb attitude. Propwash over the horizontal stabilizer amplifies the nose-up trim. Observe: nose well above horizon, airspeed decaying rapidly, stall horn or buffet.
- **6. Recognize stall cues (S6):** Stall horn/light. Airframe buffet. Sluggish elevator feel. Nose high, airspeed decay. Verbalize: 'Approaching stall — initiating recovery.'
- **7. Recover (S7):** (1) **Apply sufficient forward elevator** — reduce AOA, eliminate stall warning. (2) Maintain directional control with rudder. (3) Allow pitch to settle to normal climb attitude.
- **8. Trim and complete go-around (S8):** (1) **Trim nose-down** to relieve heavy forward elevator force. (2) Establish climb at Vx or Vy per POH. (3) Retract flaps incrementally at safe airspeed per POH. (4) Retract gear after positive rate of climb established. (5) Return to desired flightpath.

The Physics (K1–K2 — AFH Fig. 5-14)

- **Nose-up trim for approach:** On every normal approach, the pilot trims the airplane for hands-off flight at approach airspeed with idle power. The elevator trim tab is set to produce a nose-up pitching moment at approach power setting. The airplane holds the nose at the correct approach attitude without pilot input.
- **Go-around power changes everything:** When power is advanced to full, two things happen simultaneously. First, propwash from the propeller hits the horizontal stabilizer and elevator with dramatically increased force, multiplying the nose-up trim effect. Second, P-factor and torque pull the nose left. The combined pitch-up rate can be surprisingly fast.
- **The control force trap:** With nose-up trim set and full propwash, it takes significant and sustained forward elevator force to hold the nose at the proper climb attitude. If the pilot releases forward pressure to reach for flaps or gear, the nose pitches up again. The pilot must hold forward pressure AND trim simultaneously during the go-around.

Why Smooth Power Matters (K1 — AFH p. 5-21)

- The AFH specifically requires **smooth power applications** for this demonstration. An abrupt full-throttle slam sends a sudden large propwash blast over the stabilizer, creating an instant and large nose-up pitching moment that is much harder to counteract. A smooth 2-3 second advancement gives the pilot time to apply forward elevator gradually and maintain control of the climb attitude throughout.

■ ***WARNING:*** *Heavy forward elevator force is required throughout the early go-around. If the pilot relaxes this pressure to grab the flap handle or gear switch, the nose will pitch up again. Brief students: HOLD forward pressure, THEN trim nose-down to relieve it, THEN reach for configuration items.*

KEY RULE ■ The trim stall is not caused by the trim alone — it is caused by adding full power to an airplane already trimmed nose-up. The fix: anticipate the pitch-up BEFORE applying power, apply forward elevator as power goes in, then trim to relieve the force. This sequence is the go-around procedure for the rest of the pilot's career.

KEY RULE ■ S4: Trim nose-up for approach BEFORE power application — this creates the trim stall risk. S5: Smooth power advancement; anticipate pitch-up; apply forward elevator simultaneously. S7: Forward elevator reduces AOA — Step 1, always. S8: Trim nose-down to relieve heavy forward force, THEN complete go-around per POH. KEY: The trim stall scenario is the go-around. Teach it to every student at every level.

COMMON ERRORS (K6) — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — ELEVATOR TRIM STALL (AI.X.G.K6 | AFH p. 5-21)

INSUFFICIENT FORWARD ELEVATOR	NOT TRIMMING AFTER RECOVERY	ABRUPT POWER APPLICATION	DELAYING GEAR/FLAP RETRACTION	ENTERING TOO LOW / NO CLEARING
Power applied, nose rises — pilot does not push forward enough to hold climb attitude. Nose	*Pilot recovers using heavy forward elevator pressure but fails to trim nose-down. Control*	*Student slams throttle to full in one motion. Propwash hits stabilizer instantly with full force.*	*After recovery, student fixates on forward elevator and forgets to retract flaps and gear per*	*Entry must be at or above 3,000 ft AGL. The full stall (if allowed to develop) requires significant*

EVALUATION CHECKLIST — ELEVATOR TRIM STALL DEMONSTRATION

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Setup & Clearing	Two 90° clearing turns; entry altitude ≥3,000 ft AGL stated aloud; traffic scan complete; gear down (if applicable); flaps extended per POH; approach glide established at normal approach airspeed; airplane trimmed nose-up for hands-off glide	≥3,000 ft AGL; clearing turns complete; approach config set; approach airspeed stabilized; trim set for approach (nose-up) confirmed	Skipping clearing turns; entering too low; not actually trimming nose-up; not confirming glide is stabilized before power application
Go-Around Power Application	Throttle advanced smoothly to maximum allowable power; right rudder applied for directional control (P-factor/torque); forward elevator applied simultaneously to counteract nose-up trim; nose-up pitch is acknowledged verbally as trim stall setup	Smooth power advancement (≈2 sec to full); no abrupt slam; directional control maintained; forward elevator anticipation demonstrated; pitch-up above normal climb attitude observed	Abrupt full-throttle application; insufficient right rudder; failing to anticipate the pitch-up; applying back elevator instead of forward
CRITICAL	**FORWARD ELEVATOR APPLIED at stall cue to reduce AOA. Nose-up pitch arrested; stall warning eliminated by forward elevator pressure. Airplane returns to normal climb attitude. THEN: trim nose-down to relieve heavy control forces. THEN: complete go-around per POH (flaps, gear, climb speed). All steps verbalized in sequence.**	**Forward elevator at first stall indication; stall warning eliminated before trimming; trim applied to relieve forward pressure; go-around completed (flaps/gear/climb); all steps verbalized in order**	**Failing to apply sufficient forward elevator; trimming BEFORE stall warning is gone; secondary trim stall after releasing forward pressure; forgetting to complete go-around after recovery**

Debrief & Teaching	Applicant explains the physics: nose-up trim + propwash = double pitch-up force. States that this scenario occurs on every real go-around. Explains relevance to Private, Instrument, and Commercial students. States AFH requirement for smooth power applications. Correctly identifies trim management as a lifelong go-around skill.	Physics of propwash + trim explained correctly; go-around connection stated explicitly; relevance to all certificate levels discussed; smooth power requirement cited; trim-then-retract sequence correctly stated	Cannot explain propwash effect on stabilizer; describes stall as trim-only problem (not power); fails to connect to real go-around scenario; does not mention smooth power AFH requirement

KEY RULE ■ ACS S5–S8: Advance throttle smoothly; anticipate and counteract nose-up trim with forward elevator; recover at first stall indication; trim to relieve forces; complete go-around per POH. — AFH (p. 5-21): 'It is imperative to avoid the occurrence of an elevator trim stall during an actual go-around.' TEACH THIS SKILL TO EVERY STUDENT AT EVERY LEVEL.

Area X, Task H — Secondary Stall Demonstration (ASEL, ASES)

FAA-S-ACS-25 • AI.X.H • CFI Airplane — Flight Lesson | Demonstration Only

Objective

The applicant demonstrates instructional knowledge of secondary stalls by explaining the aerodynamics, the flight situations where secondary stalls occur, how to recognize them, and the correct recovery procedure. The applicant enters a stall in a specified configuration and deliberately induces a secondary stall by applying abrupt back pressure during the initial recovery — exceeding the critical angle of attack a second time. The applicant then demonstrates the correct recovery: smooth forward elevator to reduce AOA, full power simultaneously, patience to regain flying speed, then a slow and deliberate increase in AOA to a climb attitude at Vx or Vy. The applicant explains why abrupt back pressure is the cause of every secondary stall and teaches avoidance through proper recovery technique.

References

- FAA-H-8083-3C p. 5-18, Fig. 5-13 (Secondary Stall); FAA-S-ACS-25 AI.X.H; AC 61-67; FAA-H-8083-25C; FAA-H-8083-2; FAA-H-8083-9; POH/AFM

Delivery

- Pre-flight brief 10 min: review AFH Fig. 5-13 and walk through the recovery sequence (Steps 1–4). Demonstrate the abrupt vs. smooth recovery contrast on the ground with hand demonstration of pitch attitudes. In flight, instructor demonstrates a deliberate secondary stall. Student then practices entry, stall recognition, and correct recovery with emphasis on patience at Step 3 before raising the nose to climb attitude. Debrief: can the student explain WHY abrupt back pressure causes the secondary stall?

ACS Knowledge

Code	Element
AI.X.H.K1–K2	Aerodynamics of secondary stalls (exceeding critical AOA a second time during recovery); flight situations where secondary stalls may occur (recovery from any stall type: power-off, power-on, accelerated)
AI.X.H.K3–K4	Recognition of secondary stalls (stall cues recur after initial recovery: buffet, stall horn, mushy controls, nose drops again); entry procedure and minimum entry altitude (3,000 ft AGL)
AI.X.H.K5–K6	Recovery procedure (reduce AOA → full power → regain speed → slowly raise AOA to climb at Vx/Vy); common errors related to this Task

ACS Risk Management

Code	Element
AI.X.H.R1	Stall recovery procedure — AOA reduction is always Step 1; must precede power and nose-up pitch
AI.X.H.R2	Environmental effects on performance (turbulence, high density altitude reduce stall margin and increase secondary stall risk during recovery)
AI.X.H.R3	Collision hazards — two 90° clearing turns required; significant altitude may be lost in a secondary stall sequence
AI.X.H.R4	Aircraft limitations — observe Va, VFE; verify recovery altitude allows task completion above 3,000 ft AGL
AI.X.H.R5	Distractions, task prioritization, loss of situational awareness during stall sequence (fixation on instruments, ATC calls)

ACS Skills

Code	Element
AI.X.H.S1–S2	Clear the area; entry altitude ≥3,000 ft AGL
AI.X.H.S3	Enter a stall in a specified configuration and exceed the critical AOA a second time during recovery (demonstrate the secondary stall)
AI.X.H.S4	Recover promptly and appropriately after secondary stall: reduce AOA → full power → regain speed → slowly raise AOA to climb
AI.X.H.S5–S6	Describe and demonstrate conditions that lead to secondary stall (abrupt back pressure); analyze and correct common errors

CRITICAL ■ THE CAUSE: A secondary stall happens when the pilot tries to recover from an initial stall TOO ABRUPTLY — pulling back on the elevator before the wing has regained flying speed. The AOA exceeds the critical angle a second time and the airplane stalls again, often lower and with less altitude to recover. THE FIX: (1) Reduce AOA with smooth forward elevator → (2) Full power + right rudder → (3) Hold nose at/below horizon — let airspeed build (BE PATIENT) → (4) Slowly raise AOA to climb attitude at Vx or Vy. PATIENCE in Step 3 is what prevents every secondary stall.

TECHNIQUE — ENTRY, SECONDARY STALL, AND RECOVERY (K1–K5 / S3–S6)

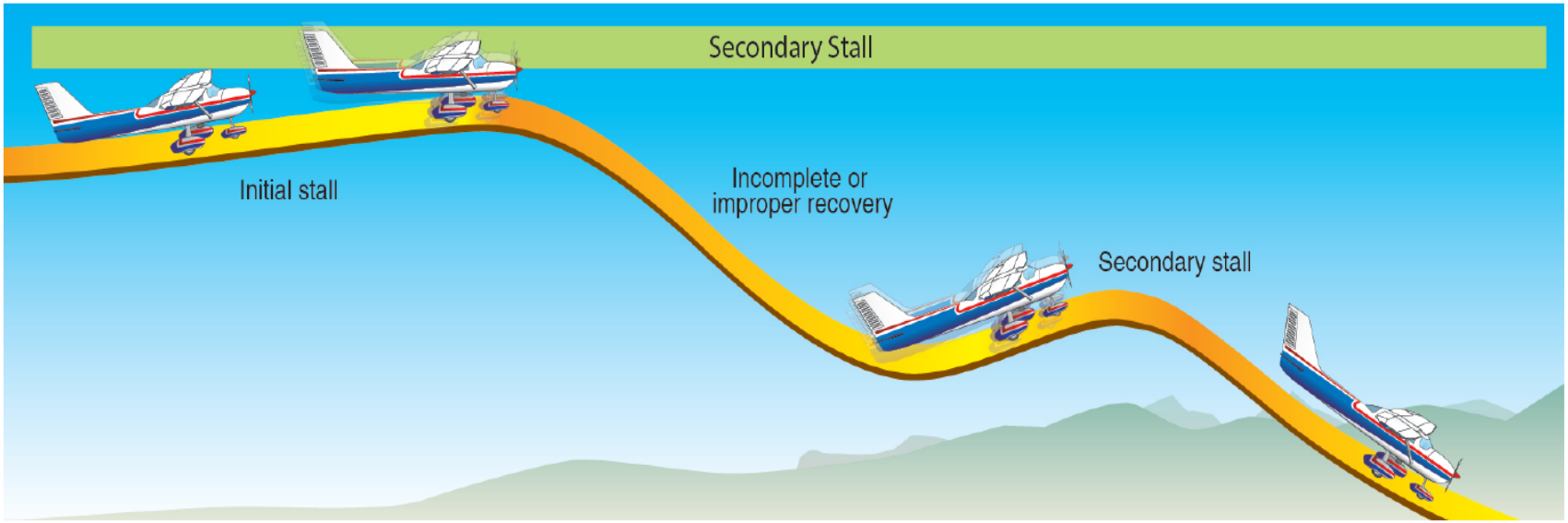


Figure 5-13. *Secondary stall.*

AFH Figure 5-13. Secondary stall — FAA-H-8083-3C p. 5-18 — Shows: Initial stall → Incomplete/improper recovery → Secondary stall.

STEP 1	STEP 2	STEP 3	STEP 4
REDUCE AOA	**FULL POWER**	**REGAIN SPEED**	**SLOWLY RAISE AOA**
Smooth forward elevator pressure *Eliminate stall warning*	Simultaneous full throttle *Right rudder for P-factor*	■ PATIENCE HERE = NO SECONDARY STALL	Smoothly pitch to climb attitude *Vx (obstacle) or Vy (normal)*

Step-by-Step Procedure (S1–S6)

- **1. Clear the area (S1–S2):** Two 90° clearing turns. Traffic scan above, below, left, right. State entry altitude aloud (≥3,000 ft AGL). Secondary stall sequence can lose significant altitude — altitude margin is critical.
- **2. Enter the initial stall (S3):** Select a configuration per the evaluator (power-off, power-on, approach, etc.). Establish the stall entry per the appropriate ACS task. Allow the stall to fully develop — buffet, stall horn, break. Verbalize: 'Stall — beginning recovery.'
- **3. Induce the secondary stall (S3):** During the initial recovery, deliberately apply **abrupt back pressure** before airspeed has recovered. The nose rises, AOA exceeds critical angle again, and the second stall occurs. Verbalize: 'Secondary stall — caused by abrupt back pressure.'
- **4. Step 1 — Reduce AOA (S4):** Smooth, sufficient forward elevator pressure to eliminate the stall warning. Do not yank the nose down — smooth and deliberate. This is the only step that actually fixes the stall. Verbalize: 'AOA reduced.'
- **5. Step 2 — Full power (S4):** Simultaneously advance throttle to full. Apply right rudder to counteract P-factor and torque. Maintain coordinated flight. Power accelerates the recovery — do not delay.
- **6. Step 3 — Regain speed (S4):** Hold the nose at or slightly below the horizon. **Be patient.** Do not pull back yet. Let airspeed build to a safe flying speed. This is the step that prevents the secondary stall. Watch the airspeed indicator — not just the stall horn.
- **7. Step 4 — Slowly raise AOA (S4):** Once flying speed is established, **smoothly and gradually** raise the nose to climb attitude. Vx if obstacle clearance required; Vy for normal climb. Smooth is the operative word — any abrupt pull repeats the error.
- **8. Complete recovery (S5–S6):** Establish climb, configure per POH. Return to entry altitude. Debrief: Why did the secondary stall occur? What does the student feel at Step 3 that tempts them to pull back too soon?

The Aerodynamics (K1–K2 — AFH Fig. 5-13)

- **Why abrupt back pressure causes the secondary stall:** During initial stall recovery, the pilot pushes forward and the AOA drops below the critical angle. The wing begins to unstall, but airspeed is still very low — often only slightly above the stall speed. If the pilot immediately pulls back to arrest the nose drop, the AOA again exceeds the critical angle at the very same low airspeed. The wing re-stalls instantly. AFH: 'careful to avoid a secondary stall.'
- **Where the secondary stall occurs in the profile (Fig. 5-13):** The initial stall occurs at altitude. The recovery begins correctly — nose drops, AOA reduces. Then the pilot pulls back too soon, and the airplane is now lower, slower, and stalling a second time with less room to recover. The figure shows the arc of the flightpath curving back upward prematurely into the second stall.
- **Why Step 3 patience is the key teaching point:** The instinct is to arrest the nose-down attitude as quickly as possible. But during Step 3, the nose is near or slightly below the horizon with full power — this is correct. The airplane is accelerating. The pilot must resist the urge to pull back until the airspeed has built to a safe margin. Teach students to watch the airspeed, not just feel the attitude.

Abrupt vs. Smooth Recovery (K5)

- Brief this contrast explicitly before every rep: **Abrupt:** Nose drops on recovery → pilot yanks back → secondary stall. **Smooth:** Nose drops on recovery → pilot holds nose below horizon with full power → speed builds → pilot *slowly* raises nose to Vx/Vy → no secondary stall. The word to use with students: SMOOTH. Smooth on the way down, smooth on the way back up.

■ ***WARNING:*** *The secondary stall demonstrates a pilot's instinctive but dangerous reaction to nose-drop during recovery. This instinct MUST be replaced with the habit of patience. Brief every rep: 'Let the speed build. The airplane will climb when it's ready — not when you want it to.'*

KEY RULE ■ Reduce AOA → Full Power → Regain Speed (BE PATIENT) → Slowly raise AOA to Vx/Vy. Abrupt back pressure at ANY point before flying speed is established = secondary stall. SMOOTH is the recovery. PATIENCE in Step 3 is what prevents the accident.

KEY RULE ■ S3: Enter stall, then apply abrupt back pressure during recovery to demonstrate secondary stall. S4 — Recovery (non-negotiable sequence): (1) Reduce AOA → (2) Full power + right rudder → (3) Nose at/below horizon — let airspeed build (patience!) → (4) Slowly raise AOA to climb at Vx or Vy. KEY TEACHING POINT: The secondary stall is caused by rushing Step 3. Smooth = safe.

