

PRIVATE PILOT COURSE

AIRPLANE, SINGLE ENGINE - LAND

LEARN TO FLY, HERE!

MICHAEL CHAVEZ, AGI
ADVANCED GROUND INSTRUCTOR

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		Getting Started:
GRD US Citizenship Verification		US Citizenship Verification
GRD Medical Certificate Obtained		Medical Certificate Obtained
GRD Student Pilot License		Student Pilot License
GRD Flight Training Materials		Flight Training Materials
GRD Pre-Training Logbook Audit		Pre-Training Logbook Audit
		Ground School:
		Risk Management
RMH		Defining Elements of Risk Management
RMH		Human Behavior
RMH		Identifying Hazards and Mitigating Risk
RMH		Aeronautical Decision Making
RMH		Single Pilot Resource Management
		Ground School
GRD Pilot Qualifications		Pilot Qualifications
GRD RUNWAY INCURSION AVOIDANCE		Runway Incursion Avoidance
GRD VISUAL SCANNING AND COLLISION AVOIDANCE		Visual Scanning and Collision Avoidance
GRD CFR 14 AND FAA PUBLICATIONS		14 CFR and Publications
GRD AEROMEDICAL FACTORS		Aeromedical Factors
SYSTEMS AND EQUIPMENT MALFUNCTIONS		Aircraft Systems
GRD AIRPLANE FLIGHT CONTROLS		Airplane Flight Controls
		Weather Theory
GRD WEATHER REPORTS AND SYSTEMS		Weather Reports
GRD WEIGHT AND BALANCE		Airplane Weight and Balance
GRD PERFORMANCE AND LIMITATIONS		Performance and Limitations
GRD AIRSPACE + LESSONS 1 2 3 4		National Airspace System
GRD NAVIGATION SYSTEMS & RADAR SERVICES		Navigation Aids: VOR
		Navigation Aids DME
		Navigation Aids: GPS
		VFR Chart Symbology
GRD NAVIGATION AND FLIGHT PLANNING		VFR Flight Planning
GRD NIGHT OPERATIONS		Night Operations
GRD HIGH ALTITUDE OPERATIONS		High Altitude Operations
GRD AERODYNAMICS + LESSONS 1 2 3 4		Principals of Flight
GRD AIRWORTHINESS REQUIREMENTS		VFR Airworthiness Requirements
		Flight Maneuvers
		Preflight Inspection

		Cockpit Management
		Engine Starting
		Taxiing
		Before Takeoff Check
		Radio Communications and ATC LightSignals
		Traffic Patterns
NORMAL TAKE-OFF		Normal Takeoff and Climb
NORMAL CLIMBS		
GO AROUNDS		Go Arounds
STRAIGHT AND LEVEL FLIGHT		Straight and Level Flight
POWER ON STALLS		Power On Stalls
POWER-OFF STALLS		Power Off Stalls
GROUND REFERENCE MANEUVERS		Ground Reference Maneuvers
GRM0 RECTANGULAR COURSES		
GRM2 S-TURNS ACROSS A ROAD		
GRM3 TURNS AROUND A POINT		
GRM4 EIGHTS ON PYLONS		
STEEP TURNS		Steep Turns
MEDIUM BANK TURNS		
SLOW FLIGHT		Slow Flight
EMERGENCY APPROACH AND LANDING		Emergency Approach and Landing
EMERGENCY DECENTS		Emergency Descent
NORMAL LANDINGS		Normal Approach and Landing
DECENTS		
FORWARD SLIP TO LANDING		Forward Slip to Landing
SHORT-FIELD TAKE-OFF		Short Field Takeoff and Climb
SHORT-FIELD APPROACH AND LANDING		Short Field Approach and Landing
SOFT FIELD TAKE-OFF		Soft Field Take off and Climb
SOFT-FIELD APPROACH AND LANDING		Soft Field Approach and Landing
CROSSWIND TAKE-OFFS		
CROSSWIND LANDING		
INSTRUMENT FLYING BASICS		Instrument Flying Basics
UNUSUAL ATTITUDE RECOVERIES		Unusual Attitudes
SPIN AWARENESS		Spin Awareness
SYSTEMS AND EQUIPMENT MALFUNCTIONS		System Equipment and Malfunctions
		Post Flight Procedures
		Makes and Models
		C172S Aircraft Systems
		C172S Flight Controls
		C172S Weight and Balance
		C172S Performance and Limitations

US Citizenship Verification

TSA Requires that New Private Pilot Students have their United States Citizenship verified prior to beginning their Flight Training. A new student can accomplish by either:

1. Providing a Valid/Unexpired US Passport or,

2. Providing their Original Birth Certificate and Driver's License.

US Passport

If a student provides you with their US Passport, check the following:

1. Picture on Passport matches Student

2. Passport is Valid and not past its Expiration Date

Birth Certificate and Driver's License

If a student provides you with their Birth Certificate and Driver's License, check the following:

1. Birth Certificate is Original and has a Raised Seal

2. Name on Birth Certificate matches the Name on Driver's License EXACTLY

3. Date of Birth on Birth Certificate matches Date of Birth on Driver's License EXACTLY

4. Driver's License is not past its Expiration Date

Student is Not a US Citizen

If your student is not a United States Citizen, they will need to complete the appropriate background checks and fingerprinting in accordance with the Alien Flight Student Program (AFSP) guidelines and receive an official/final approval email PRIOR to beginning any Flight Training.

Medical Certificate Obtained

It is not mandatory for a new student to receive a Medical Certificate prior to beginning their Flight Training. However, it is mandatory that they have one prior to conducting any Solo Flight Operations. That being said, we highly suggest that students obtain their Medical Certificate prior to ANY Flight Training so that they do not end up wasting time or money if they are unable to obtain one in the future.

How to Find an AME

You and your student can locate Aviation Medical Examiner's (AME) in your local area at the link here:

Locate an AME ›

Once your student has scheduled their Medical Examination, they will need to complete the FAA MedXPress form at the link below prior to showing up for the Exam.

FAA MedXPress ›

Student Pilot License

It is not mandatory that new students obtain a Student Pilot License prior to beginning their Flight Training. However, it is mandatory that they obtain one prior to any Solo Flight Operations. Since it can take a few weeks to obtain this license in the mail, we suggest ordering it prior to beginning the Student's Flight Training.

Ordering the Student Pilot License can be done by the Student and Flight Instructor. It is easiest to complete this together (rather than remotely) so that the Flight Instructor can verify and fix any errors made by the student on the application.

Order the Student Pilot License here ›

Flight Training Materials

Suggested Materials

- Flight Bag
- Logbook
- Kneeboard
- Headset
- Plotter
- E6B
- VFR Sectional Chart
- Current FAR/AIM
- Current PHAK
- Current Airplane Flying Handbook
- Foggles
- Aviation Flashlight
- iPad

Private Pilot Logbook Audit

FAR 61.103 & 61.109 Compliance Tracker

GENERAL ELIGIBILITY — FAR 61.103

REQUIREMENT	ACQUIRED	REQUIRED	REMAINING
At Least 17 Years Old	—	1	1
At Least 3rd Class Medical Certificate	—	1	1
Holds a Student Pilot License	—	1	1
Knowledge Test Completed	—	1	1

AERONAUTICAL EXPERIENCE — FAR 61.109

REQUIREMENT	ACQUIRED	REQUIRED	REMAINING
Total Flight Time	—	40	**40**
Dual Instruction	—	20	**20**
Cross Country Dual Instruction	—	3	**3**
Night Time Dual Instruction	—	3	**3**
Night Dual XC Flight Over 100NM	—	1	**1**
Night Takeoffs & Landings to Full Stop	—	10	**10**
Simulated Instrument Dual Instruction	—	3	**3**
Total Solo Flight Time	—	10	**10**
Solo Cross Country Flight Time	—	5	**5**
Solo XC Flight Over 150NM Total Distance	—	1	**1**
Dual Instruction in 2 Calendar Months Leading to Checkride	—	3	**3**

REQUIRED ENDORSEMENTS

ENDORSEMENT	STATUS
A.14 US Citizenship	**REQUIRED**
A.3 Pre-Solo Knowledge Test	**REQUIRED**
A.4 Pre-Solo Flight Training	**REQUIRED**
A.6 Solo Flight First 90 Days	**REQUIRED**
A.9 Solo Cross Country Flight	**REQUIRED**
A.10 Solo Cross Country Flight Plan(s)	**REQUIRED**
A.36 Aeronautical Knowledge Test	**REQUIRED**
A.2 Review of Deficiencies on Knowledge Test	**REQUIRED**
A.1 Prerequisites for Practical Test	**REQUIRED**
A.37 Flight Proficiency/Practical Test	**REQUIRED**

PRIVATE PILOT CERTIFICATE — 14 CFR PART 61

Pre-Training Logbook Audit

Private Pilot Eligibility Requirements:
Age: 17
English Proficiency: Ready, Write, Speak, and understand English
FAA Written Exam: Passed Required Knowledge Test
FAA Checkride Exam: Pass Required Practical Exam
Certificate Held: Student Pilot, Sport Pilot, Recreational Pilot.

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Private Pilot Aeronautical Knowledge
FAR: 61.105
Must receive and log ground training on the following:
Applicable Federal Aviation Regulations.
Accident Reporting requirements of the NTSB.
Use of charts for VFR Navigation using pilotage, dead reckoning, and navigation systems.
Radio communication procedures.
Recognition of critical weather situations.
Safe and efficient operation of aircraft to include: collision avoidance and wake turbulence.
Effects of density altitude on aircraft performance.
Weight and balance computations.
Principles of aerodynamics, powerplants, and aircraft systems.
Stall/spin awareness and recovery techniques.
Aeronautical decision making and judgement.
Preflight Actions: runway lengths, takeoff and landing distances, weather reports ,and forecasts, fuel requirements, and alternatives.

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Private Pilot Flight Training:
FAR: 61.107
Must receive and log ground + flight training on the following:
Preflight preparation.
Preflight procedures.
Airport Operations.
Takeoffs, Landings, and Go-arounds.
Performance maneuvers.
Ground reference maneuvers.
Navigation.
Slow Flight and Stalls.
Basic Instrument Maneuvers.
Emergency Procedures.
Night Operations.
Postflight Procedures.

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Private Pilot Aeronautical Experience
FAR: 61.109
40 Hours Total Flight Time
- 20 hours of Flight Instruction
-- 3 hours Cross Country
-- 3 hours Night Flight
--- 1 Cross Country Flight over 100NM
--- 10 Takeoffs and Landings to a Full Stop
-- 3 hours Simulated Instrument Flight
-- 3 hours in previous 2 calendar months
- 10 hours Solo Flight Time:
-- 5 Hours Solo Cross Country Flight at least 150NM with Full Stop Landings at 3 points and 1 segment greater than 50NM
-- 3 Takeoff and landings to a full stop at an airport with an Operating Control Tower.

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Private Pilot Privileges and Limitations
FAR: 61.113
What you can and can't do with a Private Pilots License:
No flying for compensation or hire.
May not pay less and their "pro-rata share."
Can be PIC for a charitable, non-profit, or community event flight.
Can be reimbursed for search and rescue operations.
Can't flight in weather conditions less than VMC.

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Recency Requirements:
To act as PIC: Complete a flight review with a CFI: 24 Months
Carry Persons (Day): 3 take offs and landings during the Day: 90 Days
Carry Persons (Night): 3 take offs and landings at Night: 90 Days
Night Definition: The period beginning 1 hour after Sunset, to 1 hour before sunrise.

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Medical Certificates:
Pilots must have a medical certificate, with few exceptions, to exercise the privileges of their airmen certificates.

Pilots must comply with FAR 61.53 which states:
"a pilot cannot act as a crewmember on an aircraft if they know, or have reason to know, of any medical condition that would make them unsafe to operate an aircraft."

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How to obtain a medical Certificate:
An AME Aviation Medical Examiner > FAA Website

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Medical Certificates:

1st Class:	2nd Class:	3rd Class
ATP	Commercial	Private Pilot (solo)
Duration:	Duration:	Duration:
<40 = 12 months	<40 = 60 months	<40 = 60 months
>40 = 6 months	>40 12 months	>40 =24 months
Total Durations	Total Durations	Total Durations
<40 = 60 months	<40 = 60 months	<40 = 60 months
>40 = 24 months	>40 = 24 months	>40 = 24 months

Medical Certificate privileges will degrade as time passes.
However this does not change the medical certificate class.
Example: A 42 year old man provides a 1st class medical certificate. The certificate is 18 months old.
1st class certificate = 3rd class privileges

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BasicMed

* BasicMed is an alternate way for pilots to fly without holding an FAA Medical Certificate as long as they meet certain requirements.

What are the Requirements?

1. Comply with the general BasicMed requirements and possess a U.S. Driver's License.
2. Get a physical exam with a state licensed physician using the Comprehensive Medical Examination Checklist that can be printed on the FAA's website.
3. Complete a BasicMed Education Course (these are free and can also be found on the FAA's website).

What are the Restrictions?

1. Any aircraft authorized to carry not more than 7 occupants.
2. Any aircraft that has a maximum certificated takeoff weight of not more than 12,500 pounds.
3. Cannot carry more than 6 passengers.
4. Must operate the flight below 18,000' MSL and less than 250 knots.
5. Flight can not be operated for compensation or hire.

Lesson Summary
In this lesson we discussed the eligibility and training requirements for an individual to achieve their Private Pilot License. We also discussed Private Pilot privileges and limitations and the durations and privileges associated with the differing types of Medical Certificates.

GROUND SCHOOL

LESSON:	RUNWAY INCURSION AVOIDANCE

OBJECTIVE:

The student will be able to understand and apply knowledge of the airport environment so that they avoid either a runway incursion, or unauthorized operation in a movement area.

MOTIVATION:

Runway incursions in General Aviation are higher than airline and charter operations due to unfamiliar airport structures and a typical one crew environment. Understanding and applying avoidance principles will help avoid runway and movement are incursions.

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate with models, and instructional aids, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate understanding to the instructor by describing the key points, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

The lesson is complete when the student can identify all airport signs and show on an airport diagram where they would be located. The student will be able to understand ATC clearances and how to minimize distractions. The student will also describe how to operate at night and at a non-towered airport.

REFERENCES / EQUIPMENT NEEDED:

FAR/AIM; FAA-H-8083-25B PHAK, AC 91-73B Taxi Operations Procedures

IMAGES / MEDIA / LINKS:

CFI Notebook LINK
https://www.faa.gov/airports/runway_safety
https://livestream.com/faasteamtv/events/2185859
https://www.faa.gov/airports/runway_safety/resources/quiz/
http://faarunwaysafetysimulator.com/

RUNWAY INCURSION AVOIDANCE	TIME:	[90] Minutes

Defining the Problem:
Runway incursions – Any occurrence at an airport involving the incorrect presence of an aircraft on the surface at an airport designated for the take-off and landing of aircraft.
Why it happens – Unfamiliar airport, complicated taxi structure, complicated taxi instructions, in attention, distractions, low visibility, incomplete information.

Tools and Information Available to the Pilot:
Airport diagrams – How to plan a taxi route
Hot Spots – How to identify them and what are the details of why they are hot spots. Airport
Signs – Use AOPA flash cards to step through with emphasis on the following: Mandatory
Signage – Runway signs, runway boundary markings (Hold short lines) Taxiway signs – On a specific taxiway sign, approaching a taxiway sign
Movement areas vs. Non-movement areas – Pavement markings – When an ATC clearance is required.
Information signs – FBO, Ramp, Military area.

Taxi Procedures and Techniques to Avoid Incursions:
Pre-planning taxi and departure procedures to reduce pilot's workload – Plan taxi routes, identify hot spots, copy clearances from ATC.

Usually taxiing and take-off operations involve movement of airplanes close to other airplane, vehicles, pedestrians, runways and taxiways where it is easy to lose situational awareness and become a potential hazard.

Maintaining situational awareness – Appropriate times for checklist usage, using airport diagrams, Foreflight runway proximity advisor, understanding the clearance or asking for clarification before moving. STOP the airplane if you are unsure.

Importance of full attention to taxi operations – Apply sterile cockpit rule, turn off Mobile phone/texts, avoid conversations with passengers, full attention to ATC communications until at a safe altitude and distance from the airport.

ATC communications and clearances – Anticipation of clearances and read backs – Problems with pilots thinking they heard the clearance as they anticipated it, but another clearance was given – Read back solves this problem.
Progressive taxi procedure from ATC.

Requirements for ATC to issue runway crossing instructions and pilot read back.
Creating a mental picture of aircraft movements and intentions that are on frequency so that the pilot gains better insight and awareness of the entire airport or section of the airport that the pilot is operating in.
Hazards of maneuvering in low visibility – Difficulty in seeing, requires extra diligence, slower taxi speeds, importance of signage, tower not able to see aircraft.

Clearance Requirements and Examples:
Requirements for obtaining a take-off clearance - Example clearances.
Requirements for a landing clearance - Examples of these clearances.
After landing instructions from ATC to pilots and hold between runway or runway crossing clearance – Examples.
During the landing phase the pilot should brief an exit strategy so that the pilot is aware of potential parallel runways with the need to hold in between, or other taxiway/runway issues that could cause the pilot to lose situational awareness.

Non-towered airport operations:
ATC clearances not required.
Pilots self-separate via radio.
Not all airplanes have radios – extra diligence required in key places: take-off, turns, 45, base to final.
No movement vs non-movement areas.
Pilots should visually clear the downwind, base and final leg in both left and right traffic before taxiing on to the runway.

Night Operations:
Requires more attention due to reduced visual cues.
Position lights and what they mean – Green right, Red left, White rear.
Runway environment lighting – Runway edge (white), taxiway (blue), threshold (green), end of runway (red), obstructions (red)
Runway signs are usually lighted at towered airports – not necessarily at non- towered airports.
Easier to make a mistake with regards to a taxiway, runway or movement area marking. Use of exterior lighting to indicate intent.

Standardized Aircraft Lighting

= Turn on	Rotating beacon	Navigation/Position lights	Strobe light*	Taxi lights	Logo lights	Landing lights
Engine(s) running	●					
Taxiing	●	●	●	●	●	
Crossing a runway	●	●	●	●	●	●
Entering departure runway for line up and wait	●	●	●	●	●	
Takeoff	●	●	●	●	●	●

KEY POINTS:

Know your Light Gun Signals | Hot Spots | Night Operations

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-7,8 Facilities

COMMON ERRORS:

Not being up to date on all Airport NOTAMS
Not having a current Airport Diagram, readily available
Not copying clearances on your Airport Diagram

QUESTIONS FOR THE STUDENT:

What does LAHSO stand for?
[Land and Hold Short Operations]

Must a pilot accept a LAHSO Clearance?
[NO]

Must a pilot adhere to a LAHSO Clearance if accepted?
[YES]

What is the Sterile Cockpit Principle?
[No unnecessary conversations or duties during critical phases of flight (taxi, takeoff, approach, and landing).]

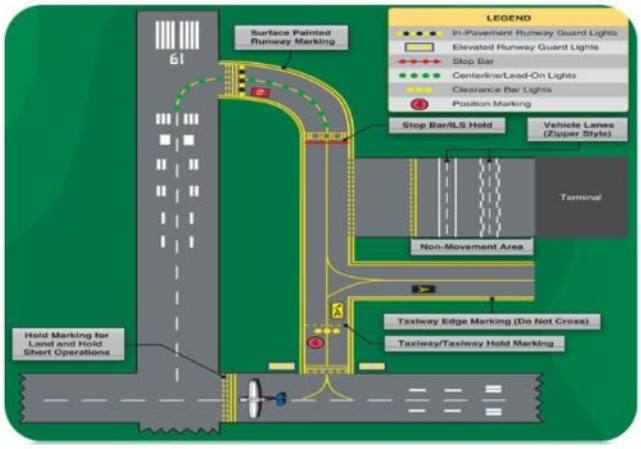
What are Airport Hot Spots?
[Spots of congestion or confusion.]

What is Situational Awareness?
[Always knowing your position and what is going on around you.]

What are common airport signs?

What are common airport markings?





LESSON: VISUAL SCANNING AND COLLISION AVOIDANCE

OBJECTIVE:

To develop a methodical approach to visual scanning & collision avoidance.

MOTIVATION:

Avoiding a collision with another airplane when VFR is always the responsibility of the pilot even if radar services are used. The See and avoid concept applies to all pilots.

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate with models, and instructional aids, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate understanding to the instructor by describing the key points, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

Area of Operation II. Preflight Procedures | Task D. Taxiing
To determine the applicant exhibits satisfactory knowledge, risk management, and skills associated with taxi operations, including runway incursion avoidance.

REFERENCES / EQUIPMENT NEEDED:

FAR/AIM; FAA-H-8083-25B PHAK, AC 91-73B Taxi Operations Procedures

IMAGES / MEDIA / LINKS:

CFI Notebook
https://www.faa.gov/airports/runway_safety
https://livestream.com/faasteamtv/events/2185859
https://www.faa.gov/airports/runway_safety/resources/quiz/
http://faarunwaysafetysimulator.com/

VISUAL SCANNING AND COLLISION AVOIDANCE TIME: [45] Minutes

1. Relationship between a pilot's physical condition and vision.
2. Environmental conditions that degrade vision.
3. Vestibular and visual illusions.
4. "See and avoid" concept.
5. Proper visual scanning procedure.
6. Relationship between poor visual scanning habits and increased collision risk.
7. Proper clearing procedures.
8. Importance of knowing aircraft blind spots.
9. Relationship between aircraft speed differential and collision risk.
10. Situations that involve the greatest collision risk.
11. Using TIS and ADS-B

- **Relationship between a pilot's physical condition and vision**
  Vision is the most important sense in flight
  Good eyesight depends on good physical health
  - Fatigue, illness, smoking, drugs, alcohol, oxygen deprivation, lack of vitamins

- **Environmental conditions that degrade vision (AIM 8-1-6)**
  Dark adaptation: Requires 30min
  - Impaired by cabin Pressure Alt >5,000'MSL, CO (exhaust or smoking), Vitamin A deficiency

- **Vestibular and visual illusions. (AIM 8-1-5)**
  False perception of one's position and motion with respect to the earth
  Sensory illusions can lead to differences between instrument indications and what the pilot "feels"
  Disoriented pilots are not aware of their orientation.
  When an attitude is maintained for extended period, the vestibular system will cause the pilot to incorrectly determine attitude.
  Abrupt change in attitude or head position can create spatial disorientation
  Correct orientation only by visual reference to reliable fixed position on ground or to flight instruments
  Examples of Illusions leading to Spatial Disorientation and Landing Errors
  - See AIM 8-1-5

- **"See and avoid" concept. (AIM 5-5-8, FAR 91.113b)**
  Regardless of type of flight plan or whether or not under control of a radar facility, the pilot is responsible to see and avoid other traffic, terrain, or obstacles

- **Proper visual scanning procedure. (AIM 8-1-6c , AC 90-48)**
  Scanning the sky for other aircraft is a key factor in collision avoidance
  It should be used continuously by the pilot and copilot to cover all areas of the sky visible from the cockpit
  Effective scanning is accomplished with a series of short, regular spaced eye movements that bring successive areas of the sky into the center visual field.
  Each movement should not exceed 10 degrees, and each should be observed for at least 1 second to enable detection
  Eyes should be outside about 3/4 of the time. 4 to 5 secs on the instrument panel for every 19 seconds outside
  Avoid "Empty-Field Myopia" - Condition such as above the clouds or in a haze layer with nothing specific to focus on outside the aircraft. This causes the eyes to relax and seek a comfortable focal distance which may range from 10 to 30 feet. This means looking without seeking, which is dangerous

- **Relationship between poor visual scanning habits and increased collision risk**
  Poor scanning habits will elevate the risk of collision.

- **Proper clearing procedures. (AC 90-48)**
  Taxi onto Runway: scan for approaching traffic (maneuver aircraft to get a clear view)
  Climb/Descent: Gentle banks left/right
  Clearing turns before maneuvers

- **Importance of knowing aircraft blind spots. (AC 90-48)**
  Look around physical obstructions (Doors / Window post)
- **Relationship between aircraft speed differential and collision risk**

- **Situations that involve the greatest collision risk. (AIM 8-1-8, AC 90-48)**
  Places where aircraft tend to cluster:
  - Airways, especially near VORs and IFR way-points
  - Near airports, especially on clear sky and good visibility days

KEY POINTS:

Pilots should be familiar with rules on right-of-way, so if an aircraft is on an obvious collision course, one can take immediate evasive action, preferably in compliance with applicable Federal Aviation Regulations

RISK MANAGEMENT:

FAA-H-8083-2A RMH Ch3-7,8 Facilities

COMMON ERRORS:

HotSpots, Looking down / Distractions while moving, No taxi Diagram

QUESTIONS FOR THE STUDENT:

What is the order of priority for Right of Way Rules?
[Aircraft in Distress]
[Balloon]
[Glider]
[Aircraft Towing another Aircraft]
[Airship]
[Airplane and Helicopter]

Which aircraft has the Right of Way when two aircraft are converging to a single point?
[The aircraft to the right.]

What should a pilot do when he/she is approaching another aircraft head on?
[Alter course to the right.]

Which aircraft has the Right of Way when one aircraft is overtaking another?
[The aircraft being overtaken.]

Which aircraft has the Right of Way when two aircraft are approaching the same runway for landing?
[The aircraft at the lower altitude.]

Where are the blindspots for a pilot flying in a high wing aircraft?
[Above the pilot.]

Where are the blindspots for a pilot flying in a low wing aircraft?
[Below the pilot.]

LESSON: CFR 14 AND FAA PUBLICATIONS

OBJECTIVE:

To locate and understand the documents and regulations which govern safe & legal flight and to understand how and when each is updated.

MOTIVATION:

In order to understand what needs to be taught and, to what level, you must have a good understanding of the relevant FAA publications, their content and update cycle.

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate with models, and instructional aids, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate understanding to the instructor by describing the key points, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

This lesson is complete when the student can locate all references found in the Flight Instructor PTS, and Private and Commercial Pilot ACS and can describe the general content of each item.

REFERENCES / EQUIPMENT NEEDED:

FAA-S-ACS-6C PPL ACS AIRPLANE, FAA-H-8083-1B (AWBH), FAA-H-8083-2A RMH, FAA-H-8083-3 AFH, FAA-H-8083-25B PHAK, FAR 14 CFR (FAR), ADVISORY CIRCULARS (AC)'S, FAA: Pilot/Controller Glossary

IMAGES / MEDIA / LINKS:

CFI Notebook | FAR/AIM.org | FAA.gov | asa2fly.com

CFR 14 AND FAA PUBLICATIONS TIME: 1 HOUR

1. Availability and method of revision of 14 CFR parts 1, 61, 91, and NTSB part 830 by describing:
    a. Purpose - Governing law for aviation
    b. General content - Describe the organization of the FARs with the attached document.
    c. Describe the contents of each Subpart of FAR Part 61.

2. Show the AIM and it's update cycle and general content. Use ASA's app to show the TOOLS then study by certificate to help constrain the amount of information a pilot in training needs to know.