COMMON ERRORS (K6) — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — SECONDARY STALL (AI.X.H.K6 | AFH p. 5-18)

ABRUPT BACK PRESSURE ON RECOVERY

The #1 cause of every secondary stall. Pilot feels nose drop, panics, yanks back before

- #1 cause — always abrupt back pressure
- Nose drops → student pulls → second stall
- Solution: smooth, gradual AOA increase
- Teach: 'feel the airspeed build first'
- AFH: 'carefully avoid a secondary stall'

NOT REDUCING AOA FIRST

Student skips or shortens Step 1 — does not fully eliminate the stall before applying power or

- AOA reduction is always Step 1
- Power into a stalled wing = wasted thrust
- Stall warning must stop before Step 2
- Forward elevator — smooth, sufficient
- Never rush past Step 1

INSUFFICIENT POWER APPLICATION

Student reduces AOA but applies partial power or delays power. Without full power, the airplane

- Full power simultaneously with AOA fix
- Partial power = slow speed recovery
- Right rudder required with full power
- Power + AOA are simultaneous, not sequential
- Delay in power = more altitude lost

RAISING NOSE BEFORE SPEED IS ESTABLISHED

Student achieves flying speed but immediately pitches for climb before speed margin is

- Step 3: be patient — let speed build
- Watch airspeed, not just stall horn
- Nose at or below horizon during Step 3
- Secondary stall happens HERE — Step 3-4
- Smooth transition to climb = safe recovery

ENTERING TOO LOW / NO CLEARING

Entry must be at or above 3,000 ft AGL. A secondary stall from an already-recovering stall

- S2: entry ≥3,000 ft AGL minimum
- Two 90° clearing turns every rep
- Secondary stall = additional alt loss
- Traffic scan above, below, all quadrants
- Never skip clearing turns

EVALUATION CHECKLIST — SECONDARY STALL DEMONSTRATION

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Setup & Clearing	Two 90° clearing turns; entry altitude ≥3,000 ft AGL stated aloud; traffic scan complete; configuration selected per evaluator; entry into initial stall established per correct ACS procedure for selected stall type	≥3,000 ft AGL; clearing turns complete; proper stall configuration established; entry verbalized; initial stall fully developed	Skipping clearing turns; entering too low; entering secondary stall attempt before initial stall is fully developed
Secondary Stall Entry (S3)	During initial stall recovery, applicant deliberately applies abrupt back pressure before airspeed has recovered. Second stall cues occur: buffet returns, stall horn sounds again, nose drops a second time. Applicant verbalizes: 'Secondary stall — caused by abrupt back pressure before flying speed was established.'	Secondary stall cues clearly demonstrated; abrupt back pressure as cause verbalized; student understands the mechanism before instructor proceeds to recovery	Failing to actually demonstrate the secondary stall (only verbal description); not verbalizing the cause; student confusion about the stall sequence
CRITICAL	**CORRECT RECOVERY SEQUENCE — non-negotiable order: (1) REDUCE AOA with smooth forward elevator — stall warning stops. (2) FULL POWER simultaneously — right rudder applied. (3) REGAIN SPEED — nose at or below horizon, patience, let airspeed build. (4) SLOWLY RAISE AOA — smooth pitch to climb attitude, Vx or Vy. All four steps verbalized in sequence during demonstration.**	**Steps 1–4 in correct order, verbalized; stall warning eliminated before pitching for climb; nose held below horizon during Step 3; smooth (not abrupt) pitch to climb attitude; Vx or Vy established and maintained**	**Abrupt back pressure during Step 3/4 (re-stall); raising nose before flying speed is established; insufficient power or delayed power application; skipping Step 1 (AOA) and going straight to power**

Debrief & Teaching	Applicant explains aerodynamics: abrupt back pressure before flying speed = second AOA exceedance. States the four-step recovery sequence. Explains why patience in Step 3 is the key to avoidance. Discusses flight situations where secondary stalls occur (all stall types). Can identify what the student should feel/watch during Step 3 to know when it's safe to climb.	Aerodynamic cause stated correctly; four-step recovery sequence correct; patience in Step 3 emphasized explicitly; real-world scenarios cited; airspeed cue for Step 3 transition identified	Cannot explain AOA mechanism; describes recovery as just 'push forward'; does not identify patience as the key lesson; omits power application from recovery sequence

KEY RULE ■ ACS S3–S4: Demonstrate the secondary stall, then recover: Reduce AOA (forward elevator) → Full power + right rudder → Regain speed (patience — hold nose at/below horizon) → Slowly raise AOA to climb at Vx or Vy. — AFH (p. 5-18): Recovery from a stall should be made while 'being careful to avoid a secondary stall.' ABRUPT BACK PRESSURE BEFORE FLYING SPEED = SECONDARY STALL. SMOOTH RECOVERY = SAFE.

Area X, Task I — Spin Awareness and Spins (ASEL)

FAA-S-ACS-25 • AI.X.I • CFI Airplane — Flight Lesson

Objective

The applicant demonstrates instructional knowledge of spins by explaining their cause, the four phases (entry, incipient, developed, recovery), aerodynamics, aircraft approval, and recovery procedures — while simultaneously providing effective instruction.

References

- AC 61-67; FAA-H-8083-3 Ch.5 (Figs. 5-15, 5-16); FAA-H-8083-25; POH/AFM

Delivery

- Ground brief: aircraft approval, 4 phases, POH recovery procedure. Entry ≥ 4,000 ft AGL.
- Spin-approved aircraft required. Parachute reqs per 14 CFR §91.307.

Aerodynamics — Why a Spin Happens

- **Cause:** Critical AOA exceeded (stall) *plus* yaw/sideslip — both must be present
- **Autorotation:** Inside wing = higher AOA/drag, drops. Outside wing = more lift, sustains rotation.
- **Yaw sources:** Rudder misuse, adverse yaw, P-factor, torque, wake turbulence
- **Prevention:** Coordinated flight. Ball centered — every phase, every maneuver.

ACS Knowledge

Code	Element
K1–K2	Purpose/procedures; aerodynamics (AOA, airspeed, load factor, CG, yaw)
K3–K4	Causes; entry, incipient, developed phases; recovery procedure
K6–K8	Aircraft approval (airworthiness/TC); unintentional spin situations; entry ≥4,000 ft AGL
K11–K13	Turn coordinator reliable, ball NOT; recovery ≥1,500 ft AGL; common errors

ACS Risk Management

Code	Element
R1–R2	Inadvertent spin / LOC; stall warning indicator limitations
R3–R4	Recovery procedure (follow POH); environmental effects
R5–R6	Collision hazards; task saturation / disorientation

ACS Skills

Code	Element
S1	Clear the area (above AND below — spins descend ≈1,000 ft first turn)
S2	Select entry altitude ≥4,000 ft AGL
S3	Enter and recover from intentional spin (if requested by evaluator)
S4	Analyze and correct common errors

CRITICAL ■ POH/AFM RECOVERY PROCEDURE TAKES PRECEDENCE — PARE (Power idle / Ailerons neutral / Rudder opposite / Elevator forward) is the FAA's generic teaching baseline. Recovery procedures VARY BY AIRCRAFT. Before every spin session, CFI and student must brief and verify the specific recovery procedure for the aircraft being flown. Never assume PARE applies without checking the POH.

TECHNIQUE — FOUR PHASES OF A SPIN (K3 / K4 / K8–K12)

FOUR PHASES OF A SPIN — ENTRY → INCIPIENT → DEVELOPED → RECOVERY

1 ENTRY	2 INCIPIENT	3 DEVELOPED	4 RECOVERY
Power idle → stall → yaw input	*≈2 turns — forces unbalanced*	*Rotation / speed / descent stable*	*Per POH/AFM — PARE is generic baseline*
• Reduce power to idle • Raise nose to stall attitude • At stall: full rudder in spin direction • Full back elevator to stops • Ailerons — NEUTRAL throughout • Entry altitude ≥ 4,000 ft AGL • Either intentional or accidental	• Wing(s) stalled, rotation begins • Nose pitching toward vertical • Aero & inertial forces NOT balanced • IAS stabilizing at low value • Turn coordinator: shows spin direction • Slip/skid ball: UNRELIABLE — ignore • ≈ 1,000 ft altitude lost first turn	• Near-vertical nose-down attitude • Aero & inertial forces in balance • Constant rotation rate • Constant low airspeed (stalled) • ≈ 500 ft per additional turn • Some aircraft skip this phase • May go incipient → spiral dive instead	• P — Power to IDLE • A — Ailerons NEUTRAL • R — Rudder OPPOSITE rotation (brisk, full) • E — Elevator briskly FORWARD • Neutralize rudder when rotation stops • Pull out smoothly — respect VA & G-limits • Complete recovery ≥ 1,500 ft AGL
STALL + YAW required to spin	**RECOVER HERE if possible**	**CG affects spin aft CG = flatter**	**PARE = generic POH may differ!**

Entry Procedure (S1–S3)

- **Clear area:** Two 90° clearing turns — check ABOVE and BELOW; spins lose ≈1,000 ft first turn
- **Altitude:** ≥4,000 ft AGL for entry; plan to complete recovery by 1,500 ft AGL
- **Aircraft check:** Confirm spin-approved; verify W&B; within limits; carb heat per POH
- **Entry:** Power idle → raise nose to stall → at stall: FULL rudder in spin direction + full back elevator
- **Ailerons neutral:** Throughout entry and spin; aileron deflection can worsen or flatten the spin
- **Maintain:** Hold full rudder and full back elevator; let the spin develop
- **Orient:** Count rotations by ground reference: ‘one turn… two turns…’

Recovery — Follow POH First (S3)

- **P — Power IDLE:** Power aggravates spin — flattens attitude, increases rotation rate
- **A — Ailerons NEUTRAL:** Aileron with spin = faster rotation; against spin = flatten; best = neutral
- **R — Rudder OPPOSITE:** Full, brisk, to the stops — not tentative. Hold until rotation stops.
- **E — Elevator FORWARD:** Immediately after rudder. Reduces AOA, unstalls wing. Do NOT wait.
- **Rudder neutral:** As rotation stops — failure to neutralize causes yaw / sideslip
- **Pull out:** Smooth back pressure to level flight; stay within VA and G-limits

CRITICAL ■ POH FIRST — PARE is a generic fallback. Some aircraft require a different sequence. Brief YOUR specific aircraft’s recovery before every flight.

AFH REFERENCE — FIGURE 5-15 (FAA-H-8083-3C P. 5-22): AUTOROTATION MECHANISM

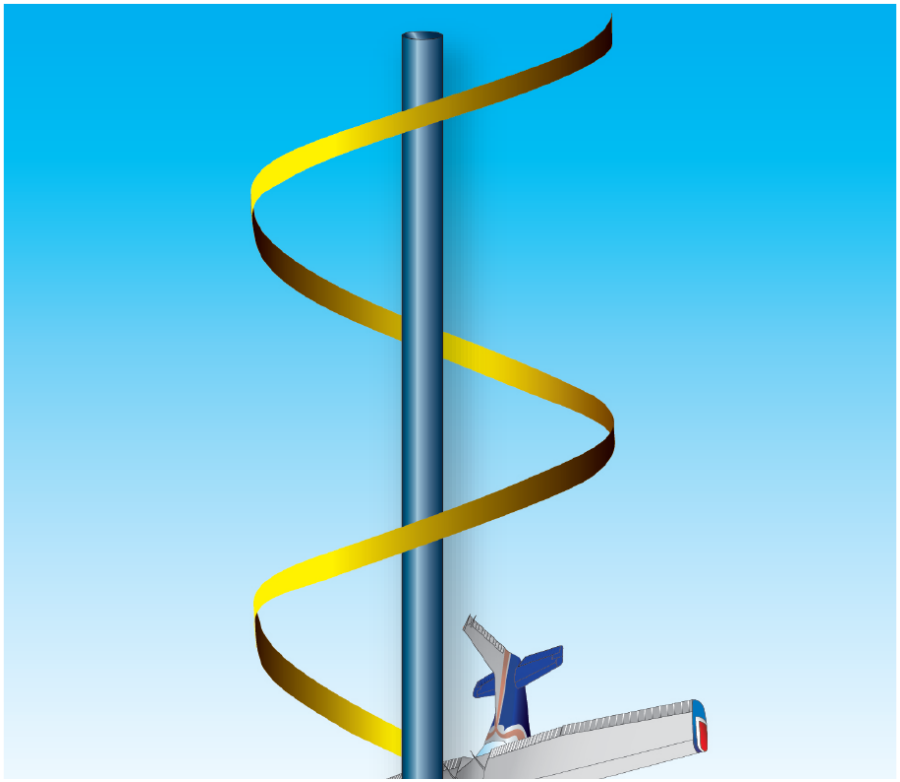


Figure 5-15 *— Spin: an aggravated stall and autorotation. The outside wing travels faster, generates more lift, and less drag; the inside wing is more deeply stalled with higher drag — differential forces sustain the corkscrew rotation. AFH p. 5-22.*

> ***Instructor Note:*** *Ground brief: walk through Fig. 5-15 to explain WHY the spin sustains itself — differential lift/drag on stalled wings. Students must understand the aerodynamics before practicing spin entry. AFH Ch. 5, pp. 5-22–5-23.*

AFH REFERENCE — FIGURE 5-16 (FAA-H-8083-3C P. 5-23): SPIN ENTRY AND RECOVERY

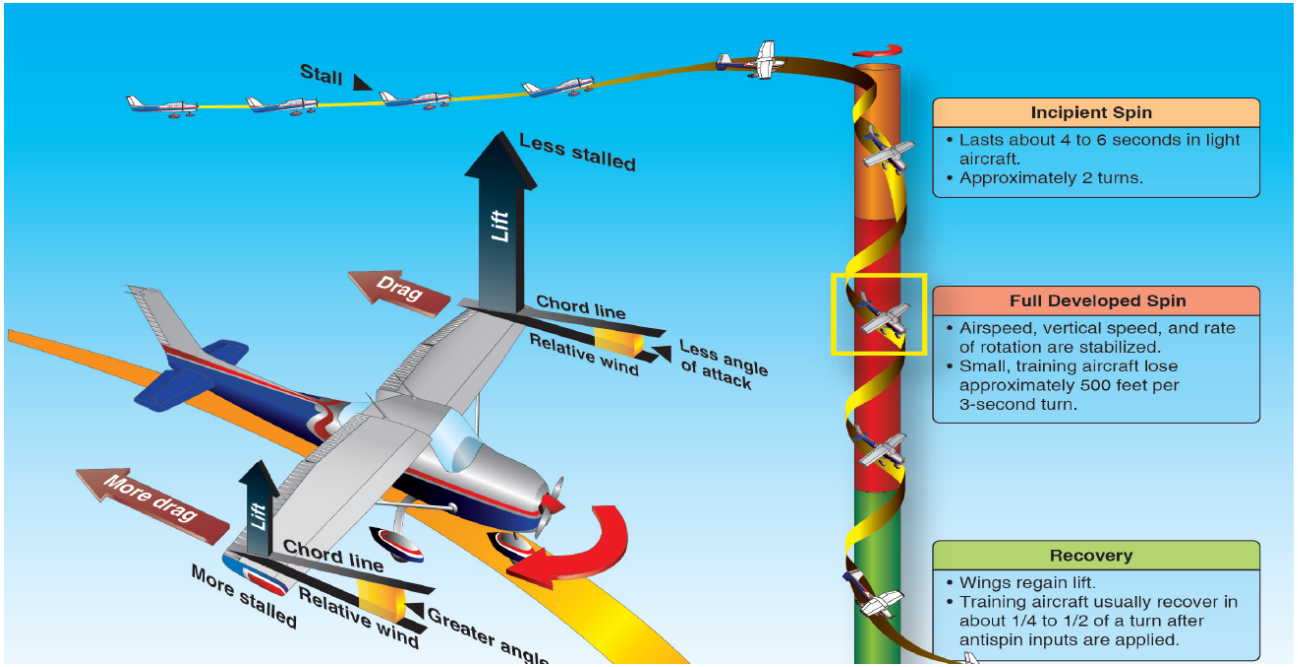


Figure 5-16 *— Spin Entry and Recovery. Four-phase progression from stall entry through developed spin and recovery. AFH p. 5-23.*

UNINTENTIONAL SPIN SCENARIOS — RECOGNITION AND AVOIDANCE (K7 / R1)

SCENARIO	HOW THE SPIN DEVELOPS	AVOIDANCE
Base-to-final overshoot	Inside rudder to tighten an overshoot; skidding turn at low airspeed → inside wing stalls → spin toward terrain	Never skid a turn at low altitude. Overshoot = go-around. Always fly coordinated.
Go-around from slow flight	Full power + nose-up trim + slow airspeed + uncoordinated → departure spin	Right rudder with power; smooth application; maintain coordination throughout climb
Uncoordinated stall recovery	Pilot yaws during recovery (wrong rudder or unchecked P-factor) → spin entry	Reduce AOA first, then coordinate. Practice until recovery is instinctive.
Power-on departure stall	High pitch + torque + P-factor + insufficient right rudder → left roll, stall, spin	Right rudder follows throttle — progressively more as pitch and power increase

COMMON ERRORS (K13) — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — SPIN AWARENESS AND SPINS (AI.X.I.K13)

INCOMPLETE ENTRY	WRONG DIRECTION ID	TENTATIVE RECOVERY	WRONG INPUT SEQUENCE	ALTITUDE AWARENESS
Insufficient rudder or back pressure — spin becomes spiral dive instead.	*Using slip/skid ball for spin direction — ball location determines its movement, not spin*	*Slow or half-hearted opposite rudder allows spin to continue — more altitude lost.*	*Leading with aileron or pulling back before rotation stops — can worsen or sustain spin.*	*Failing to maintain altitude awareness; forgetting 1,500 ft AGL recovery floor.*
• Full rudder to the stops	• Use TURN COORDINATOR only	• Opposite rudder: BRISK and FULL	• Aileron with spin: faster rotation	• Entry: ≥4,000 ft AGL (ACS S2)
• Full back elevator at stall	• Ball is unreliable in a spin	• Apply elevator immediately after rudder	• Aileron against spin: may flatten spin	• Recovery complete: ≥1,500 ft AGL
• Ailerons neutral throughout	• Ball may indicate OPPOSITE direction	• Do NOT wait for rotation to stop	• Never lead with aileron — rudder first	• ≈1,000 ft lost on first turn
• Partial inputs = spiral, not spin	• Practice: ID by turn needle deflection	• Slow inputs = extra turns = altitude loss	• Back pressure before unstalled = 2nd stall	• ≈500 ft per additional turn
• Must stall first, then apply yaw	• Brief instrument limitations pre-flight	• Positive, aggressive technique required	• Follow POH — PARE is not universal	• Abort if altitude is marginal

EVALUATION CHECKLIST — SPIN AWARENESS AND SPINS

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Pre-flight Brief	Aircraft approval confirmed; POH recovery procedure briefed	Spin-approved a/c verified; W&B; within limits; POH procedure confirmed	Assuming PARE applies without verifying the POH/AFM
Clearing	Two 90° clearing turns; confirms above AND below	Area clear above and below; altitude ≥4,000 ft AGL confirmed	Only looking horizontally; not checking below the airplane
Entry	Power idle; nose raised to stall; full rudder + full back elevator	Full control inputs to stops; ailerons neutral	Insufficient rudder; partial back pressure; aileron deflection on entry
Incipient	Spin direction identified via turn coordinator only	Correctly IDs direction; does not use slip/skid ball	Using ball for direction; confusion causes wrong rudder input
CRITICAL	**RECOVERY — Per POH/AFM; correct sequence, brisk inputs**	**Opposite rudder brisk + full; elevator forward immediately; rotation stops**	**Tentative rudder; pulling back before rotation stops; wrong aircraft procedure**
Pull-out	Wings level pull to level flight; airspeed and G controlled	Smooth back pressure; respects VA and G-limits; no secondary stall	Abrupt pull; exceeding maneuvering speed or G-limits on recovery

KEY RULE ■ ACS AI.X.I — PARE is a teaching mnemonic, not a universal standard. The recovery procedure must match YOUR aircraft's POH/AFM. Know it. Brief it. Fly it. Complete spin recovery no lower than 1,500 ft AGL.

Area XI, Task A — Straight-and-Level Flight (ASEL)

FAA-S-ACS-25 • AI.XI.A • CFI Airplane — Flight Lesson • Solely by Reference to Instruments

Objective

The applicant demonstrates instructional knowledge of attitude instrument flying during straight-and-level flight — explaining instrument limitations, attitude indication, cross-check technique, and common errors — while providing effective instruction solely by reference to instruments.

References

- FAA-H-8083-15B (IFH) Ch.6 Fig. 6-17 (radial scan); Ch.7 Fig. 7-57 (primary/supporting roles)
- FAA-H-8083-3C (PHAK) Ch.8; FAA-H-8083-25C; POH/AFM

Delivery

- Ground brief: primary vs. supporting concept, scan pattern, trim discipline. Walk through IFH Fig. 7-57 with student.
- Flight: foggles/view-limiting device at cruise altitude, VMC. Progress: wings-level S&L; → airspeed changes → trim drill.