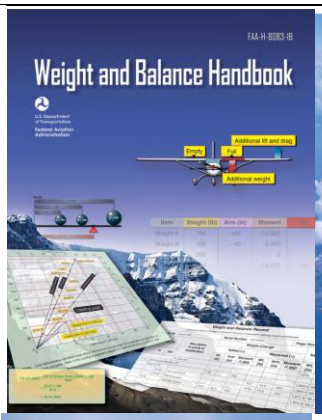
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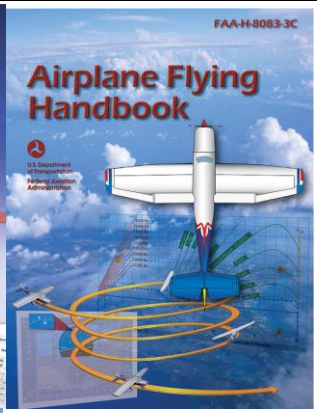
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Federal Aviation Administration

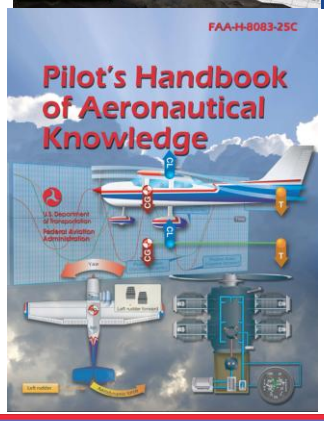
Private Pilot – Airplane
Airman Certification Standards

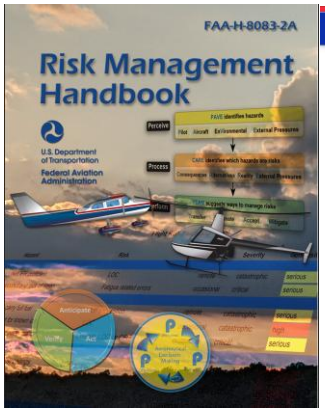
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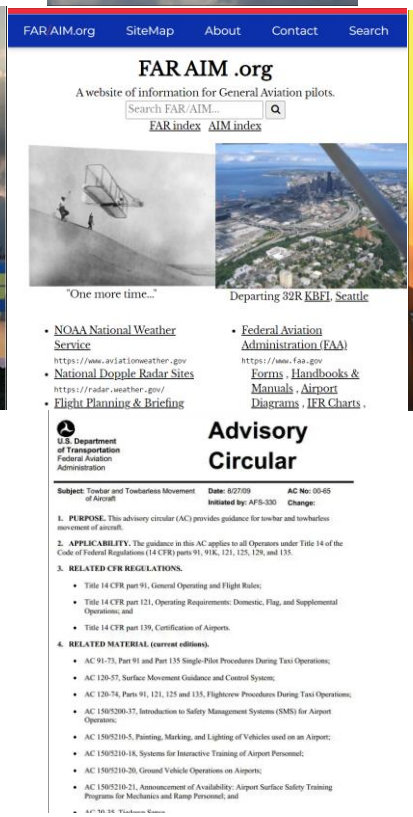
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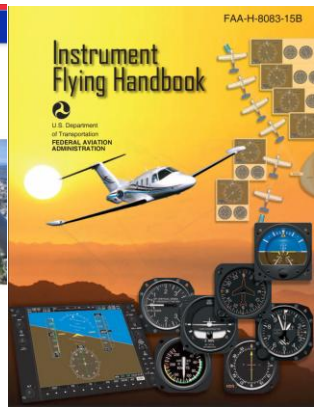












U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: Towbar and Towbarless Movement of Aircraft
Date: 8/27/09 **AC No:** 00-65
Initiated by: AFS-330 **Change:**

1. PURPOSE. This advisory circular (AC) provides guidance for towbar and towbarless movement of aircraft.

2. APPLICABILITY. The guidance in this AC applies to all Operators under Title 14 of the Code of Federal Regulations (14 CFR) parts 91, 91K, 121, 125, 129, and 135.

3. RELATED CFR REGULATIONS.

- Title 14 CFR part 91, General Operating and Flight Rules;
- Title 14 CFR part 121, Operating Requirements: Domestic, Flag, and Supplemental Operations; and
- Title 14 CFR part 139, Certification of Airports.

4. RELATED MATERIAL (current editions).

- AC 91-73, Part 91 and Part 135 Single-Pilot Procedures During Taxi Operations;
- AC 120-57, Surface Movement Guidance and Control System;
- AC 120-74, Parts 91, 121, 125 and 135, Flightcrew Procedures During Taxi Operations;
- AC 150/5200-37, Introduction to Safety Management Systems (SMS) for Airport Operators;
- AC 150/5210-5, Painting, Marking, and Lighting of Vehicles used on an Airport;
- AC 150/5210-18, Systems for Interactive Training of Airport Personnel;
- AC 150/5210-20, Ground Vehicle Operations on Airports;
- AC 150/5210-21, Announcement of Availability: Airport Surface Safety Training Programs for Mechanics and Ramp Personnel; and

61.1 – Definitions. This section contains definitions like cross country, authorized instructor and so on. This section makes it clear that only cross-country flights of over 50nm from the original point of departure with a landing count towards, Private, Instrument and Commercial Cross- Country Experience Requirements.

61.2 – 61.60 – General – Medicals Durations, Currency – Recent flight experience, flight review, change of address, Logging PIC – 61.51, pilot logbooks, Additional aircraft authorizations – 61.31 such as Complex, High Performance, Tailwheel, etc., hidden endorsements 61.39, retesting after failure.

61.61 – 61.77 - Additional category/class additions, Issuance of a pilot certificate based upon a foreign license.

61.81 – 61.95 – Student Pilot – Everything for solo and Cross-country training/authorizations

61.96 – 61.101 – Recreational Pilots

61.102 – 61.118 – Private Pilot Requirements, limitations and privileges. Pilot currency is not here. It is in 61.57 "Recency of experience Pilot in Command". Medical requirements are in 61.23

61.121 – 61.135 – Commercial Pilot Requirements, limitations and privileges Pilot currency is not here. It is in 61.57. Medical requirements are in 61.23. What can be done without 135 or 121 authorizations is in 119.1

61.181 – 61.201 – Flight Instructor Requirements, limitations and privileges Requirements to Log Flight and Ground Instruction 61.189. Limitations on instructors training first time instructor applicants – 61.195

Notes:
1. Regulations point to what must be done
2. PTS points to what must also be trained and what will be tested
3. PTS references what will be tested when a pilot holds the category (airplane, rotorcraft, LTA, Glider) and is adding a class rating (i.e., airplane single engine land) to it. This is in the rating task table in the PTS.
4. PTS Includes references for all Tasks. These references are handbooks, ACs, POHs etc. A list of them all appears in the front part of the PTS.

Pay attention to the words, especially when reading the Commercial Pilot Aeronautical Experience Requirements -- 61.129. When determining what time counts from another category of aircraft, such as rotorcraft, to airplane you must read understand and apply the following definitions, so you can credit the time that can be credited and work up what is missing and must be done.

The word AIRCRAFT means anything with a Registration, US or Foreign. Example N824LB. This holds for Glider, Airplane, and Rotorcraft etc.
1. The word AIRPLANE means single or multi engine airplane land or sea
2. Single Engine Airplane means Single engine airplane land or sea
3. Multi Engine Airplane means Multi engine airplane land or sea
4. Instrument training means Instrument training that must be given by a CFII. Example: For Commercial Pilot training.
5. Flight by sole reference to the flight instrument is NOT instrument training and can therefore be given by a CFI without CFII. Example: For Private Pilot training.

KEY POINTS:

All material listed here is FREE for download on the FAA website. Printed material available for a printing cost.

QUESTIONS FOR THE STUDENT:

How old must a person be to be eligible for a Private Pilot License?
[17]

How many total flight hours are required to obtain a Private Pilot License?
[40]

How many solo flight hours are required to obtain a Private Pilot License?
[10]

How many solo flight hours must be accomplished as cross country flight time?
[5]

How old must a person be to be eligible for a Commercial Pilot License?
[18]

How many total flight hours are required to obtain a Commercial Pilot License?
[250]

What must a pilot do in order to maintain currency to act as Pilot In Command (PIC)?
[Flight Review]

How often are flight reviews required to maintain Pilot In Command (PIC) currency?
[24 Calendar Months]

What must a PIC do in order to carry persons during the day?
[3 takeoffs and landings within the preceding 90 days in same category, class, and type of aircraft.]

What must a PIC do in order to carry persons at night?
[3 takeoffs and landings within the preceding 90 days, at night, in same category, class, and type of aircraft.]

What privileges are awarded to pilots who have current First Class Medical Certificate Privileges?
[Exercise ATP Certificate]

What is the duration of First Class Medical Certificate Privileges for a pilot who is over 40 years old?
[6 Calendar Months]

What is the duration of First Class Medical Certificate Privileges for a pilot who is under 40 years old?
[12 Calendar Months]

What privileges are awarded to pilots who have current Second Class Medical Certificate Privileges?
[Exercise Commercial Pilot Certificate]

What is the duration of Second Class Medical Certificate Privileges for a pilot who is over 40 years old?
[12 Calendar Months]

What is the duration of Second Class Medical Certificate Privileges for a pilot who is under 40 years old?
[12 Calendar Months]

What privileges are awarded to pilots who have current Third Class Medical Certificate Privileges?
[Exercise Private Pilot License // Take any Pilot Checkride]

What is the duration of Third Class Medical Certificate Privileges for a pilot who is over 40 years old?
[24 Calendar Months]

What is the duration of Third Class Medical Certificate Privileges for a pilot who is under 40 years old?
[60 Calendar Months]

LESSON: AEROMEDICAL FACTORS

OBJECTIVE:

To become familiar with aeromedical factors.

MOTIVATION:

It's almost a sure thing that you will have a passenger who exhibits a medical symptom from being in the air. Knowing how to identify what they are having trouble with and then taking the corrective action is why you need to understand aeromedical factors.

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate with models, and instructional aids, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate understanding to the instructor by describing the key points, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

XXPRESENTATIONHEREXX

REFERENCES / EQUIPMENT NEEDED:

FAA-H-8083-3A AFH, FAA-H-8083-25B PHAK (CH.17), FAR/AIM, NTSB REPORTS, PERSONAL STORIES, FAA-S-ACS-6C PPL ACS

IMAGES / MEDIA / LINKS:

CFI Notebook

AEROMEDICAL FACTORS — TIME: [45] Minutes

WHAT IT IS	CAUSES	SYMPTOMS	CORRECTIVE ACTIONS
Hypoxia	Lack of oxygen	Headache, Dizziness, Numbness in extremities, Cyanosis	Lower altitude or supplemental oxygen
Hyperventilation	Not enough CO, Nervousness, Anxiety, Fright	Clammy sweaty skin, rapid breathing	Breath Slower
Middle ear and sinus problems	Inflammation, Disease, Cold / Flu	Pain due to pressure difference	VALSALVA method, Clear ears, descend more slowly
Spatial Disorientation	Loss of horizon or visual reference	Loss of control, Confusion of airplane attitude	Use the flight instruments
Motion Sickness	Motion not matching visual cues	Clammy skin, Pale color, hot, Nausea	Look out to the horizon, climb to avoid turbulence, Open ventilation, Sick sack
Carbon monoxide poisoning	Hypoxia caused by CO	Same as hypoxia except red extremities in the later stages	Turn off heater, land, ventilate cabin
Stress and Fatigue	Chronic or Acute	Delayed reaction, not thinking well, Fatigued, Loss of Muscle control	Acute - Rest and eliminate stress Chronic – Under care of physician
Dehydration	Loss of water or electrolytes	Loss of balance or muscle control, Confusion, Disorientation	Restore electrolytes and hydrate
Alcohol	Produces hypoxia like symptoms and dehydration	8 hrs. before last drink, 0.4% BAC, Not under the influence	Wait

Drugs	Prescription vs. Non prescription	Varies	Use AOPA guide to drugs
Scuba – Nitrogen	Nitrogen excess	Produces the bends	24 hours waiting for a controlled ascent, 12 for non-controlled ascent

As a pilot, it is important to stay aware of the mental and physical standards required for the type of flying done. This page provides information on medical certification and on aeromedical factors related to flying activities.

Obtaining a Medical Certificate
Pilots must have held a medical certificate in the previous 10 years to use the new system. If this is the case the pilot needs to have his regular Doctor sign a checklist and the pilot keeps it to prove his fitness for flight. This must be done every 4 years. Also, an online course about aeromedical factors must be taken every two years. No submission of anything is required to FAA. If the pilot has not held a medical certificate in the previous 10 years, then they must get at least a Third Class Medical certificate.

Environmental and Health Factors Affecting Pilot Performance
A number of health factors and physiological effects can be linked to flying. Some are minor, while others are important enough to require special attention to ensure safety of flight. In some cases, physiological factors can lead to in-flight emergencies. Some important medical factors that a pilot should be aware of include hypoxia, hyperventilation, middle ear and sinus problems, spatial disorientation, motion sickness, carbon monoxide poisoning, stress and fatigue, dehydration, and heatstroke.
Other subjects include the effects of alcohol and drugs, anxiety, and excess nitrogen in the blood after scuba diving.

Hypoxia
Hypoxia means “reduced oxygen” or “not enough oxygen.” Although any tissue will die if deprived of oxygen long enough, usually the most concern is with getting enough oxygen to the brain, since it is particularly vulnerable to oxygen deprivation. Any reduction in mental function while flying can result in life-threatening errors. Hypoxia can be caused by several factors including an insufficient supply of oxygen, inadequate transportation of oxygen, or the inability of the body tissues to use oxygen. The forms of hypoxia are divided into four major groups based on their causes: hypoxic hypoxia, hypemic hypoxia, stagnant hypoxia, and histoxic hypoxia.

Hypoxic Hypoxia
Hypoxic hypoxia is a result of insufficient oxygen available to the lungs.

Hypemic Hypoxia
This occurs when the blood is not able to take up and transport a sufficient amount of oxygen to the cells in the body. Hypemic means “not enough blood.”

Stagnant Hypoxia
Stagnant means “not flowing,” and stagnant hypoxia results when the oxygen-rich blood in the lungs isn’t moving, for one reason or another, to the tissues that need it.

Histotoxic Hypoxia
The inability of the cells to effectively use oxygen is defined as histotoxic hypoxia. “Histo” refers to tissues or cells, and “toxic” means poison.

Symptoms of Hypoxia

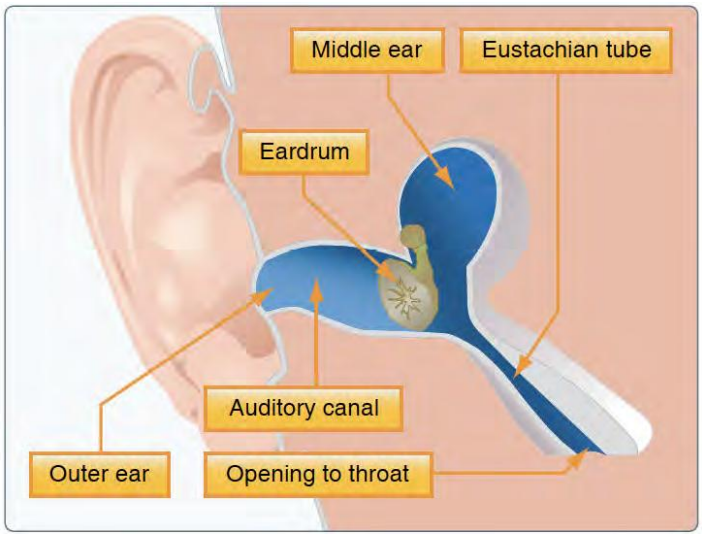
Common symptoms include:
• Cyanosis (blue fingernails and lips)
• Headache
• Decreased reaction time
• Impaired judgment
• Euphoria
• Visual impairment
• Drowsiness
• Lightheaded or dizzy sensation
• Tingling in fingers and toes
• Numbness

Altitude	Time of useful consciousness
45,000 feet MSL	9 to 15 seconds
40,000 feet MSL	15 to 20 seconds
35,000 feet MSL	30 to 60 seconds
30,000 feet MSL	1 to 2 minutes
28,000 feet MSL	2½ to 3 minutes
25,000 feet MSL	3 to 5 minutes
22,000 feet MSL	5 to 10 minutes
20,000 feet MSL	30 minutes or more

Hyperventilation
Hyperventilation occurs when an individual is experiencing emotional stress, fright, or pain, and the breathing rate and depth increase, although the carbon dioxide level in the blood is already at a reduced level.
The result is an excessive loss of carbon dioxide from the body, which can lead to unconsciousness due to the respiratory system's overriding mechanism to regain control of breathing.
Common symptoms of hyperventilation include:
• Headache
• Decreased reaction time
• Impaired judgment
• Euphoria
• Visual impairment
• Drowsiness
• Lightheaded or dizzy sensation
• Tingling in fingers and toes
• Numbness
• Pale, clammy appearance
• Muscle spasms

Hyperventilation may produce a pale, clammy appearance and muscle spasms compared to the cyanosis and limp muscles associated with hypoxia.
The treatment for hyperventilation involves restoring the proper carbon dioxide level in the body. Breathing normally is both the best prevention and the best cure for hyperventilation.
In addition to slowing the breathing rate, breathing into a paper bag or talking aloud helps to overcome hyperventilation. Recovery is usually rapid once the breathing rate is returned to normal.

Middle Ear and Sinus Problems

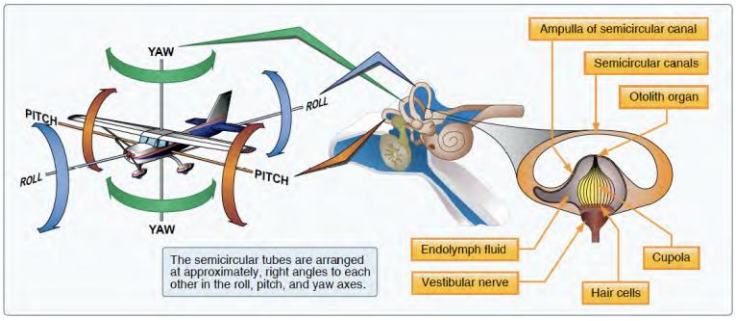


The eustachian tube allows air pressure to equalize in the middle ear

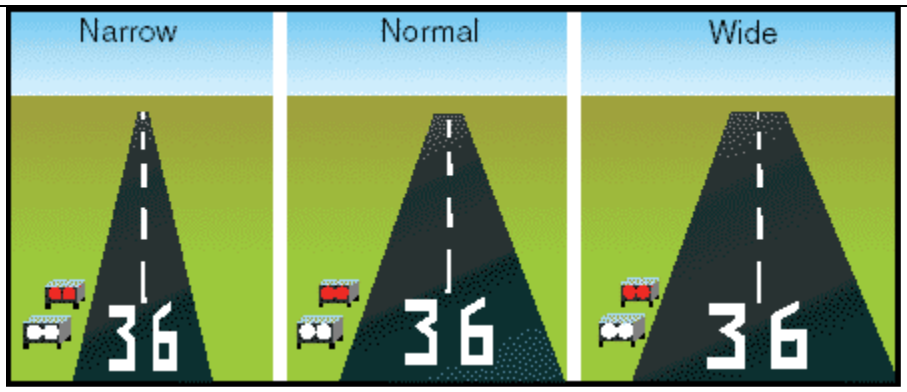
Blocked or swollen Eustachian tube causes a difference in pressure on the ear drum causing pain. In a similar way, air pressure in the sinuses equalizes with the pressure in the cockpit through small openings that connect the sinuses to the nasal passages. An upper respiratory infection, such as a cold or sinusitis, or a nasal allergic condition can produce enough congestion around an opening to slow equalization. As the difference in pressure between the sinus and the cockpit increases, congestion may plug the opening. This "sinus block" occurs most frequently during descent. Slow descent rates can reduce the associated pain. A sinus block can occur in the frontal sinuses, located above each eyebrow, or in the maxillary sinuses, located in each upper cheek. It will usually produce excruciating pain over the sinus area. A maxillary sinus block can also make the upper teeth ache. Bloody mucus may discharge from the nasal passages.

Spatial Disorientation and Illusions

Spatial disorientation specifically refers to the lack of orientation with regard to the position, attitude, or movement of the airplane in space.



The semicircular canals lie in three planes, and sense motions of roll, pitch, and yaw.



Runway Illusions

Motion Sickness
Motion sickness, or airsickness, is caused by the brain receiving conflicting messages about the state of the body.

Carbon Monoxide Poisoning
Carbon monoxide (CO) is a colorless and odorless gas produced by all internal combustion engines. Since it attaches itself to the hemoglobin in the blood about 200 times more easily than oxygen, carbon monoxide prevents the hemoglobin from carrying oxygen to the cells, resulting in hypemic hypoxia. It can take up to 48 hours for the body to dispose of carbon monoxide.
Anytime a pilot smells exhaust odor, or any time that these symptoms are experienced, immediate corrective actions should be taken. These include turning off the heater, opening fresh air vents and windows, and using supplemental oxygen, if available.

Stress
Stress is defined as the body's response to physical and psychological demands placed upon it.
Acute stress involves an immediate threat that is perceived as danger.
Chronic stress can be defined as a level of stress that presents an intolerable burden, exceeds the ability of an individual to cope, and causes individual performance to fall sharply.

Fatigue
Fatigue is frequently associated with pilot error.
Acute and chronic. Acute fatigue is short term and is a normal occurrence in everyday living.
A special type of acute fatigue is skill fatigue. This type of fatigue has two main effects on performance:
• Timing disruption Appearing to perform a task as usual, but the timing of each component is slightly off.
• Disruption of the perceptual field Concentrating attention upon movements or objects in the center of vision and neglecting those in the periphery. This may be accompanied by loss of accuracy and smoothness in control movements.
Chronic fatigue, extending over a long period of time, usually has psychological roots, although an underlying disease is sometimes responsible.

Dehydration and Heatstroke
Dehydration is the term given to a critical loss of water from the body. The first noticeable effect of dehydration is fatigue. If this fluid is not replaced, fatigue progresses to dizziness, weakness, nausea, tingling of hands and feet, abdominal cramps, and extreme thirst.
Heatstroke is a condition caused by any inability of the body to control its temperature. Onset of this condition may be recognized by the symptoms of dehydration, but also has been known to be recognized only by complete collapse.

Alcohol

Alcohol impairs the efficiency of the human mechanism.

Alcohol interferes with the brain's ability to utilize oxygen, producing a form of histotoxic hypoxia.

14 CFR part 91 requires that blood alcohol level be less than .04 percent and that 8 hours pass between drinking alcohol and piloting an airplane. A pilot with a blood alcohol level of .04 percent or greater after 8 hours cannot fly until the blood alcohol falls below that amount. Even though blood alcohol may be well below .04 percent, a pilot cannot fly sooner than 8 hours after drinking alcohol.

Although the regulations are quite specific, it is a good idea to be more conservative than the regulations.

Drugs

Pilot performance can be seriously degraded by both prescribed and over-the-counter medications, as well as by the medical conditions for which they are taken.

The Code of Federal Regulations prohibits pilots from performing crewmember duties while using any medication that affects the faculties in any way contrary to safety. The safest rule is not to fly as a crewmember while taking any medication, unless approved to do so by the FAA. If there is any doubt regarding the effects of any medication, consult an aviation medical examiner before flying.

Scuba Diving

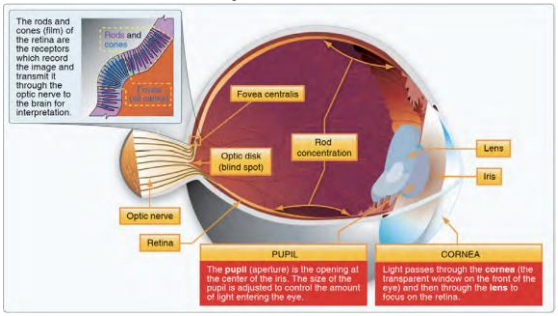
The bends can be experienced from as low as 8,000 feet MSL, with increasing severity as altitude increases. As noted in the Aeronautical Information Manual (AIM), the minimum recommended time between scuba diving on non decompression stop dives and flying is 12 hours, while the minimum time recommended between decompression stop diving and flying is 24 hours.



Scuba divers must not fly for specific time periods following dives to avoid the bends.

Vision in Flight

There are two kinds of light sensitive cells in the eyes: rods and cones.



The cones are responsible for all color vision



The eye's blind spot.

The area where the optic nerve enters the eyeball has no rods or cones, leaving a blind spot in the field of vision. Normally, each eye compensates for the other's blind spot. Figure 7 provides a dramatic example of the eye's blind spot. Cover the right eye and hold this page at arm's length. Focus the left eye on the X in the right side of the windshield and notice what happens to the airplane while slowly bringing the page closer to the eye.

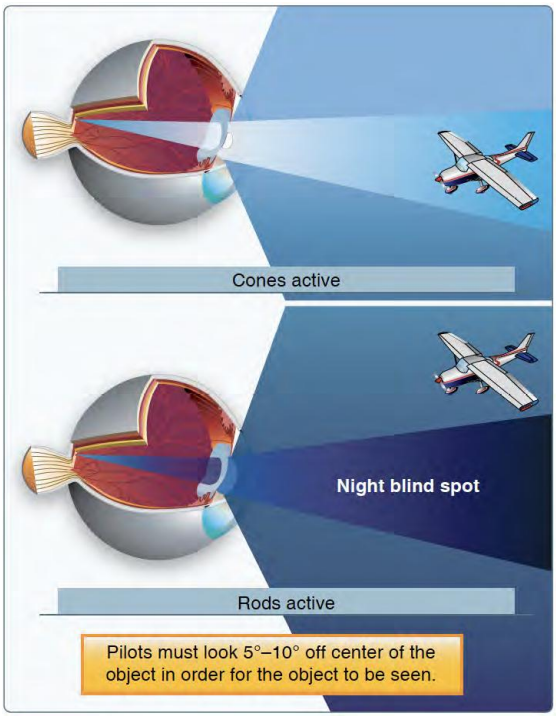
Empty-Field Myopia

Another problem associated with flying at night, in instrument meteorological conditions and/or reduced visibility is empty-field myopia, or induced nearsightedness.

With nothing to focus on, the eyes automatically focus on a point just slightly ahead of the airplane. Searching out and focusing on distant light sources, no matter how dim, helps prevent the onset of empty-field myopia.

Night Vision

The concentration of cones in the fovea can make a night-blind spot in the center of the field of vision. To see an object clearly at night, the pilot must expose the rods to the image. This can be done by looking 5° to 10° off center of the object to be seen.



Night blind spot

Apparent Horizon
When looking directly at an object, the image is focused mainly on the fovea, where detail is best seen. At night, the ability to see an object in the center of the visual field is reduced as the cones lose much of their visual acuity and the rods become more sensitive. Looking off center can help compensate for this night-blind spot. Along with the loss of sharpness and color at night, depth perception and judgment of size may be lost.

Night Visual Illusions
There are many different types of visual illusions that commonly occur at night. Anticipating and staying aware of them is usually the best way to avoid them.
Auto kinesis is caused by staring at a single point of light against a dark background for more than a few seconds. After a few moments, the light appears to move on its own. To prevent this illusion, focus the eyes on objects at varying distances and avoid fixating on one target. Be sure to maintain a normal scan pattern.

False Horizon
A false horizon can occur when the natural horizon is obscured or not readily apparent.



Actual Horizon

Night Landing Illusions
Above featureless terrain at night, there is a natural tendency to fly a lower-than-normal approach. Elements that cause any type of visual obscuration, such as rain, haze, or a dark runway environment also can cause low approaches.
Bright lights, steep surrounding terrain, and a wide runway can produce the illusion of being too low, with a tendency to fly a higher-than-normal approach.

Often a set of regularly spaced lights along a road or highway can appear to be runway lights.
Pilots have even mistaken the lights on moving trains as runway or approach lights. Bright runway or approach lighting systems can create the illusion that the airplane is closer to the runway, especially where few lights illuminate the surrounding terrain.

KEY POINTS:

Hypoxic, Hypemic, Stagnant, Histotoxic HYPOXIA

Spatial Disorientation and Illusions

Night Vision & Visual Illusions

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-5 PAVE

QUESTIONS FOR THE STUDENT:

What privileges can be exercised by pilots with a current First Class Medical Certificate?
[ATP Privileges]

What are the First Class Medical Certificate Privilege Durations for a pilot over the age of 40?
[6 Calendar Months]

What are the First Class Medical Certificate Privilege Durations for a pilot under the age of 40?
[12 Calendar Months]

What privileges can be exercised by pilots with a current Second Class Medical Certificate?
[Commercial Pilot Privileges]

What are the Second Class Medical Certificate Privilege Durations for a pilot over the age of 40?
[12 Calendar Months]

What are the Second Class Medical Certificate Privilege Durations for a pilot under the age of 40?
[12 Calendar Months]

What privileges can be exercised by pilots with a current Third Class Medical Certificate?
[Private Pilot Privileges
Take any Checkride Exam]

What are the Third Class Medical Certificate Privilege Durations for a pilot over the age of 40?
[24 Calendar Months]

What are the Third Class Medical Certificate Privilege Durations for a pilot under the age of 40?
[60 Calendar Months]

What are the 4 types of Hypoxia?
[Hypoxic Hypoxia]
[Hypemic Hypoxia]
[Stagnant Hypoxia]
[Histotoxic Hypoxia]

What causes Hypoxic Hypoxia?
[Not enough oxygen in the environment (high altitude).]

What causes Hypemic Hypoxia?
[Oxygen cannot attach to blood cells (CO poisoning).]

What causes Stagnant Hypoxia?
[Blood not flowing to the brain (G-Forces).]

What causes Histotoxic Hypoxia?
[Brain rejects the oxygen molecules (drugs and alcohol).]

What are the symptoms of Hypoxia?
[Cyanosis (blue fingernails and lips)]
[Headache]
[Decreased Response Times]
[Impaired Judgement]

[Euphoria]
[Visual Impairment]
[Drowsiness]
[Dizzy Sensations]
[Numbness]
[Tingling in the Fingers and Toes]

How can a pilot correct for Hypoxia?
[Descend to a lower altitude.]
[Put on an oxygen mask.]
[Stop pulling G-Forces.]

What causes Hyperventilation?
[Too much Oxygen. Not enough Carbon Dioxide.]

What is The Leans?
[Feeling as if you are in a turn when you are not.]

What causes Coriolis Illusion?
[Rapid head movement in a prolonged turn.]

What is Graveyard Spiral?
[A slow descending turn caused by an extended condition of The Leans.]

What is Somatogravic Illusion?
[Acceleration makes a pilot feel as if they are climbing.]
[Deceleration makes a pilot feel as if they are descending.]

What is Inversion Illusion?
[The feeling of tumbling backward when a pilot performs a sharp level off following a steep climb.]

What is Elevator Illusion?
[Updrafts make a pilot feel as if they are in a nose high attitude.]
[Downdrafts make a pilot feel as if they are in a nose low attitude.]

What is False Horizon Illusion?
[Lights obscuring the natural horizon.]

What is Autokinesis?
[When stationary lights appear to be moving.]

What is Runway Width Illusion?
[Wider than normal runways make a pilot feel low.]
[Narrower then normal runways make a pilot feel high.]

What is Runway Slope Illusion?
[Upsloping runways make a pilot feel high.]
[Downsloping runways make a pilot feel low.]

What effect may a pilot notice when flying over Featureless Terrain?
[The pilot may feel higher than actual.]

What effect may a pilot notice when flying over Featureless Terrain?
[The pilot may feel higher than actual.]

What effect may a pilot notice when flying through Haze?
[The pilot may feel higher than actual.]

What effect may a pilot notice when flying into Fog?
[Can create the illusion of pitching up.]

What causes Motion Sickness?
[The brain receiving conflicting messages about the state of the body.]

What is Carbon Monoxide (CO) Poisoning?
[A color and odorless gas that attaches itself to blood cells 200 times faster than oxygen molecules.]

What is a common cause of CO Poisoning in aircraft?
[The aircraft heater.]

What are common symptoms of CO Poisoning?
[Headache]
[Blurred Vision]
[Dizziness]
[Drowsiness]
[Loss of Muscle Power]
[Death]

How can a pilot correct for CO Poisoning in flight?
[Turn off the aircraft heater.]
[Open any window for airflow.]
[Don an oxygen mask.]

What are the 2 different types of Stress?
[Acute Stress & Chronic Stress]

What are the 2 different types of Fatigue?
[Acute Fatigue & Chronic Fatigue]

What rules are associated with Alcohol and flying?
[8 hours from bottle to throttle]
[.04% BAC max]
[No flying while under the influence or hungover]

What does DCS stand for?
[Decompression Sickness]

How long should a pilot wait to fly after Scuba Diving?
[24 Hours]

What is included in the IMSAFE Checklist?
[I = Illness] | [M = Medication] | [S = Stress] | [A = Alcohol] | [F = Fatigue] | [E = Eating/Emotion]

LESSON: AIRPLANE FLIGHT CONTROLS

OBJECTIVE:

To gain an understanding of the way a pilot uses the flight controls to provide the necessary aerodynamic forces to maneuver the airplane around its three axes.

MOTIVATION:

Every flight will involve the movement of the airplane using the primary and sometimes secondary flight controls. Understanding how each control works allows the pilot to know which control to use to maneuver the airplane in the desired direction.

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate with models, and instructional aids, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate understanding to the instructor by describing the key points, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

PA.I.G.R1: Detection of system malfunctions or failures.
PA.I.G.R2: Management of a system failure.
PA.I.G.R3: Monitoring and management of automated systems.
PA.I.G.S1: Operate at least three of the systems listed in K1a through K1l appropriately.
PA.I.G.S2: Complete the appropriate checklist(s).

Also, the student will be able to describe the primary and secondary flight controls and explain how each control can be used to change the flight path of the airplane. The student will also describe the effects of the left turning tendencies and adverse yaw and how their effects can be eliminated.

REFERENCES / EQUIPMENT NEEDED:

FAA-H-8083-2A RMH, FAA-H-8083-3 AFH, FAA-H-8083-25B PHAK POH/AFM; FAA: Pilot/Controller Glossary

IMAGES / MEDIA / LINKS:

CFI Notebook

AIRPLANE FLIGHT CONTROLS — TIME: [30] Minutes

1. Ailerons
2. Elevator (or stabilator)
3. Rudder

Behavior of Controls:
At low airspeed, the controls usually feel soft and sluggish, and the aircraft responds slowly to control applications. At higher airspeeds, the controls become increasingly firm and aircraft response in more rapid.

Movement of any of the three primary flight control surfaces (ailerons, elevator or stabilator, or rudder), changes affect the lift and drag, and allow a pilot to control the aircraft about its three axes of rotation.

Ailerons - Control roll. A control wheel in the airplane can be turned left of right to cause the airplane to roll.

Elevator - Controls pitch. The control wheel can be pulled and pushed to cause the airplane to pitch up and down.

The airplane can have an elevator, which is a hinged control surface mounted at the rear of the horizontal stabilizer or a stabilator which is a full flying horizontal stabilizer.

Rudder - Controls yaw: The foot pedals on the floor under the instrument panel can be pushed independently to cause yaw. The tops of the pedals also can be pushed for braking of the left and right wheel.

Effects of the left turning tendencies on flight control inputs and effectiveness.

Secondary Flight Controls:
1. Flaps
2. Leading edge devices
3. Trim

Flaps: increase the angle of attack from the leading edge of thawing to the trailing edge.
Results in more left and drag. The primary purpose of flaps is to increase the descent angle without increasing airspeed.

Leading Edge Devices: Usually in the form of slats. These devices result in additional lift when deployed. They are mounted on the leading edge of a wing and typically deployed downward.

Trim: Most typically a trim tab (Cessna) or an anti-servo tab (Piper). A trim tab is mounted on the elevator. Its position can be changed by moving a trim wheel in the cockpit. Trim tabs move opposite then the elevator direction for climb/descents to provide aerodynamics force to hold it in place for a given airspeed. An anti-servo tab moves with the stabilizer to provide aerodynamic feel. Without an anti-servo tab, because the stabilator is large, the pilot would cover control the airplane in pitch. The anti-servo tab can also be used for trim in the pitch axis.

How the Flight Controls Work
Ailerons
Ailerons control roll about the longitudinal axis. Discuss adverse yaw.

Elevator
The elevator controls pitch about the lateral axis.

Stabilator
A stabilator is essentially a one-piece horizontal stabilizer that pivots from a central hinge point.
Because a stabilator pivots around a central hinge point, they are extremely sensitive to control inputs and aerodynamic loads. Anti-servo tabs are incorporated on the trailing edge.
They deflect in the same direction as the stabilator. This results in an increase in the force required to move the stabilator, thus making it less prone to pilot-induced over- controlling.

Rudder
The rudder controls movement of the aircraft about its vertical axis. Explain that to be coordinated the airplane's longitudinal axis must always be aligned with the flight path of the airplane.

Secondary Flight Controls Systems
- **Flaps**
- **Leading Edge**
- **Devices Spoilers**
- **Trim Systems**

Flaps

Flaps are attached to the trailing edge of the wing to increase both lift and induce drag for any given AOA. There are four common types of flaps:

- Plain
- Split
- Slotted
- Fowler

Leading Edge devices

High-lift devices on the leading edge of the airfoil. The leading-edge devices are used to increase lift.

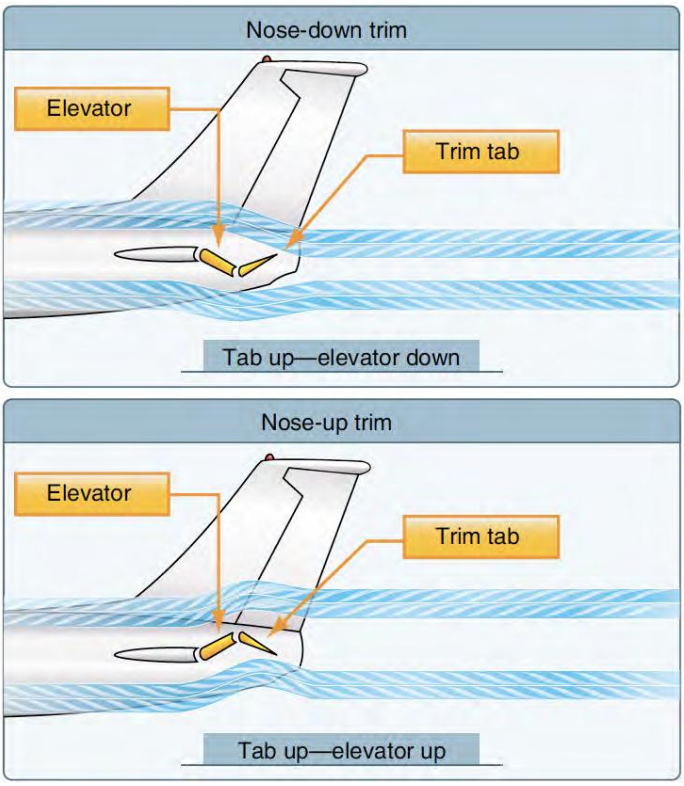
Spoilers

High-drag devices on the airfoil, which are deployed to spoil the smooth airflow, reducing lift and increasing drag.

Trim Systems

Trim systems are used to relieve the pilot of the need to maintain constant pressure on the flight controls. Common types of trim systems include trim tabs, balance tabs, antiservo tabs, ground adjustable tabs, and an adjustable stabilizer.

Trim Tabs

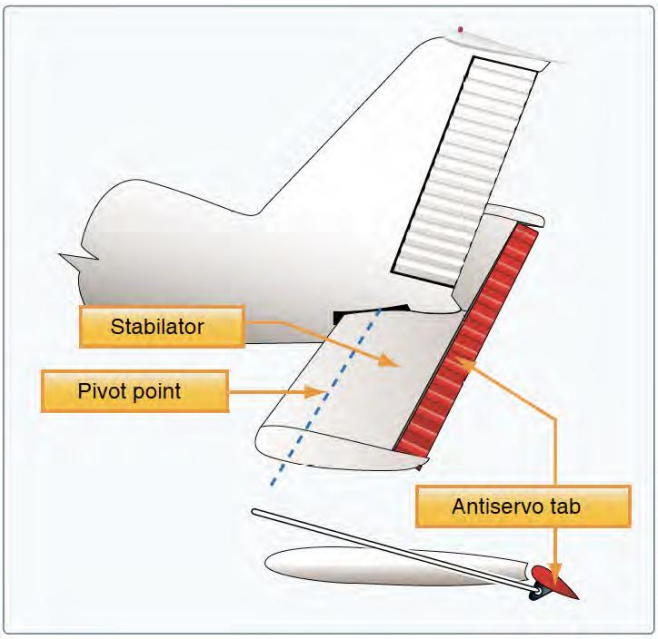


Pilots should normally establish the desired power, pitch attitude, and configuration first, and then trim the aircraft to relieve control pressures that may exist for that flight condition.

Balance Tabs

The control forces may be excessively high in some aircraft, and, in order to decrease them, the manufacturer may use balance tabs. They look like trim tabs and are hinged in approximately the same places as trim tabs.

Antiservo Tabs



Antiservo tabs work in the same manner as balance tabs except, instead of moving in the opposite direction. In addition to decreasing the sensitivity of the stabilator, an antiservo tab also functions as a trim device to relieve control pressure and maintain the stabilator in the desired position.

Ground Adjustable Tabs
Many small aircraft have a non-movable metal trim tab on the rudder. This tab is bent in one direction or the other while on the ground to apply a trim force to the rudder.

Adjustable Stabilizer
Rather than using a movable tab on the trailing edge of the elevator, some aircraft have an adjustable stabilizer.

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH3-6 PAVE & CH5-1 Mitigating Risk

COMMON ERRORS:

Skipping Critical Preflight Inspections

QUESTIONS FOR THE STUDENT:

What are the Primary Flight Controls?
[Ailerons]
[Elevator]
[Rudder]

What are some Secondary Flight Controls?
[Wing Flaps]
[Leading Edge Devices]
[Spoilers]
[Trim]

What are the different types of Ailerons?

What are the different types of Wing Flaps?
[Plain Flaps]
[Split Flaps]
[Slotted Flaps]
[Fowler Flaps]

What are the different types of Leading Edge Devices?
[Fixed]
[Movable]
[Leading Edge Flaps]

[Differential Ailerons]
[Frise-Type Ailerons]
[Coupled Ailerons and Rudder]
[Flaperons]

What are the different types of Elevators?
[Elevator]
[T-Tail Elevator]
[Stabilator]
[Canard]

What are the different types of Rudders?
[Rudder]
[V-Tail Design]

[Cuffs]

What are the different types of Trim Systems?
[Trim Tabs]
[Balance Tabs]
[Servo Tabs]
[Anti-Servo Tabs]
[Ground Adjustable Tabs]
[Adjustable Stabilizer]

What effect do Spoilers have on aircraft?
[Greatly increase drag and reduce lift.]

LESSON: WEATHER REPORTS AND SYSTEMS

OBJECTIVE:

To understand how to use weather reports and systems so that they can be applied to the requirements in the regulations and to understand where each chart fits into a complete weather briefing.

MOTIVATION:

In order to understand what needs to be taught and, to what level, you must have a good understanding of the relevant FAA publications, their content and update cycle

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate with models, and instructional aids, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate understanding to the instructor by describing the key points, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

This lesson is complete when the student demonstrates a basic understanding of weather and weather-related products during oral quizzing and the ability to obtain a weather briefing by phone and using Foreflight.

REFERENCES / EQUIPMENT NEEDED:

FAA-H-8083-28A Aviation Weather Handbook, AC00-6B (Aviation Weather for pilots), AC00-45H (Aviation Weather Services), FAA-H-8083-25B PHAK, FAA-S-ACS-6B- (Private pilot ACS), FAR/AIM, FAA: Pilot/Controller Glossary, NTSB reports

IMAGES / MEDIA / LINKS:

CFI Notebook | aviationweather.gov | youtube.com | aopa.org |

WEATHER REPORTS AND SYSTEMS TIME: [1] HOUR

1. METAR and TAF
2. Surface analysis chart
3. Graphical Forecast for Aviation (GFA)
4. Winds and temperature aloft chart
5. Significant weather prognostic charts
6. Convective outlook chart
7. AWOS, ASOS, and ATIS reports
8. Use of Foreflight to obtain and weather briefing
9. The telephone briefing system - Will change soon to be more automated (2019)

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-7

COMMON ERRORS:

Not having a complete weather picture, before take off.
Skipping the weather brief

QUESTIONS FOR THE STUDENT:

How can a pilot obtain pre-flight weather briefings?
[By calling - 1(800) WX-BRIEF]

What contents are included in a Standard Weather Briefing?
[Adverse Conditions]
[VFR Flight Recommendation]
[Synopsis]
[Current Conditions]
[En-Route Forecast]
[Destination Forecast]
[Forecast Winds and Temperatures Aloft]
[NOTAMs]

When should a pilot request a Standard Weather Briefing?
[Prior to any Cross Country Flight.]

What content is included in an Abbreviated Weather Briefing?
[Shortened version of the Standard Briefing.]

When should a pilot request an Abbreviated Weather Briefing?
[Anytime the original departure time has been delayed (after receiving a Standard Briefing).]

What content is included in an Outlook Weather Briefing?
[Forecasted weather conditions.]

When should a pilot request an Outlook Weather Briefing?
[When departure time is more than 6 hours in the future.]

What does HIWAS stand for?
[Hazardous In-Flight Weather Advisory Service]

What does METAR stand for?
[Aviation Routine Weather Report]

What information does a METAR provide to a pilot?
[Current surface weather observations.]

What does PIREP stand for?
[Pilot Reports]

What information do PIREPs provide to pilots?
[Current weather conditions experienced by other pilots in flight.]

What does TAF stand for?
[Terminal Aerodrome Forecast]

What information do TAFs provide to pilots?
[Forecasted weather for a 5 mile radius around an airport.]

What are the 3 different types of AIRMETS?
[Sierra - IFR conditions and mountain obscuration.]
[Tango - Turbulence.]
[Zulu - Icing.]

What are the 3 different types of AIRMETS?
[Sierra - IFR conditions and mountain obscuration.]
[Tango - Turbulence.]
[Zulu - Icing.]

Which type of aircraft are affected by AIRMETS?
[Smaller light aircraft.]

What is a SIGMET?
[Worse AIRMET conditions.]

Which type of aircraft are affected by SIGMETS?
[All aircraft.]

What is a Convective SIGMENT?
[A SIGMET associated with Thunderstorm activity.]

How often are Low Level Prognostic Charts issued?
[4 times daily at: 0000Z, 0600Z, 1200Z, 1800Z]

What information is provided by Radar Summary Charts?
[Areas of precipitation (not cloud coverage).]

What information is provided by Satellite Imagery Charts?
[Could coverage (not areas of precipitation).]

++
How much of the atmosphere is comprised of Nitrogren?
[78%]

How much of the atmosphere is comprised of Oxygen?
[21%]

In the Northern Hemisphere, Coriolis Force deflects airflow to the...
[Right]

In the Southern Hemisphere, Coriolis Force deflects airflow to the...
[Left]

What is Standard Atmospheric Pressure at Sea Level?
[29.92]

What is Standard Temperature at Sea Level?
[15 Degrees Celsius]

How does Atmospheric Pressure change with Altitude?
[Decreases 1" per 1,000']

How does Temperature change with Altitude?
[Decreases 2 Degrees Celsius per 1,000']

Horizontally moving air is called...
[Wind]

Vertically moving air is called...
[Convection]

How does airflow circulate in a High Pressure System?
[Clockwise, Downward, Outward]

How does airflow circulate in a Low Pressure System?
[Counterclockwise, Inward, Upward]

What is Windshear?
[A sudden or drastic change in wind direction or velocity (or both) over a short distance.]

What is the most dangerous type of Windshear?
[Low Level Windshear (LLWS)]

What is the typical lifespan of a Microburst?
[5-15 Minutes]

Downdrafts in a Microburst can be as strong as...
[6,000 Feet Per Minute]

Headwind Losses in a Microburst can be as strong as...
[30-90 Knots]

What can be expected in a Stable Atmosphere?
[Poor Visibility]
[Little or No Turbulence]
[Showery Precipitation]

What can be expected in an Unstable Atmosphere?
[Better Visibility]
[More Turbulence]
[Potential for Hazardous Storm Weather]

What is an Inversion?
[When temperature increases with altitude gain.]

What are the Different Types of Fog?
[Radiation Fog] [Advection Fog]
[Upslope Fog] [Steam Fog]
[Ice Fog]

How does Radiation Fog form?
[Clear nights with little to no wind present.]

How does Advection Fog form?
[Warm, moist air moves over a cold surface.]

How does Upslope Fog form?
[Moist air is forced up sloping terrain and cools.]

How does Steam Fog form?
[Cold, dry air moves over warmer water.]

How does Ice Fog form?
[Water vapor forms directly into ice crystals.]

What are the different Cloud Families?
[Strato Clouds]
[Alto Clouds]
[Cirrus Clouds]
[Could with Extensive Vertical Development]

At what altitudes do Strato Clouds form?
[Surface to 6,500' AGL.]

At what altitudes do Alto Clouds form?
[6,500' AGL to 20,000' AGL.]

At what altitudes do Cirrus Clouds form?

[20,000' AGL and above.]

What are the 4 different types of Frontal Systems?
[Warm Front]
[Cold Front]
[Stationary Front]
[Occluded Front]

What are the 3 stages of a Thunderstorm?
[Cumulus Stage - Updrafts. Storm is building.]
[Mature Stage - Up and Downdrafts. Precipitation begins to fall.]
[Dissipating Stage - Downdrafts. Storm is dying out.]

How far should pilots circumnavigate around Thunderstorms?
[At least 20 NM.]

What are the 3 different types of Icing?
[Clear Ice - Clear in color. Mostly develops from large water droplets.]
[Rime Ice - Milky in color. Mostly develops from smaller water droplets.]
[Mixed Ice - Mixture of Clear and Rime Ice.]

LESSON:	WEIGHT AND BALANCE

OBJECTIVE:

To understand the principles of weight and balance including terminology, and computational methods for a given airplane and understand and correct it if necessary for an overweight or out of balance condition.

MOTIVATION:

As long as the airplane is within its weight and center of gravity limitations you will be able to control the airplane through all ranges of speed and perform any operation listed in the Pilot Operating Handbook (POH). The pilot can also make changes to the configuration for the most advantageous situation.

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate with models, and instructional aids, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate understanding to the instructor by describing the key points, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

You will be expected to present a weight and balance for the check ride flight. And you will be required to show your work.

REFERENCES / EQUIPMENT NEEDED:

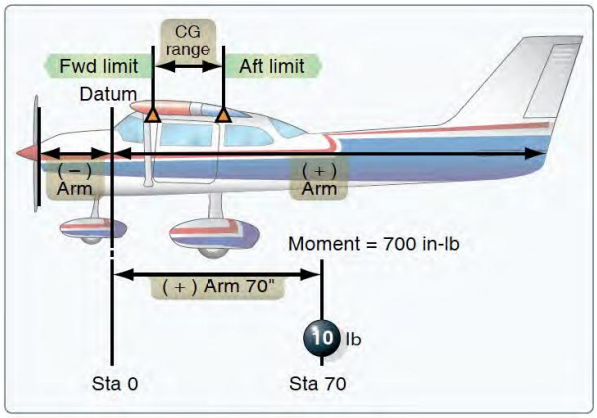
FAA-H-8083-1B (AWBH), FAA-H-8083-2A RMH, FAA-H-8083-3 AFH, FAA-H-8083-25B PHAK POH/AFM, NTSB reports

IMAGES / MEDIA / LINKS:

CFI Notebook

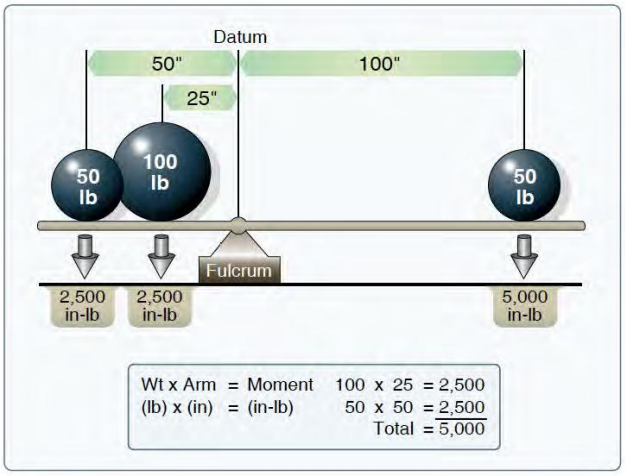
WEIGHT AND BALANCE	TIME:	[1] HOUR

1. Maximum Weight and Center of Gravity limitations (from a POH)
2. Location of the weight and balance for an aircraft (In the airplane)
3. Maintaining weight and balance records
4. Proper loading of the aircraft – Going outside will cause elevator control problems. Going overweight will decrease performance and compromise structure.



Definitions

- Arm (Moment arm)
- Basic empty weight
- Center of gravity
- Center-of-gravity limits
- Center-of-gravity range
- Datum (reference datum)
- Moment
- Moment index (or index)
- Standard weights
  Gasoline .....6 lb./US gal
- Station
- Useful load



Determining Weight and CG

- Computational Method
  The following is an example of the computational method involving the application of basic math functions.

- Aircraft Allowances:

Maximum gross weight	3,400 pounds
CG range	78–86 inches

- Given:

Weight of front seat occupants	340 pounds
Weight of rear seat occupants	350 pounds
Fuel	75 gallons
Weight of baggage in area 1	80 pounds

1. List the weight of the aircraft, occupants, fuel, and baggage. Remember that aviation gas (AVGAS) weighs 6 pounds per gallon and is used in this example
2. Enter the moment for each item listed. Remember "weight x arm = moment"
3. Find the total weight and total moment
4. To determine the CG, divide the total moment by the total weight.

Item	Weight	Arm	Moment
Aircraft Empty Weight	2,100	78.3	164,430
Front Seat Occupants	340	85.0	28,900
Rear Seat Occupants	350	121.0	42,350
Fuel	450	75.0	33,750
Baggage Area 1	80	150.0	12,000
Total	3,320		281,430
			281,430 ÷ 3,320 = 84.8

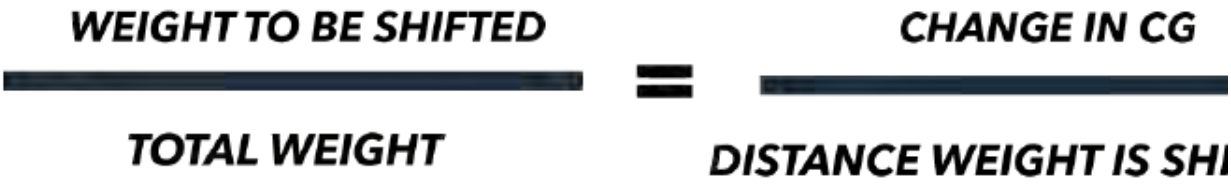
The total loaded weight of 3,320 pounds does not exceed the maximum gross weight of 3,400 pounds, and the CG of 84.8 is within the 78–86 inch range; therefore, the aircraft is loaded within limits.

Cessna 172 Example:
Use the Cessna 172S POH and calculate the weight and balance using the sample weight and balance table in that section. Demonstrate how to use the loading envelopes both for Center of Gravity and Moment/1000.