Primary / Supporting Summary (Straight-and-Level)

Pitch: Altimeter (primary) — AI, VSI supporting • **Bank:** Heading Ind. (primary) — AI, TC supporting • **Power:** Airspeed Ind. (primary) — MP/tach supporting

ACS Knowledge

Code	Element
K1a/c	Instrument limitations, errors, function/operation (vacuum, pitot-static, gyroscopic)
K1b	Attitude indication — reading pitch, bank, and power state from instruments
K1d	Cross-check technique — selective, radial, pattern scan; scan discipline
K2	Common errors: fixation, omission, emphasis, late/large corrections, poor trim

ACS Risk Management

Code	Element
R1–R2	Instrument hazards: VFR into IMC, spatial disorientation, LOC, fatigue; emergency recognition
R3–R4	Collision hazards; distractions, task saturation, situational awareness, disorientation
R5–R6	Fixation and omission errors; instrument interpretation errors in cross-check
R7–R8	Control by reference to instruments only; trim for hands-off stability

ACS Skills

Code	Element
S1	Maintain S&L; using proper cross-check, interpretation, and coordinated control
S2	Maintain altitude ±100 ft, heading ±10°, airspeed ±10 kts
S3	Analyze and correct common errors (fixation, omission, emphasis, over-control)

CRITICAL ■ SCAN DISCIPLINE IS THE FOUNDATION OF ALL INSTRUMENT FLIGHT — a disciplined, continuous cross-check is non-negotiable. Fixation on a single instrument — especially the AI — is the single most common error in instrument students and the root cause of undetected altitude, heading, and airspeed deviations. Train the scan from the first instrument lesson and reinforce it on every flight.

TECHNIQUE — CONTROL & PERFORMANCE METHOD | RADIAL SCAN PATTERN (K1A–K1D / S1)



Figure 6-17. *Radial cross-check.*

***Figure 6-17** — Radial cross-check. The AI is the hub. Eyes move outward to each surrounding instrument and return to the AI every 2–3 seconds. IFH Ch.6, p. 6-11.*

> ***Instructor Note:** Explain C&P; like this: 'Think of it as a 3-step loop — SET, CHECK, ADJUST. You SET the attitude on the AI and the power on the throttle. Then you CHECK the altimeter, HI, and ASI to see if the airplane is actually doing what you told it to. If it's not, you ADJUST — back on the AI, not by chasing the altimeter needle. The AI alone doesn't confirm you're straight and level. The altimeter and HI do.'*

Control & Performance Method (K1b / K1d)

STEP	YOU DO	INSTRUMENT USED
1 SET	Establish attitude on AI; set power on throttle/MP	AI, MP gauge / tach (Control instruments)
2 TRIM	Remove all control pressure; hands off the controls	Trim — not an instrument but essential every time
3 CHECK	Read the performance instruments — are you getting the result you want?	Altimeter, HI, ASI, VSI (Performance instruments)
4 ADJUST	If performance is off, go back to Step 1 — correct on the AI/throttle, not by chasing the altimeter	Back to AI / throttle then re-check performance

Establishing S&L; — Procedure (S1–S2)

- **Establish:** Cruise power per POH → level wings on AI → pitch to hold altitude
- **Trim:** Set attitude → power → trim off all pressure → hands off → check → re-trim
- **Scan loop:** AI → Altimeter → AI → HI → AI → ASI → AI → VSI/TC → AI
- **Corrections:** Small and smooth. Chase deviations on AI/throttle — not on primary instruments directly.
- **Heading drift:** Bank ≈ ½ heading error; lead rollout. Re-trim after.

CRITICAL ■ NEVER FIXATE — no single instrument tells the whole story. Eyes must move every 2–3 seconds. If the scan stops, the flight deteriorates.

KEY RULE ■ C&P; loop: SET on control instruments → CHECK on performance instruments → ADJUST if needed. Small errors caught early require small corrections.

IFH REFERENCE — FIGURE 7-57 (FAA-H-8083-15B P. 7-40): STRAIGHT-AND-LEVEL FLIGHT



Figure 7-57. *Straight-and-level flight (normal cruising speed).*

Figure 7-57 *— Straight-and-level flight at normal cruising speed. The altimeter is primary for pitch; the heading indicator is primary for bank; the airspeed indicator is primary for power. The attitude indicator, VSI, and manifold pressure gauge serve as supporting instruments. Labels identify the primary and supporting role of each instrument in the panel. IFH Ch.7, p. 7-40.*

> ***Instructor Note:*** *Walk through Figure 7-57 with the student before flight. Point to each labeled instrument and ask: 'What is this instrument telling you right now? Is it primary or supporting — and for which axis?' Students who understand WHY an instrument is primary for a given axis will not fixate on the AI. Emphasize: the AI sets the attitude, but the altimeter and HI CONFIRM it. Never accept the AI alone as proof of S&L.;*

COMMON ERRORS (K2) — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — STRAIGHT-AND-LEVEL INSTRUMENT FLIGHT (AI.XI.A.K2)

FIXATION (STARING)	OMISSION (SKIPPING)	EMPHASIS ERRORS	LATE / LARGE CORRECTIONS	IMPROPER TRIM
Staring at one instrument — usually the AI or altimeter — while heading drifts and airspeed	*Omitting instruments from the scan — typically the VSI, TC, or airspeed — until an error has*	*Over-relying on the AI for all three functions (pitch, bank, power) instead of using primary*	*Making large control inputs in response to instrument deviations — overcontrolling because*	*Failing to trim the aircraft in S&L — pilot fights constant control pressure, scan suffers, fatigue*
• Move eyes every 2–3 seconds	• Every instrument has a role	• AI supports — it does not command	• Small corrections early = stable flight	• Trim reduces workload — use it
• No single instrument holds the answer	• VSI catches pitch errors early	• Altimeter is primary pitch (S&L)	• Large inputs = PIO cycle begins	• Set attitude → power → trim
• Altimeter drift = symptom of fixation	• TC confirms coordinated flight	• HI is primary bank (S&L)	• Scan faster, correct smaller	• Hands off → check drift → re-trim
• Brief student: 'glance, not stare'	• ASI reflects power management	• ASI is primary power (S&L)	• 1° of bank per 1° of heading error	• Poorly trimmed a/c = distracted pilot
• Timer drill: force scan rhythm	• Structured scan prevents gaps	• AI cross-checks each, not replaces	• Trim is the key to hands-off stability	• Trim is not optional in IMC

EVALUATION CHECKLIST — STRAIGHT-AND-LEVEL INSTRUMENT FLIGHT

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Setup	Trim and power set for S&L; foggles/hood in place; instruments checked functional	Cruise power set per POH; aircraft trimmed; view-limiting device properly worn	Skipping trim; not verifying instrument function before beginning task
Attitude Est.	Attitude set on AI; verified on altimeter (pitch) and HI (bank)	Wings level; pitch attitude appropriate for cruise airspeed	Accepting AI alone without crosschecking altimeter and HI
CRITICAL	**SCAN — Continuous, disciplined cross-check: AI → primary → supporting, no fixation**	**Eyes moving every 2–3 seconds; no single-instrument stare; all instruments included in scan**	**Fixating on AI or altimeter; omitting VSI, TC, or airspeed from scan**
Corrections	Small, coordinated corrections to altitude, heading, and airspeed deviations	Inputs proportional to error; coordinated; no overcontrol or PIO	Large pitch/bank inputs; chasing altimeter; uncoordinated corrections
Trim	Aircraft re-trimmed after each power or configuration change	Hands-off check confirms trim; no sustained control pressure required	Never re-trimming; forcing altitude with sustained back pressure
Tolerance	Sustained S&L; within ACS tolerances	±100 ft altitude, ±10° heading, ±10 kts airspeed	Heading drift from neglected scan; altitude exceedance from fixation

KEY RULE ■ ACS AI.XI.A — Straight-and-level instrument flight is not about holding the AI centered. It is about a disciplined, continuous scan that catches deviations on the PRIMARY instruments (altimeter, heading indicator, ASI) before they grow. Teach the scan. Demand the scan. Tolerances: ±100 ft altitude • ±10° heading • ±10 kts airspeed.

Area XI, Task B — Constant Airspeed Climbs (ASEL)

FAA-S-ACS-25 • AI.XI.B • CFI Airplane — Flight Lesson • Solely by Reference to Instruments

Objective

The applicant demonstrates instructional knowledge of attitude instrument flying during constant airspeed climbs — explaining instrument indications through entry, established climb, and level-off phases — while providing effective instruction solely by reference to instruments.

References

- FAA-H-8083-15B (IFH) Ch.7 pp.7-14 to 7-16; Fig. 7-26 (constant airspeed), Fig. 7-27 (constant rate)
- FAA-H-8083-3C (PHAK) Ch.4 (aerodynamics of climb); POH/AFM — Vx, Vy, cruise climb airspeeds

Delivery

- Ground brief: three climb types, POH speed selection, primary/supporting shift across phases, level-off math.
- Flight: foggles/hood at cruise. Demonstrate entry → stabilized climb → level-off. Student flies same sequence.

ACS Knowledge

Code	Element
K1a	Instrument indications: entry, established climb, and level-off phases
K1b	Power, pitch, and trim coordination during climb; effect on airspeed and rate
K1c	Primary and supporting instrument roles — shift from AI to ASI at stabilization
K2	Common errors: wrong speed, chasing ASI, fixation, late level-off, poor trim

ACS Risk Management

Code	Element
R1–R2	Spatial disorientation during nose-high attitude; instrument failure during climb
R3–R4	Task saturation at entry (power, pitch, trim, scan simultaneously); traffic awareness
R5–R6	Fixation on ASI or AI during established climb; missing heading drift
R7	Altitude overshoot from delayed or abrupt level-off; high-altitude airspace awareness

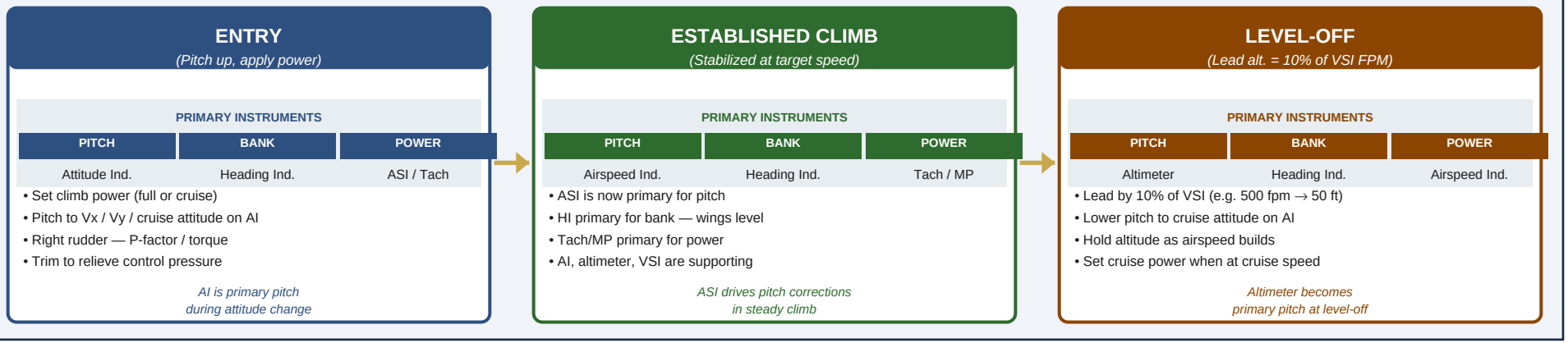
ACS Skills

Code	Element
S1	Establish constant airspeed climb at POH-specified speed using instruments only
S2	Level off at pre-determined altitude within ±100 ft; anticipate by 10% of VSI FPM
S3	Maintain heading ±10° and target airspeed ±10 kts throughout climb
S4	Identify and correct common errors in airspeed, heading, and level-off technique

CRITICAL ■ POH/AFM SPEED SELECTION IS NON-NEGOTIABLE — The climb speed must come from the airplane's POH or AFM for the current gross weight and conditions. Do not guess or memorize a generic number. Vx (best angle) maximizes altitude per horizontal distance — use for obstacle clearance. Vy (best rate) maximizes altitude per unit time — the standard training climb. Cruise climb is faster, improves forward visibility, and reduces engine heat — appropriate for cross-country and long climbs. Brief the speed BEFORE the climb, every time.

TECHNIQUE — CONSTANT AIRSPEED CLIMB | ENTRY → ESTABLISHED → LEVEL-OFF (K1A–K1C / S1–S2)

CONSTANT AIRSPEED CLIMB — THREE PHASES | PRIMARY & SUPPORTING INSTRUMENTS



Step-by-Step Procedure (S1–S2)

- **Pre-climb:** Confirm POH speed (Vx / Vy / cruise climb) and target altitude before initiating.
- **Entry:** Apply climb power → pitch to climb attitude on AI → right rudder for P-factor → trim off pressure.
- **Stabilize:** Cross-check ASI — fine-tune pitch until target speed is stable. ASI is now primary for pitch.
- **Established climb:** Continuous instrument scan — AI, ASI, HI, altimeter, VSI, tach in rotation.
- **Level-off cue:** When altimeter reaches *lead altitude* (10% of VSI), smoothly lower pitch to cruise attitude.
- **Level-off execution:** Hold altitude as speed builds → set cruise power → re-trim → altimeter becomes primary pitch.

Instructor Note: *Use the '10% rule' as a concrete ground brief: 'At 500 fpm, I start leveling off 50 feet early. At 1,000 fpm, I lead by 100 feet. Set your bug on the DI 10% below your target altitude so the altimeter tells you when to start.' Walk through this math with the student before flight — it becomes instinctive after 2–3 practice climbs.*

Key Technique Points

1 — Continue the Instrument Scan Throughout

The scan does not pause during a climb. Heading drift is the most common undetected error — it accumulates while the student fixates on the ASI or AI. Eyes must move every 2–3 seconds: ASI (pitch) → HI (bank) → altimeter (level-off cue) → tach (power) → back to ASI.

2 — Use Trim to Reduce Workload

After establishing the climb attitude and confirming airspeed, trim off ALL back pressure. A well-trimmed airplane holds the climb with hands off — freeing mental bandwidth for the scan. Untrimmed back pressure is the leading cause of scan breakdown in student climbs. Verify trim with a brief hands-off check: does airspeed hold without input?

3 — Anticipate Level-Off: 10% of FPM

Begin level-off when the altimeter reaches **10% of the VSI reading below target altitude**. At 500 fpm → lead by 50 ft. At 1,000 fpm → lead by 100 ft. Smooth forward pressure to cruise attitude, hold altitude as airspeed builds, then set cruise power. An abrupt pitch-forward overshoots below target; a late level-off overshoots above.

KEY RULE ■ In a constant airspeed climb: SET attitude on AI → confirm speed on ASI (now primary pitch) → TRIM → SCAN continuously → LEAD level-off by 10% of FPM. Speed comes from the POH — always.

IFH REFERENCE — FIGURE 7-27 (FAA-H-8083-15B P. 7-15): STABILIZED CLIMB AT CONSTANT RATE



Figure 7-27. *Stabilized climb at constant rate.*

Figure 7-27 *— Stabilized climb at constant rate. Once stabilized in a constant airspeed climb, the* ***airspeed indicator becomes primary for pitch*** *— it confirms the airplane is holding the target climb speed. The heading indicator remains primary for bank. The tachometer or manifold pressure gauge is primary for power. The attitude indicator, altimeter, and VSI serve as supporting instruments throughout the established climb. IFH Ch.7, p. 7-15.*

> ***Instructor Note:*** *Walk through Figure 7-27 with the student before flight. Point to each labeled instrument and ask: 'In the established climb, which instrument is primary for pitch — and why?' The correct answer is the Airspeed Indicator — because pitch controls airspeed in a constant airspeed climb. Students who understand WHY the primary instrument shifts from the AI (entry) to the ASI (established) will make smoother corrections and stop chasing the attitude indicator. Also use this figure to preview the level-off: as pitch lowers, the altimeter takes over as primary pitch.*

COMMON ERRORS (K2) — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — CONSTANT AIRSPEED CLIMBS (AI.XI.B.K2)

WRONG SPEED (NO POH CHECK)	CHASING THE ASI	FIXATING / STOPPING SCAN	LATE OR MISSED LEVEL-OFF	POOR TRIM / HIGH WORKLOAD
Using a memorized or arbitrary climb speed instead of the POH-specified Vx, Vy, or cruise	*Over-correcting pitch in response to every ASI fluctuation — causing a porpoising climb instead*	*Staring at the ASI or AI throughout the climb — missing heading drift, bank, or the approaching*	*Failing to anticipate the level-off altitude — resulting in over-shooting by 50–150 feet and a*	*Failing to trim after establishing the climb — pilot fights back pressure the entire climb, scan*
• Always reference the POH/AFM	• Set attitude; let ASI stabilize	• Scan never stops — even in climbs	• Lead by 10% of VSI reading	• Trim immediately after establishing
• Vx/Vy change with gross weight	• Small pitch changes only (±1–2°)	• HI drift = undetected bank	• 500 fpm → start level-off at 50 ft early	• Trim = reduced workload in climb
• Cruise climb: better cooling, visibility	• Wait 3–5 sec before re-correcting	• Altimeter: watch for level-off cue	• 1,000 fpm → start level-off at 100 ft early	• Re-trim after every power change
• Wrong speed = wrong performance	• AI sets attitude; ASI confirms it	• VSI confirms rate, not pitch control	• Watch altimeter, not just VSI	• Hands off test: does speed hold?
• Brief the speed before every climb	• Smooth inputs, not continuous chasing	• Move eyes every 2–3 seconds	• Smooth pitch forward — not abrupt	• Poorly trimmed a/c degrades scan

EVALUATION CHECKLIST — CONSTANT AIRSPEED CLIMBS

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Pre-Climb	POH/AFM climb speed identified and briefed; target altitude set	Correct Vx, Vy, or cruise climb speed from POH; altitude target stated	Using a generic or memorized speed without POH reference
Entry	Power applied, pitch set to climb attitude on AI; right rudder applied; trim set	Smooth coordinated entry; trim adjusted before scan resumes; no skid	Abrupt pitch-up; forgetting right rudder; neglecting trim at entry
CRITICAL	**TRIM + SCAN — Aircraft trimmed for hands-off climb; continuous instrument scan maintained throughout**	**No sustained control pressure; eyes moving every 2–3 sec across all instruments; no fixation**	**Fighting back pressure entire climb; fixating on ASI or AI; heading drifts undetected**
Established	Constant airspeed held at POH-specified value; heading maintained	±10 kts target airspeed; ±10° heading; steady VSI	Chasing ASI with large pitch inputs; heading drift from scan omission
Level-Off	Level-off initiated at 10% of VSI below target altitude; smooth pitch forward	Altitude overshoot/undershoot ±100 ft; smooth pitch transition to cruise attitude	Late level-off (overshoots high); abrupt pitch forward (overshoots low)
Cruise	Cruise power set, trim adjusted; altimeter is now primary pitch instrument	Stabilized S&L; within ±100 ft, ±10°, ±10 kts at cruise power	Forgetting to reduce power; failing to re-trim for level flight

KEY RULE ■ ACS AI.XI.B — Speed from the POH, always. Entry: AI primary for pitch. Established: ASI primary for pitch. Level-off: lead by 10% of VSI (500 fpm → 50 ft early). Trim immediately — fight no pressure. Scan continuously — stop never. Tolerances: ±100 ft altitude • ±10° heading • ±10 kts airspeed.