Effects of Weight Balance
- The aircraft will need a higher takeoff speed, which results in a longer takeoff run.
- Both the rate and angle of climb will be reduced.
- The service ceiling will be lowered.
- The cruising speed will be reduced.
- The cruising range will be shortened.
- Maneuverability will be decreased.
- A longer landing roll will be required because the landing speed will be higher.
- Excessive loads will be imposed on the structure, especially the landing gear.

Weight Shifting
Moving weight from one location to the other will cause a corresponding change in CG.

The below basic weight and balance equation can be used for solving these problems



The above equation can be rearranged to find the following:
- Distance a weight must be shifted to give a desired change in CG location
- Amount of weight to shift to move the CG to desired location
- Amount the CG is moved when a given amount of weight is shifted

Use the Cessna 172S sample weight and balance from the POH and determine how much weight would need to be shifted from the rear seats to baggage area 2 to change the Center of Gravity by 0.5 inches rearward.

Solution:
Weight to be shifted/2550 = 0.5/9 (Cg of pax 73 to cg of baggage area 1, 82)
Weight to be shifted= 0.5/9 * 2550
141.66 pounds

XXX

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE

COMMON ERRORS:

Incorrectly, or skipping the weight and balance for a flight

QUESTIONS FOR THE STUDENT:

What is the definition of ARM?
[The horizontal distance from the reference datum to the CG of an item.]

What is the definition of BALLAST?
[Weight carried in the aircraft to shift the CG within allowable limits.]

What is the definition of CENTER OF GRAVITY (CG)?
[The point at which the airplane would balance if suspended.]

What is the definition of CENTER OF LIFT?
[The point at which the lift is concentrated on the wing.]

What is the definition of CG LIMITS?
[The extreme locations the CG must land within.]

What is the definition of DATUM?
[An imaginary vertical plane from which all measurements of arms are taken.]

What is the definition of MOMENT?
[The product of the weight of an item multiplied by its arm.]

What is the definition of STATION?
[A location along the airplane fuselage usually given in terms of distance.]

What are the effects of the airplane being overweight?
[Longer Takeoff Run]
[Reduced Rate and Angle of Climb]
[Service Ceiling Lowered]
[Cruise Speed Reduced]
[Cruise Range Shortened]
[Maneuverability Decreased]
[Longer Landing Roll]
[Excessive Loads on Landing Gear]

What effects can a Forward CG have on an airplane?
[Longer Takeoff Roll]
[Longer Landing Roll]
[Higher Stall Speed]
[Easier Stall Recovery]
[Decreased Cruise Speed]

What effects can an Aft CG have on an airplane?
[Lower Stall Speed]
[Reduced Elevator Authority]
[Difficult Stall Recovery]
[Faster Cruise Speed]

What is the Weight and Balance Formula?
[Weight x Arm = Moment]

LESSON:	PERFORMANCE AND LIMITATIONS

OBJECTIVE:

To understand how density and temperature affect airplane performance by describing the uses of CAS, IAS, TAS, GS and be able to use real time weather to determine predicted airplane performance by using each chart in the performance section of the POH by interpolating data and applying any notes to the end calculations.

MOTIVATION:

Deciding what performance the airplane will have prior to a flight will help reduce or eliminate risks associated with terrain, usable runway, density and temperature on aircraft performance. Knowing the airplane is capable allows the pilot to make the right decisions.

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate with models, and instructional aids, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate understanding to the instructor by describing the key points, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

This lesson is complete when the student demonstrates their ability to understand the effects of density and temperature on performance and can use the performance charts in the POH including interpolation of data and application of any notes using real world weather. The student will also be able to explain when CAS, IAS, TAS and GS are used in performance calculations and secondary flight controls.

REFERENCES / EQUIPMENT NEEDED:

FAA-H-8083-25B PHAK, FAA-H-8083-3C AFH, FAA-H-8083-1B (AWBH), AIRCRAFT POH / Performance Charts, AC61-84B ROLE OF PREFLIGHT PREPARATION, FAA-S-ACS-6C PPL ACS AIRPLANE, FAA: Pilot/Controller Glossary
NTSB Reports & Personal stories

IMAGES / MEDIA / LINKS:

CFI Notebook | mycfibook.com |

PERFORMANCE AND LIMITATIONS	TIME:	[1:30] HOURS

1. Explain the purpose of each chart in the POH Performance section.

2. Explain how to calculate pressure altitude (PA) and how it affects performance.

3. Explain how to get the OAT and how temperature affects performance.

4. Explain how to interpolate

5. Using a METAR or other source calculate Crosswind //headwind component, short field takeoff distance over a 50-foot obstacle, time speed distance to climb from 2000ft PA to6000ft PA, calculate percentage power, TAS and Fuel flow for a flight at 6000ft and 20 deg over standard temperature using 2400RP, Calculate maximum range, maximum endurance and short field landing distance over a 50-foot obstacle. Emphasize the notes area in the chart i.e. time speed distance to climb add 1.4 gallons for taxi and run up.

6. Explain the difference between CAS, IAS, TAS and GS.

7. Show how to calculate density altitude.

8. Explain the effects of density and how to maximize performance at high density altitudes.

9. Show how to calculate TAS from CAS, PA and OAT. Show how to get TAS for flight planning from POH.

10. Discuss why the same indicated airspeed should be used regardless of the altitude or density of the airport for takeoff and landing

COMMON ERRORS:

Not verifying your numbers, before flight
Not understanding what effect, Density Altitude has on an airplane

QUESTIONS FOR THE STUDENT:

What are the different types of Altitude?
[Indicated Altitude]
[True Altitude]
[Absolute Altitude]
[Pressure Altitude]
[Density Altitude]

What is Indicated Altitude?
[The altitude read directly off the Altimeter in flight.]

What is True Altitude?
[The altitude above Mean Sea Level (MSL).]

What is Absolute Altitude?
[The altitude Above Ground Level (AGL).]

What is Pressure Altitude?
[The altitude above the Standard Datum Plane (29.92).]

What is Density Altitude?
[The altitude at which the aircraft will perform. Regardless of its actual altitude.]

What factors will increase Density Altitude?
[Hotter Temperatures]
[Increased Humidity]
[Lower Air Pressure]

What are the different types of Airspeed?
[Indicated Airspeed]
[Calibrated Airspeed]
[True Airspeed]
[Ground Speed]

What is Indicated Airspeed and what is it used for?
[The airspeed read directly off the Airspeed Indicator.
Used for: speed limits, ATC speed restrictions, and aircraft V-Speeds.]

What is Calibrated Airspeed and what is it used for?
[Indicated Airspeed corrected for Pitot-Tube installation. Used for: calculating True Airspeed.]

What is True Airspeed and what is it used for?
[The speed of the aircraft relative to the airmass in which it is flying. Used for: calculating Ground Speed.]

What is Ground Speed and what is it used for?
[The speed of the aircraft over the surface of the Earth.
Used for: time and distance calculations.]

What is the definition of Vso?
[Power off stalling speed in the landing configuration.]

What is the definition of Vs1?
[Power off stalling speed in a specified configuration.]

What is the definition of Vy?
[Best rate of climb speed. Maximum increase in altitude per unit of time.]

What is the definition of Vx?
[Best angle of climb speed. Maximum increase in altitude per horizontal distance unit.]

What is the definition of Vle?
[Maximum speed the aircraft can be operated with the landing gear extended.]

What is the definition of Vlo?
[Maximum speed at which the landing gear can be safely extended or retracted.]

What is the definition of Vfe?
[Maximum permissable speed with the wing flaps extended to a specified degree.]

What is the definition of Va?
[Design maneuvering speed.]

What is the definition of Vno?
[Maximum structural cruising speed.]

What is the definition of Vne?
[The speed that should never be exceeded in flight.]

LESSON: AIRSPACE

OBJECTIVE:

To understand how to operate in the National airspace system by using aeronautical charts and by applying knowledge of airspace to all types of airspace.

MOTIVATION:

By understanding the national airspace system, you will be able to identify the airspace you are in, the airspace ahead and what you need to do to operate in it.

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate with models, and instructional aids, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate understanding to the instructor by describing the key points, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

Area of Operation I. Preflight Preparation | Task E. National Airspace System
To determine the applicant exhibits satisfactory knowledge, risk management, and skills associated with National Airspace System (NAS) operations under VFR as a private pilot.

This lesson is complete when the student exhibits knowledge of the elements related to the National Airspace System by explaining:

1. Basic VFR weather minimums - for all classes of airspace
2. Airspace classes - their operating rules, pilot certification, and airplane equipment requirements for the following -
   - Class A
   - Class B
   - Class C
   - Class D
   - Class E
   - Class G
3. Special use and other airspace areas.

Area of Operation VI. Navigation | Task B. Navigation Systems and Radar Services
To determine the applicant exhibits satisfactory knowledge, risk management, and skills associated with navigation systems and radar services.

REFERENCES / EQUIPMENT NEEDED:

FAA: Pilot/Controller Glossary, FAA-H-8083-15 IFH, FAA-H-8083-25B PHAK, AOPA

IMAGES / MEDIA / LINKS:

CFI Notebook LINK | faa.gov/air_traffic/nas | https://skyvector.com |

AIRSPACE (National Airspace System) TIME: [2] HOURS

Breakdown of Lessons is in Schedule section below

1. Classifications
2. Uncontrolled (Class G)
3. Controlled
4. Class E
5. Class D
6. Class C
7. Class B
8. Class A
9. Special VFR
10. Special Use (Military)
11. Other airspace (firefighting areas)
12. Emergency Air Traffic Rules
13. ADIZ
14. Usage Requirements
15. Cloud Clearances

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-8

COMMON ERRORS:

Class G / E Airspace, Special VFR, and DC Airspace Rules

AIRSPACE LESSON 1

AIRSPACE (National Airspace System)

United States airspace is organized into six classes (A, B, C, D, E and G), designated either controlled or uncontrolled.

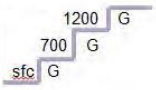
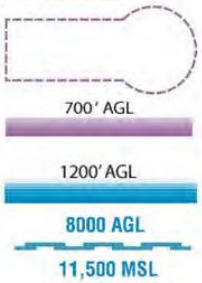
Uncontrolled Airspace (Class G)

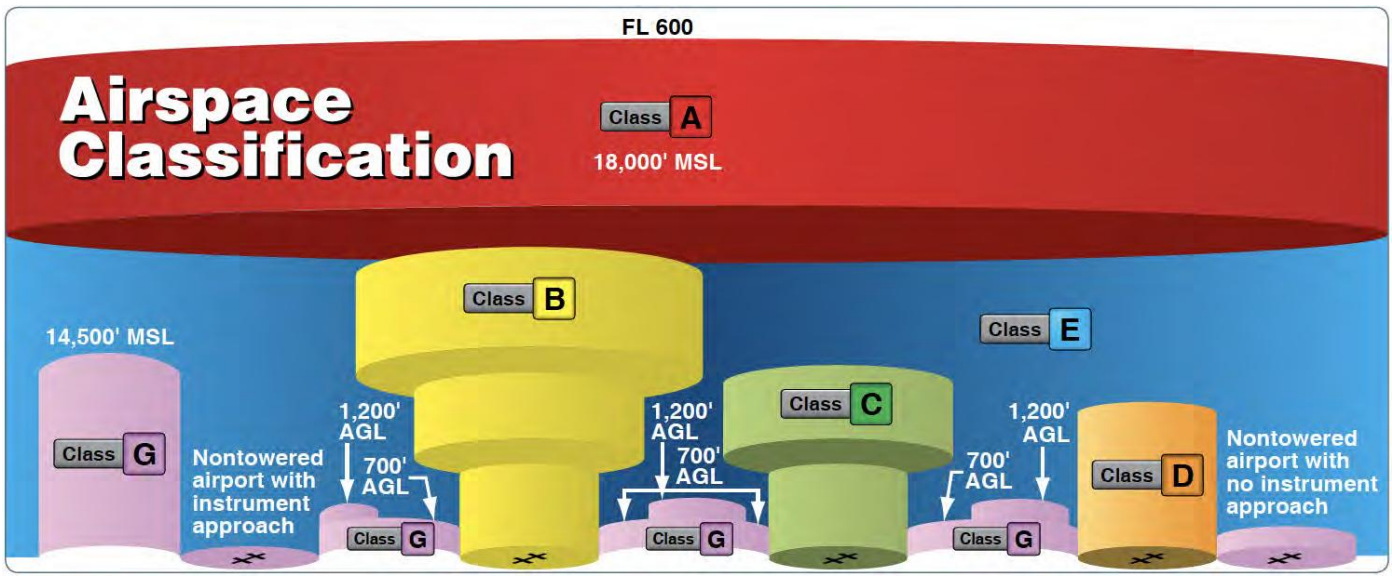
- ATC Services are not provided

Controlled Airspace (Class A, B, C, D and E)

Class A is most restrictive & class E the least restrictive

- ATC services provided to IFR aircraft & VFR aircraft
- Separation of aircraft provided with ATC services
- VFR aircraft may not be required to use ATC services
- Traffic Advisories
- Safety Alerts

Class A	Controlled	Altitude	Starts at 18,000'	IFR only
Class B	Controlled	Big	 sfc at primary airport	Looks like an upside down wedding cake.
Class C	Controlled	Crowded	 sfc at primary airport	Similar to B, but less tiers.
Class D	Controlled	Dialogue		Defined by boundaries.
Class E	Controlled	Elsewhere		Can start at surface or 700, 1200 feet or at specified altitudes. 
Class G	Uncontrolled	Government Free		Every else that is not controlled airspace.



- After completing a review of the above information then use a VFR Sectional Chart to point out the different airspace. Then have the student identify different airspace.

AIRSPACE LESSON 2

Airspace Classes	Communications	Entry Requirements	Separation	Special VFR in Surface Area
A	Required	ATC Clearance	All	N/A
B	Required	ATC Clearance	All	Yes
C	Required	Two-way communications prior to entry	VFR/IFR	Yes
D	Required	Two-way communication prior to entry	Runway operations	Yes
E	Not required for VFR	None for VFR	None for VFR	Yes
G	Not required	None	None	N/A

An Easy-to-Read Chart for VFR Flight						
Airspace Features	Class A	Class B	Class C	Class D	Class E	Class G
Entry Requirements	ATC Clearance	ATC Clearance	Prior two-way communications	Prior two-way communications	None	None
Minimim Pilot Qualification	Instrument rating	Private or student certificate location	Student certificate	Student certificate	Student certificate	Student certificate
Two-Way Radio Communications	Yes	Yes	Yes	Yes	Not required	Not required
Special VFR Allowed	No	Yes	Yes	Yes	Yes	N/A
VFR Visibility Minimum	N/A	3 Statute Miles**	3 Statute Miles**	3 Statute Miles**	3 Statute Miles**	1 Statue Mile**
VFR Minimum Distance from clouds	N/A	Clear of clouds	500 feet below 1,000 feet above 2,000 feet horizontally **	500 feet below 1,000 feet above 2,000 feet horizontally **	500 feet below 1,000 feet above 2,000 feet horizontally **	Clear of clouds**
VFR Aircraft separation	N?A	All	IFR	Runway Operations	None	None
Traffic Advisories	Yes	Yes	Yes	Workload Permitting	Workload Permitting	Workload Permitting
Former Airspace Equivalent	Positive control area (PCA)	Terminal control area (TCA)	Airport radar service area (ARSA)	Airport traffic area and control zone	General controlled airspace	Uncontrolled airspace

AIRSPACE LESSON 2

Class A

- VFR Private Pilot Cannot enter: requires IFR rating.
- High altitude traffic and jet routes
- Including the airspace overlying the waters within 12 nautical miles of the coast from 18,000 feet to FL600 over the 48 states & Alaska.
- Not charted

Class B

- Surrounding the nation's busiest airports in terms of IFR operations or passenger enplanements
- Required 2-way radio communication.
- Requires a clearance to enter.
- Requires a Mode C Transponder.
- Typical dimensions
    - Surface to 10,000 feet MSL
        - Exceptions are numerous (7,000' – 12,500')
    - Lateral dimensions are adjusted to the specific airport(s)
        - Contain all instrument approaches
- 30-mile radius Mode C Transponder Vail.

Class C

- Airport with operating control tower, approach radar and certain number of operations or passenger enplanements.
- Student / Private Pilot
- Required: establish and maintain 2-way radio communication.
- Requires Mode C Transponder.
- Typically, surface to 4,000 feet AGL
- Typical lateral dimensions
    - Inner circle – 5 nautical mile radius
    - Outer circle – 10 nautical mile radius
        - Altitude is generally 1,200 feet AGL to 4,000 feet AGL
    - Outer Area – 20 nautical mile radius
        - Not shown on chart

Class D

- Airports that have an operational control tower
- Required: establish and maintain 2-way radio communication.
- Transponder required only: If under Mode C vail.
- Typically, surface up to and including 2,500 feet AGL
- Later dimensions
    - Vary at each Class D
    - 4 to 8 nautical mile radius (mostly) plus extensions
    - Extensions
        - Class D
        - Class E

AIRSPACE LESSON 2

Class E

- Other controlled airspace including that airspace overlying the waters within 12 nautical miles of the coast of the 48 contiguous states and Alaska
- No requirements (accept above 10,000' MSL or within 2,000' AGL)
- Has the ability to receive ATC services.
- Lateral dimensions vary tremendously
- Vertical dimensions – for start
    - Surface
    - 700 feet AGL
    - 1,200 feet AGL
    - 14,500 feet MSL unless below 1,500 feet AGL
    - Above FL600
- Types
    - Surface based (NAV, ATC, & WX)
    - Extensions (instrument approaches)
    - Imposes higher weather minimums than uncontrolled
    - Transition (700 feet & 1,200 feet)
    - En-route domestic areas
    - Federal airways
    - Offshore

Class G

- Dimensions vary
    - From the surface to overlying controlled airspace if controlled airspace does not start at the surface
- No requirements.
- No ATC services available.

NOTE: After reviewing the above information, then use a VFR Sectional chart to look at all airspace and quiz student on the differences.

Cloud Clearance & Visibility Requirements		
Class A	Not Applicable	Not Applicable
Class B	3 Statute Miles	Clear of Clouds
Class C	3 statute miles	500 feet below 1,000 feet above 2,000 feet horizontal
Class D	3 statute miles	500 feet below 1,000 feet above 2,000 feet horizontal
Class E Less than 10,000 feet MSL	3 statute miles	500 feet below 1,000 feet above 2,000 feet horizontal
At or above 10,000 feet MSL	5 statute miles	1,000 feet below 1,000 feet above 1 statute mile horizontal
Class G 1,200 feet or less above the surface (regardless of MSL altitude)		
Day, except as provided in section 91.155(b)	1 statute mile	Clear of Clouds
Night, except as provided in section 91.155(b)	3 statute miles	500 feet below 1,000 feet above 2,000 feet horizontal
More than 1,200 feet above the surface but less than 10,000 feet MSL		
Day	1 statute mile	500 feet below 1,000 feet above 2,000 feet horizontal
Night	3 statute miles	500 feet below 1,000 feet above 2,000 feet horizontal
More than 1,200 feet above the surface and at or above 10,000 feet MSL	5 statute miles	1,000 feet below 1,000 feet above 1 statute mile horizontal

5 Cases – Cloud Clearance

A No Cloud Clearance Requirement: IFR only

B 3sm Clear of Clouds

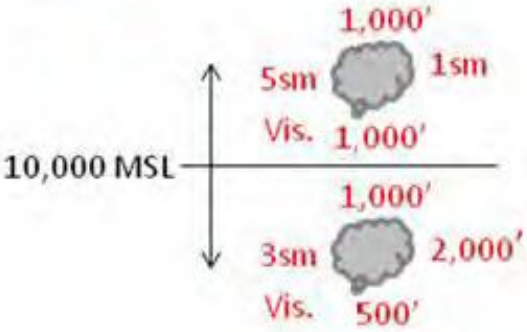
C



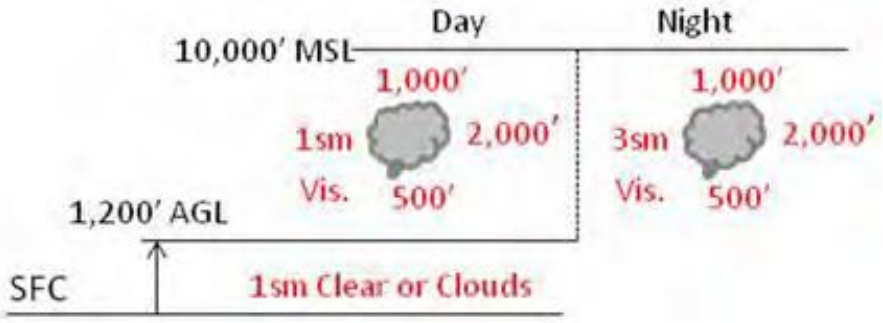
D



E

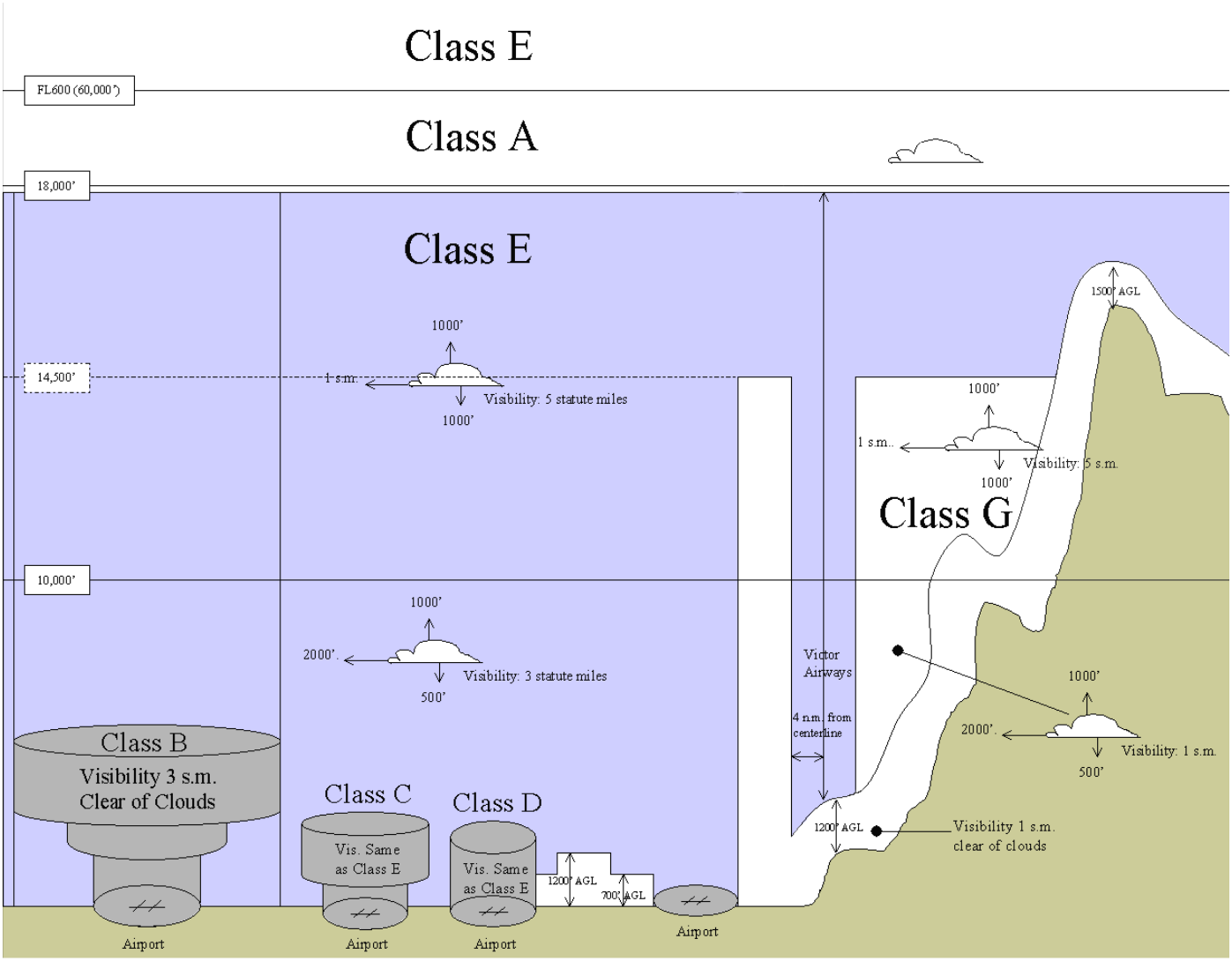


G



VFR Chart Test:
1). Test B, C and D areas first.
2). Test E & G if B, C and D are going good.

AIRSPACE LESSON 3



AIRSPACE LESSON 4

SPECIAL USE AIRSPACE (SUA) & Other Airspace

Prohibited Areas

- Entry not Allowed
    - Areas like around the White House

Restricted Areas

- Not allowed unless permission is received from the controlling agency
    - This is usually not ATC
- Contains things like live firing!
- Can fly in it when it is not active

Warning Area

- Contains the Same hazards as Restricted, but is in international territory
    - Greater than 3 nautical miles offshore
    - Can fly in it, but are forewarned

Military Operations Area (MOA)

- Area of military activity that does not contain live firing
    - Can enter under VFR
- Clearance is NOT needed
    - See and avoid
    - Military pilots may be doing aerobatics!!!

Alert Areas

- Area of unusually activities & flight training
- Keep your eyes open

Controlled Firing Area

- Areas of operations which would be hazardous to nonparticipating aircraft if not controlled
    - Not Charted
    - Spotters stop the firing any time an aircraft is near

AIRSPACE LESSON 4

OTHER AIRSPACE AREAS

National Security Area

- Areas where aircraft are asked to avoid due to the sensitivity of national security
    - May be expected to avoid entirely or at certain altitudes

Airport Advisory Area

- Local Airport Advisory program
- If an FSS is located on the airport (w/o a tower), the FSS will advise inbound and outbound traffic within 10 statute miles
- Not Charted

Military Training Routes (MTR)

Special low-level training routs for the military

- In excess of 250 knots
- Visual vs. instrument
    - IFR Military Training Routes (IR) – Operations on the routes are conducted in accordance with IFR regardless of weather conditions
    - VFR Military Training Routes (VR) – Operations on these routes are conducted in accordance with VFR except flight visibility shall be 5 miles or more; and flight shall not be conducted below a ceiling of less than 3,000 feet AGL

Number system

- MTRs with no segment about 1,500 feet AGL shall be identified by four number characters; e.g., IR1206, VR1207
- MTRs that include one or more segments above 1,500 feet AGL shall be identified by three number characters; e.g., IR206, VR207
- Alternate IR / VR routes or route segments are identified by using the basic /principal route designation followed by a letter suffix, e.g., IR008A, VR10007B, etc.

Temporary Flight Restrictions (TFR)

- Generally, a NOTAM restriction
    - Prohibited
    - Restricted
    - National security

Parachute, Glider, Ultra-light

- Description and symbology on Sectional

Terminal Radar Service Area (TRSA)

- Similar to Class C but non-regulatory
- Class D airspace surrounded by an area where ATC services can be and would prefer that it was provided to all aircraft

QUESTIONS FOR THE STUDENT:

Quiz: 5 Questions To See How Much You Know About Airspace

What are the dimensions of Class A Airspace?
[From 18,000' MSL up to and including FL600.]

What are the entry requirements for Class A Airspace?
[All operations conducted under Instrument Flight Rules (IFR).]

What are the VFR Weather Minimums for Class A Airspace?
[N/A (all operations IFR).]

What are the dimensions of Class B Airspace?
[Customizable - surrounding large international airports. Shaped like an upside down wedding cake.]

What are the entry requirements for Class B Airspace?
[ATC Clearance. Minimum Private Pilot License or proper Student Pilot Endorsement. Mode C Transponder and ADS-B Out.]

What are the VFR Weather Minimums for Class B Airspace?
[Visibility = 3 SM]
[Cloud Clearance = Clear of Clouds]

What are the dimensions of Class C Airspace?
[Customizable - typically with 2 shelves. The upper shelf reaches from the surface to 4,000' AGL with a 10 NM radius. The lower shelf reaches from the surface to 1,200' AGL with a radius of 5 NM.]

What are the entry requirements for Class C Airspace?
[Establish 2 way radio communications.]
[Mode C Transponder and ADS-B Out.]

What are the VFR Weather Minimums for Class C Airspace?
[Visibility = 3 SM]
[Cloud Clearance = 1,000' above, 500' below, 2,000' horizontal.]

What are the dimensions of Class D Airspace?
[Customizable - typically reaches from the surface to 2,500' AGL with a 4 NM radius.]

What are the entry requirements for Class D Airspace?
[Establish 2 way radio communications.]

What are the VFR Weather Minimums for Class D Airspace?
[Visibility = 3 SM // Cloud Clearance = 1,000' above, 500' below, 2,000' horizontal.]

What are the dimensions of Class E Airspace?
[Can start at one of three different floors and reaches up to the overlying airspace.]
[Surface and up.]
[700' AGL and up.]
[1,200' AGL and up.]

What are the entry requirements for Class E Airspace?
[None for VFR Flight Operations.]

What are the VFR Weather Minimums for Class E Airspace?
[Below 10,000' MSL: // Visibility = 3 SM // Cloud Clearance = 1,000' above, 500' below, 2,000' horizontal.]
[Above 10,000' MSL: Visibility = 5 SM // Cloud Clearance = 1,000' above, 1,000' below, 1 SM horizontal.]

What are the dimensions of Class G Airspace?
[Any airspace that isn't classified as A, B, C, D, or E. Typically below E beginning at the surface.]

What are the entry requirements for Class G Airspace?
[None.]

What are the VFR Weather Minimums for Class G Airspace?
[Above 10,000' MSL Day or Night: Visibility = 5 SM // Cloud Clearance = 1,000' above, 1,000' below, 1 SM horizontal.]
[1,200' AGL to 10,000' MSL during the DAY: Visibility = 1 SM // Cloud Clearance = 1,000' above, 500' below, 2,000' horizontal.]
[1,200' AGL to 10,000' MSL at NIGHT: Visibility = 3 SM // Cloud Clearance = 1,000' above, 500' below, 2,000' horizontal.]
[Below 1,200' AGL during the DAY: Visibility = 1 SM // Cloud Clearance = Clear of clouds.]
[Below 1,200' AGL at NIGHT: Visibility = 3 SM // Cloud Clearance = 1,000' above, 500' below, 2,000' horizontal.]
Can ATC assign Special VFR to a pilot in flight?
[No. Must be pilot requested.]

What weather criteria must be met in order to obtain Special VFR during the day?
[Visibility = 1 SM // Cloud Clearance = Clear of clouds.]

To perform Special VFR at night...
[The pilot and aircraft must be Instrument Rated.]

What is the aircraft speed limit below 10,000' MSL?
[250 KIAS.]

What is the aircraft speed limit below 2,500' AGL and within 4 NM of a Class C or Class D Airport?
[200 KIAS.]

What is the aircraft speed limit when flying below Class B Airspace or through a Class B Corridor?
[200 KIAS.]

May pilots fly through Prohibited Airspace?
[NO]

May pilots fly through Restricted Airspace?
[Yes, with Proper clearance.]

May pilots fly through a Military Operating Area (MOA)?
[Yes. No clearance is needed.]

LESSON:	NAVIGATION SYSTEMS & RADAR SERVICES

OBJECTIVE:

To understand how the current navigation systems installed in airplanes work and can be used and the radar services available to pilots.

MOTIVATION:

In order to understand what needs to be taught and, to what level, you must have a good understanding of the relevant FAA publications, their content and update cycle.

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate with models, and instructional aids, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate understanding to the instructor by describing the key points, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

The student will be able to answer the FAA test questions regarding navigation systems. They will also be able to use an iPad app or equivalent to describe how to use VOR, DME and GPS navigation from a scenario given by the instructor. The student will also be able to explain the limitations of primary and secondary radar, what flight following is and how to get this service.

REFERENCES / EQUIPMENT NEEDED:

AC91-78A-Use of EFB's, FAA-H-8083-2A RMH, FAA-H-8083-3 AFH, FAA-H-8083-25B PHAK, FAA: Pilot/Controller Glossary, FAR/AIM

IMAGES / MEDIA / LINKS:

CFI Notebook | https://luizmonteiro.com |

NAVIGATION SYSTEMS & RADAR SERVICES	TIME:	[2] HOURS

1. Radio signals and limitations
2. Radio facilities and aeronautical charts
3. Communication radio tuning and testing
4. Navigational radio tuning and testing.
5. Avionics monitoring essential for safety.
6. How a VOR works on the ground and in the air.
7. VOR warning alarm flag.
8. VOR receiver accuracy check
9. VOR sensitivity, deflection 10 of center
10. VOR's CDI interpretation.
11. VOR TO-FROM indications
12. VOR determining position fixes.
13. DME accuracy 3% or .5 miles.
14. Transponder check and codes.
15. GPS navigation systems.
16. Database integrity and how to check expiration dates
17. Limitations on GPS – Lack of standards i.e. what range to set in the GPS on take-off, cruise and approach.
18. Manufacturer's operating instructions.
19. Radar services available to pilots – Primary radar, Secondary Surveillance Radar (discrete code) TIS, ADS-B for Foreflight and other displays.
20. What flight following is and how to get it.

COMMON ERRORS:

- Station turning and identification faulty.
- Misinterpretation of navigational signals.
- Plotting and determination of fixes faulty
- Radial versus bearings confusion.

- Using the direct to function of the GPS without regard to airspace, terrain etc.
- Airport destination facilities not checked.
- NOTAM's not checked, stations Out of Service.

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 6-4, & 7

VOR NAVIGATION

BASIC VOR NAVIGATION

- Pick a VOR for use in navigation
- Tune and identify the VOR

Tune and Identify

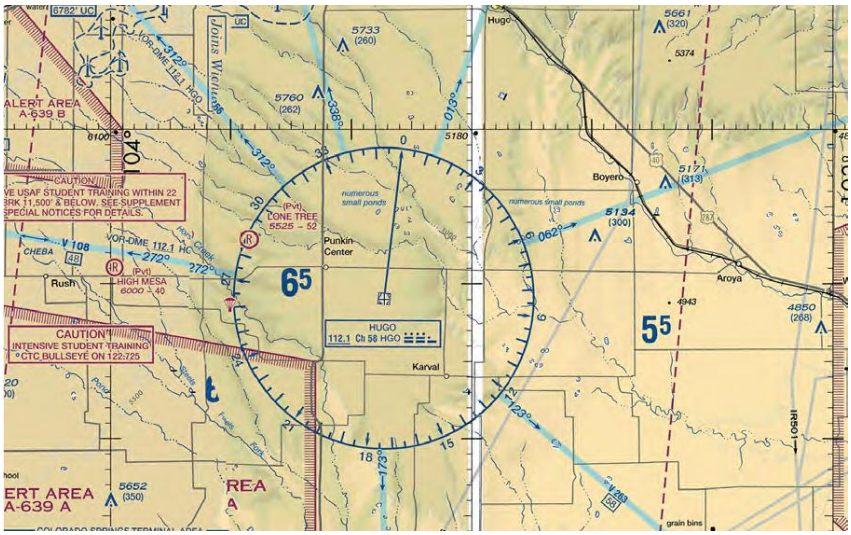
Tune the VOR frequency in the navigation radio. It will be listed on VFR and IFR charts as well as instrument approaches if it is a part of the approach. Identify that you have the correct station and the sign is reliable by listening to the Morse code identifier.



Get Your Bearing

Determine which radial you are on by turning the OBS (Omni Bearing Selector) knob until the CDI (Course Deviation Indicator) needle is centered and you have a FROM indication.

Looking at the picture to the right, you can see that the needle is centered and it gives a FROM indication (small white triangle pointing to "FR"), so the aircraft is on the 210 degree radial. It doesn't matter what the heading of the aircraft is, it is located somewhere along a line 210° from the VOR station. In order to fly to the station, you would first twist the OBS knob until the needle is centered and the white triangle points to "TO." Note that this will be 030 degrees, exactly 180° from the current radial. Now turn the aircraft to this new heading and keep the needle centered- this will take you to the VOR station.



Fly the heading of the desired course

You can find the heading of an airway on either a VFR or IFR chart. Set the course into the OBS and turn the aircraft to fly that heading. Once established on the heading, note the position of the CDI. If it is to the right, your course is to the right. Likewise, if it is left, the course is left.

Intercept the course

Turn 30 degrees in the direction of the CDI to intercept the course. Although 30° is most common and easy to use, you can use any intercept angle. For instance, if you are far enough from the desired course, it may take more than 30° to intercept the course before reaching your destination.

Track the course

As the CDI moves close to the center, turn your heading to match the course. Keep the needle centered to stay on course. If it starts drifting left, turn left to get back on course. Tracking inbound (towards the station) and outbound (away from the station) radials is exactly the same, except you should get a TO indication when flying inbound and a FROM indication when flying outbound on a radial.



Adjust for wind
If you find yourself blown off course by the wind, intercept the course and use a wind correction angle (WCA) of about ten degrees into the wind. If that is not enough, increase the WCA. If it is too much, decrease the WCA until the CDI centered. Identifying an Intersection, sometimes you may need to identify an intersection of two VOR radials. This may be a point where the airway changes heading, to intercept another airway, a change in minimum altitude for IFR flights, holding point, or a reporting point for ATC. The intersection can be determined by using two VOR radials or sometimes one VOR radial and Distance Measuring Equipment (DME).

Tune and identify both VORs just as before
Two VOR receivers are best, but you can still identify an intersection with one VOR by switching the frequency and comparing the radials of both VORs.

Set the OBS
Use the OBS to set the correct radials from each VOR. The radials will be displayed on VFR and IFR charts. On VFR charts, the arrows identifying the intersection point to the VOR, while the arrows on an IFR chart point from the VOR toward the intersection.

Wait for both CDI needles to center
While tracking the course on one VOR, watch the other VOR to see when the CDI centers. When both needles are centered, you are on the intersection. Use DME to eliminate the need for a second VOR. While tracking the VOR radial, use the DME to find your distance from the station. DME distances will be displayed on IFR charts when it can be used to identify an intersection. For example, WARIC intersection is defined by the 238 radial from the VOR and the 21 nm DME fix. Occasionally a localizer may be used in place of the second VOR. The procedure is exactly the same, but note that the localizer will be twice as sensitive as a VOR.

VOR TRIANGULATION

- Identify 2 VOR in the area
  - Tune VOR 1 / Spin to FROM / Center Needle / Identify Radial
  - Identify radials on map

  - Tune VOR 2 / Spin to FROM / Center Needle / Identify Radial
  - Identify radials on map

- Identify where radials intersect on the map
- Determine direction by Compass
- Fly direction you want to go

Intercepting a Course

Pilotage - Navigation by visual reference to landmarks.

> **Note** - When flying by pilotage, match as much as possible of what you see on the ground to
> the features on your chart to avoid getting lost.
> - Sectional (6 months)
> - TAC (6 months)
> - Chart Supplements (56 days)

Dead Reckoning - Based on time, speed, and distance calculations.
- Plot course using navigation plotter (true course)
- Measure distance between two points
- Collect weather data (winds, temp, etc…)
- Calculate TAS and fuel consumption from POH
- Use winds aloft and E6B to calculate wind correction angle and ground speed
- Convert True heading to Mag heading according to Variation.

Radio Navigation - Navigation by reference to VOR, ADF, and GPS.
VOR - Very high frequency Omnidirectional Range
- Provides course guidance TO and From the station
- VOR/DME and VORTAC signal provides slant range distance info
- 108.0 MHz to 117.95 MHz
- Limited to line of sight
- Terminal - 12,000' and below = 25 mile radius
- Low - 18,000' and below = 40 mile radius
- High –

  below 14,500' = 40 mile radius
  14,500' to 18,000' = 100 mile radius
  18,000' to FL 450 = 130 mile radius
  FL 450 to 60,000' = 100 mile radius

GPS - Global Positioning System
- Space-based radio navigation using satellites providing global coverage.
- 26 satellites orbiting approximately 10,900 NM above the earth.
- Extremely accurate - Used in the IFR environment for approaches.
- Transmitted through UHF frequency range
- Virtually unaffected by weather however subject to line-of-sight limitations

References
Aeronautical Information Manual (AIM) - Chapter 1
Pilot's Handbook of Aeronautical Knowledge, pp 14-18 through 14-26

Notes

Situational awareness is key:

Variation is the difference between True and Mag. North EAST IS LEAST WEST IS BEST

Deviation magnetic fields in the aircraft that disturb the compass

True Course (**TC**) = Pilot from sectional
True Heading (**TH**) = Apply wind correction
Mag Course (**MC**) = Add/Sub variation
Mag Heading (**MH**) = Apply deviation

VOR transmit radials FROM the station (360degrees) through the use of 2 signals
Reference - Signal sends out a constant pulse around the VOR
Phase - Signal electronically rotated at 1800 RMP

The VOR receiver in the plane measures the phase difference between the two signals and calculates the directional from the station.

Elements
1. Advances in radio navigation allow pilots to determine their exact position and to navigate almost anywhere with precision.

2. Beginning pilots should use this equipment to supplement navigation by visual reference to the ground – the use of pilotage will safeguard against disorientation in the event of a navigation radio malfunction.

3. There are four radio navigation systems available for VFR navigation:
   a. VHF Omnidirectional Range (VOR).
   b. Nondirectional Radio Beacon (NDB).
   c. Long Range Navigation (LORAN-C).
   d. Global Positioning System (GPS).

4. Very High Frequency (VHF) Omnidirectional Range (VOR) Station and VOR Receiver:
   a. Three types:
      I. VOR.
      II. VOR/DME (VOR with distance measuring equipment, or DME)
      III. VORTAC (VOR with military tactical air navigation, or TACAN).

   b. Provides magnetic bearing (in degrees) to and from the VOR station.

   c. VOR/DME and VORTAC stations provide distance from the station.

d. Line courses based on magnetic north, or radials, are projected from the station.

e. A compass rose is superimposed on aeronautical charts at the station location.

f. VOR stations use the very high frequency (VHF) band of 108.0 - 117.95 MHz.

g. Reception of signal is subject to line-of-sight restrictions.

h. Three classes based on power: **T** (terminal), **L** (low altitude), and **H** (high altitude).

i. Normal usable altitudes and radius distances:
   I. **T**: (12,000' and below) 25 nm.
   II. **L**: (below 18,000') 40 nm
   III. **H**: (below 14,500') 40nm, (14,500–17,999) 100nm, (18,000-FL450) 130, (FL450-FL600) 100.

j. The accuracy is generally +/- 1°.

k. The station is identified via transmitted Morse code or recorded voice identification.

l. If the station is out of service for maintenance, the coded identifier is removed.

m. The VOR receiver includes an alarm flag to indicate weak or no signal reception.

n. The VOR receiver also includes:
   I. A rotating omnibearing selector (OBS) knob.
   II. A course deviation indicator (CDI) needle (left-right needle).
   III. TO - FROM indicator flags.

o. The OBS is rotated to select a radial ("FROM" the station) or course ("TO" the station).

p. Moving the OBS rotates the face of the instrument and moves the CDI needle to indicate the position of the course or radial relative to the airplane.

q. If centered, the CDI will move off-center if the airplane drifts off the course or radial.

r. If flying to the station with a "TO" indication or from the station with a "FROM" indication, a corrective turn toward the CDI will get back on the course or radial.

s. Station passage is indicated by the “TO” flag changing to a “FROM” flag.

t. If flying to the station with a “FROM” indication or from the station with a “TO” indication, the instrument will exhibit reverse-sensing:
   I. Flying away from the deflected needle will turn toward the course or radial.
   II. Flying toward the deflected needle will turn away from the course or radial.
   III. To remedy reverse-sensing, turn the OBS 180°.

u. Distance measuring equipment (DME) uses the ultra high frequency (UHF) band.

v. DME measures the nautical mile slant range distance from the station to the airplane.

w. The DME signal is also identified via transmitted Morse code identification.

x. Most DME receivers also provide groundspeed and time-to-station features.

QUESTIONS FOR THE STUDENT:

What does VOR Stand for?
[Very High Frequency Omnidirectional Range]

What Altitude does a High Altitude VOR Reach?
[FL600]

To what altitude does a Low Altitude VOR reach?
[FL180]

To what Altitude does a Terminal VOR reach?
[12,000AGL]

What is the radius of a Terminal VOR?
[25NM]

What does OBS stand for?
[Omnibearing Selector]

What does CDI stand for?
[Course Deviation Indicator]

What is the Cone of Confusion?
[Area near the VOR where the signal may become unreliable]

What item must a pilot note when making a VOR check?
[SLED: Signature / Location / Error Amount / Date]

What are the different types of VOR checks?
VOT (VOR Test Facility)
Ground Check
Airbourne Check
Dual VOR Check

What tolerances are given when performing a VOT check?
[+/- 4Degrees]

What tolerances are given when performing a Ground Check?
[+/- 4Degrees]

What tolerances are given when performing an Airborne Check?
[+/- 6Degrees]

What tolerances are given when performing a Dual VOR Check?
[4 Degree difference between the two VORs.]

What does DME Stand for?
[Distance Measuring Equipment]

When is Slant Range Distance least accurate?
[When close to the station at higher altitudes.]

When is Slant Range Distance most accurate?
[At further distances from the station and lower altitudes.]

Traditional DME is given in...
[Slant Range Distance]

GPS distance is given in...
[Straight Line Distance]

How many satellites make up the Global Positioning System (GPS)?
[24]

How many Orbital Planes do these satellites operate on?
[6]

What 3 pieces of information is relayed to our aircraft by the GPS Satellites?
[ID (Name/Number) // Position (LAT/LONG) // Time Code]

How many satellites are needed to calculate a 2D position?
[3]

How many satellites are needed to calculate a 3D position?
[4]

How many satellites are required for RAIM?
[5]

What does RAIM stand for?
[Receiver Autonomous Integrity Monitoring]

How many satellites are required for FDE?
[6]

What does FDE stand for?
[Fault Detection and Exclusion]

What are the 3 GPS Sensitivity Modes?
[En-Route Sensitivity]
[Terminal Sensitivity]

[Approach Sensitivity]

When does a GPS default to En-Route Sensitivity?
[When more than 30 NM from the Departure and Destination Airports.
Anytime a full flight plan has not been loaded into the GPS.]

When does a GPS switch to Terminal Sensitivity?
[When within 30 NM of either the Departure or Destination Airports.]

When will a GPS switch to Approach Sensitivity?
[When within 2 NM of the FAF (Final Approach FIx).]

What CDI Sensitivity is experienced when a GPS is in En-Route Mode?
[2NM]

What CDI Sensitivity is experienced when a GPS is in Terminal Mode?
[1NM]

What CDI Sensitivity is experienced when a GPS is in Approach Mode?
[0.3NM]

What does WAAS stand for?
[Wide Area Augmentation System]

What does LAAS stand for?
[Local Area Augmentation System]

What does GBAS stand for?
[Ground Based Augmentation System]

LESSON: NAVIGATION AND FLIGHT PLANNING

OBJECTIVE:

To understand the various types of navigation, plan a VFR cross-country- flight using available weather, charts and airport data using a Nav Log and also Foreflight and explain how to open a flight plan.

MOTIVATION:

Cross-country flights with airplanes need to be pre-planned using several different forms of navigation. Understanding how to plan a flight manually and using Foreflight will allow you to safely plan a flight that avoids hazards and optimizes the route to save time, money and is regulatory compliant.

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate with models, and instructional aids, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate understanding to the instructor by describing the key points, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

This lesson is complete when the student demonstrates the ability to plan a VFR flight using a Nav Log and Foreflight using real time weather, explain the ATC services available and can explain how to use Dead reckoning, Pilotage GPS and VOR to navigate. The student will also be able to file and simulate opening a VFR flight plan.

REFERENCES / EQUIPMENT NEEDED:

FAA-H-8083-3 AFH, FAA-H-8083-25B PHAK, FAA: Pilot/Controller Glossary; FAR/AIM

IMAGES / MEDIA / LINKS:

CFI Notebook

NAVIGATION AND FLIGHT PLANNING TIME: [2] HOURS

1. Definitions and example of: Pilotage and dead reckoning – VFR Navigation Log
2. Obtaining the weather briefing for proposed flight
3. Weather charts that apply to cross-country flight planning – Especially Winds Aloft
4. VFR Aeronautical Charts – True North vs Magnetic North
5. Identifying landmarks by relating surface features to chart symbols – What makes good checkpoints
6. Choosing a route and altitude considering terrain, weather, safety, airspace.
7. Top of Climb – Top of Descent – Cruise is what is left
8. Performance charts to determine TOC, TOD, and Cruise legs (TOD may not be in POH)
9. If No TOD, then 500 ft./min at 90 KIAS = 1.5nm/min - Altitude to lose/500 ft. min x 1.5= TOD distance
10. Definition of TC (True Course), +/- Wind correction angle gives TH (True Heading) +/- Variation gives MH (Magnetic Heading) +/- Deviation gives CH (Compass Heading)
11. Using the Nav Log to pre-compute headings, groundspeeds, and leg time –Using a flight computer for Speed, Time Distance calculations, Fuel burn per leg and calculation of WCA
12. Discuss differences between pre-flight groundspeed and heading calculations that occur during flight from the pre-calculated NAV LOG data.
13. Discuss Navigation systems and radar services including GPS, VOR and flight following, opening a flight plan and how to get inflight weather.
14. Airborne electronic navigation systems – GPS and VOR
15. Intercepting and tracking a given course, radial, or bearing, as appropriate
16. Diversion to include potential reasons and then, choosing an appropriate alternate airport and route
17. How to estimate initial heading, arrival time and Fuel required
18. Lost procedures – 4 C's – Climb, Communicate, Confess, Comply
19. Using Foreflight for flight planning – Setting up airplane profile, how to use the flight planning section, limitations on only one TOC
20. Getting a weather briefing using Foreflight
21. Foreflight display of SUA including Using ADS-B with Foreflight – TFRs.
22. Weather and traffic – discuss limitations Filing and opening a VFR flight plan

Navigation - Quick Reference

Introduction

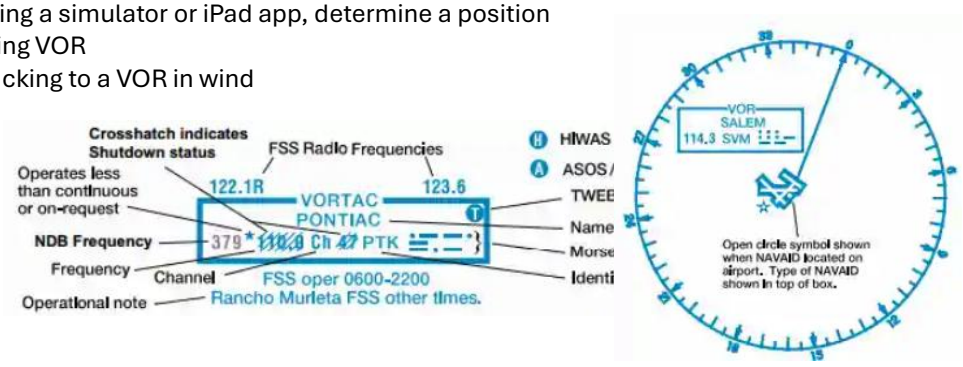
- Aeronautical Charts
  - Sectional, and VFR Terminal Area Charts, Foreflight
  - Overview and legend
- Measurement of direction
  - Variation (PHAK)
    - Angle between true north and magnetic north
  - Deviation
    - Compass error from magnetic influences within AC
- Effect of Wind
- Fuel Consumption

Methods of Navigation

Pilotage

- Navigate by reference to visual landmarks or checkpoints.
- Choose prominent features.
- Chose checkpoints every 10-15 miles, and always use cross-check points.
  - Make first checkpoint close to start to confirm initial heading
- Dead reckoning
  - Navigation solely by means of computations based on time, airspeed, distance and direction
  - Is the process of estimating your position by advancing a known position using course, speed, time, and distance to be traveled. In other words, figure out where you will be at a certain time if you hold the speed, time, and course you plan to travel.

- Radio navigation
  - VOR / VORTAC
    - Radials - aligned with magnetic north
    - Morse identifier; may also have voice
    - Line of sight 8-19
    - T - Term 25 NM 1,000-12,000ft
    - L - Low alt. 40 NM 1,000-FL 180
    - H - High alt 40 NM (1000ft-14,500ft) 100 NM (14,500ft-FL180) 130nm (FL180-FL450)
    - Fly to VOR: tune, ident, center CDI, bracket
    - Intercept inbound radial
    - Using a simulator or iPad app, determine a position using VOR
    - Tracking to a VOR in wind



- GGPSS
    - ➢ Constellation of satellites
    - ➢ Unaffected by weather

Flight Planning

- Assemble the necessary materials (91.103). Each pilot in command shall, before beginning a flight, become familiar with all available information concerning that flight
    - WX Briefing
    - Sectional / VFR terminal charts
    - Chart supplements paper and on Foreflight - Study the info for each airport
    - Plotter, E6B, highlighter, post-its, iPad with Foreflight
    - Compass deviation values from the compass card
    - POH - for loading and performance data
    - Night flight: flashlights

- Chart the course
    - Route should be mindful of fuel stops, terrain, water, airspace, obstructions, current and forecast weather
    - Choose method of navigation
    - Plot the course
    - Choose and mark appropriate checkpoints along the way
    - Choose cruising altitude appropriate for terrain obstructions, airspace, direction of flight, winds aloft
    - Fill out flight log with starting point, checkpoints and stopping points
    - Calculate TC and distance for each leg
    - Interpolate winds aloft for each leg
    - Calculate CH = TC + WCA / Var - Dev
    - Calculate GS, time, and fuel used for each leg

XXX

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3

QUESTIONS FOR THE STUDENT:

What is the definition of Pilotage?
[Navigation by reference to landmark checkpoints.]

What is the definition of Dead Reckoning?
[Navigation by means of time and distance calculations.]

What is the definition of True Course?
[The course measured on the chart (this is in reference to True North).]

What is the definition of Wind Correction Angles?
[Adjusting heading to compensate for wind drift.]

What is the definition of Magnetic Variation?
[The angular difference between True and Magnetic North.]

What is the definition of Magnetic Heading?
[Correcting True Heading for Magnetic Variation.]

What is the definition of Magnetic Deviation?
[Electromagnetic fields that cause erroneous compass indications.]

If our course heading is between 000-179, we should fly...
[Odd Altitudes + 500']

If our course heading is between 180-359, we should fly...
[Even Altitudes + 500']

What are the VFR Fuel Requirements when flying during the Day?
[Destination + 30 Minutes]

What are the VFR Fuel Requirements when flying at Night?
[Destination + 45 Minutes]

What are the 5 C's of Lost Procedures?
[Climb]
[Conserve]
[Call]
[Confess]
[Comply]

LESSON: NIGHT OPERATIONS

OBJECTIVE:

To understand and prepare an airplane and pilot for night flying by applying the limitations of the eye, illusions, pre-flight planning, for the operation of the airplane at night and the night environment.

MOTIVATION:

Night flying is more challenging that flying during the day. A pilot needs to understand the night environment, limitation of the eye, possible illusions and regulations that make a night flight as safe as possible.