Area XI, Task C — Constant Airspeed Descents (ASEL)

FAA-S-ACS-25 • AI.XI.C • CFI Airplane — Flight Lesson • Solely by Reference to Instruments

Objective

The applicant demonstrates instructional knowledge of attitude instrument flying during constant airspeed descents — explaining instrument indications through entry, established descent, and level-off phases — while providing effective instruction solely by reference to instruments. Central emphasis: **Power + Pitch = Airspeed**. Both must be set deliberately and in sequence.

References

- FAA-H-8083-15B (IFH) Ch.7 pp.7-17 to 7-19; Fig. 7-30 (throttle error), Fig. 7-32 (level-off)
- FAA-H-8083-3C (PHAK) Ch.4 (aerodynamics of descent); POH/AFM — descent power settings

Delivery

- Ground brief: Power + Pitch = Airspeed formula, RPM-first sequence, Fig. 7-30 (error) vs. Fig. 7-32 (correct).
- Flight: foggles/hood at cruise. Demonstrate entry → stabilized descent → level-off. Student repeats.

ACS Knowledge

Code	Element
K1a	Instrument limitations and potential errors
K1b	Indication of the aircraft attitude
K1c	Function and operation
K1d	Proper instrument cross-check techniques
K2	Common errors related to this Task

ACS Risk Management

Code	Element
R1–R2	Instrument flying hazards (VFR failure, spatial disorientation, loss of control, fatigue, stress, emergency off-airport landing); when to seek assistance or declare an emergency
R3–R4	Collision hazards; distractions, task prioritization, loss of situational awareness, or disorientation
R5–R6	Fixation and omission; instrument interpretation
R7–R8	Control application solely by reference to instruments; trimming the aircraft

ACS Skills

Code	Element
S1	Transition to the descent pitch attitude and power setting on an assigned heading using proper instrument cross-check and interpretation, and coordinated flight control application
S2	Descend at a constant airspeed to specific altitudes in straight flight and turns
S3	Level off at the assigned altitude and maintain altitude ±100 feet, heading ±10°, and airspeed ±10 knots
S4	Analyze and correct common errors related to this Task

CRITICAL ■ POWER + PITCH = AIRSPEED — In a constant airspeed descent both elements must be set deliberately. The student sets the desired RPM (descent power) FIRST, then places the nose just below the horizon. If power is wrong, no amount of pitch correction will give a stable airspeed. If pitch is wrong, the airplane descends too steeply or too shallow regardless of RPM. Both must be coordinated. Use Fig. 7-30 to show what happens when throttle is not set correctly, and Fig. 7-32 to show the proper stabilized technique and level-off.

TECHNIQUE — CONSTANT AIRSPEED DESCENT | ENTRY → ESTABLISHED → LEVEL-OFF (K1A–K1C / S1–S2)

CONSTANT AIRSPEED DESCENT — THREE PHASES | POWER + PITCH = AIRSPEED

ENTRY
(Set RPM → pitch below horizon)

PRIMARY INSTRUMENTS

PITCH	BANK	POWER
Attitude Ind.	Heading Ind.	Tach / RPM

- Step 1: Reduce to descent RPM (per POH)
- Step 2: Pitch nose just below horizon
- Trim off forward pressure
- Cross-check ASI — fine-tune pitch

RPM set FIRST — then pitch.
Power + Pitch = Airspeed

ESTABLISHED DESCENT
(Stabilized at target speed)

PRIMARY INSTRUMENTS

PITCH	BANK	POWER
Airspeed Ind.	Heading Ind.	Tach / MP

- ASI is primary for pitch control
- HI primary for bank — wings level
- Tach/MP primary for power
- AI, VSI, altimeter are supporting

ASI drives pitch corrections
in steady descent

LEVEL-OFF
(Lead altitude: 10% of VSI FPM)

PRIMARY INSTRUMENTS

PITCH	BANK	POWER
Altimeter	Heading Ind.	Airspeed Ind.

- Lead by 10% of VSI (e.g. 500 fpm → 50 ft)
- Add cruise power (IFH: power at 50 ft lead)
- Smoothly pitch up to cruise attitude
- Hold altitude as airspeed stabilizes

Add power at lead altitude.
Altimeter = primary pitch.

Step-by-Step Procedure (S1–S2)

- **Pre-descent:** Confirm descent power setting from POH and target altitude before initiating.
- **Entry — Step 1 (POWER):** Reduce to descent RPM. Allow airspeed to begin settling.
- **Entry — Step 2 (PITCH):** Place nose just below the horizon on the AI. Trim off forward pressure.
- **Stabilize:** Cross-check ASI — fine-tune pitch until target speed is stable. ASI is now primary for pitch.
- **Established descent:** Continuous instrument scan — AI, ASI, HI, altimeter, VSI, tach in rotation.
- **Level-off cue:** When altimeter reaches *lead altitude* (10% of VSI, e.g. 50 ft early for 500 fpm), add cruise power.
- **Level-off execution:** Smoothly pitch up to cruise attitude → hold altitude as speed stabilizes → re-trim.

> ***Instructor Note:*** *Teach the 'RPM-first' habit as a verbal checklist: 'Power → Pitch → Trim → Scan.' Walk through this ground-to-air: 'We set our descent RPM first — then we move the nose just below the horizon. The two together give us our airspeed. Change one without the other and you'll chase the needles the whole way down.'*

Key Technique Points

1 — Power First, Then Pitch

Reduce to the desired descent RPM before moving the pitch. Once power is set, the nose goes just below the horizon on the AI. This two-step sequence is the foundation of the Power + Pitch = Airspeed formula. Reversing the order — pitching first — results in an unstabilized descent that requires constant chasing of the ASI.

2 — Nose Just Below the Horizon

The pitch target is a **small nose-low attitude** on the AI — not an aggressive dive. Once RPM is set, placing the miniature aircraft just below the horizon line on the AI gives the initial pitch reference. Trim off all forward pressure immediately. The ASI then becomes primary for pitch: if speed is high, raise pitch slightly; if low, lower slightly.

3 — Anticipate Level-Off: Add Power at Lead Altitude

Begin level-off when the altimeter is **10% of the VSI reading above target** (50 ft for 500 fpm). Add cruise power first, then smoothly pitch up to cruise attitude. Hold the altitude as airspeed builds back to cruise speed, then re-trim. An abrupt pitch-up without power overshoots above target; late level-off overshoots below.

IFH REFERENCE — FIG. 7-30 (THROTTLE ERROR) VS. FIG. 7-32 (PROPER TECHNIQUE) | FAA-H-8083-15B CH.7

■■ FIGURE 7-30 — WHAT GOES WRONG



Figure 7-30. *Constant airspeed descent, airspeed high—reduce power.*

Fig. 7-30 — Constant airspeed descent, airspeed high — reduce power. *Airspeed indicator is high (too much power). Primary power correction required. This is what happens when RPM is not set correctly before pitching.*

✓ FIGURE 7-32 — PROPER TECHNIQUE



Figure 7-32. *Level off at descent airspeed.*

Fig. 7-32 — Level off at descent airspeed. *Power is primary as airspeed approaches the desired value at the 50 ft lead altitude. Heading indicator and bank remain supporting. This is the correct sequence.*

> ***Instructor Note:*** *Walk through both figures together in the ground brief. Point to Fig. 7-30 first: 'Look at the airspeed indicator — it's reading high. That tells us the power is too high for this pitch attitude. Power and pitch are fighting each other. The airplane is not stable.' Then point to Fig. 7-32: 'Here the power is set correctly and is now primary as we approach the lead altitude. The descent is stabilized — power and pitch are working together.' Reinforce the verbal mantra: 'Set your RPM first. Then put the nose just below the horizon. Both have to be right. Power + Pitch = Airspeed.'*

COMMON ERRORS (K2) — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — CONSTANT AIRSPEED DESCENTS (AI.XI.C.K2)

WRONG RPM / NO POWER SET	NOSE TOO HIGH OR TOO LOW	FIXATING / STOPPING SCAN	LATE OR MISSED LEVEL-OFF	POOR TRIM / HIGH WORKLOAD
Setting pitch first without establishing descent RPM — airspeed wanders as power and pitch	*Pitching too far below horizon (too fast, steep descent) or not far enough (not descending),*	*Staring at the VSI or ASI throughout the descent instead of maintaining a continuous instrument*	*Failing to add power and raise pitch at the lead altitude — overshooting below target altitude by*	*Failing to trim after establishing the descent — pilot fights forward pressure the entire descent,*
• Set RPM FIRST, then pitch	• Visual ref: nose just below horizon	• Scan never stops in a descent	• Lead by 10% of VSI reading	• Trim immediately after stabilizing
• Power + Pitch = Airspeed	• Small corrections only (±1–2°)	• HI drift = undetected bank	• IFH: add power at 50 ft early	• Trim = reduced workload in descent
• Verify tach before adjusting pitch	• Let ASI confirm, then hold attitude	• Altimeter: watch for level-off cue	• Watch altimeter, not just VSI	• Re-trim after every power change
• Too much power = airspeed too high	• AI is primary at entry, then ASI	• VSI confirms rate, does not set pitch	• Pitch up smoothly — not abruptly	• Hands-off check: does speed hold?
• Too little power = descent too steep	• Avoid chasing the VSI needle	• Eyes every 2–3 sec across all instruments	• Late level-off = altitude bust	• Untrimmed descent degrades scan

EVALUATION CHECKLIST — CONSTANT AIRSPEED DESCENTS

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Pre-Descent	POH descent power setting identified and briefed; target altitude set	Correct RPM/MP for descent airspeed from POH; altitude target stated	Using arbitrary power without POH reference; no altitude target stated
Entry — Power	Descent RPM set FIRST before changing pitch attitude	Smooth power reduction to descent setting; no abrupt throttle movement	Pitching before reducing power; forgetting to set RPM at all
Entry — Pitch	Nose placed just below horizon on AI after RPM is set; trim applied	Small nose-low attitude on AI; trim adjusted before scan resumes	Nose too far below horizon (too steep); or not enough (not descending)
CRITICAL	**POWER + PITCH = AIRSPEED — Both RPM and pitch attitude set correctly and coordinated from the outset**	**Descent RPM set first; nose just below horizon; ASI stabilizes at target ±10 kts; no chasing needles**	**Setting pitch before power; airspeed unstable throughout; constant large corrections to ASI**
Established	Constant airspeed held at POH-specified value; heading maintained; continuous scan	±10 kts target airspeed; ±10° heading; steady VSI; eyes moving every 2–3 sec	Fixating on VSI; heading drift undetected; large pitch corrections chasing ASI
Level-Off	Level-off initiated at lead altitude (10% of VSI); power added; pitch raised smoothly	Altitude overshoot/undershoot ±100 ft; smooth transition to cruise attitude	Late level-off (undershoots altitude); power added too late; abrupt pitch-up
Cruise	Cruise power set, trim adjusted; altimeter is primary pitch instrument	Stabilized S&L; within ±100 ft, ±10°, ±10 kts at cruise power	Forgetting to set cruise power; failing to re-trim for level flight

KEY RULE ■ ACS AI.XI.C — POWER + PITCH = AIRSPEED. Set descent RPM first, then nose just below horizon. Trim immediately. Scan continuously — ASI is primary for pitch in the established descent. Lead level-off by 10% of VSI: add power first, then raise pitch. Tolerances: ±100 ft altitude • ±10° heading • ±10 kts airspeed.

Area XI, Task D — Turns to Headings (ASEL)

FAA-S-ACS-25 • AI.XI.D • CFI Airplane — Flight Lesson • Solely by Reference to Instruments

Objective

The applicant demonstrates instructional knowledge of attitude instrument flying during turns to predetermined headings — explaining primary and supporting instrument indications through roll-in, established standard-rate turn, and rollout phases. Central emphasis: **lead the rollout by one-half the bank angle** and use the **HSI heading bug** to eliminate overshoot and undershoot.

References

- FAA-H-8083-15B (IFH) Ch.7 pp.7-19 to 7-22; Fig. 7-33 (Standard rate turn, constant airspeed)
- FAA-H-8083-3C (PHAK) Ch.5 (aerodynamics of turns, load factor, bank angle)
- FAA-S-ACS-25 Area XI Task D; POH/AFM — cruise power settings

Delivery

- Ground brief: standard rate definition, bank angle formula (KIAS÷10+5), rollout lead formula (½ bank), instrument priority shift (AI→TC→HI), HSI bug technique.
- Flight: foggles/hood at cruise altitude. Demonstrate full turn sequence. Student practices to specific headings, both left and right.

ACS Knowledge

Code	Element
K1a	Instrument limitations and potential errors during turns
K1b	Indication of aircraft attitude through entry, turn, and rollout
K1c	Function and operation of each instrument during bank changes
K1d	Proper instrument cross-check and interpretation in turns
K2	Common errors related to this Task

ACS Risk Management

Code	Element
R1–R2	Instrument flying hazards (spatial disorientation, loss of control, VFR into IMC, fatigue); when to seek assistance or declare an emergency
R3–R4	Collision hazards; distractions, task prioritization, loss of situational awareness
R5–R6	Fixation and omission errors; instrument interpretation errors during bank changes
R7–R8	Proper control application in turns by reference to instruments; trimming in turns

ACS Skills

Code	Element
S1	Establish and maintain a standard-rate turn using proper instrument cross-check and interpretation, with coordinated flight controls
S2	Roll out on the specified heading ±10°
S3	Maintain altitude ±100 feet and airspeed ±10 knots throughout the turn
S4	Analyze and correct common errors related to this Task

CRITICAL ■ LEAD THE ROLLOUT — Begin rolling out when the heading indicator shows you are one-half the bank angle away from the target heading. At 15° bank, start the rollout at 7–8° before the target. The rollout itself takes degrees, and if you wait until the bug is on the target, you will overshoot every time. Teach students to SET THE HSI BUG on the target heading before every turn — the bug gives a visual lead-point reference and removes the need to fixate on the HI dial during higher-workload situations.

IFH REFERENCE — FIG. 7-33: STANDARD RATE TURN, CONSTANT AIRSPEED | FAA-H-8083-15B CH.7

✓ **FIGURE 7-33 — Standard Rate Turn, Constant Airspeed** IFH p.7-20 | FAA-H-8083-15B

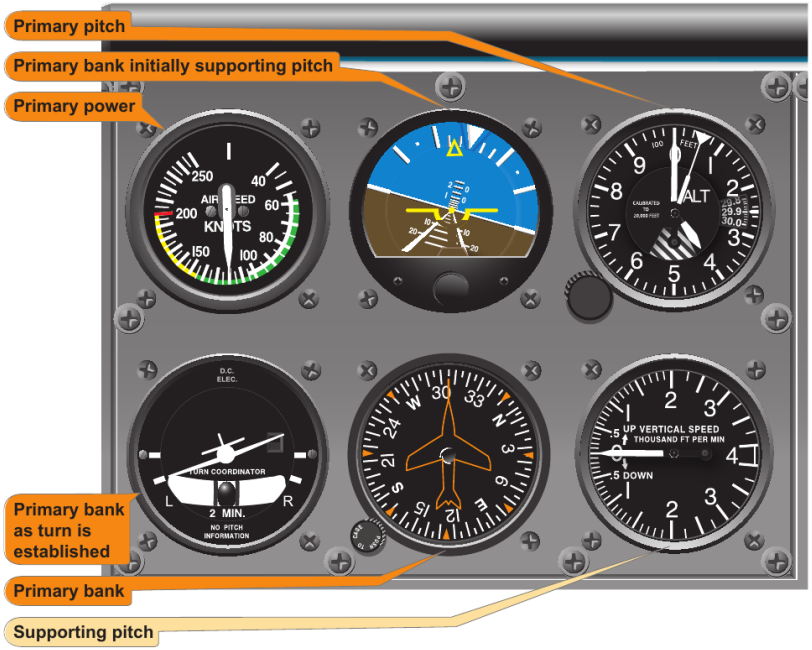


Figure 7-33. *Standard rate turn, constant airspeed.*

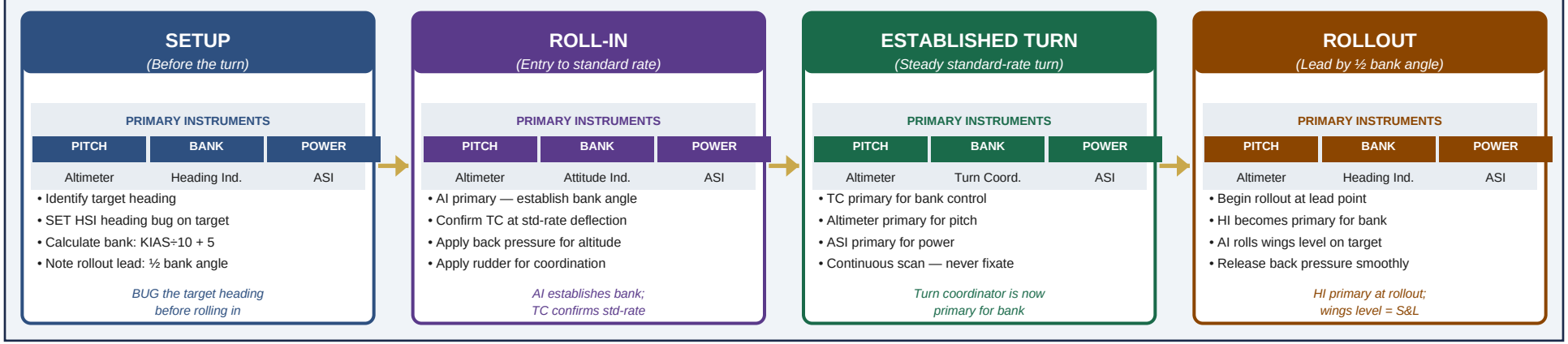
7-20

Fig. 7-33 *— During the roll-in, the* ***Attitude Indicator*** *is primary for bank and initially supporting pitch. Once the standard-rate turn is established, the* ***Turn Coordinator*** *becomes primary for bank; the* ***Altimeter*** *is primary for pitch; the* ***ASI*** *is primary for power. The TC's miniature aircraft must remain at the standard-rate deflection mark throughout the established turn.*

HSI HEADING BUG TECHNIQUE ■ Before every turn to a heading, teach students to **set the HSI heading bug on the target heading**. The bug serves as a visual countdown to the rollout lead point — when the bug is ½ the bank angle away from the lubber line, it's time to roll out. This removes the need to mentally calculate "how many more degrees" during the turn and eliminates fixation on the HI dial. In higher-stress situations — ATC heading assignments, missed approaches, holds — the bug is a critical workload-reduction tool that prevents both overshoot and undershoot. **Make it a habit from the first lesson: identify, bug, then roll.**

TECHNIQUE — TURNS TO HEADINGS | SETUP → ROLL-IN → ESTABLISHED → ROLLOUT (K1A–K1D / S1–S2)

TURNS TO HEADINGS — FOUR PHASES | STANDARD RATE = 3°/SEC | LEAD ROLLOUT = ½ BANK ANGLE



Step-by-Step Procedure (S1–S2)

- **Setup:** Identify target heading. **Set HSI heading bug on the target.** Calculate bank angle (KIAS÷10+5). Determine lead point (½ bank angle).
- **Roll-in:** Use AI as primary for bank — smoothly establish the calculated bank angle. Confirm turn coordinator at standard-rate deflection. Apply back pressure for altitude.
- **Established turn:** TC becomes primary for bank. Altimeter is primary for pitch. ASI is primary for power. Maintain coordinated ball-centered flight.
- **Continuous scan:** TC → Altimeter → ASI → HI in rotation. Watch HSI bug to monitor approach to rollout point.
- **Lead point:** When HI shows you are ½ bank angle away from target, initiate rollout. Example: 15° bank → begin rollout at 7–8° prior.
- **Rollout:** Smoothly roll wings level — HI is now primary for bank. Release back pressure as wings level. Confirm heading within ±10°.