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate with models, and instructional aids, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate understanding to the instructor by describing the key points, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

- 3 hours of night flight training in a single-engine airplane
- Night cross-country training flight in a single-engine airplane of over 100 nautical miles total distance
- 10 takeoffs and 10 full stop landings in a single-engine airplane at an airport at night

REFERENCES / EQUIPMENT NEEDED:

FAA-H-8083-2A RMH, FAA-H-8083-3 AFH, FAA-H-8083-25B PHAK; AIM; POH/AFM

IMAGES / MEDIA / LINKS:

CFI Notebook

NIGHT OPERATIONS TIME: 2 HOURS

1. Factors related to night vision
2. Regulations regarding night flying. Definition of night, civil twilight, passenger carrying requirements 61.57
3. Disorientation and night optical illusions
4. Importance of having a flashlight with a red lens
5. Night preflight inspection
6. Engine starting procedures, including use of position and anti-collision lights prior to start.
7. Taxing and orientation on an airport
8. Takeoff and climb out
9. In flight orientation
10. Importance of verifying the airplane's attitude by reference to flight instruments
11. Night emergencies procedures
12. Traffic patterns
13. Approaches and landings with and without landing lights
14. Go-around

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3=8

COMMON ERRORS:

Using a white light flashlight in the cockpit during night flight.

QUESTIONS FOR THE STUDENT:

The Cones are located...
[In the center of the Retina.]

The Rods are located...
[In a ring around the Cones.]

The Cones detect...
[Color, details, and faraway objects.]

The Rods are best for...
[Peripheral Vision and Night Vision]

The Night Blind Spot is in...
[The Center of the Field of Vision.]

How much time does it take for the eyes to fully adjust to Night Lighting?
[30 Minutes]

What additional equipment should a pilot have when performing a Night Flight?
[Aviation Flashlight with White and Red Lights.]

What is the White Light of the flashlight used for?
[Pre-flighting the aircraft.]

What is the Red Light of the flashlight used for?
[In-flight viewing of navigation charts.]

Why is the Red Light used when flying in the cockpit?
[It is "non-glaring" and will not ruin a pilot's night vision.]

Civilian Airport Beacon Lights flash...
[1X White]
[1X Green]

Seaport Beacon Lights flash...
[1X White]
[1X Yellow]

Heliport Beacon Lights flash...
[1X White]
[1X Green]
[1X Yellow]

Military Airport Beacon Lights flash...
[2X White]
[1X Green]

4 White Lights on a PAPI indicate the pilot is...
[Above the normal glidepath.]

3 White Lights on a PAPI indicate the pilot is...
[Slightly above the normal glidepath.]

2 White Lights and 2 Red Lights on a PAPI indicate the pilot is...
[On the normal glidepath.]

3 Red Lights on a PAPI indicate the pilot is...
[Slightly below the normal glidepath.]

4 Red Lights on a PAPI indicate the pilot is...
[Below the normal glidepath.]

Lesson plan Notes: Expanded Content

- **Night Vision (AFH)**
  - Human eyes do not function as well at night. They eye require a lot of light and Oxygen.
    - **Rods** - Located around the cones. Provides peripheral vision. They detect movement, without detail or color, only shades of gray.
    - Because they are more sensitive to light than cones they make night vision possible, but require off center viewing because there are no cones in the center of the eye.
    - **Cones** - Located in the center of the retina. Cones detect color detail, and work best in daylight with direct viewing
  - Both the Rods and Cones are used during day
  - Dark Adaptation
    - Stay out of bright light from 30 minutes:
    - Cones adjust in 5-10 minutes, and eyes become 100 times more sensitive to light
    - Rods adjust in 30 minutes, and eyes become 100,000 time more sensitive
    - In bright lighting conditions the eyes read just almost instantly and require re adaptation to dark conditions
    - White light can cause temporary blindness and illusions
    - Impaired by cabin altitudes over 5,000 carbon monoxide and, Vitamin A deficiency
  - Eyesight degrades with:
    - Fatigue, illness, smoking, drugs, alcohol, oxygen deprivation, lack of vitamins.

- **Night illusions**
  - False horizons - Sloping cloud banks, slanted ground, road lighting, moving trains, northern lights
  - Autokinesis - Starting at a point of light makes it appear to move
  - Flicker vertigo - Strobes can cause nausea, dizziness, headaches, confusion, even unconsciousness
  - Black-hole - When approaching straight in or over water or non-lighted terrain the illusion causes the pilot to be lower than thought resulting in touchdown prior to the runway. To prevent it, use a VASI or glide-slope or fly over the airport and join a normal traffic pattern

- Bright runway and Approach lighting systems - creates illusion of being closer to the runway
- Lights in clouds, haze or smoke can cause distortions in objects appearance.
- Bright lights appear closer, and dim ones farther away resulting in high or low approaches.

- **Pilot Equipment**
  - Flashlights - At last two (with spare batteries for all):
    - Large white light flashlight for preflight, and ice checks (if IFR)
    - Small red or Blue light for use in cockpit. Red or blue light does not destroy night vision
      - Note: Red light will make chart colored (red) features difficult to see

- **Aircraft Equipment**
  - 91.205c in addition to equipment needed for VFR day flight, the airplane also needs:
    - Approved position lights
    - An approved aviation red or aviation white anti-collision light system
    - if the aircraft is operated for hire, one electric landing light
    - An adequate source of electrical energy for all installed electrical and radio equipment
    - One spare set of fuses, or three space fuses of each kind required, that are accessible to the pilot in flight
  - Position lights must be turned on from sunset to sunrise, anti-collision lights whenever engine running (Day or Night)

- **Airport and Position Lighting Aids**
  - Rotating beacon colors
    - White - Green - Civilian Land
    - White - White-Green- Military
    - White - Yellow - Civilian Sea
    - White - Green - Yellow - Heliport

- **Taxi way lights:** Blue edge, green center lights,
- **Runway lights:** White runway lights-yellow in last 2,000ft
    - Intensity can often be adjusted by pilot or tower
    - Check the Chart supplements for lighting specifications and pilot controlled lighting
- **Obstacle lights:** Red steady, flashing and strobes

- **Preparation & Preflight**
    - Definition of night and how to determine the beginning and end of civil twilight. FAR Part 1
    - FAR requirements for carrying passengers at night FAR 61.57
    - Review of weather
    - Clean windows and windshield
    - During preflight - ensure position lights, landing lights, anti -collision and instrument and interior lights work
    - Adjust interior lights to minimum brightness

- **Startup, Taxi & Run-up**
    - Cockpit Management
    - Lights on before starting
    - Taxi with landing or if equipped taxi lights on.
        - Taxi slowly, and use yellow taxi centerlines
    - Run-up - Airplane movement is harder to detect at night

- **Takeoff, climb & Go-around**
    - Flight Instruments should be used since there are fewer outside visual references
        - Ensure positive rate of climb using the flight instruments and any outside indications

- **Approaches & Landings**
    - Making sure to positively Identify the airport as soon as possible. Identify the runways
    - Distance perception may be distorted. Use navigation instruments
    - If the heading indicator has a bug, set it to runway heading to help with orientation in the traffic pattern

- Fly a stabilized approach: Maintain proper airspeed and glideslope. use glide slope indicator if available
- In the round out and flare judgement of height, speed & sink rate is more difficult due to less features available to see.
    - Inexperienced pilots tend to fly the approach to slow and flare too high
    - Practice landing without using the landing light -use runway lights in peripheral vision to determine your height above the runway

- **Night Emergencies**
    - Engine failure
        - The number of choices will be less
        - Choosing an emergency landing area away from congestion, but near public access

    - Alternator
      Attempt to re-set the alternator by circuit breaker and / or by cycling off then on the alternator side of the master switch

      XXX

LESSON: HIGH ALTITUDE OPERATIONS

OBJECTIVE:

To understand the physiology, equipment and regulations regarding normal and emergency procedures so that the pilot can properly react to normal operations and emergencies at high altitudes.

MOTIVATION:

This lesson will provide the knowledge required to obtain a pressurized airplane high altitude endorsement. You will understand normal and emergency operations while operating at high altitude.

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate with models, and instructional aids, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate understanding to the instructor by describing the key points, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

To determine that the applicant exhibits instructional knowledge of the elements of high altitude operations by describing:

1. Regulatory requirements for use of oxygen.
2. Physiological hazards associated with high altitude operations.
3. Characteristics of a pressurized airplane and various types of supplemental oxygen systems.
4. Importance of "aviator's breathing oxygen."
5. Care and storage of high-pressure oxygen bottles.
6. Problems associated with rapid decompression and corresponding solutions.
7. Fundamental concept of cabin pressurization.
8. Operation of a cabin pressurization system.

REFERENCES / EQUIPMENT NEEDED:

14 CFR 91 91.211 - Supplemental Oxygen | AC 61-107B, Aircraft Operations at Altitudes Above 25,000 ft MSL or Mach Numbers Greater than .75 | FAA-H-8083-25B, PHAK (CH 7, CH 17) | POH/AFM | AIM

IMAGES / MEDIA / LINKS:

CFI Notebook LINK

HIGH ALTITUDE OPERATIONS — TIME: [1:30] HOURS

1. Physiology
2. Regulations
3. Jet Stream
4. Supplemental Oxygen
5. Pressurization
6. Decompression
7. Fuel vaporization
8. Severe Turbulence

Physiology:
Hypoxia - As altitude increases pressure decreases. Ability to absorb Oxygen decreases.

Time of useful Consciousness

Altitude	Time of useful consciousness
45,000 feet MSL	9 to 15 seconds
40,000 feet MSL	15 to 20 seconds
35,000 feet MSL	30 to 60 seconds
30,000 feet MSL	1 to 2 minutes
28,000 feet MSL	2½ to 3 minutes
25,000 feet MSL	3 to 5 minutes
22,000 feet MSL	5 to 10 minutes
20,000 feet MSL	30 minutes or more

Adverse effects of long-term oxygen use include Bronchial coughing, fever, vomiting and lowered energy.

Decompression sickness: nitrogen in the body changing from liquid form to gaseous state due to a dramatic reduction in surrounding atmospheric pressure.

Regulations

91.211a- General

I. Minimum crew must use oxygen between 12,500 and 14,000 (inclusive) for any period over 30 minutes
II. Minimum crew must use oxygen above 14,000 at all times
III. All passengers must be provided with oxygen above 15,000

91.211a- Supplemental Oxygen above FL250

I. Above FL250, minimum of 10-minutes of supplemental oxygen available for each passenger

II. Above FL350, at least one pilot must be wearing and using an oxygen mask; unless at or below FL410, if there are two pilots at the controls, and both have quick donning type mask that can be put on and working within 5 seconds. Even with quick donning masks, if one pilot leaves, other must wear and use oxygen until other pilot returns weather considerations.

Jet Stream

Travels east at approximately 50-200 kts

- Caused by large temperature differences aloft
- Has a meandering path that is constantly changing
- Closer to the equator in the winter, farther in the summer
- General circulation patterns move south in the winter due to less heating activity
- Clear air turbulence (CAT) found on the polar side of the Jetstream
  a) phenomenon of turbulence associated with high altitude winds, and not associated with clouds
  b) can be caused by wind shear, mountain waves, low pressures aloft, etc.
  c) difficult to forecast since there are no visual signs of it.

Supplemental Oxygen

- Oxygen is stored in high pressure tanks (usually around 1800-2200 PSI)
- 22 cu ft. container will supply 4 people at 18,000 ft. for up to 1.5 hours
- Aviation oxygen should be the only oxygen to be used (100% oxygen)
- Care and storage of Oxygen Bottles:

  Oxygen bottles should not be subject to hot temperatures or in situations where the bottle could become punctured or the regulator to be damaged. High pressure vessels can explode if they are not maintained properly. Don't store around any source of flames.

  Continuous-flow - most common type of system for piston aircraft as well as for passengers in turboprop and jets



- Not adequate above 25,000 ft. (although certified up to 41,000
- Designs may include constant-flow, adjustable-flow, altitude- compensated flow
- Available as built-in system, or portable system

Mask - Style

- Oronasal rebreather - covers both nose and mouth, and includes a bag to allow reuse of exhaled oxygen
- Cannula breathing device - oxygen is supplied to the nose only, a l lowing use of normal communication methods (not certified as high as oronasal rebreathers)
- Diluter-demand/pressure-demand - supply oxygen only when the user inhales through the mask

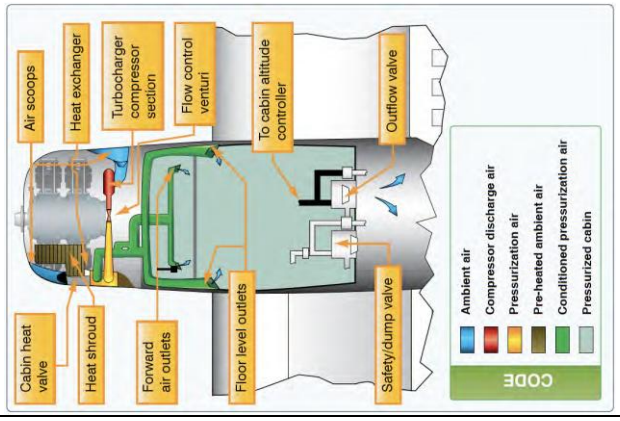
Oxygen Generators

- Available on airliners, oxygen generators use a chemical reaction to produce oxygen for a set amount of time.
- Each passenger has an individual “supply” from a generator pressurization

Cabin Pressurization

- Outside air is compressed in the aircraft cabin in order to maintain a cabin altitude lower than the actual flight altitude
- Most light aircraft compress air to the cabin via the turbocharger or an engine-driven pump

- An outflow valve keeps pressure constant by releasing excess pressure into the atmosphere cabin altitude can be manually selected via a cabin altitude controller, and if needed regulated via a backup control to a safety dump valve



- Vacuum relief valve prevents cabin pressure from becoming lower than ambient pressure in the case of a rapid descent
- Heat exchanger conditions the air before entry into the cabin
- The lower effective altitude in the cabin eliminates the need for oxygen masks at all times

Indications and Controls



- Maximum pressure differential
- Maximum allowable difference between atmospheric pressure and cabin pressure
- Cabin Altimeter – Shows the altitude of the pressurized cabin
- Cabin VSI – Shows if the cabin is climbing or descending in altitude
- Pressure controller – Allow the pilot to set the airplane to be pressurized (Various types: Refer to POH for details)
- Dump Valves – Allow the cabin to be depressurized by the pilot in the event of smoke etc.
- Weight on wheels switch – Depressurizes upon weight on wheels, won't allow pressurization until weight is off wheels.

Decompression

- The inability of the aircraft's pressurization system to maintain designed pressure schedule its
- Types of decompression
- slow decompression - may be difficult to detect. many systems include audible and visual warnings of high cabin altitudes
- Explosive decompression - an extremely dangerous condition in which he aircraft decompresses faster than the lungs can decompress.
  I. typically occurs in less than 0.5 seconds
  II. lung damage can occur
  III. flying debris may cause further injury
- Rapid decompression - decompression that occurs quickly but is slower than the rate at which the lungs can decompress.

Recovery

- Use supplemental oxygen as quickly as possible
- Descend as quickly as possible to a safe altitude
- Balance between reaching a safe altitude, and taking care of the engine must be made (most significantly in piston engines)

Fuel Vaporization

- At high altitudes engine driven fuel pumps may be subject to fuel vaporization

- Boost pumps are typically installed to address this situation

Severe Turbulence

- If severe turbulence is encountered, maintain appropriate airspeed, and attempt to keep wings level, and heading approximately correct.
- Accept changes in altitude and airspeed as long as pitch is relatively constant.

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE

COMMON ERRORS:

Not taking DENSITY ALTITUDE into account. Especially on a hot day in Colorado.

QUESTIONS FOR THE STUDENT:

When is a High Altitude Endorsement required for a pilot?
[If the aircraft being flown has a Service Ceiling or Maximum Operating Altitude above 25,000' MSL.]

Supplemental Oxygen Requirements - Above 12,500' MSL...
[Oxygen used for anytime over 30 minutes by the required flight crew.]

Supplemental Oxygen Requirements - Above 14,000' MSL...
[Required flight crew must use supplemental oxygen for the entire duration of flight above this altitude.]

Supplemental Oxygen Requirements - Above 15,000' MSL...
[Each occupant of the aircraft must be provided with supplemental oxygen (they do not have to use it).]

What are the 4 types of Hypoxia?
[Hypoxic Hypoxia] [Hypemic Hypoxia]
[Stagnant Hypoxia] [Histotoxic Hypoxia]

What is Hypoxic Hypoxia?
[Not enough oxygen in the environment (high altitudes).]

What is Hypemic Hypoxia?
[Oxygen molecules unable to attach to blood cells (CO poisoning).]

What is Stagnant Hypoxia?
[Blood not flowing to the brain (G-Forces).]

What is Histotoxic Hypoxia?
[Brain is rejecting the oxygen molecules being delivered (drugs and alcohol).]

What are the Symptoms of Hypoxia?
[Cyanosis (blue fingernails and lips)] [Headache]
[Decreased Response Times] [Impaired Judgement]
[Euphoria] [Visual Impairment]
[Drowsiness] [Dizzy Sensations]
[Numbness] [Tingling in the Fingers and Toes]

What are the Corrective Actions if experiencing Hypoxia?
[Descend to a lower altitude.] [Hypoxic Hypoxia]
[Don an oxygen mask.] [Hypoxic Hypoxia]
[Stop pulling G-Forces.] [Stagnant Hypoxia]

How long should a pilot wait after Scuba Diving before flying?
[24 Hours]

What are the 2 different types of Decompression?
[Rapid Decompression - The lungs decompress faster than the cabin.]
[Explosive Decompression - The cabin decompresses faster than the lungs.]

LESSON: AERODYNAMICS

OBJECTIVE:

To understand the principles of flight so that as the aircraft is being controlled by the pilot, the pilot also understands the capabilities and limitations of aerodynamic forces.

MOTIVATION:

There are many instances where certain required flight inputs and judgment are counter intuitive. By understanding the aerodynamics of flight, you will make appropriate choices and avoid causing excessive force on the airplane.

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate with models, and instructional aids, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate understanding to the instructor by describing the key points, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

This lesson is complete when the student demonstrates a basic understanding of the aerodynamics of maneuvering flight during oral quizzing.

REFERENCES / EQUIPMENT NEEDED:

FAA - Pilot/Controller Glossary; FAA-H-8083-25B PHAK

IMAGES / MEDIA / LINKS:

CFI Notebook

AERODYNAMICS TIME: [3:30] Minutes

1. Aerodynamics physics and theory.
2. Forces acting on the airplane in flight.
3. Dynamics of the airplane in flight.
4. Ground effect.
5. How airplanes turn.
6. Torque and left turning tendency.
7. Airplane stability.
8. Loads and load factors
9. Stalls and spins

KEY POINTS:

Bernoulli's Principle
Angle of Attack
Forces in Turns
Stability, Controllability and Maneuverability

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE

COMMON ERRORS:

Under Utilizing the right rudder at take off.

Not understanding the Dangers and benefits of Ground Effect.

QUESTIONS FOR THE STUDENT:

What are the 4 Forces of Flight?
[Lift // Weight // Thrust // Drag]

What are the 4 causes of Left Turning Tendencies?
[P-Factor // Torque // Gyroscopic Precession // Spiraling Slipstream]

Bernoulli's Principle indicates that...

[An increase in the speed of a fluid (air) is accompanied by a decrease in pressure.]

What are the 2 main types of Drag?
[Parasite Drag - Does not function in the aid of flight.]
[Induced Drag - Is a by-product of lift.]

What are the 3 sub-types of Parasite Drag?
[Form Drag - Shape of the aircraft.]
[Interference Drag - Intersections of aircraft components.]
[Skin Friction Drag - Skin is not perfectly smooth.]

To avoid another aircraft's wake turbulence on takeoff, a pilot should...
[Rotate prior to the preceding aircraft.]
[Stay above the preceding aircraft's flight path or perform a side-step maneuver.]

To avoid another aircraft's wake turbulence on landing, a pilot should...
[Stay above the preceding aircraft's flight path.]
[Land further down the runway.]

What is Ground Effect?
[A sudden decrease in drag and increase in both lift and airspeed when an aircraft is close to the surface. This is due to Wingtip Vortices being blocked by the proximity to the ground.]

An aircraft pitchs about the...
[Lateral Axis]

An aircraft rolls about the...
[Longitudinal Axis]

An aircraft yaws about the...
[Vertical Axis]

An aircraft flying below it's Maneuvering Speed (Va) will...
[Stall before it experiences structural damage.]

An aircraft flying above it's Maneuvering Speed (Va) will...
[Experience structural damage before it stalls.]

Higher Maneuvering Speeds (Va) are awarded to...
[Heavier aircraft.]

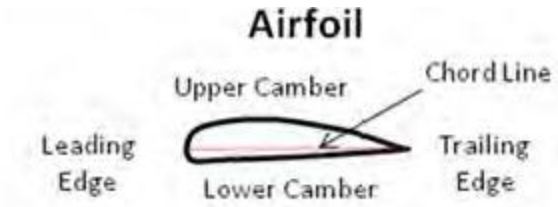
Slower Maneuver Speeds (Va) are awarded to...
[Lighter aircraft.]

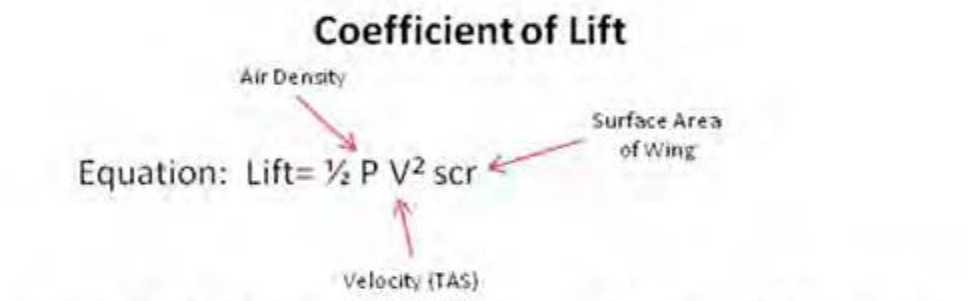
AERODYNAMICS LESSON 1

AERODYNAMICS

Introduction

Even though it is possible to pilot an aircraft without almost any knowledge of how it actually flies at all, a solid knowledge in the principles of flight will undoubtedly make it easier to learn and understand new skills quicker. Also, knowing the limitations, why they are there, and how to avoid breaking them, will make you a safer pilot.

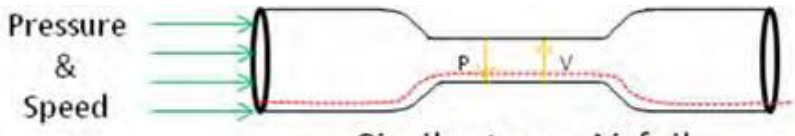




Lift = .5 x Lift Coefficient x Air Density x Velocity² x Wing Area

NOTE: Velocity has greatest effect on Lift because it is squared



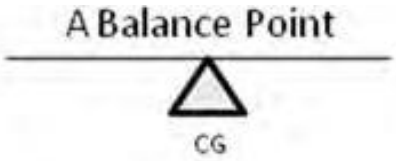


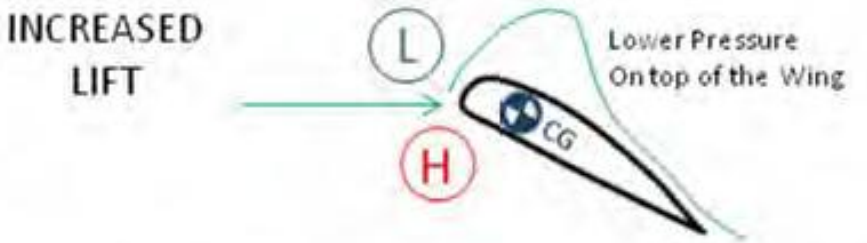
Similar to an Airfoil



Same all the way through







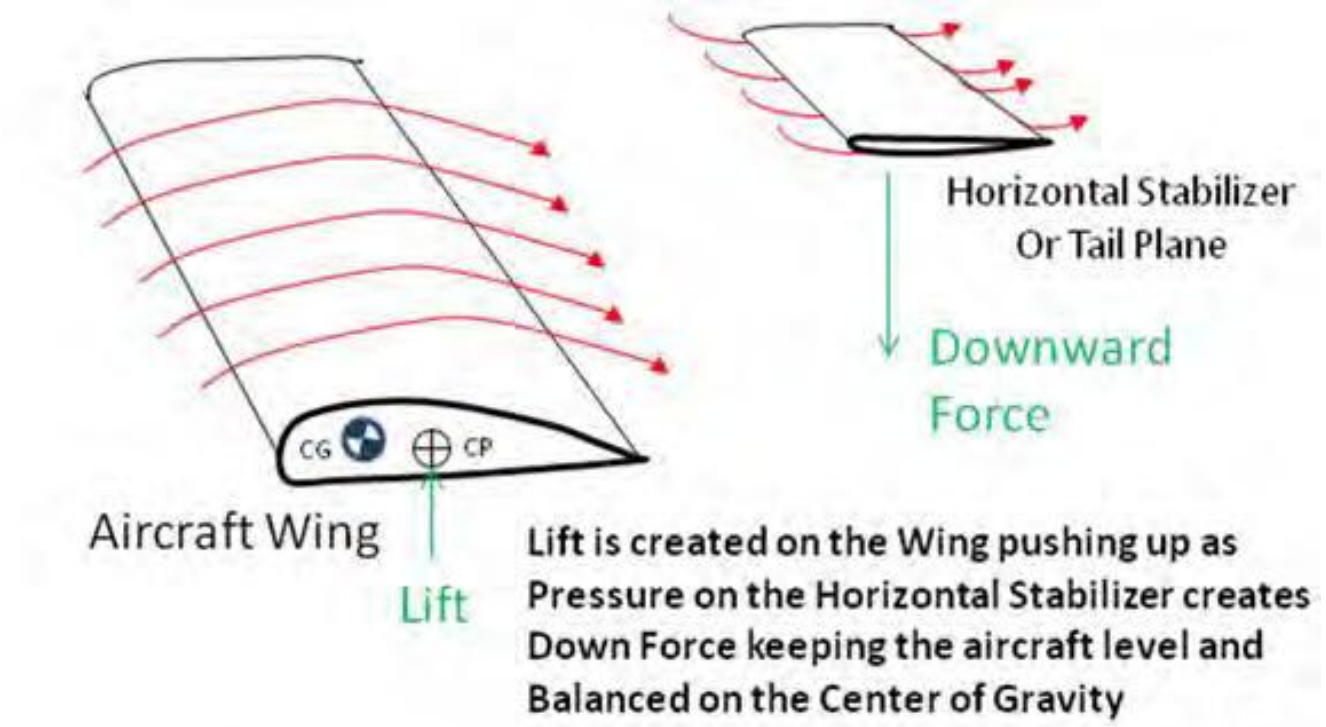
ANGLE OF ATTACK

Relative Wind: Opposite and Parallel to Flight Path



As Angle of Attack increases Center of Pressure will Move forward. Initially increasing lift until Critical Angle of Attack, then air separates and causes a stall.

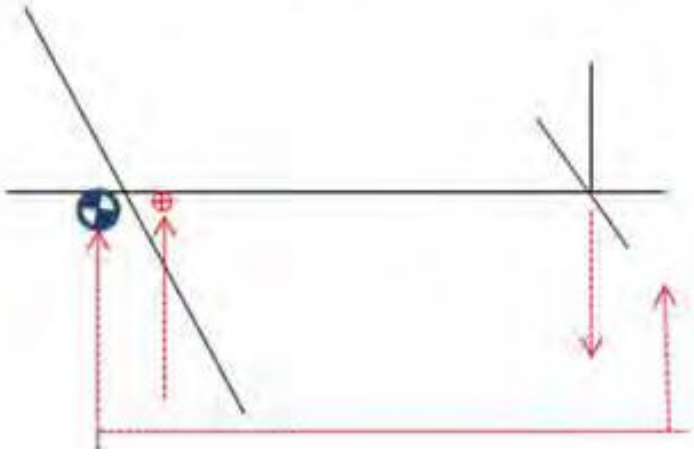
NOTE: You always want Center of Gravity to be ahead of Center of Pressure.



Lift is created on the Wing pushing up as Pressure on the Horizontal Stabilizer creates Down Force keeping the aircraft level and Balanced on the Center of Gravity



If the Angle of Attack increase too much, Center of Pressure can move so far forward that when the airplane stalls, it is unable to recover because the nose will no longer pivot forward in order for airflow to increase across the wings resulting in breaking the stall.

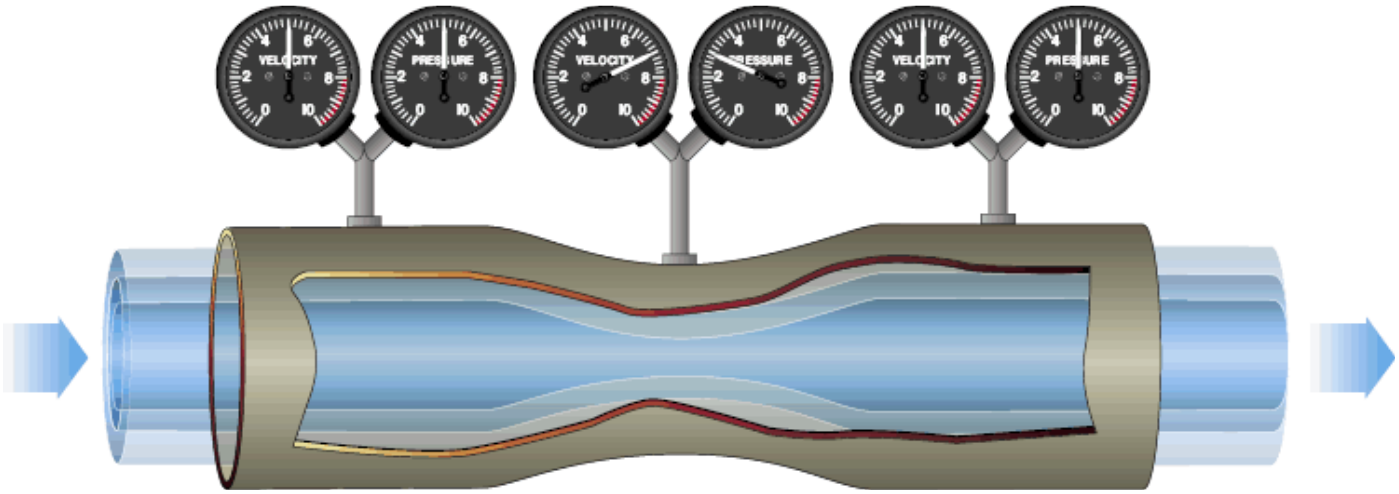


Lift = C_L x ½ p V^2 x S
The equation of continuity

A*V = Constant in a venturi tube. Smaller cross section gives higher velocity.

Bernoulli's Principle (Dutch-Swiss Mathematician Daniel Bernoulli 1738) PTOT = PSTAT + PDYNAMIC

With decreased cross section, velocity increases, and a low is created. Compare this to a wing. The pressure differential creates lift.

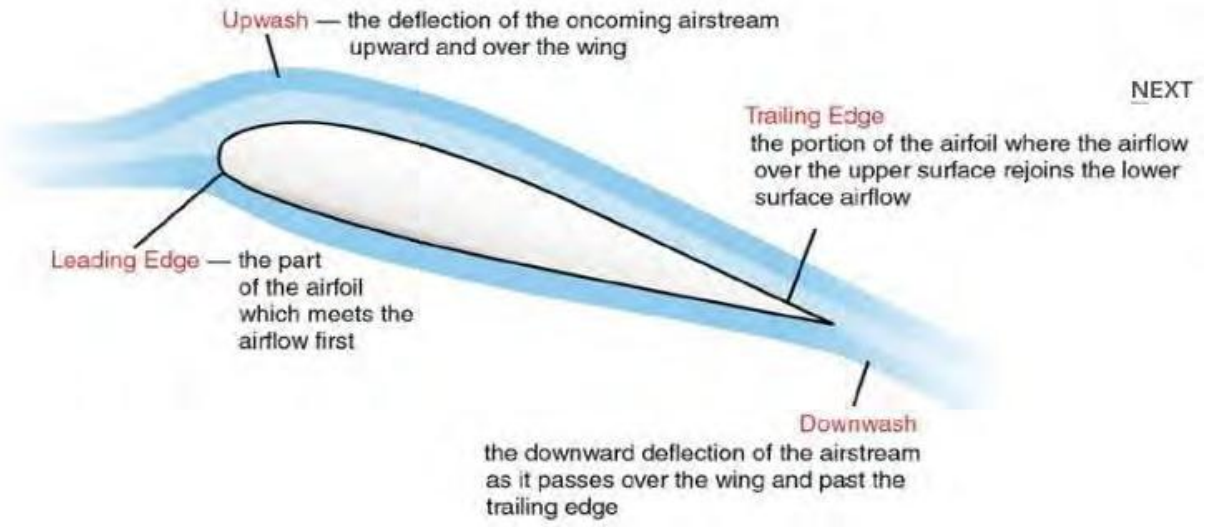


Airflow Around a Wing

• Lift is mostly generated by deflecting air downwards; enough air is pushed to generate an opposite reaction that keeps us airborne -> Lift. (Newton's third law).

• Discuss and define these key points:

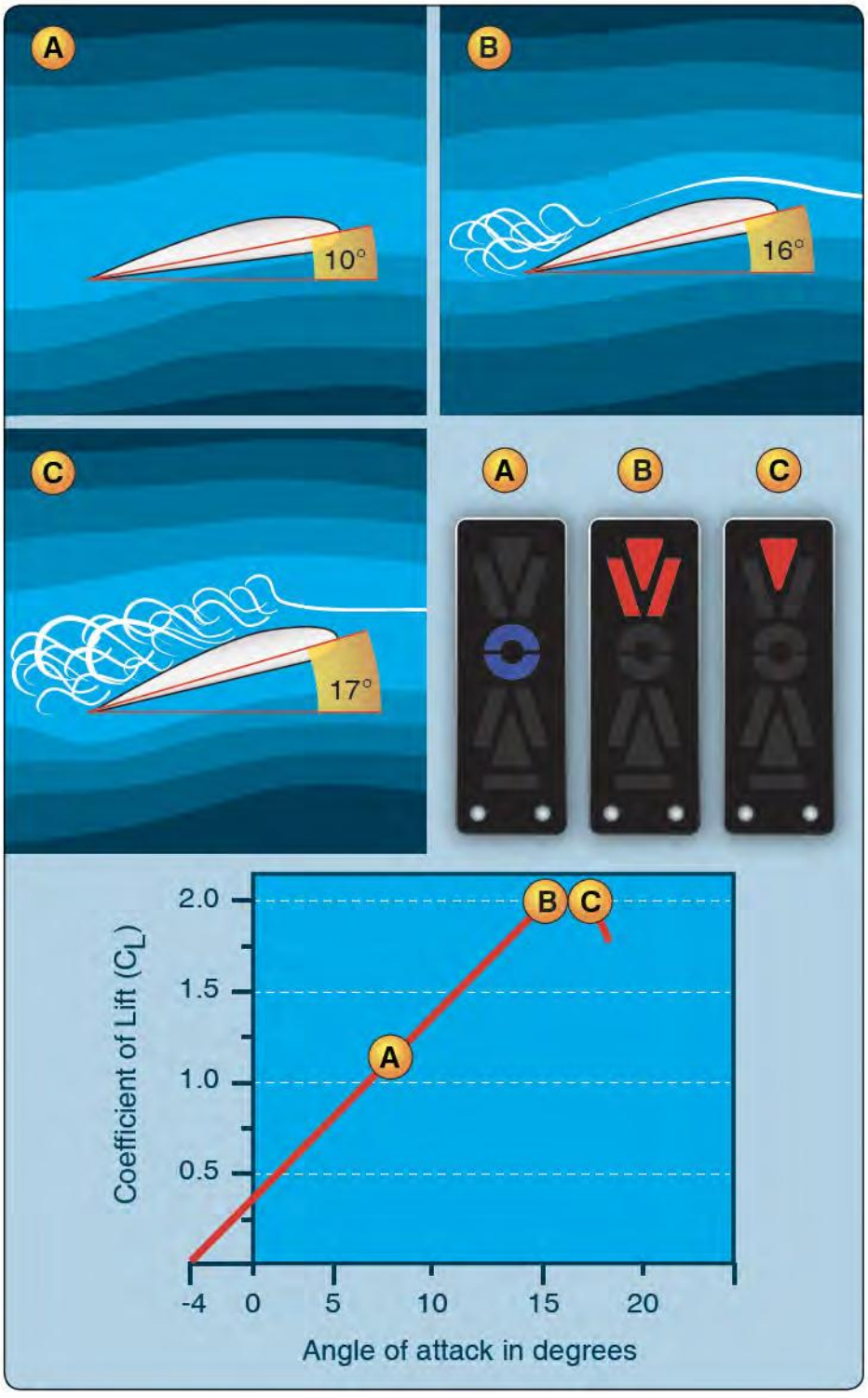
- Lift (force perpendicular to flight path)
- Leading edge
- Trailing edge
- Up wash
- Downwash
- Chord/Chord line (straight line from leading to trailing edge)
- Camber/Camber line (line equidistant from top and bottom of profile)
- Relative wind
- Flight path
- Angle of Attack
- Stagnation point (trailing and leading edge, leading edge stagnation point moves downwards with increased AoA)
- Separation point (moves forward with increased AoA)
- CP



Angle of Attack

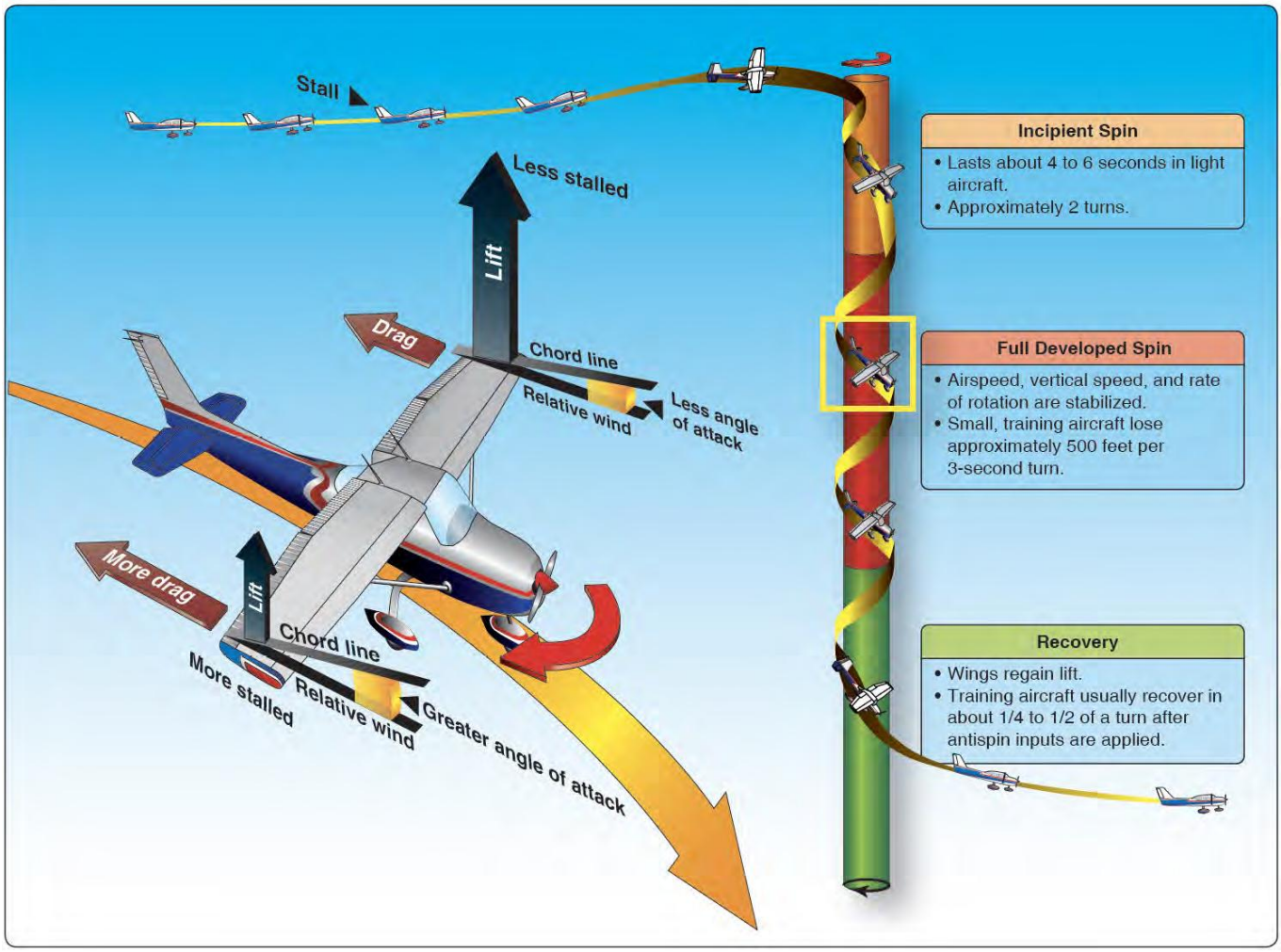
- As AoA is changed, the flow, and pressure distribution on a wing is changed.
- Increasing AoA increases lift. (CL)
- CL is directionally proportional to the amount of lift produced.

Stall (If you bank and want to maintain Altitude stall speed will Increase)



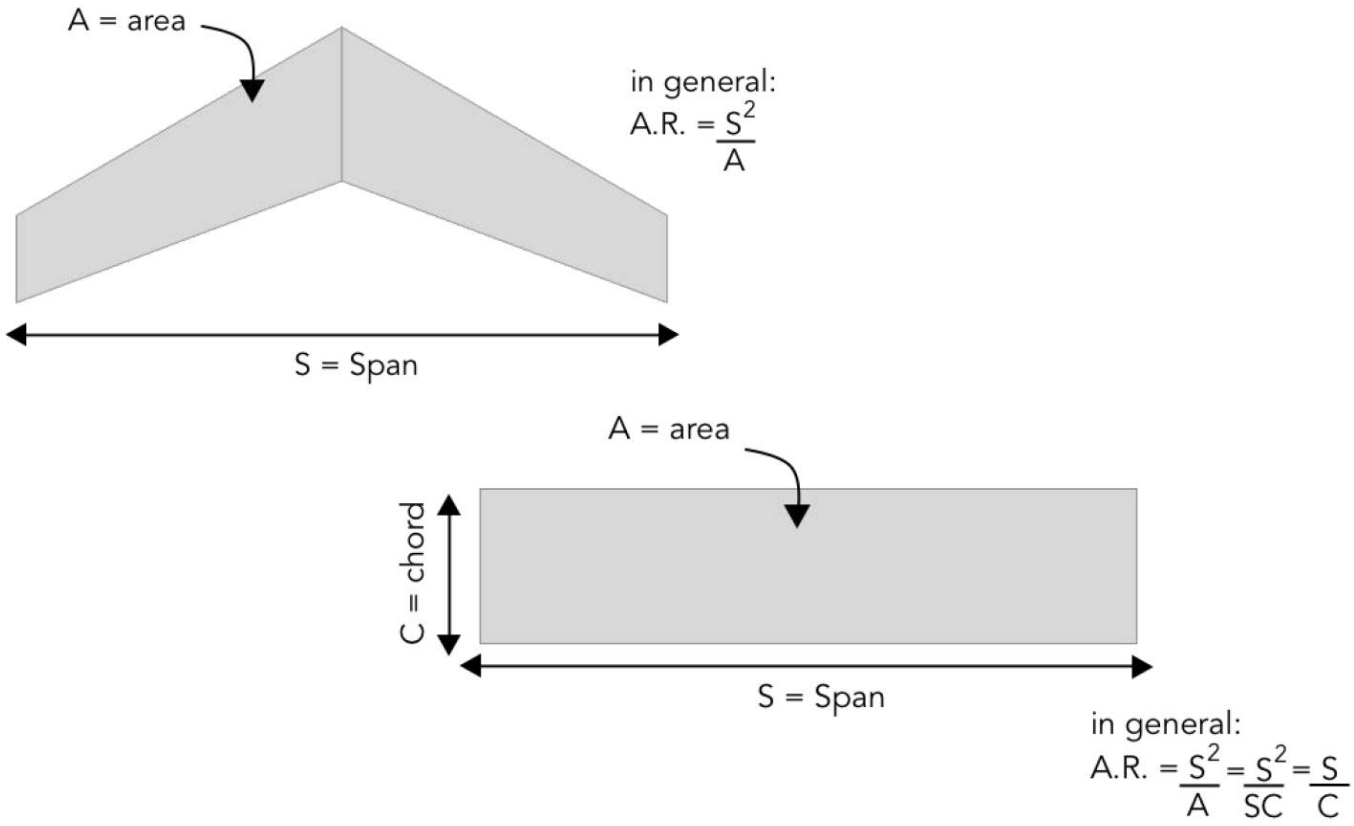
SPINS

- A spin is an aggravated stall that results in what is termed **autorotation**, in which the airplane follows a **corkscrew** path in a downward direction.
- If the nose of the airplane is allowed to **yaw** at the beginning of a stall, the **wing will drop** in the direction of the yaw.
- At the same time, the airplane continues to roll toward the lowered wing.
- In order to spin, both of the airplane's wings must first be stalled: then one wing becomes less stalled than the other.
- A flat spin occurs when the spin axis is located near the airplane's CG. This can happen on aircraft with an aft CG.



Airfoil Design Characteristics

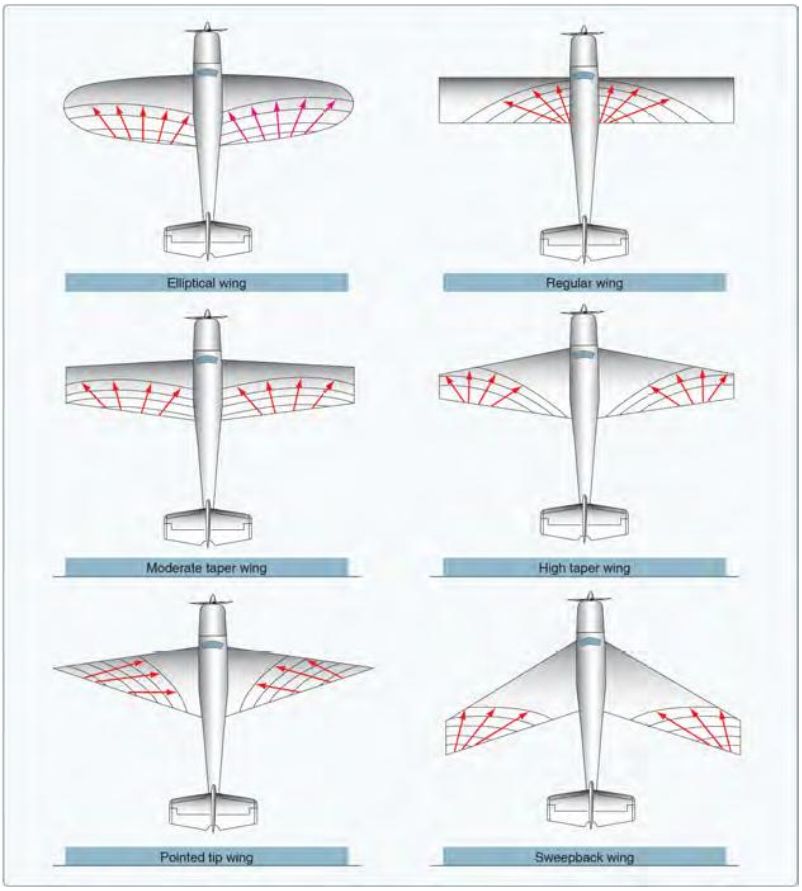
- Thickness to chord ratio:
    - Thick wing:
        - Much curvature, higher pressure difference, more deflection of the air.
        - Higher CL_{MAX}
        - More drag
        - Good for low speed flying
- Camber
    - Highly cambered wing:
        - Much curvature, higher pressure difference, more deflection of the air.
        - Higher CL_{MAX}
        - More drag
        - Good for low speed flying
- Aspect ratio
    - High aspect ratio: (high span to chord ratio)
        - Good L/D ratio
        - Low roll rate
        - Ground clearance can be a problem during landing/takeoff in x-wind conditions.
        -



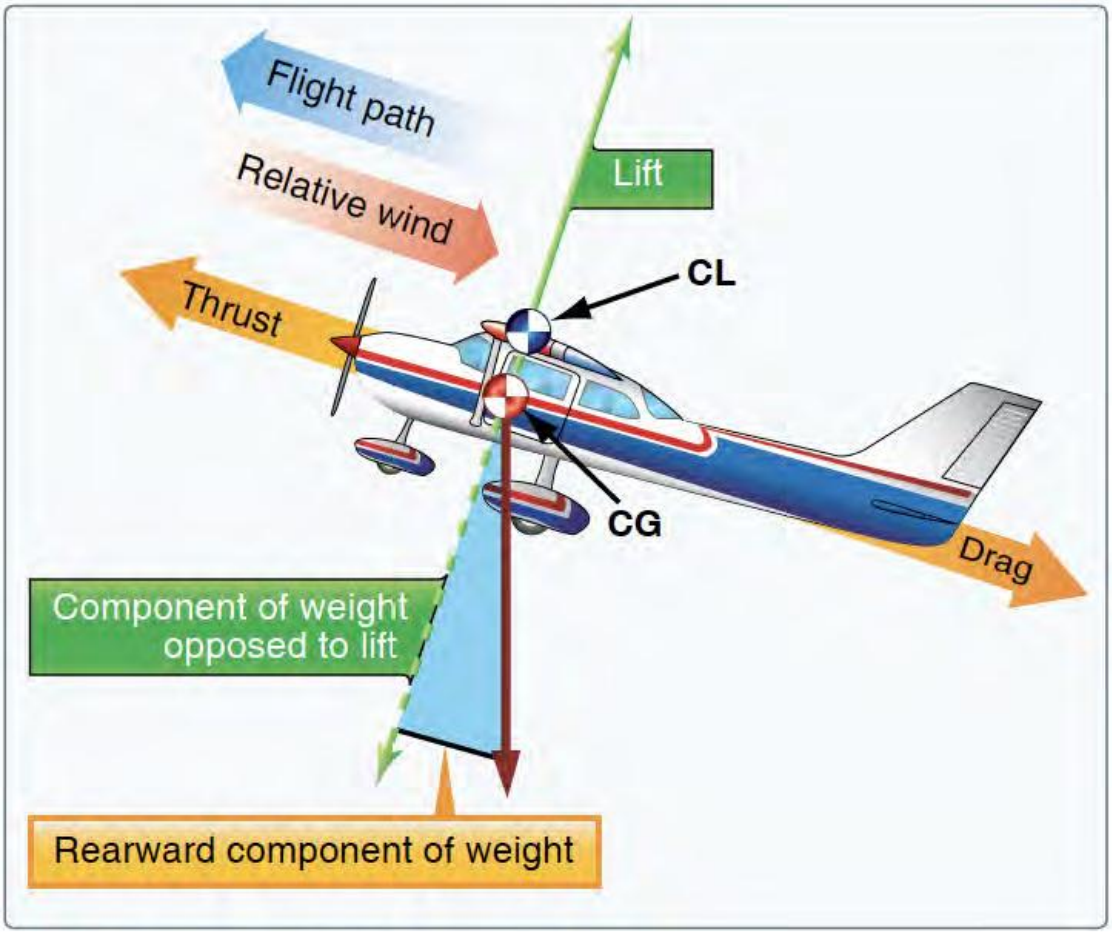
Wing Plan Form (draw on white board)

- Straight wing
    - Good for low speeds
    - Simple to build, cheap

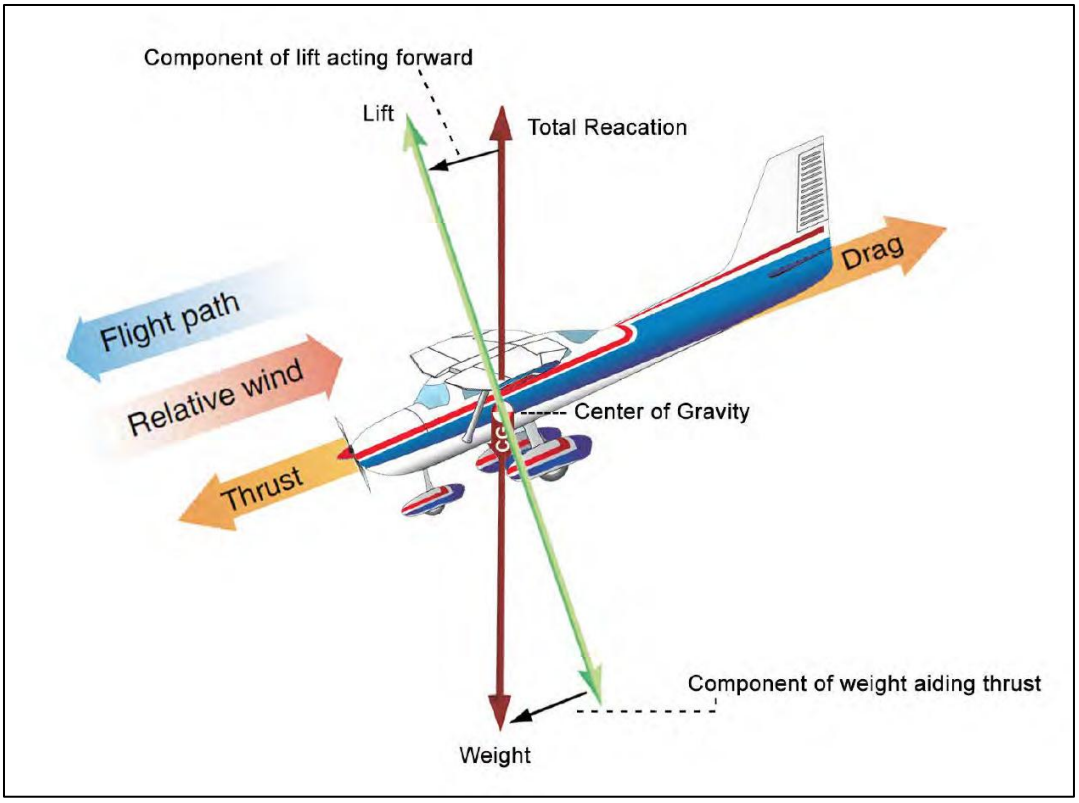
o Elliptical wing
    - Good for low speeds
    - Reduced induced drag (due to small tip area)
    - Difficult to build, expensive
- Tapered wing
    - Also good for low speeds
    - Compromise between elliptical wing and straight wing
    - Easier to build
- Swept back wing
    - High speed
- Delta wing
    - High speed



Forces in Climbs



Forces in Descents


Component of lift acting forward
Lift
Total Reacation
Drag
Flight path
Relative wind
Thrust
Center of Gravity
CG
Component of weight aiding thrust
Weight

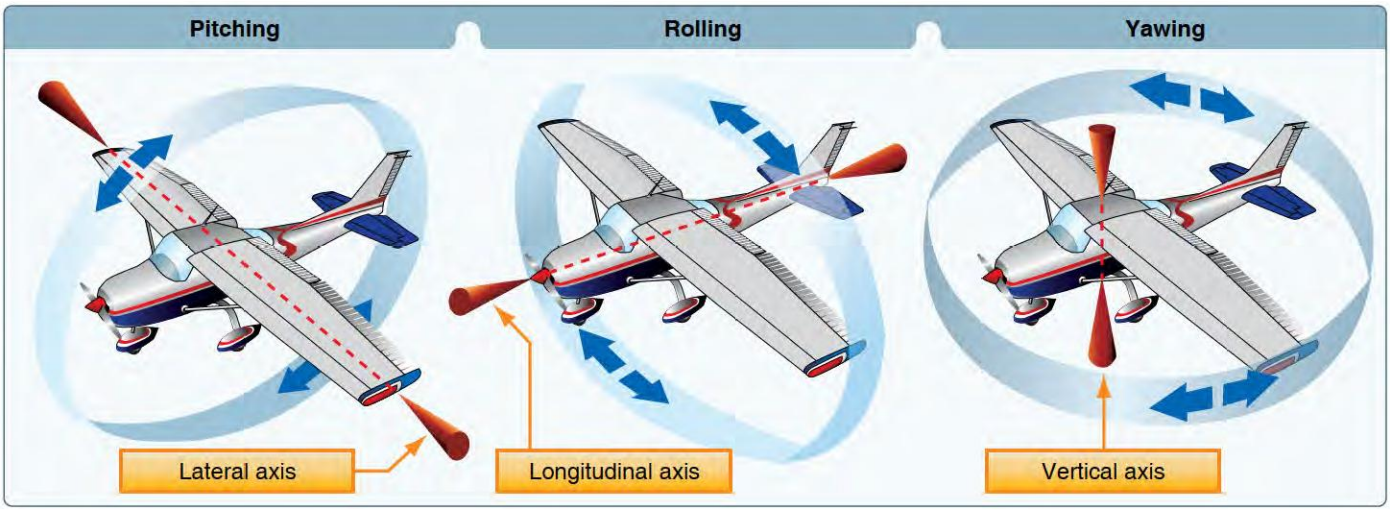
AERODYNAMICS LESSON 2

Forces Acting on an Airplane in Flight

Three Axes of Rotation

Before looking into stability, we need to define the axes around which the aircraft moves.