> ***Instructor Note:*** *Brief the bank angle formula before every flight: 'We take our airspeed, divide by 10, add 5 — that's our standard-rate bank angle. At 100 knots, that's 15 degrees. At 120 knots, 17 degrees. We roll to that on the AI, then let the turn coordinator confirm we're at standard rate.' Reinforce the lead: 'Half my bank, 7 to 8 degrees early. That's when I start coming back.'*

Key Technique Points

1 — Standard Rate = 3°/Second

A standard-rate turn completes 360° in exactly 2 minutes. The turn coordinator's miniature aircraft deflects to the standard-rate mark. Bank angle varies with airspeed: the faster the aircraft, the more bank is required to maintain 3°/sec. Use the formula **KIAS ÷ 10 + 5** as the starting point, then fine-tune with the TC.

2 — Instrument Priority Shifts Through the Maneuver

The primary bank instrument changes through three phases: **AI** during roll-in (sets the bank angle), **Turn Coordinator** in the established turn (maintains standard rate), and **Heading Indicator** during rollout (confirms wings-level heading). Students who fixate on the AI throughout the entire turn will fail to detect standard-rate deviation.

3 — Back Pressure Prevents Altitude Loss

As bank angle increases, the vertical component of lift decreases. Without back pressure, the aircraft will descend in the turn. Anticipate this on roll-in and apply smooth back pressure to maintain the altimeter. The altimeter is the primary pitch instrument throughout the turn. A trim adjustment may be needed to reduce sustained back pressure.

KEY RULE ■ Standard rate = 3°/sec. Bank = KIAS÷10+5. Lead rollout by ½ bank angle. HSI bug the target heading before every turn.

COMMON ERRORS (K2) — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — TURNS TO HEADINGS (AI.XI.D.K2)

OVERSHOOT / UNDERSHOOT	ALTITUDE LOSS IN THE TURN	NON-STANDARD RATE TURN	FIXATING / POOR SCAN	COORDINATION FAILURE
Rolling out too late or too early — missing the target heading by more than ±10°. Most	*Letting the nose drop during the bank, causing an altitude loss of 50–200 feet. Students forget*	*Failing to establish and maintain a standard-rate (3°/sec) turn — either too steep or too shallow*	*Staring at the heading indicator waiting for the target to arrive — missing altitude deviations*	*Failure to keep the ball centered throughout the turn — skidding or slipping — leading to*
• Lead = ½ bank angle (e.g., 8° for 15° bank)	• Back pressure required in any bank	• Formula: KIAS÷10 + 5 = bank angle	• Scan: TC → Alt → ASI → HI in rotation	• Ball must be centered at all times
• Set HSI bug BEFORE rolling in	• Altimeter is primary pitch — watch it	• At 100 kts: 15° bank = std rate	• HSI bug removes need to fixate on HI	• Inside rudder for skid; outside for slip
• Bug shows lead point visually	• Entry: anticipate, apply pressure early	• TC miniature aircraft at std-rate mark	• Altimeter drift = nose dropping in turn	• Right turns: left rudder tendency reduced
• Watch HI — do not fixate on AI	• Bank → vertical lift reduces → back pressure	• AI sets bank; TC confirms std rate	• ASI change = power or pitch problem	• Left turns: right rudder often needed
• Overshooting = rolling out too late	• Re-trim after establishing the turn	• Adjust bank if TC deflection is wrong	• Never lock onto any single instrument	• Uncoordinated turn = inaccurate heading

EVALUATION CHECKLIST — TURNS TO HEADINGS

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Setup	Target heading identified; HSI heading bug set on target; bank angle calculated; lead point noted	Bug on target before roll-in; bank formula stated (KIAS÷10+5); lead point identified	No bug set; no bank calculation; student does not know the lead point before starting the turn
Roll-in	AI used as primary to establish standard-rate bank; TC confirms standard-rate deflection; back pressure applied	Smooth bank entry to correct angle; TC at standard-rate mark; altitude holds within ±100 ft	Over-banking past standard rate; forgetting back pressure; using TC instead of AI to set bank
Established	TC primary for bank (standard-rate maintained); altimeter primary for pitch; continuous instrument scan	TC held at std-rate mark; altitude ±100 ft; ASI ±10 kts; heading tracking toward target	Fixating on HI; altitude lost; bank drifts off standard rate without correction
CRITICAL	**LEAD THE ROLLOUT — Rollout initiated at ½ bank angle before target; rolls out on or within ±10° of target heading**	**Rollout begun at lead point; wings level within ±10° of target; no overshoot/undershoot beyond tolerance**	**Rolling out on the target (too late = overshoot); no lead calculated; no HSI bug = fixation during rollout**
Rollout	HI primary for bank during rollout; back pressure released as wings level; coordinated throughout	Heading within ±10°; altitude within ±100 ft; airspeed within ±10 kts; ball centered	Abrupt rollout; releasing back pressure too early (altitude gain); ball not centered (uncoordinated turn)
Post-Turn	Straight-and-level established; trim adjusted; altimeter and HI confirm target altitude and heading	Stable S&L; within ±100 ft, ±10°, ±10 kts at cruise power	Forgetting to trim; heading drifting off target; altitude not recaptured after turn

KEY RULE ■ ACS AI.XI.D — Standard rate = 3°/sec. Bank angle = KIAS÷10+5. AI sets bank on roll-in; TC confirms standard rate; HI primary at rollout. Lead the rollout by ½ the bank angle. Set the HSI bug before every turn. Tolerances: ±100 ft altitude • ±10° heading • ±10 kts airspeed.

Area XI, Task E — Recovery from Unusual Flight Attitudes (ASEL)

FAA-S-ACS-25 • AI.XI.E • CFI Airplane — Flight Lesson • Solely by Reference to Instruments

Objective

The applicant demonstrates instructional knowledge of attitude instrument flying during recovery from unusual attitudes — identifying both nose-high and nose-low conditions using the instrument cross-check and applying the correct recovery sequence. Central emphasis: **trust the instruments, not your senses**. Memory aid: **"In the blue, power through — in the brown, power down."**

References

- FAA-H-8083-15B (IFH) Ch.7 pp.7-27 to 7-29; Fig. 7-39 (nose-high), Fig. 7-40 (nose-low)
- FAA-H-8083-25C (PHAK) Ch.17 (spatial disorientation); POH/AFM — unusual attitude procedures
- FAA-H-8083-2 (PHAK aerodynamics); FAA-H-8083-9; FAA-H-8083-16

Delivery

- Ground brief: spatial disorientation demonstration (chair spin), Fig. 7-39 vs. 7-40 instrument cues, recovery sequence for both attitudes.
- Flight: foggles/hood at altitude. Instructor induces unusual attitude (eyes closed, student recovers on 'recover.') Min. 1,500 AGL.
- Debrief: review which instrument confirmed attitude first; was recovery sequence correct?

ACS Knowledge

Code	Element
K1	Prevention of unusual attitudes: flight causal, physiological, environmental factors, system/equipment failures
K2	Procedures for recovery from unusual attitudes in flight
K3	Procedures to regain VMC after IIMC/UIMC
K4	Appropriate use of automation, if applicable
K5	Common errors related to this Task

ACS Risk Management

Code	Element
R1	Situations that could lead to LOC-I or unusual attitudes (stress, task saturation, inadequate scan, distractions, spatial disorientation)
R2	Assessment of the unusual attitude
R3	Control input errors inducing undesired attitudes
R4–R5	Collision hazards; distractions, task prioritization, loss of SA, disorientation
R6–R8	Interpreting flight instruments; control application solely by instruments; operating envelope considerations

ACS Skills

Code	Element
S1	Use proper instrument cross-check and interpretation to identify an unusual attitude (nose-high and nose-low) and apply correct flight control, power input, and configuration in correct sequence to return to stabilized level flight
S2	Use SRM or CRM as appropriate
S3	Analyze and correct common errors related to this Task

CRITICAL ■ MEMORY AID — "IN THE BLUE, POWER THROUGH — IN THE BROWN, POWER DOWN." Nose-high (sky = blue): add power + forward elevator + level wings. Nose-low (earth = brown): reduce power + level wings FIRST + smooth back pressure. In BOTH cases: trust the instruments completely. The body will lie. Use Fig. 7-39 (nose-high) and Fig. 7-40 (nose-low) to teach instrument recognition BEFORE flight.

IFH REFERENCE — FIG. 7-39 (NOSE-HIGH) VS. FIG. 7-40 (NOSE-LOW) | FAA-H-8083-15B CH.7

FIGURE 7-39 — NOSE-HIGH UNUSUAL ATTITUDE

Gaining altitude • Airspeed DECREASING • Climbing turn | FAA-H-8083-15B p.7-27



■ IN THE BLUE — POWER THROUGH

Recovery sequence: (1) Add power — (2) Forward elevator — (3) Level wings

FIGURE 7-40 — NOSE-LOW UNUSUAL ATTITUDE

Losing altitude • Airspeed INCREASING • Diving turn | FAA-H-8083-15B p.7-28



■ IN THE BROWN — POWER DOWN

Recovery sequence: (1) Reduce power — (2) Level wings (TC first) — (3) Raise nose

COMMON ERRORS (K5) — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — RECOVERY FROM UNUSUAL FLIGHT ATTITUDES (AI.XI.E.K5)

TRUSTING SENSES / SPATIAL DISORIENTATION	SLOW SCAN / FIXATION	WRONG NOSE-LOW SEQUENCE (PULL FIRST)	OVER-CONTROLLING DURING RECOVERY	NOT RETURNING TO ASSIGNED ALTITUDE
Believing the body's sensory cues over instrument indications — the leans, graveyard	*Staring at the attitude indicator alone instead of cross-checking ASI, altimeter, VSI, and turn*	*Instinctively pulling back elevator before leveling wings in a nose-low steep bank — multiplies*	*Applying abrupt or excessive control inputs in response to unusual attitude indications —*	*After stabilizing from an unusual attitude, failing to return to the assigned altitude and heading —*
• Instruments are always right — trust them	• Scan ALL instruments before acting	• Nose-low: POWER DOWN first	• Initial pressures may be large — then smooth	• After recovery: note original altitude
• Body sensations are unreliable in IMC	• ASI + altimeter confirm nose position	• Level wings BEFORE raising nose	• Monitor rate of change, not just position	• Return at optimum climb/descent rate
• Do not chase the 'feel' of level flight	• Turn coordinator confirms bank direction	• Bank + back pressure = high load factor	• As needles slow, reduce control pressure	• 500–1,000 fpm rate of change (IFH p.7-37)
• Spatial disorientation = #1 LOC-I cause	• Never fixate on AI during recovery	• 60° bank = 2G pull-up = structural risk	• Trim is not a recovery tool mid-recovery	• Re-confirm heading on HI after wings level
• Verbal cross-check: say the instrument out loud	• Fast cross-check: every 1–2 sec	• Turn coordinator shows wing position	• Cross-check to catch over-correction	• Report back to S&L: altitude, heading, airspeed

EVALUATION CHECKLIST — RECOVERY FROM UNUSUAL FLIGHT ATTITUDES

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Pre-flight Brief	Instructor demonstrates instrument cues on Figs. 7-39 / 7-40; recovery sequence verbalized for both attitudes	Student correctly identifies nose-high vs. nose-low instrument cues and states correct recovery order before flight	Student confuses nose-high and nose-low instrument signatures; cannot state recovery sequence
Nose-High Identification	Student recognizes nose-high from ASI decreasing, altimeter rising, VSI positive, AI above horizon	Correct identification within one full instrument scan cycle; no hesitation beyond 3 seconds	Relying on AI alone without confirming ASI/altimeter; slow scan or fixation; missing the attitude
Nose-High Recovery	Power added FIRST, then forward elevator to lower nose, then wings leveled with coordinated inputs	Correct sequence; airspeed recovers; no secondary unusual attitude; smooth inputs	Pulling back instead of pushing forward; wings leveled before power added; abrupt control inputs
Nose-Low Identification	Student recognizes nose-low from ASI increasing, altimeter falling, VSI negative, AI below horizon	Correct identification within one full instrument scan cycle; turn coordinator used for bank confirmation	Not noticing accelerating airspeed; missing bank on turn coordinator; slow to act
CRITICAL	**NOSE-LOW SEQUENCE — Power reduced FIRST, wings leveled via turn coordinator SECOND, back pressure THIRD**	**Correct 3-step sequence every repetition; no back pressure before wings are level; smooth recovery to S&L;**	**Pulling back first in a banked nose-low (load factor / structural risk); failure to reduce power before pitching up**
Recovery Quality	Smooth, progressive inputs throughout; continuous cross-check; no secondary unusual attitude introduced	Returns to S&L; within ±100 ft, ±10° hdg, ±10 kts; no over-controlling	Abrupt inputs causing secondary attitude; cessation of scan; fixating on single instrument
Post-Recovery	Returns to originally assigned altitude and heading after stabilizing in S&L;	Altitude re-established at 500–1,000 fpm rate of change; heading verified on HI	Forgetting original altitude; maintaining recovery altitude instead of assigned altitude

Area XII, Task A — Emergency Descent (ASEL/ASES)

FAA-S-ACS-25 • AI.XII.A • CFI Airplane — Flight Lesson

Objective

The applicant demonstrates instructional knowledge of emergency descent by describing its purpose, triggering situations, immediate action items, aircraft performance limits, and common errors — while demonstrating the maneuver and providing effective instruction.

References

- FAA-H-8083-3 Ch.18 pp.18-8 to 18-9; FAA-H-8083-2; FAA-H-8083-9; POH/AFM; AFH Fig 18-6

Delivery

- Pre-flight brief: open POH emergency descent page; confirm VNE, VLE, VFE, VA for today
- Demo then student; narrate each step; terminate when stabilized (engine cooling)
- Debrief: airspeed discipline, recovery altitude, checklist execution

Triggering Situations (K2)

- **Uncontrolled fire** (engine, electrical, or cabin) — descend immediately
- **Rapid depressurization** (pressurized a/c) — descend to breathable altitude
- **Any situation** demanding immediate altitude loss — POH defines the procedure

ACS Knowledge

Code	Element
K1–K2	Purpose and procedures; triggering situations (fire, depressurization, other)
K3–K4	Immediate action items; aircraft performance and limitations
K5	Airspeed limits: VNE, VLE, VFE, VA (turbulence limit)
K6	Common errors

ACS Risk Management

Code	Element
R1	Altitude, terrain, obstructions, glide distance, landing distance
R2	Collision hazards — scan below before and during descent
R3	Configuring the airplane — sequence, speed compliance
R4	Task prioritization, situational awareness, disorientation

ACS Skills

Code	Element
S1–S2	Clear area; establish airspeed and config per POH/AFM scenario
S3–S4	Maintain orientation; divide attention; bank 30–45° (positive G)
S5–S7	Airspeed +0/–10 kts; level off ±100 ft; checklist; correct errors

CRITICAL ■ POH/AFM IS THE PROCEDURE — There is no universal emergency descent. The manufacturer defines the configuration, airspeeds, and sequence for each airplane. AFH Ch.18 is guidance only. Brief the specific POH procedure before every flight. Bank 30–45° serves two purposes: scan for traffic below AND maintain positive G on the airframe. Recovery altitude must be planned BEFORE entry — not decided during the descent.

TECHNIQUE — EMERGENCY DESCENT PROCEDURE (K1 / K3 / S1–S6)

EMERGENCY DESCENT — PROCEDURE SEQUENCE (AI.XII.A.K1 / S1–S6)

1	2	3	4	5
CLEAR AREA	ESTABLISH DESCENT	CONFIGURE A/C	MONITOR SPEED	RECOVER EARLY
Two 90° clearing turns — scan	Bank 30–45° Power idle	Gear & flaps per POH/AFM — max	Max allowable per config	Initiate recovery at safe altitude

Step-by-Step Procedure

- **1 — Clear the area:** Two 90° clearing turns; scan below for traffic; identify potential landing area.
- **2 — Establish bank:** 30–45°. Maintains positive G on the structure; enables visual scan below.
- **3 — Power to idle:** Smooth throttle reduction to idle.
- **4 — Prop high RPM** (if equipped): Low pitch / high RPM — windmilling prop acts as aerodynamic brake, limiting airspeed buildup.
- **5 — Configure per POH:** Gear and flaps as manufacturer directs. Max drag = max descent rate, no overspeed.
- **6 — Airspeed discipline:** Max allowable for config. Never exceed VNE, VLE, VFE, or VA (turbulence).
- **7 — Monitor + communicate:** Scan instruments; consider traffic advisory radio call.
- **8 — Recover early:** Initiate at safe altitude for ±100 ft level-off. Smooth pull-out. Checklist.

Pre-Flight Brief Points

- Open POH emergency descent section before engine start
- Confirm VA, VFE, VLE, VNE for today's weight and conditions
- Agree on recovery altitude before takeoff — not during the descent

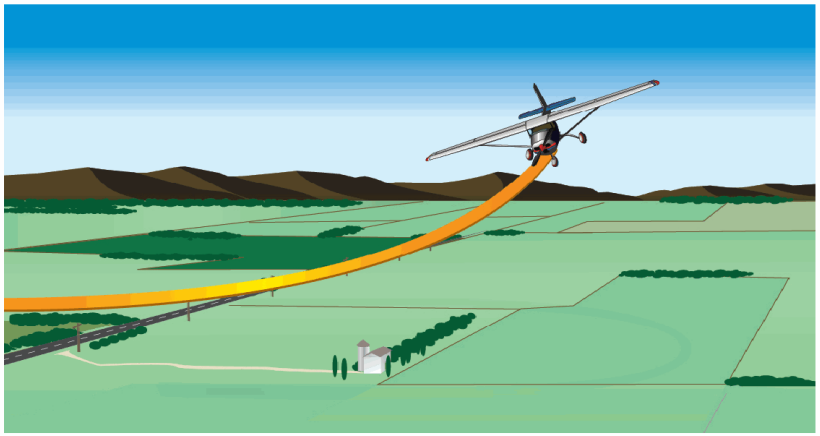


Figure 18-6. Emergency descent. (AFH Ch.18, p.18-8)

Technique Notes

- **Prop high RPM is counterintuitive:** Idle power + high RPM = flat blade pitch = drag device. Brief this before the first demo.
- **Engine fire:** High airspeed may blow out a fuel-fed fire but increases structural stress. POH defines the tradeoff.
- **Turbulence:** VA — not VNE — is the limit in rough air. Exceedance in chop can cause structural failure below VNE.
- **No prolonged practice:** Rapid cylinder cooling with idle power. Terminate when stabilized in training.

KEY RULE ■ Clear → Bank 30–45° → Idle → High RPM → Gear/Flaps per POH → Max speed (no limit exceedance) → Recover early.

COMMON ERRORS (K6) — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — EMERGENCY DESCENT (AI.XII.A.K6)

SKIPPING THE CHECKLIST

Flying the scenario from memory instead of per POH — wrong config or airspeed.

- Brief POH procedure before flight
- Fly config as published, not from memory
- POH defines this maneuver — not AFH
- Treat as memory items + checklist verify
- No two airplanes are the same

OMITTING CLEARING TURNS

Initiating descent without scanning below — collision risk with aircraft below.

- Two 90° turns before descending
- Scan below AND ahead for traffic
- Radio call: optional but professional
- Identify emergency landing area first
- ACS S1: clear area is the FIRST step

WRONG BANK ANGLE

Too shallow (no positive G) or too steep (overstress) — ACS requires 30–45°.

- 30–45° bank — firm ACS requirement
- Maintains positive load on airframe
- Steeper = overstress risk
- Shallower = reduced descent efficiency
- Hold bank constant during descent

AIRSPEED EXCEEDANCE

Allowing airspeed to build past VLE, VFE, or VNE during the steep descent.

- Monitor ASI continuously
- High RPM prop = aerodynamic brake
- Gear/flaps = drag to limit buildup
- In turbulence: limit to VA not VNE
- Never trade altitude for airspeed

LATE OR LOW RECOVERY

Initiating recovery too late — insufficient altitude for safe level-off or landing.

- Plan recovery altitude BEFORE entry
- Recovery takes altitude — brief it first
- Level off ±100 ft of target (ACS S5)
- Simulated: terminate when stabilized
- Real: recover as high as possible

EVALUATION CHECKLIST — EMERGENCY DESCENT (AI.XII.A)

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Pre-Entry	POH/AFM briefed; clearing turns completed; landing area identified	Specific procedure reviewed; two 90° turns; traffic scan complete	No brief; skipping clearing turns; no landing area identified
Entry	Bank established 30–45°; power to idle; prop high RPM	Bank within ACS range; smooth power reduction; prop positioned correctly	Insufficient bank; abrupt power; prop left in cruise pitch
Configuration	Gear and flaps extended per POH/AFM sequence	Config per manufacturer; no limit exceedance during configuration	Wrong sequence; extending flaps above VFE; skipping gear
CRITICAL	**AIRSPEED: Max allowable, +0/–10 kts — NO exceedance of VNE, VLE, VFE, or VA**	**Maintain max config speed +0/–10 kts; structural limits never exceeded**	**Allowing airspeed to exceed applicable limit; failure to use high RPM prop**
Recovery	Smooth level-off at planned altitude; coordinated recovery	Level off ±100 ft of specified altitude; no abrupt control inputs	Late recovery; abrupt pull; loss of heading during level-off
Checklist	Appropriate emergency checklist completed	Checklist referenced or verbalized during or after maneuver	Flying from memory only; no checklist verification

KEY RULE ■ ACS S5: Airspeed +0/–10 kts; level off ±100 ft. ACS S4: Bank 30–45°. The structural limits (VNE, VLE, VFE, VA) are HARD LINES — not targets, not guidelines. If the POH says configure and the speed is already at VFE, the flaps stay up until speed is controlled.

SCENARIO BRIEFING GUIDE — EMERGENCY DESCENT (AI.XII.A.K2 / K3 / R1–R4)

SMOKE / CABIN FIRE	DEPRESSURIZATION	ENGINE FIRE
• Smell burning or see smoke in cabin	• Pressurized: rapid altitude loss, ear pop, fog	• Smoke/flame from cowling; CHT spike; oil pressure drop
• Immediate: descend NOW — oxygen depletes, fire spreads	• Immediate: don oxygen (if equipped); descend to 10,000 ft or MEA	• Immediate: mixture to idle cutoff; fuel selector off; descend
• Config per POH; max speed consistent with fire risk	• Config per POH; descent rate to reach breathable air quickly	• High airspeed may blow out fuel fire; low airspeed = less structural stress; POH decides
• Electrical fire: master off (if safe); land ASAP	• Maintain heading to nearest suitable airport	• If fire extinguished: do not restart; land ASAP; squawk 7700
• Land as soon as possible — not nearest, soonest	• Level off at 10,000 ft or lowest safe altitude; assess	• If fire continues: accept structural risk of high-speed descent; evacuate on landing

INSTRUCTOR DEBRIEF CHECKLIST

Flight Performance

- Did student review POH procedure before flight?
- Clearing turns completed — full two turns, traffic scan below?
- Bank angle 30–45° established and held throughout descent?
- Power reduction smooth? Prop control used correctly?
- Gear and flaps in correct sequence per POH?
- Airspeed maintained within tolerance (+0/–10 kts)?
- No structural limit exceeded (VNE, VLE, VFE, VA)?
- Recovery initiated at planned altitude? Level-off ±100 ft?
- Checklist completed or verbalized?

Instructional Technique

- Did CFI-applicant clearly state the emergency scenario before initiating?
- Did CFI-applicant reference the POH by name and locate speeds?
- Did CFI-applicant explain the purpose of each step (not just do it)?
- Was the airspeed limitation discussion accurate and specific?
- Did CFI-applicant correctly explain why high RPM limits airspeed buildup?
- Was recovery altitude briefed and planned in advance?
- Were common errors identified and corrected in real time?

■ ***Risk Note:*** *Recovery altitude must be sufficient to level off safely. The most common student failure is initiating recovery too late — resulting in a level-off below the planned altitude or requiring an abrupt, high-G pull. Brief the recovery altitude explicitly before every rep.*

KEY RULE ■ Emergency descent = the fastest way down without breaking the airplane. POH is the authority. AFH is the guide. Brief the procedure, know the limits, plan the recovery, and never let the airspeed exceed a structural limit during training or in an actual emergency.

Area XII, Task B — Emergency Approach and Landing (Simulated)

FAA-S-ACS-25 • AI.XII.B • CFI Airplane — Flight Lesson (ASEL/ASES)

Objective

The applicant demonstrates instructional knowledge of power failure at altitude and associated emergency approach and landing procedures — immediate actions, best glide airspeed, terrain and field selection, checklist execution, declaring an emergency, and ELT use — while simultaneously demonstrating the maneuver and providing effective instruction.

References

- FAA-H-8083-3 Ch.18 pp.18-1 to 18-7; FAA-H-8083-2; AFH Figs 18-2, 18-3; POH/AFM

Delivery

- Pre-flight: confirm Vg from POH — it is NOT Vy. Brief the distinction on the ground.
- Brief A,B,C,D,E before departure; student recites from memory before engine start.
- Demo at altitude; student flies. Terminate at safe altitude per evaluator directive.

Triggering Scenarios (K1)

- **Engine failure at altitude** — power loss, prop stops or windmills
- **Partial power loss** — rough engine, low oil pressure, abnormal indications
- **Simulated** — instructor reduces to idle; student executes full A,B,C,D,E

ACS Knowledge

Code	Element
K1	Immediate action items and emergency procedures
K2a–c	Best glide (Vg) vs. min. sink; distance relationship; wind effects on glide
K3–K4	Atmospheric effects; stabilized approach and energy management
K5–K7	ELT types/operation; ATC services in distress; common errors

ACS Risk Management

Code	Element
R1–R2	Altitude, wind, terrain, obstructions, glide distance; following/changing flightpath
R3–R4	Collision hazards; configuring the airplane during emergency
R5–R6	Low altitude maneuvering (stall/spin/CFIT); distractions and task prioritization

ACS Skills

Code	Element
S1–S2	Establish/maintain best glide ±10 kts; configure per POH/AFM and conditions
S3–S4	Select suitable landing area; plan and follow flightpath to selected field
S5–S7	Prepare for landing per evaluator; complete checklist(s); correct common errors

CRITICAL ■ THE A,B,C,D,E METHOD IS THE FRAMEWORK FOR THIS ENTIRE TASK — Airspeed (best glide NOW) → Best field → Checklist (restart + emergency) → Declare (7700 + Mayday) → ELT (activate). Every student must recite A,B,C,D,E from memory before flying. The most lethal error is fixating on any single step while forgetting the others.

TECHNIQUE — BEST GLIDE, FIELD SELECTION & APPROACH (K1 / K2 / K4 / S1–S4)

A — Airspeed: Best Glide (Vg)

- **Establish immediately:** Nose to Vg attitude NOW — every second at cruise speed burns altitude and distance.
- **Vg ≠ Vy:** Vy is best rate of climb. Vg gives maximum distance per foot of altitude lost. Brief this every time.
- **Min. sink ≠ Vg:** Min. sink (slowest altitude loss/min) is slower than Vg — more time, less distance. Use Vg.
- **Trim to Vg:** Hands-off trim immediately — frees attention for checklist and radios.
- **Wind effects (K2c):** Headwind shortens glide distance; tailwind extends it. Adjust pattern accordingly.

B — Best Field: Terrain, Wind, Obstacles

- **Priority order:** Airport/runway → paved road → grass/crop field → open terrain. Avoid soft/plowed, trees, water.
- **Into the wind — see Fig 18-2:** Into wind = lower groundspeed = dramatically shorter stopping distance.
- **Commit by 1,000 AGL:** Changing fields below this altitude leaves no margin for a new approach.
- **Plan slightly high:** Excess altitude removed with flaps or slip. Undershooting with no engine has no fix.

CRITICAL ■ TERRAIN SELECTION — Fig 18-2 shows why wind matters: doubling groundspeed quadruples stopping distance. A 15-kt tailwind vs. headwind can be the difference between a controlled stop and a collision. ALWAYS land into wind when terrain options are equal. Choose the field AND the landing direction together — not just the field.

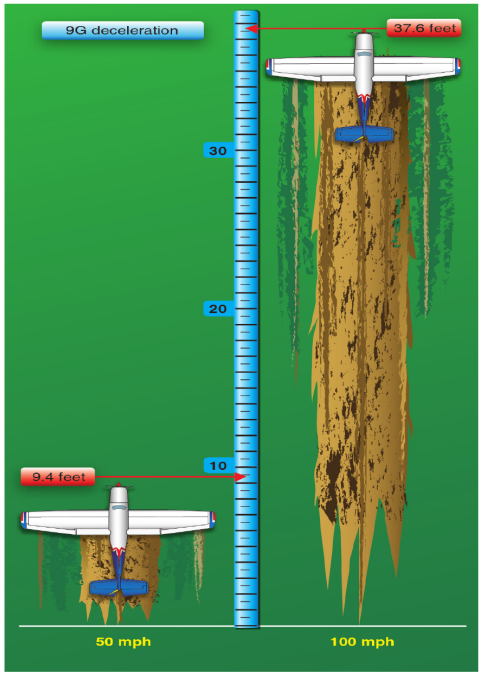


Figure 18-2. *Stopping distance vs. groundspeed.*

Figure 18-2. Stopping distance vs. groundspeed. (AFH Ch.18, p.18-3)

Approach Pattern (K4)

- High key: ~1,800–2,000 ft AGL over touchdown; low key: ~800–1,000 ft AGL opposite.
- Do NOT glide straight-in from altitude — preserve height for pattern options.
- Base-to-final: no lower than 300 ft AGL. Slip — never skid — to correct overshoot.
- Flaps on base; remaining flaps on final only when field is clearly made.

KEY RULE ■ Vg is in the POH — brief it on the ground, trim to it immediately. Pick field AND wind direction together. Commit by 1,000 AGL.

FIELD LANDING, ENERGY MANAGEMENT & THE A,B,C,D,E METHOD (K1 / K3 / K4 / R1–R6)

C — Checklist: Restart Attempt + Emergency Flows

- **Attempt restart FIRST** (altitude permitting): Many failures are fuel, mags, or carb ice — fixable in flight.
- **Key flows (from memory):** Fuel → BOTH | Carb heat → ON | Mags → BOTH | Primer → IN/LOCKED | Mixture → RICH | Throttle → slight advance.
- **If no restart:** Emergency checklist per POH. Fuel OFF, mixture IDLE CUTOFF, mags OFF, master OFF on short final.
- **Know the flows cold:** Below 1,000 AGL there is no time to read. Flows from memory; checklist verifies if time permits.

D — Declare: Squawk 7700 + Mayday

- **Squawk 7700 first** — 2 seconds, auto-alerts all ATC radar. Do this before the radio call if pressed.
- **Mayday format:** "Mayday ×3 — [callsign] — [position] — engine failure — [altitude] — [souls] — [intentions]."
- **Frequency:** Current ATC freq first; 121.5 MHz (Guard) if no response. ATC provides vectors, emergency equipment, traffic advisories.

E — ELT: Emergency Locator Transmitter (K5)

- **406 MHz:** SARSAT-detected within minutes; must be registered with NOAA. Unregistered = delayed SAR.
- **121.5 MHz (legacy):** Not satellite-monitored since 2009. Ground/air only. 406 MHz is the standard.
- **Activation:** Most 406 ELTs auto-activate on impact. Manual activation before touchdown preferred when able.

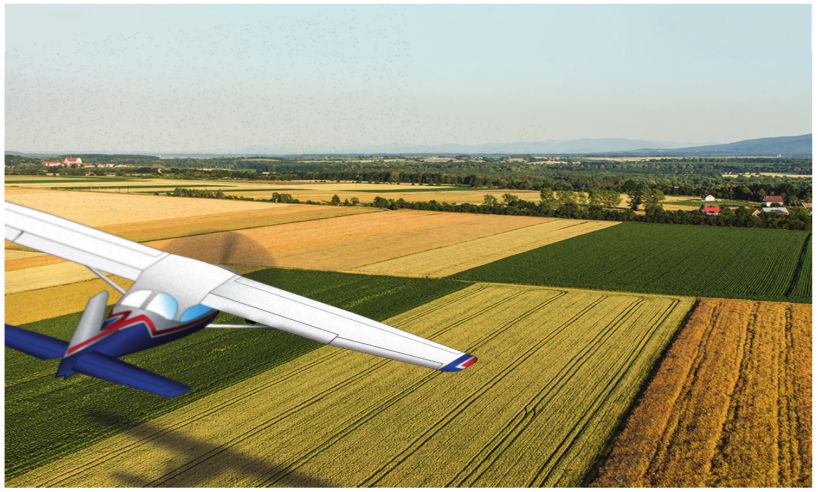


Figure 18-3. *Intentional gear-up landing.*

These three factors are seldom compatible. When compromises have to be made, the pilot should aim for a wind/obstacle/terrain combination that permits a final approach with some margin for error in judgment or technique. A pilot who overestimates the gliding range may be tempted to stretch the glide across obstacles in the approach path. For this reason, it is sometimes better to plan the

Figure 18-3. Intentional gear-up landing. (AFH Ch.18, p.18-5) — A properly executed off-field landing is the outcome of A,B,C,D,E done correctly.

CRITICAL ■ THE A,B,C,D,E METHOD — Teach in this exact order every rep: (A) Best Glide immediately; (B) Best field — terrain + wind, commit by 1,000 AGL; (C) Checklist — restart attempt, then emergency flows; (D) Declare — 7700 + Mayday; (E) ELT — activate before touchdown. Students freeze at (C) and forget (D) and (E). Brief ABCDE before EVERY engine-failure scenario.

Energy Management (K4)

- High key ~1,800–2,000 AGL over touchdown point; low key ~800–1,000 AGL opposite.
- Aim for the NEAR end of the field — better long than short with no engine.
- Forward slip: fastest way to shed altitude without gaining airspeed. Teach it every rep.
- Flaps: add in stages on base/final. Do NOT retract below 500 AGL once deployed.

■ ***Risk Note:*** ■ *R5 — Cross-controlled stall on base-to-final is the most common fatal error in off-field approaches. Teach: if high, SLIP — never skid the turn or steepen the bank below 300 AGL.*

CHECKLISTS, EMERGENCY COMMUNICATIONS & ELT REFERENCE (K1 / K5 / K6 / S6)

ENGINE FAILURE FLOWS (From Memory)

Know these flows COLD. With limited altitude, there is no time to reference a checklist. The checklist confirms the flow after the fact.

Step 1 — Immediate Action (Altitude > 1,000 AGL)

- Pitch → Best Glide (Vg per POH)
- Fuel Selector → BOTH (or richest tank)
- Carburetor Heat → ON
- Magnetos → BOTH (check L and R individually)
- Mixture → RICH
- Primer → IN and LOCKED
- Throttle → advance slightly

Step 2 — If No Restart (Emergency Checklist)

- Fuel Selector → OFF
- Mixture → IDLE CUTOFF
- Magnetos → OFF (on short final)
- Master → OFF (on short final, after squawk)
- Seat belts / shoulder harness → TIGHT
- Doors → UNLATCH (before touchdown)

NOTE: The above is a generic teaching flow. Always brief the POH-specific emergency checklist for the aircraft being flown.

DECLARING AN EMERGENCY (K6)

Declaring is not admitting defeat. It activates a search and rescue chain and provides ATC resources that may save lives.

Step 1 — Squawk 7700

Takes 2 seconds. Activates emergency alert on all ATC radar displays. Do this FIRST — before the radio call if pressed for time.

Step 2 — Mayday Call

Format:

"Mayday, Mayday, Mayday — [Callsign] — [Position / over / bearing from] — Engine failure — [Altitude] — [# souls on board] — Descending / heading [direction] for [field or area]."

Frequency Priority:

- Current ATC frequency → first attempt
- 121.5 MHz (Guard) → if no response

ATC Services Available:

- Radar vectors to nearest suitable airport
- Emergency equipment notification (crash/fire/rescue)
- Traffic advisories and airspace clearances
- Pilot discretion retained — no penalty for declaring

If no radio: squawk 7700 and fly the airplane. ATC will track the transponder and alert emergency services based on last position.

EMERGENCY LOCATOR TRANSMITTER (K5)

The ELT is the last line of communication after radio contact is lost. A registered 406 MHz ELT can alert SAR within minutes.

ELT Types:

- **406 MHz (current standard):** Detected by COSPAS-SARSAT satellite network. Transmits aircraft registration. SAR alert within minutes of activation.
- **121.5 MHz (legacy):** No longer monitored by satellite (since 2009). Ground and air monitoring only. Limited range. Being phased out.

Activation:

- **Auto-activation:** Most 406 ELTs activate automatically when G-forces exceed threshold on impact. Verify the arming switch is in ARM before each flight.
- **Manual activation:** Preferred before touchdown if time and altitude permit. Ensures signal is broadcast during the most critical window.

Registration (Critical):

406 MHz ELTs must be registered with NOAA. An unregistered ELT causes SAR teams to treat the signal as a possible false alarm — significantly delaying response. Check aircraft registration status at beaconregistration.noaa.gov.

Post-Landing:

- Stay with the aircraft — it is easier for SAR to spot
- Verify ELT is transmitting (ELT monitor on 121.5 if equipped)
- Signal using mirror, whistle, or phone if available

KEY RULE ■ Checklists are the confirm; flows are the action. In an emergency, fly first — then work A,B,C,D,E in order. Squawk 7700 and a Mayday call cost seconds but save lives. A registered 406 MHz ELT activated before touchdown is the best insurance policy in aviation.

COMMON ERRORS (K7) — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — EMERGENCY APPROACH & LANDING (AI.XII.B.K7)

WRONG AIRSPEED

Flying best climb (Vy) instead of best glide (Vg) — wastes altitude for no distance gain.

- Vg = max distance per ft lost
- Vy is NOT best glide — teach this
- Nose too high = sink, not glide
- Trim immediately to Vg
- Every 5 kts slow = distance lost

CHANGING FIELDS TOO LATE

Abandoning the committed field below 1,000 AGL — insufficient altitude to establish new

- Commit to a field by 1,000 AGL
- Changing fields = full approach lost
- Below 500 ft: land where aimed
- Brief student: first choice is best
- Poor choice early beats panic late

STRETCHING THE GLIDE

Raising nose beyond Vg to 'reach' the field — stall risk, shorter glide, no go-around available.

- Vg = optimal L/D ratio — trust it
- Nose up past Vg = LESS distance
- No engine = no go-around option
- Better to land short than stall
- Use slip/approach flap for excess

SKIPPING THE CHECKLIST

Fixating on flying and never attempting restart or emergency checklist — some failures are

- Many engine failures are fuel, mags
- Brief: fly first, then checklist
- Carb heat + both mags = first try
- Keep checklist to key flows only
- Don't sacrifice Vg to read checklist

NO MAYDAY/ ELT

Landing off-field without declaring or activating ELT — delays search and rescue significantly.

- Squawk 7700 FIRST (takes 2 sec)
- Mayday on current freq → 121.5
- Activate ELT before touchdown
- 406 MHz = SARSAT alert in minutes
- Every minute of SAR delay matters

EVALUATION CHECKLIST — EMERGENCY APPROACH AND LANDING (AI.XII.B)

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Trigger / Immediate	Airspeed established to best glide; A,B,C,D,E sequence initiated	Vg established within ±10 kts; ABCDE started within 10 sec of power loss	Flying Vy instead of Vg; delayed reaction; freezing on one step
Field Selection	Suitable landing area selected: altitude, wind, terrain, obstructions (S3)	Field selected and verbalized with justification; committed by 1,000 AGL	Choosing downwind field; changing fields below 1,000 AGL; no verbalization
CRITICAL	**AIRSPEED: Best glide maintained ±10 knots throughout approach (S1)**	**Vg +10/–10 kts continuously maintained from power loss to evaluator termination**	**Stretching glide (nose too high); fixating on cockpit and losing sight of field**
Checklist & Comms	Restart attempt verbalized; checklist initiated; Squawk 7700; Mayday call (D)	All key flows verbalized in correct order; 7700 squawked; Mayday format correct	Skipping restart attempt; no radio call; incorrect Mayday format; forgetting 7700
Approach Path	Flightpath planned and followed to selected field (S4); energy managed (K4)	Pattern follows high/low key concept; arrives on final with margin; no stretching	Flying straight-in from any altitude; insufficient energy management; too low on base
Configuration & ELT	Flaps/gear configured per POH; ELT verbalized; doors unlatched briefed (S2, S5, S6)	Configuration matches conditions and POH; ELT activation briefed or simulated	Premature flap deployment; forgetting ELT; no door unlatch briefing

KEY RULE ■ ACS S1: Best glide ±10 kts — the single most evaluated element. S3: Field selection must be verbalized with justification. The A,B,C,D,E method is the framework for everything on this task — airspeed, field, checklist, declare, ELT — in order, every rep, from memory.

Area XII, Task C — Systems and Equipment Malfunctions

FAA-S-ACS-25 • AI.XII.C • CFI Airplane — Flight Lesson (ASEL/ASES)

Objective

The applicant demonstrates instructional knowledge of system and equipment malfunctions appropriate to the aircraft used, can apply that knowledge, manage associated risks, demonstrate appropriate skills, and provide effective instruction.

References

- FAA-H-8083-3 Ch.18 pp.18-9 to 18-16; FAA-H-8083-2; AFH Figs 18-10, 18-11; POH/AFM

Delivery

- Ground brief: walk through each malfunction category before flight. POH checklists must be reviewed.
- In flight: evaluator specifies at least 3 of K1–K5 elements for simulated malfunction.
- No universal procedure exists — teach from the specific aircraft's POH/AFM.

Malfunction Categories (K1–K5)

- **K1** — Power loss (partial or complete): engine, fuel, ignition, carburetion
- **K2a–f** — System failures: electrical, vacuum, pitot-static, glass cockpit, gear/flap, trim
- **K3** — Smoke and fire: engine, electrical, cabin
- **K4** — Other aircraft-specific systems (deice, supplemental O■)
- **K5** — Inadvertent door or window opening

ACS Knowledge

Code	Element
K1	Causes of partial or complete power loss (powerplant specific)
K2a–b	Electrical malfunction; vacuum/pressure and instrument malfunctions
K2c–d	Pitot-static malfunction; electronic flight deck display malfunction
K2e–f	Landing gear or flap malfunction; inoperative trim
K3–K5	Smoke/fire causes and remedies; other systems; inadvertent door opening

ACS Risk Management

Code	Element
R1	Startle response to unexpected malfunction
R2	Checklist usage for system or equipment malfunction
R3	Distractions, task prioritization, situational awareness, disorientation
R4	Undesired aircraft state resulting from malfunction response

ACS Skills

Code	Element
S1	Determine appropriate action for ≥3 simulated emergencies from K1–K5
S2	Complete appropriate checklist(s) per POH/AFM
S3	Analyze and correct common errors related to this task

CRITICAL ■ POH/AFM IS THE AUTHORITY — No universal malfunction procedure exists. Every response begins with: (1) FLY THE AIRPLANE, (2) identify the failure with multiple cross-checks, (3) execute the POH/AFM checklist — never improvise. Startle response is the #1 cause of a manageable malfunction becoming a fatal accident.

POWER LOSS (K1) — ELECTRICAL SYSTEM (K2A) — VACUUM / PRESSURE (K2B)

UNIVERSAL MALFUNCTION RESPONSE — FLY FIRST, THEN TROUBLESHOOT

1	2	3	4
AVIATE	**IDENTIFY**	**CHECKLIST**	**LAND / PLAN**
Fly the airplane.	What failed?	POH/AFM checklist.	Land ASAP if

K1 — Power Loss: Partial or Complete

- **Partial power loss:** Rough engine, low manifold pressure, abnormal CHT/EGT. First action: carb heat ON, fuel selector BOTH, mixture RICH, check mags L/R.
- **Complete power loss:** Establish best glide immediately. Attempt restart per POH flows. If no restart, execute emergency approach (see Task B).
- **Engine fire (fuel-fed, bright orange):** Mixture IDLE CUTOFF → Fuel selector OFF → Mags ON (burn residual) → land immediately.
- **Engine fire (oil-fed, black smoke):** Stop prop — feather or reduce RPM + raise nose to windmill stop. Kills oil pump feeding fire.
- **Key principle:** Leave mags ON after fuel shutoff to burn remaining fuel in lines. Mags OFF only on short final.

K2b — Vacuum / Pressure System

- **Vacuum-driven instruments:** AI and HI fail with vacuum pump failure. Turn coordinator (electric) remains valid.
- **First indication:** AI slowly erects to unusual position; HI precesses rapidly. Cross-check with TC, altimeter, ASI.
- **Partial panel flying:** TC for bank, altimeter + VSI for pitch, ASI for power management. Brief student before flight.
- **Glass cockpit:** AHRS failure may appear as unusual attitude on PFD. Verify with backup/standby instruments before reacting.

KEY RULE ■ Vacuum pump failure is insidious — AI continues to appear functional as it slowly precesses. Always cross-check; never trust a single instrument.

K2a — Electrical System Malfunction

- **Source failure:** Alternator or generator goes off-line — battery becomes sole power source.
- **Battery life:** 25-amp hour battery at 40-amp load drains in 10–15 minutes. Battery condition + prior use dictate actual time available.
- **Immediate action:** Shed non-essential electrical loads immediately to maximize battery life.
- **Electric gear/flaps:** Motor loads drain battery far faster than avionics. Plan arrival before selecting gear or flaps electrically; anticipate manual extension.
- **Electrical fire:** Burning insulation odor is first indicator. Identify faulty circuit via breakers; if unidentifiable, master + alternator OFF. Land ASAP.
- **Isolation procedure:** Master OFF → all individual switches OFF → master back ON → select switches back one at a time with pause for odor/smoke. Recreates the problem — use only if absolutely necessary.
- **VFR vs. IFR:** "Emergency" load following generator failure is situation-dependent. Distance to airport, day/night, VMC/IMC all factor into what to keep on.

■ ***Risk Note:*** ■ *R2 — Before selecting electrically-operated gear or flaps on a failing battery, consider the risk of total electrical loss mid-sequence. Plan the arrival and use manual extension if the battery state is uncertain.*

PITOT-STATIC MALFUNCTIONS (K2C) — ELECTRONIC DISPLAYS (K2D) — INOPERATIVE TRIM (K2F)

K2c — Pitot-Static System Malfunction

- **Blockage causes:** Ice, dirt, insects, water. Affects ASI, VSI, and altimeter.
- **Blocked pitot tube only:** ASI increases with altitude gain (static decreases, pitot pressure trapped). VSI and altimeter unaffected.
- **Blocked static port:** Most dangerous — affects all three instruments.
- **Blocked static in descent:** Altimeter reads too HIGH; VSI confirms descent lag; ASI reads faster than actual. Instruments say: too high, too fast, low sink rate.
- **Blocked static in climb:** ASI may drop alarmingly toward stall speed indication. Pilots have stalled aircraft reacting to false ASI.
- **Partial blockage is insidious:** May appear normal in cruise; only reveals itself during descent or climb.
- **Fix:** Open alternate static source while in a climb or descent. Significant needle movement = static problem confirmed. Use alternate static for remainder of flight.

K2d — Electronic Flight Deck Display Malfunction

- **No universal indications:** Primary and backup displays may respond differently to the same failure. Equipment-specific training is required.
- **Glass cockpit risk:** Many light aircraft use the same pitot-static input for both PFD and backup. A single blockage can fail both simultaneously.
- **ADC/AHRS combo units:** A pitot-static blockage may also corrupt attitude display (AHRS fed by ADC).
- **Response:** Cross-check primary display with standby instruments. Do not chase conflicting indications without confirming source.



Effect of Blocked Pitot/Static Sources on Airspeed, Altimeter, and Vertical Speed Indications	Indicated Airspeed	Indicated Altitude	Indicated Vertical Speed
Pitot source blocked	Increases with altitude gain, decreases with altitude loss.	Unaffected	Unaffected
One static source blocked	Inaccurate while sideslipping; very sensitive in turbulence.		
Both static sources blocked	Decreases with altitude gain, increases with altitude loss.	Does not change with actual gain or loss of altitude.	Does not change with actual variations in vertical speed.
Both static and pitot sources blocked	All indications remain constant, regardless of actual changes in airspeed, altitude, and vertical speed.		

Figure 18-10. *Effects of blocked pitot-static sources.*

Figure 18-10. Effects of blocked pitot-static sources. (AFH Ch.18, p.18-14)

K2f — Inoperative Trim

- **Elevator cable failure (one cable only):** Most aircraft lose only one direction, not both.
- **Lost up-elevator cable:** Aft yoke produces no response; forward yoke works. Apply nose-up trim + use forward pressure to manage pitch.
- **Lost down-elevator cable:** Forward yoke ineffective; aft yoke works. Apply nose-down trim + use aft pressure.
- **Trim tabs as backup:** If primary linkage fails, trim tab can raise or lower elevator within limits — less effective at low airspeed.
- **Jammed elevator:** Use power + flap combination for limited pitch authority. Survivable landing is possible but difficult — declare emergency.

KEY RULE ■ Alternate static source should be tested on every IFR flight. On VFR aircraft, brief its location before flight and demonstrate its use to students.

FLAP / GEAR MALFUNCTIONS (K2E) — SMOKE & FIRE (K3) — DOOR OPENING (K5)

K2e — Landing Gear Malfunction

- **Gear-up landing:** Select airport with crash/rescue if possible. Foam runway if available. Burn off excess fuel (reduces speed and fire risk). Hard surface creates sparks; soft surface causes more structural damage.
- **One main gear only:** Option A — land on available gear (strong directional yaw). Option B — retract all gear and land flat. Narrow runway with ditches = Option B.
- **One gear retracted:** Touch down nose-high, wings level; use aileron to keep unsupported wing flying as long as possible. Expect strong yaw when wing contacts surface — full opposite rudder + braking.
- **Nose gear only retracted:** Hold nose off until near full up-elevator, then release slowly. Do NOT hold full up-elevator until stall — nose drops abruptly and burrowing occurs.

K2e — Flap Malfunctions

- **No-flap landing:** 50% more runway required. Nose-high attitude makes runway harder to see. Aircraft less stable in pitch/roll. Significant float in roundout — do not force onto runway.
- **Wider, longer pattern:** Extra altitude needs room to bleed off. Avoid diving to lose altitude (builds excessive speed).
- **Split (asymmetric) flaps:** Roll toward the less-deflected wing. Counter with opposite aileron + opposite rudder — creates cross-control condition. Approach at higher airspeed. Do NOT land with a crosswind from the deployed-flap side.

K3 — Smoke and Fire

- **Engine fire (fuel-fed):** Bright orange flames from cowling. Mixture IDLE CUTOFF → Fuel selector OFF → Mags ON (burn residual) → Emergency descent → Land immediately. Extinguished fires can re-ignite — do not slow down.
- **Engine fire (oil-fed):** Thick black smoke. Stop prop rotation (feather or min RPM + raise nose). Kills oil pump. Declare emergency — structural integrity compromised.
- **Electrical fire:** Burning insulation odor. Master + alternator OFF if circuit unidentifiable. Materials already burning continue after power off. Land ASAP.
- **Cabin fire:** Identify and shut off faulty system. Use extinguisher first, then open air vents to purge smoke. If smoke increases when vents open: close them immediately (fire in nose or heating system). Depressurize or descend as needed.

K5 — Inadvertent Door or Window Opening

- **Not a flight emergency** in most light aircraft. Door opening creates noise, vibration, possible buffet — but rarely affects controllability.
- **Correct response:** Fly the airplane. Climb to normal pattern altitude, fly a normal pattern, make a normal landing.
- **Do NOT:** Release seatbelt to reach the door. Rush to land with steep turns at low altitude. Most doors bang open then settle partly closed.
- **Slip effect:** A slip toward the door may open it wider; a slip away may push it closed.

CRITICAL ■ DOOR OPENING — Accidents are almost never caused by the open door itself. They are caused by the pilot's distraction and failure to maintain aircraft control. Ignore the door. Fly the airplane. Land normally.

ABNORMAL ENGINE INSTRUMENT INDICATIONS (AI.XII.C.K1 / K6) — FIG 18-11

Malfunction	Probable Cause	Corrective Action
Loss of rpm during cruise flight (non-altitude engines)	Carburetor or induction icing or air filter clogging	Apply carburetor heat. If dirty filter is suspected and non-filtered air is available, switch selector to unfiltered position.
Loss of manifold pressure during cruise flight	Same as above	Same as above.
	Turbocharger failure	Possible exhaust leak. Shut down engine or use lowest practicable power setting. Land as soon as possible.
Gain of manifold pressure during cruise flight	Throttle has opened, propeller control has decreased rpm, or improper method of power reduction	Readjust throttle and tighten friction lock. Reduce manifold pressure prior to reducing rpm.
High oil temperature	Oil congealed in cooler	Reduce power. Land. Preheat engine.
	Inadequate engine cooling	Reduce power. Increase airspeed.
	Detonation or preignition	Observe cylinder head temperatures for high reading. Reduce manifold pressure. Enrich mixture.
	Forthcoming internal engine failure	Land as soon as possible or feather propeller and stop engine.
	Defective thermostatic oil cooler control	Land as soon as possible. Consult maintenance personnel.
Low oil temperature	Engine not warmed up to operating temperature	Warm engine in prescribed manner.
High oil pressure	Cold oil	Same as above.
	Possible internal plugging	Reduce power. Land as soon as possible.
Low oil pressure	Broken pressure relief valve	Land as soon as possible or feather propeller and stop engine.
	Insufficient oil	Same as above.
	Burned out bearings	Same as above.
Fluctuating oil pressure	Low oil supply, loose oil lines, defective pressure relief valve	Same as above.
High cylinder head temperature	Improper cowl flap adjustment	Adjust cowl flaps.
	Insufficient airspeed for cooling	Increase airspeed.
	Improper mixture adjustment	Adjust mixture.
	Detonation or preignition	Reduce power, enrich mixture, increase cooling airflow.
Low cylinder head temperature	Excessive cowl flap opening	Adjust cowl flaps.
	Excessively rich mixture	Adjust mixture control.
	Extended glides without clearing engine	Clear engine long enough to keep temperatures at minimum range.
Ammeter indicating discharge	Alternator or generator failure	Shed unnecessary electrical load. Land as soon as practicable.
Load meter indicating zero	Same as above	Same as above
Surging rpm and overspeeding	Defective propeller	Adjust propeller rpm.
	Defective engine	Consult maintenance.
	Defective propeller governor	Adjust propeller control. Attempt to restore normal operation.
	Defective tachometer	Consult maintenance.
	Improper mixture setting	Readjust mixture for smooth operation.
Loss of airspeed in cruise flight with manifold pressure and rpm constant	Possible loss of one or more cylinders	Land as soon as possible.
Rough running engine	Improper mixture control setting	Adjust mixture for smooth operation
	Defective ignition or valves	Consult maintenance personnel.
	Detonation or preignition	Reduce power, enrich mixture, open cowl flaps to reduce cylinder head temp. Land as soon as practicable.
	Induction air leak	Reduce power. Consult maintenance.
	Plugged fuel nozzle (fuel injection)	Same as above.
	Excessive fuel pressure or fuel flow	Lean mixture control.
Loss of fuel pressure	Engine-driven pump failure No fuel	Turn on boost pumps. Switch tanks, turn on fuel.

Figure 18-11. *Commonly experienced in-flight abnormal engine instrument indications, their possible causes, and corrective actions.*

18-16

Figure 18-11. Commonly experienced in-flight abnormal engine instrument indications, their possible causes, and corrective actions. (AFH Ch.18, p.18-16) — Follow POH/AFM for the specific aircraft; this table is generic guidance only.

COMMON ERRORS (K6) — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — SYSTEMS & EQUIPMENT MALFUNCTIONS (AI.XII.C.K6)

FIXATION / STARTLE

Startle response leads to tunnel vision — staring at failed instrument while attitude deteriorates.

- Aviate FIRST — every time
- Failed AI ≠ failed airplane
- Cross-check immediately
- Eyes moving = brain working
- Brief: startle is normal, fixation kills

SKIPPING THE CHECKLIST

Attempting to troubleshoot from memory alone — skipping or missing POH/AFM emergency

- POH checklist IS the procedure
- Memory flows confirm; don't replace
- Partial power loss is often fixable
- Carb heat + mags = most common fix
- No checklist = incomplete response

MISREADING PITOT-STATIC

Believing instruments showing blocked-static errors — chasing false altimeter or ASI

- Blocked static: alt high, ASI fast
- Cross-check with VSI + power
- Open alternate static: test it
- If needles jump → static problem
- Glass cockpit: both screens can fail

NO-FLAP LANDING ERRORS

Approaching at normal speed and normal pattern with no flaps — too fast, floats, uses

- 50% more runway required — brief it
- Nose-high attitude hides runway
- Don't force onto runway early
- Use longer, wider pattern
- No flares — fly it on smoothly

DOOR / TRIM DISTRACTION

Reacting to non-critical malfunction (open door, trim failure) by abandoning aircraft control — the

- Open door = fly the airplane
- Never unbuckle to reach door
- Land normally at pattern altitude
- Trim failure: use trim tab or pressure
- Distraction = leading cause of loss of control

EVALUATION CHECKLIST — SYSTEMS AND EQUIPMENT MALFUNCTIONS (AI.XII.C)

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Trigger / Initial	Aviate maintained; startle response controlled; aircraft attitude/heading stable (R1)	No altitude loss >100 ft; heading deviation <10° during identification phase	Fixating on failed instrument; staring at panel while attitude deteriorates
Identification	Failure identified correctly using multiple sources; no premature action (K2a–K2f)	Failure correctly named and confirmed via cross-check before checklist initiated	Guessing rather than confirming; misidentifying instrument error vs. system failure
CRITICAL	**POH/AFM CHECKLIST EXECUTED: correct procedure for the malfunction specified (S1, S2)**	**Appropriate checklist completed in correct order; no steps skipped; from memory if below 1,000 AGL**	**Improvising instead of using checklist; skipping steps; mixing up procedures from different aircraft**
Pitot-Static (if simulated)	Blocked static or pitot correctly identified; alternate static source used appropriately (K2c)	Alternate static source opened; cross-check confirms diagnosis; continues flight on alternate source	Chasing false ASI/altimeter indications; not testing with alternate static; no cross-check
Gear / Flap (if simulated)	No-flap or gear-up landing briefed and executed with appropriate technique (K2e)	Pattern adjusted for no-flap; runway length/surface briefed; approach speed correct per POH	Normal pattern speed and length with no flaps; not briefing extra runway required
Debrief / Errors	Common errors identified; instruction provided on avoidance (S3, K6)	At least 3 common errors discussed with cause, effect, and correction method	Listing errors without explaining causes or how to correct them in flight

KEY RULE ■ ACS S1: at least 3 elements from K1–K5 must be simulated — evaluator chooses. S2: the correct POH/AFM checklist must be completed for each. No universal malfunction procedure exists — POH is the authority. FLY THE AIRPLANE FIRST; identify second; checklist third; land if required.

Area XII, Task D — Emergency Equipment and Survival Gear

FAA-S-ACS-25 • AI.XII.D • CFI Airplane — Ground / Pre-Flight Lesson

Objective

The applicant demonstrates instructional knowledge of emergency equipment and survival gear by explaining ELT operations and requirements, fire extinguisher use, and survival gear appropriate to the training environment. The applicant briefs passengers on emergency equipment use and identifies common errors related to this task.

References

- FAA-H-8083-2; FAA-H-8083-3 Ch.18; FAA-H-8083-9; FAA-H-8083-25; 14 CFR 91.207; POH/AFM

Delivery

- Ground brief 20–25 min; physical inspection of aircraft equipment; practice passenger brief; debrief on local survival gear requirements before first cross-country

ACS Knowledge

Code	Element
AI.XII.D.K1	ELT operations, limitations, and testing requirements
AI.XII.D.K2	Fire extinguisher operations and limitations
AI.XII.D.K3a	Emergency/survival gear — climate extremes (hot/cold)
AI.XII.D.K3b	Emergency/survival gear — mountainous terrain
AI.XII.D.K3c	Emergency/survival gear — overwater operations
AI.XII.D.K4–5	Ballistic parachute and auto-land systems (if equipped)
AI.XII.D.K6	Common errors related to this task

ACS Risk Management

Code	Element
R1	Survival gear (water, clothing, shelter) for 48–72 hours
R2	Use of a ballistic parachute system (if installed)
R3	Use of an emergency auto-land system (if installed)

ACS Skills

Code	Element
S1	Identify appropriate equipment and personal gear
S2	Brief passengers on proper use of on-board emergency equipment
S3	Simulate ballistic parachute deployment procedures (if equipped)
S4	Analyze and correct common errors related to this task

CRITICAL ■ GEAR MUST MATCH YOUR TRAINING ENVIRONMENT — This lesson is not one-size-fits-all. Training in Arizona summers? Extra water is not optional — pilots have died within hours of forced landings in the desert. Training in northern climates or mountains? A jacket and insulation layer belong in the aircraft. Training near or over water? One life jacket per occupant, period. Teach students to assess their environment BEFORE every flight and pack accordingly.

EQUIPMENT OVERVIEW (K1 / K2 / K3) — KNOW IT, LOCATE IT, USE IT

EMERGENCY EQUIPMENT OVERVIEW — AI.XII.D.S1 / S2

EMERGENCY LOCATOR TRANSMITTER (ELT) — 406 MHz	FIRE EXTINGUISHER — PASS	SURVIVAL GEAR CATEGORIES — 48–72 HRS
• 406 MHz (SARSAT) — digital, GPS-linked	• Type: Halon 1211 or dry chemical (ABC)	• Water — 1 qt/person/day minimum
• 121.5 MHz — legacy, monitored by pilots only	• DO NOT use CO2 in cockpit — asphyxiation risk	• Shelter — space blanket, tarp, fire starter
• Activates on impact (>5G) or manually	• P — Pull the pin	• Signaling — mirror, whistle, flares, PLB
• Annual inspection req'd (91.207)	• A — Aim at base of fire	• First aid kit — basic trauma care
• Battery: replace at 50% life or 1 hr use	• S — Squeeze the handle	• Food — high-calorie bars (3-day supply)
• Test only first 5 min of each hour	• S — Sweep side to side	• Navigation — paper chart, compass
• Location: typically aft fuselage / baggage	• After use: land ASAP; fumes remain	• Knife / multi-tool — essential utility

ELT — Key Requirements (K1 / 14 CFR 91.207)

- **406 MHz (SARSAT):** Digital signal with GPS coordinates; detected by satellite in minutes; dramatically faster SAR response than legacy 121.5 MHz units
- **121.5 MHz (legacy):** No longer monitored by SARSAT; monitored by overflying aircraft and ATC only — student must understand the difference
- **Activation:** Automatic (impact G-switch) or manual; some portable units are water-activated
- **Annual inspection (91.207(d)):** Installation, battery corrosion, controls, crash sensor, antenna signal — must be in aircraft records
- **Battery replacement:** At 50% of useful life OR after 1 cumulative hour of use; expiration date marked on unit and in maintenance log
- **Testing:** Only in first 5 minutes of any hour; limit to 3 audio sweeps; notify ATC first on 121.5 MHz if possible

Passenger Safety Brief (S2) — Use SAFETY

- **S — Seat belts:** How to fasten, adjust, and release
- **A — Air vents / Automation:** Adjust comfort; explain autopilot if applicable
- **F — Fire extinguisher:** Location and PASS technique
- **E — Exit doors:** How to open; alternate exits; evacuation plan
- **T — Traffic / Talking:** Help scan; sterile cockpit during critical phases
- **Y — Your questions?** Speak up at any time

Fire Extinguisher (K2)

- **GA aircraft type:** Halon 1211 (preferred) or dry chemical (ABC rated); Halon leaves no residue and is safe in confined spaces
- **CO_2 warning:** Never use CO_2 extinguishers in an occupied cockpit — displaces oxygen and can incapacitate occupants
- **PASS:** Pull pin → Aim at base of fire → Squeeze handle → Sweep side-to-side
- **After use:** Land at nearest suitable airport immediately; extinguisher residue and fumes require inspection before further flight
- **Check pre-flight:** Confirm gauge in green, pin intact, no corrosion or damage

Ballistic Parachute & Auto-Land (K4 / K5) — If Equipped

- **Ballistic parachute (K4):** Deploy when aircraft control is lost and altitude permits; brief passengers: brace position, stay belted through touchdown
- **Auto-land (K5):** Activate if pilot incapacitated (e.g., Garmin Autoland); brief passengers on button location and what to expect
- **Key rule:** Both systems are last-resort tools — they are not substitutes for aeronautical decision-making; know your aircraft's specific procedures

KEY RULE ■ Every pilot is also their own search and rescue coordinator. Know your gear, know your environment, and ensure someone on the ground has your flight plan.

GEAR FOR YOUR ENVIRONMENT (K3A / K3B / K3C) — MATCH GEAR TO MISSION

GEAR FOR YOUR ENVIRONMENT — K3a / K3b / K3c

HOT / ARID (e.g. AZ, NV, NM Summers)	COLD / MOUNTAINOUS (e.g. Northern States, Rockies)	OVERWATER (Coastal, Lakes, Island Ops)
■ EXTRA WATER — 1 gallon/person minimum	■ INSULATION LAYER — jacket, gloves, wool hat	■ LIFE JACKET — one per occupant, worn or accessible
Wide-brim hat, sun protection (SPF 50+)	Waterproof outer layer (hypothermia risk)	Inflatable raft if extended overwater flight
Light-colored, long-sleeve clothing	Mylar space blanket — critical item	406 MHz PLB (Personal Locator Beacon)
Electrolyte packets / salt tabs	Fire starter: lighter + waterproof matches	Waterproof container for essentials
Signal mirror — works perfectly in bright sun	High-calorie food (metabolism runs high in cold)	Signal mirror + marine flares
Shade material — tarp or space blanket (reflective side OUT)	Snowshoes or traction aids if mountain ops	Dye marker — visible from SAR aircraft
Night travel preferred if lost — cooler temps	Avoid sweating — wet clothing is deadly in cold	Hypothermia: 1°C water = incapacitation in minutes

COMMON ERRORS (K6) — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — EMERGENCY EQUIPMENT AND SURVIVAL GEAR (AI.XII.D.K6)

ELT NOT KNOWN / TESTED	WRONG FIRE EXT. USE	WRONG GEAR FOR CLIMATE	NO PASSENGER BRIEFING	MISSING CHECKLIST ITEMS
Pilot cannot locate, explain, or activate the ELT after a forced landing.	*Using CO2 in an enclosed cockpit or aiming at flames instead of base.*	*Student carries no water on AZ summer flight, or no insulation for mountain ops.*	*CFI or student performs no passenger briefing on emergency equipment use.*	*Pre-flight skips confirming ELT status, battery, or survival gear adequacy.*
• Locate and identify ELT pre-flight	• CO2 = asphyxiation risk in cockpit	• Gear must match the training environment	• Brief every passenger before every flight	• ELT on checklist: confirm armed/auto
• Know: fixed vs. portable vs. 406 MHz	• Always aim at BASE of fire, not flames	• AZ summer: gallon of water minimum	• Fire extinguisher: location and PASS	• Verify battery expiry in aircraft records
• Know battery expiry date and location	• After discharge: land ASAP	• Mountain/winter: insulation layer required	• Exits: primary and alternate	• Cross-country: check survival gear loaded
• Review 91.207 requirements with student	• Know extinguisher type in the aircraft	• Overwater: life jacket per occupant	• ELT: activation if pilot incapacitated	• Overwater: confirm PFDs aboard
• Simulate activation during ground brief	• Teach PASS before every solo endorsement	• 48–72 hrs minimum planning standard	• Use SAFETY acronym as a checklist	• Build gear check into standard pre-flight

EVALUATION CHECKLIST — EMERGENCY EQUIPMENT AND SURVIVAL GEAR

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Pre-Flight	ELT status confirmed — armed/auto, battery current	Expiry date checked; switch in ARM/AUTO; annual current	ELT ignored on pre-flight; no knowledge of battery status
Ground Brief	Fire extinguisher identified — type, location, PASS technique	Correctly describes type; demonstrates PASS without prompting	Can't locate extinguisher; confuses CO■ type with Halon
CRITICAL	**SURVIVAL GEAR MATCHES TRAINING ENVIRONMENT**	**Water for desert ops; insulation for cold; PFD for overwater; 48–72 hr standard**	**Generic gear list with no environmental consideration**

Passenger Brief	Completes full SAFETY passenger briefing	All six SAFETY items covered; clear, confident delivery	Skips fire extinguisher or exit doors; brief too rushed
Knowledge	Explains 406 MHz vs. 121.5 MHz ELT distinction	Correctly explains SARSAT detection, GPS encoding, SAR speed advantage	Believes 121.5 MHz is still satellite-monitored
If Equipped	Explains ballistic parachute or auto-land activation	Describes conditions, passenger brief, and procedure per POH	No awareness of when or how to use system

KEY RULE ■ ACS R1: Plan for 48–72 hours of self-sufficiency. The gear in your bag on a standard day flight should keep you and your passengers alive for three days if you don’t walk out. That standard changes with every climate, every terrain, and every leg over water.

Area XIV, Task A — After Landing, Parking, and Securing (ASEL, AMEL)

FAA-S-ACS-25 • AI.XIV.A • CFI Airplane — Flight Lesson

Objective

The applicant demonstrates instructional knowledge of after-landing, parking, and securing procedures by explaining proper shutdown sequence, postflight inspection, aircraft securing, and discrepancy documentation. The applicant simultaneously provides effective instruction while demonstrating each skill element.

References

- FAA-H-8083-2; FAA-H-8083-3 Ch.2; FAA-H-8083-9; FAA-H-8083-25; POH/AFM

Delivery

- Begins on rollout — CFI narrates from touchdown to tie-down; demonstrate checklist use; walk student through postflight inspection; debrief documentation habit

ACS Knowledge

Code	Element
AI.XIV.A.K1	Airplane shutdown, securing, and postflight inspection
AI.XIV.A.K2	Documenting in-flight and postflight discrepancies
AI.XIV.A.K3	Common errors related to this Task

ACS Risk Management

Code	Element
R1	Activities and distractions during shutdown and securing
R2	Airport-specific security procedures
R3	Disembarking passengers safely; monitoring movement on ramp

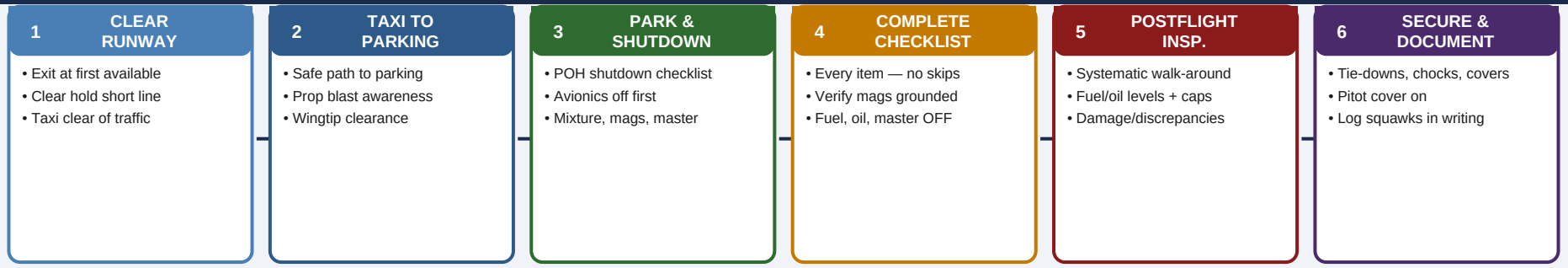
ACS Skills

Code	Element
S1	Park in appropriate area — safety of persons and property
S2	Complete the appropriate checklist(s)
S3	Postflight inspection — document discrepancies and servicing needs
S4	Secure the airplane
S5	Analyze and correct common errors

CRITICAL ■ THE CHECKRIDE IS NOT OVER AT TOUCHDOWN — A practical test is not complete until the engines are off, the checklist is finished, and the aircraft is tied down. Applicants have failed checkrides in the parking area by skipping checklist items, securing improperly, or leaving the master on. Teach students that postflight IS part of the evaluation — every time, without exception.

TECHNIQUE — POSTFLIGHT SEQUENCE (K1 / S1–S5)

POSTFLIGHT SEQUENCE — AI.XIV.A.S1 THROUGH S5



Step-by-Step Procedure

- **Clear the runway:** Exit at the first available taxiway; clear the hold-short line; do not stop on the runway or in the safety area
- **Taxi to parking:** Follow airport diagram or FBO instructions; maintain prop blast and wingtip awareness; taxi speed on congested ramp
- **Park:** Position per FBO/airport guidance; consider prop wash direction relative to nearby aircraft, structures, and persons; set brakes before shutdown
- **Shutdown (per POH checklist):** Avionics off, mixture to idle cutoff, mags OFF and verified grounded, master off; turbocharged engines: idle 2–3 min first
- **Complete the checklist:** Every item — no memory shortcuts; confirm fuel selector, carb heat off, flaps up per POH; this is S2 — the evaluator watches checklist use
- **Postflight inspection:** Systematic walk-around per POH; fuel caps seated; oil level and leaks; fuel sample (color + water check); note any new damage, FOD, or abnormalities
- **Secure the aircraft:** Three-point tie-down (both wings + tail); chocks fore and aft on at least one main gear; pitot cover on; control lock installed; close and secure all vents, windows, and doors
- **Document discrepancies:** Any squawk goes in the aircraft logbook or squawk sheet in writing — verbal reports are not sufficient; include symptom, phase of flight, and conditions observed

Passenger Safety on the Ramp (R3)

- **Brief before shutdown:** Tell passengers to remain seated until engines stop and you give the clear signal; prop is still spinning
- **Escort off the ramp:** Lead passengers clear of prop arc, other aircraft, ground equipment, and fuel trucks; never let them wander
- **Children:** Direct parent to hold hand from exit to terminal — ground ops are the highest risk phase for passenger injury

Distraction Management (R1)

- **FBO / fuel personnel:** Greet courteously but complete checklist first; do not allow ramp staff to interrupt shutdown sequence
- **Student debriefs:** Do not begin the verbal debrief until the aircraft is fully secured and documented — secure first, teach second
- **Phones and radios:** Complete the checklist before checking messages or logging flight time; task saturation causes missed items

Airport Security (R2)

- **Know the airport:** Some fields require specific FBO escort, badge access, or after-hours codes — brief student before arrival
- **Unattended aircraft:** Confirm aircraft is locked if required; verify avionics master, GPS, and ELT are in correct state

KEY RULE ■ The practical test is not complete until: engines off • checklist done • aircraft tied down.

COMMON ERRORS (K3) — WHAT TO WATCH FOR AND CORRECT

COMMON ERRORS — AFTER LANDING, PARKING, AND SECURING (AI.XIV.A.K3)

RUSHING THE SHUTDOWN	SKIPPING THE CHECKLIST	INCOMPLETE INSPECTION	IMPROPER SECURING	FAILING TO DOCUMENT
Skipping cool-down, pulling mixture before idle cutoff, or improper shutdown sequence per	*Memory-flying the shutdown — the most common postflight error. Results in hot mags,*	*Walking around without actually checking — not sampling fuel, not checking oil, not noting*	*Tie-downs skipped, too loose, or only two of three. Aircraft unsecured in overnight wind or*	*Discrepancies noted mentally but never written down. Next crew or student encounters*
• Brief: follow POH checklist order	• Checklist is not optional — ever	• Fuel caps: verify seated and locked	• Three-point tie-down minimum	• Write it down — every time
• Turbo: idle 2–3 min before shutdown	• Mags left on = prop strike hazard	• Oil: check level, check for leaks	• Snug — not over-tight (fabric stress)	• Squawk sheet or aircraft logbook
• Mags: grounded — verify before prop	• Master left on = dead battery	• Fuel sample: check for water/color	• Chocks fore and aft on main gear	• Include: symptom, phase, conditions
• Master: last item after everything off	• Fuel selector wrong = sump issue	• Damage: note any new dings/strikes	• Pitot cover on every time	• Verbal reports are not sufficient
• Rushing = missed items = safety risk	• Use checklist even for familiar aircraft	• Document everything — even if minor	• Control lock or gust lock installed	• Legal obligation if airworthy affected

EVALUATION CHECKLIST — AFTER LANDING, PARKING, AND SECURING

PHASE	EVALUATION POINT	STANDARD / TOLERANCE	COMMON ERROR
Taxi / Parking	Parks in appropriate area; considers safety of persons and property	Safe position; prop blast directed away; brakes set before shutdown	Parking in wrong area; prop blast toward other aircraft or people
Shutdown	Follows POH shutdown checklist in correct sequence	Checklist used; each item completed in order; avionics off first	Pulling mixture before idle cutoff; skipping sequence from memory
CRITICAL	**CHECKLIST COMPLETED IN FULL — mags grounded, master off, fuel correct**	**Every checklist item verbalized and verified — no items skipped**	**Memory-flying the shutdown; mags or master left on**
Postflight Inspection	Systematic walk-around; fuel caps, oil, fuel sample, damage check	All items inspected; discrepancies identified and noted	Rushing the walk-around; skipping fuel cap or oil check
Securing	Three-point tie-down; chocks; pitot cover; control lock	Aircraft fully secured per field standards before task complete	Loose tie-downs; pitot cover forgotten; no control lock
Documentation	Discrepancies entered in writing in logbook or squawk sheet	Written record for any squawk; nothing left undocumented	Verbal-only squawk; forgetting to document minor items

KEY RULE ■ ACS S2: ‘Complete the appropriate checklist(s).’ — The checklist is not a suggestion. It is the standard. The evaluator is watching. Train students that postflight is not a formality — it is the last evaluated task of every flight.