- All axes pass through the CG, at a 90-degree angles to each other's.
- Lateral axis – Pitch
- Longitudinal axis – Roll
- Vertical axis – Yaw



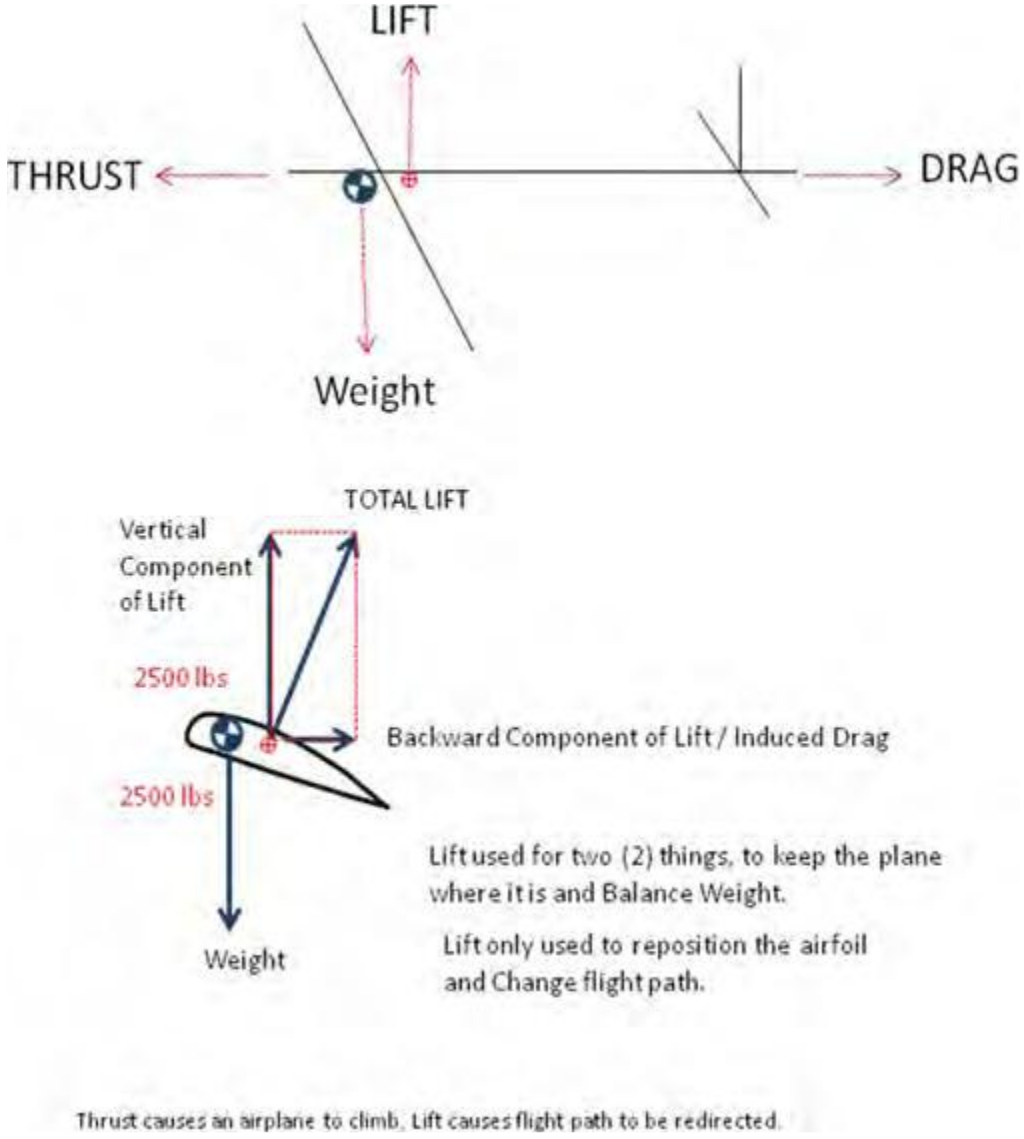
Newton's Three Laws:

- A body will remain in rest or uniform motion until acted upon by an external force.
- The force applied to a body is directionally proportional to its mass times its weight
- (F=m*a)
- To all forces there is an equal and opposite force. (F_1=F_2)

Four Forces

- Four main forces: Lift, Weight, Thrust and Drag.
- Level flight requires that all forces are in balance.
- Lift – Perpendicular to the flight path through CP. "Keeps plane in the air and redirects flight path"
- Weight – Vertical downward through the airplane's CG.
- Thrust – Forward force produced by power plant/propeller. Said to act parallel to the longitudinal axis.
- Excess Thrust: "Creates the ability to climb."

- Drag – Rearward force, parallel to the relative wind.



Lift

- Lift is the upward acting force that opposes weight.
- Lift is produced by the dynamic effect of the air acting on the wing and acts perpendicular to the flight path through the wing's center of lift.
- **Lift = C_L x ½ p V^2 x S**
    - C_L is the coefficient of lift.
    - p is dynamic pressure
    - V is the airspeed.
    - S is the size of the object.

Weight

- Caused by the gravity pulling the aircraft towards the center of the earth. Acts through CG.
- Aircraft rotates around CG.
- Increased weight decreases cruising speed, range, performance in general. More lift needs to be generated -> More drag.
- Increased weight increases stall speed.

Thrust

- Generated by engine.
- Required to accelerate or maintain speed.
- If thrust is larger than drag -> Acceleration. When drag equals thrust, airspeed is maintained.

Drag

- Drag is the retarding force, parallel and opposite to the flight path.
- Made up by **Parasite** and **Induced** drag.
- **Drag= C_D x ½ p V^2 x S**
    - C_D is the coefficient of drag.
    - p is dynamic pressure
    - V is the velocity or airspeed.
    - S is the size of the object.

Parasite Drag

- Resistance from moving through air.
- Increases with v^2 – 2x airspeed gives 4x parasite drag
- Divided into Form drag, interference drag, and skin friction drag.

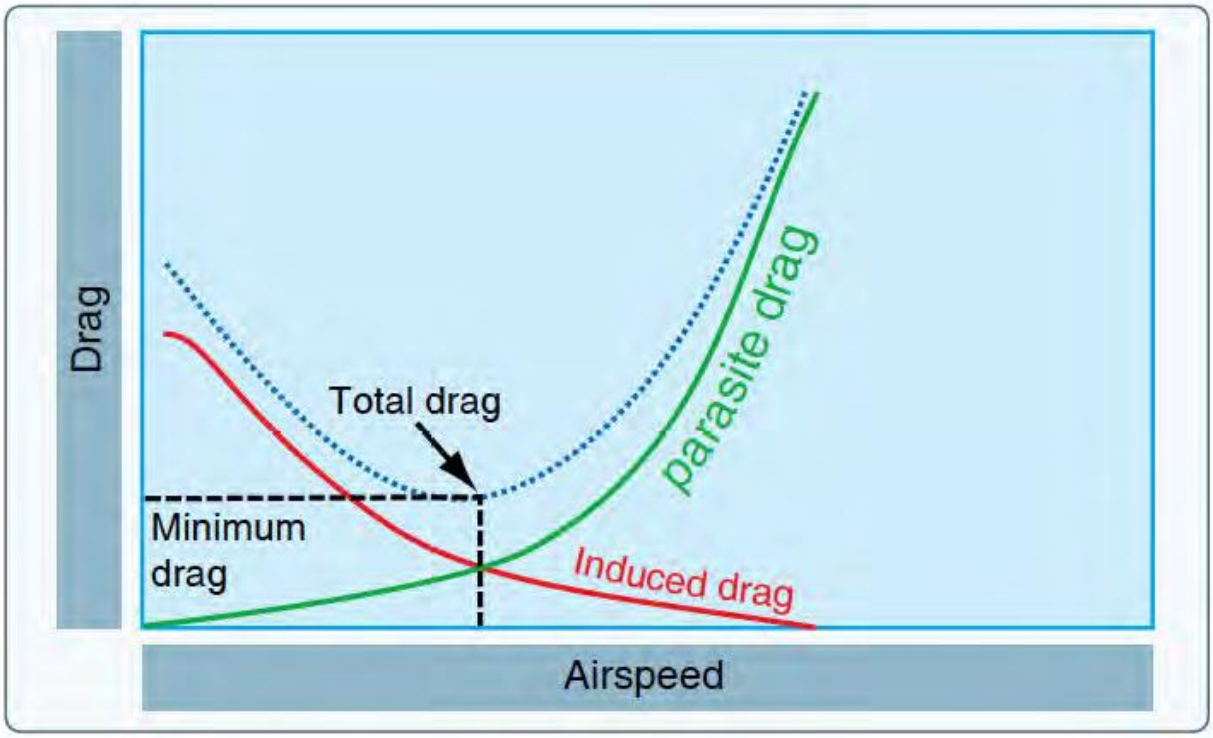
Induced Drag

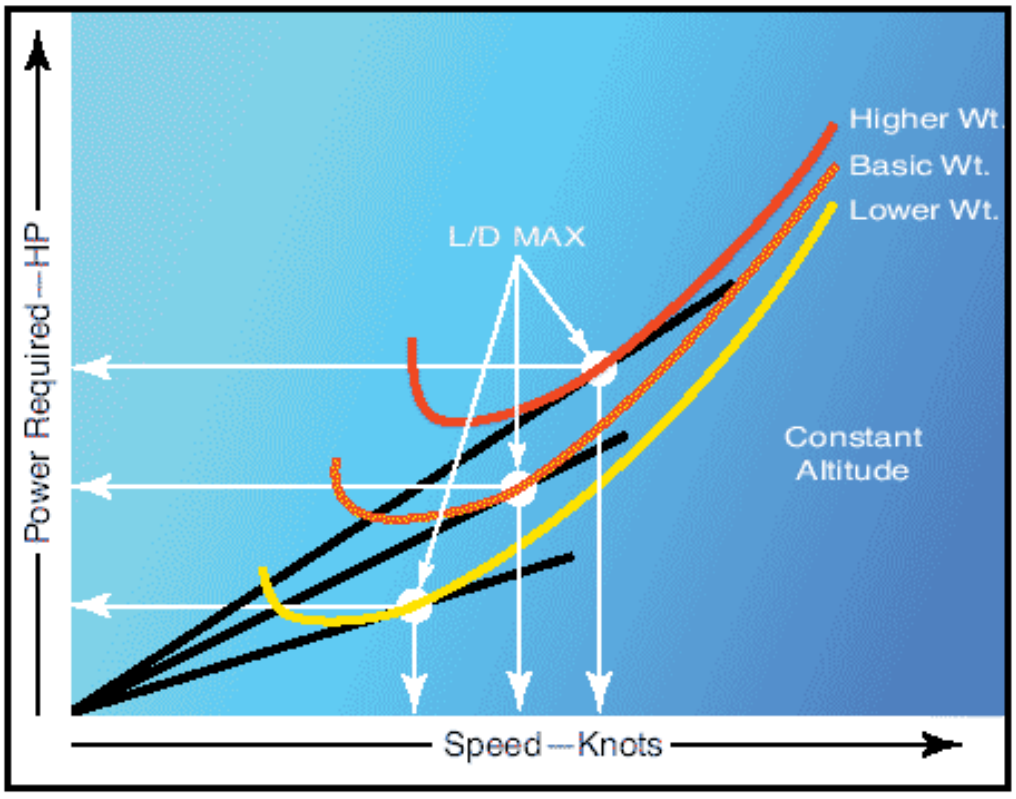
- Pressure differences between upper and lower wing surface creates span wise flow from high to low around the wing tips. This creates corkscrew like wingtip
- The vortices incline the vector of the lift force backwards, generating drag.
- Higher AoA -> More lift -> stronger pressure gradient -> more span wise flow -> more induced drag.
- Induced drag varies with $1/\sqrt{v}$ – Airspeed halved -> Induced drag -> Quadruples

Total Drag

- Adding up induced drag and parasite drag, we get total drag.
- Speed stability at over V_{MD}, speed instability below V_{MD}.

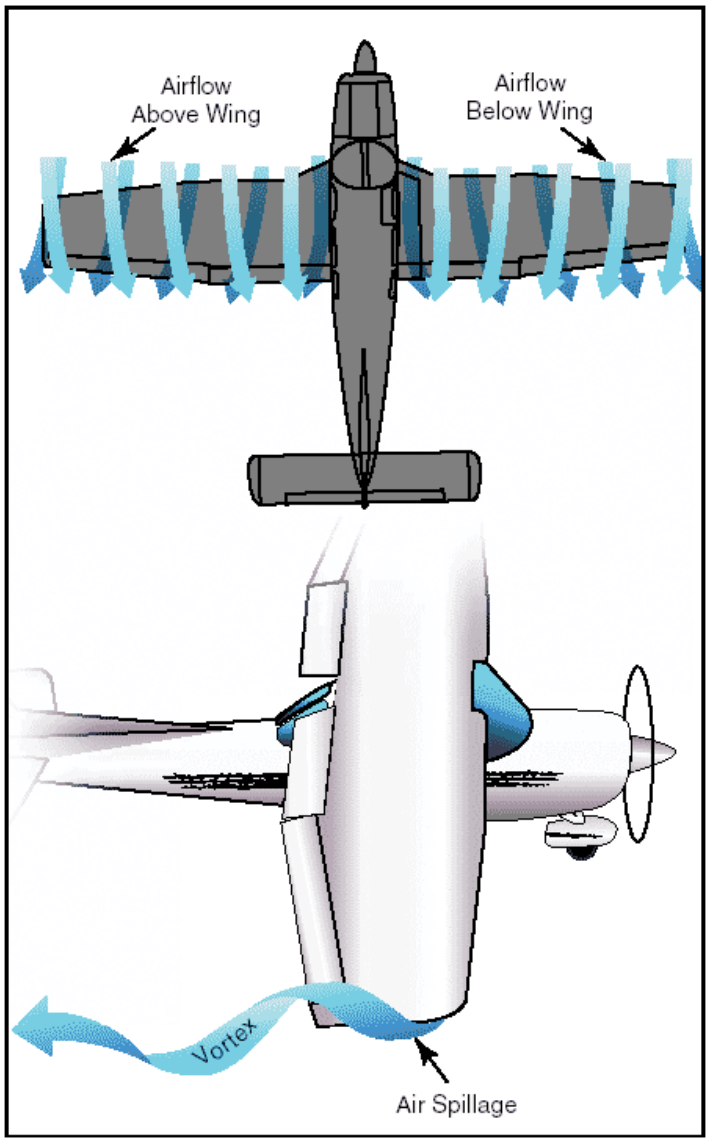
- The point of lowest drag is known as V_{MD}. That is also L/D_{MAX}, and speed for best glide ratio.
- Speed stability at over V_{MD}, speed instability below V_{MD}.





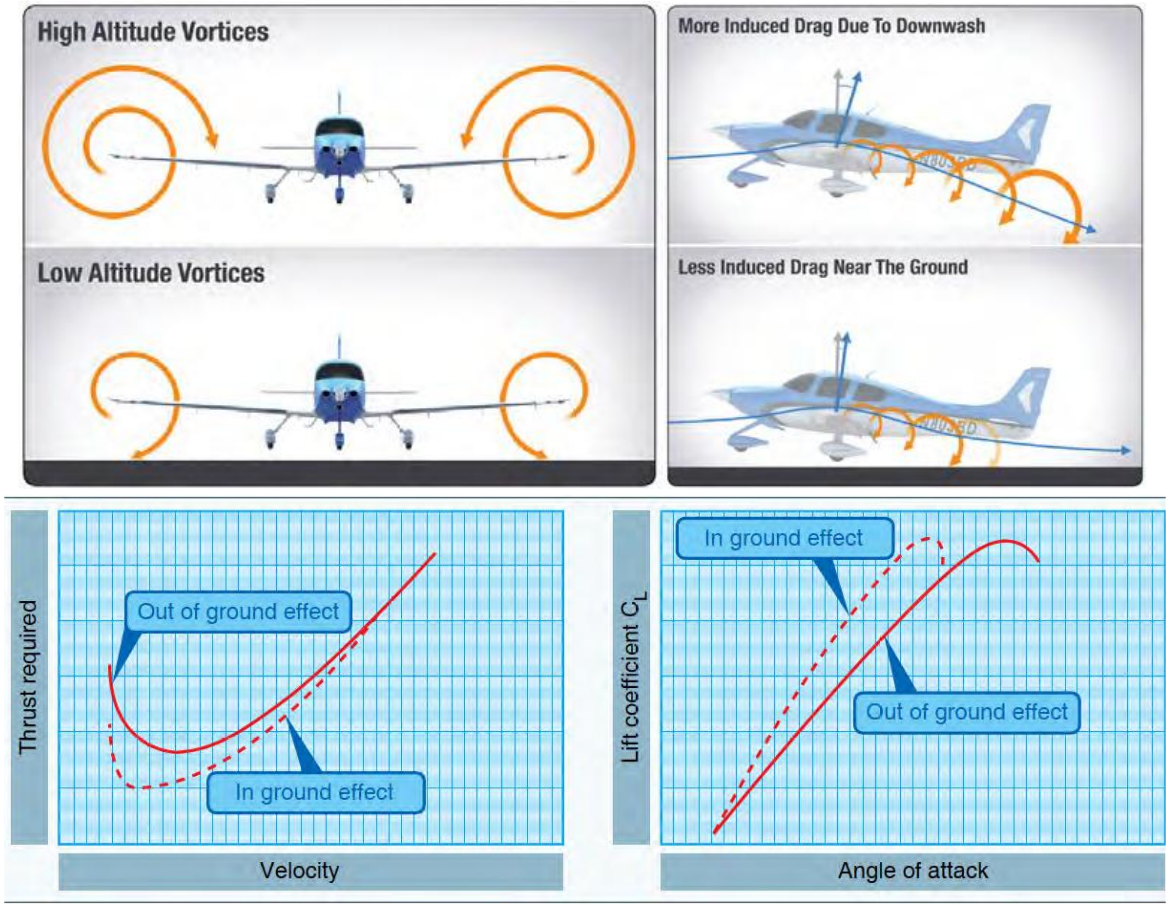
Wingtip Vortices

- Wing tip vortices cause wake turbulence and are generated as soon as lift is generated.



Ground Effect

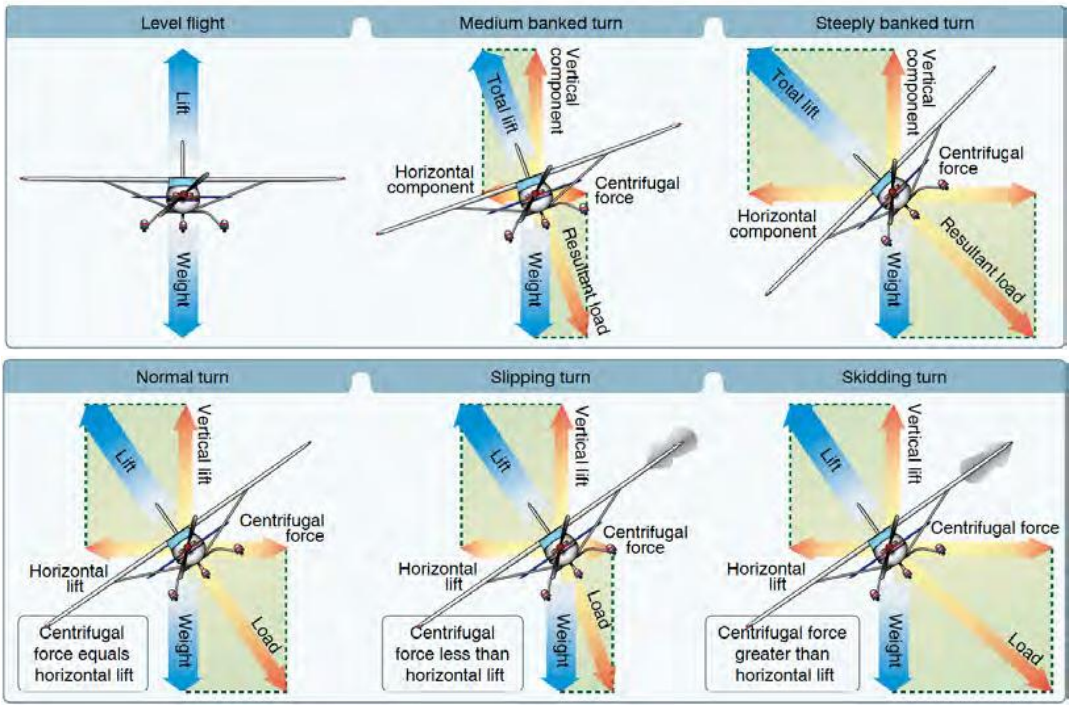
- It is possible to fly an airplane just clear of the surface (ground or water) at slightly slower airspeed than that required to sustain level flight at higher altitudes.



AERODYNAMICS LESSON 3

Aerodynamics of Turning Flight

Forces in Turns



Load Factor

- Any force applied to deflect an airplane from a straight line produces a stress on its structure. The amount of this force is called Load Factor.

Load Factor = Total load supported by the wings / Total weight of the airplane

Load factor vs. stall speed

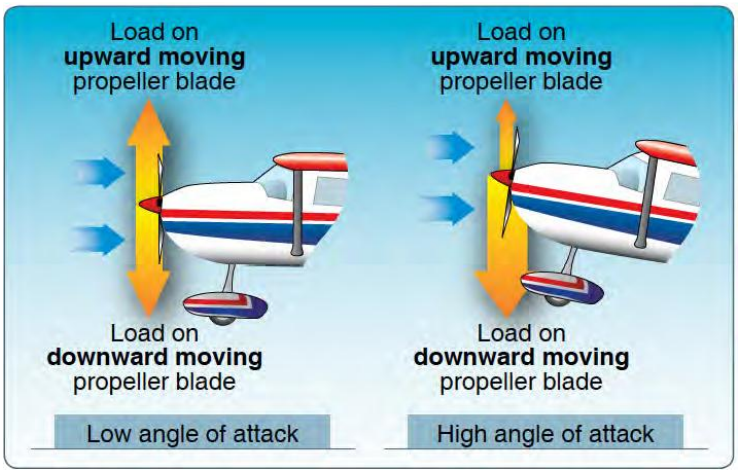
- If you bank and want to maintain altitude, the stall speed will increase.
- $V_S = V_{S1G} * \sqrt{n}$
- V_A = Maximum speed at which the airplane may be stalled safely
- Stalling the aircraft at a speed over V_A could impose damaging loads on the aircraft.
    - In a single axis only. (applying multiple axes changes simultaneously is not rated)

Load Factor in Turns

- As an aircraft is banked, more lift needs to be generated, because the loss in vertical lift component.

P-Factor

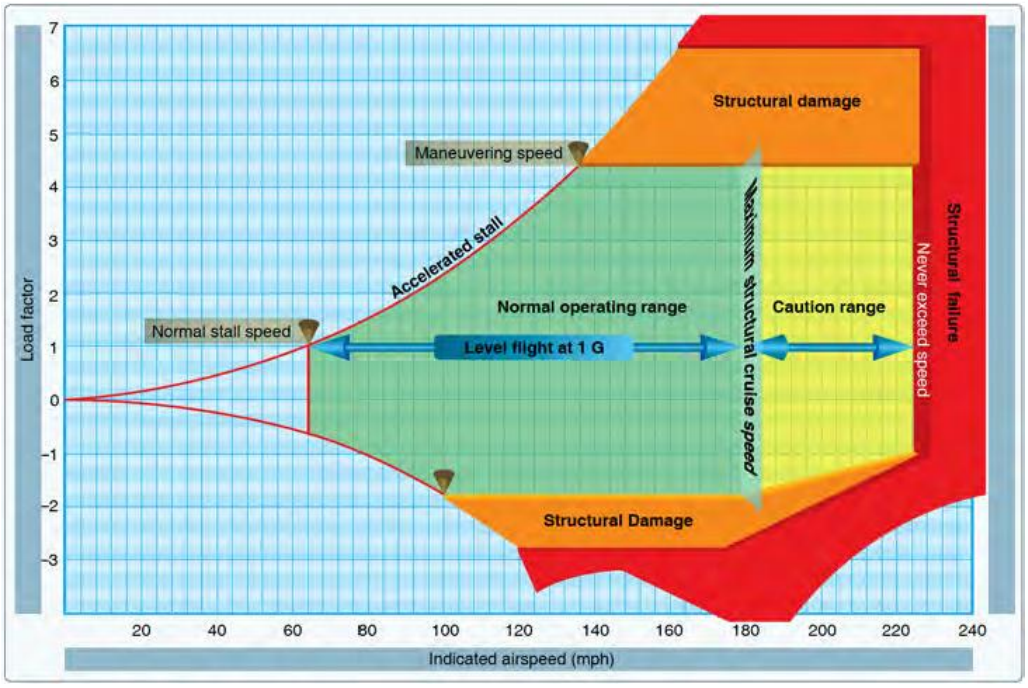
- When the airplane has an angle of attack, the angle of attack of the propeller will be larger on the down going blade.



Limitations

- When designing an aircraft, consideration must be taken to how high load factors are going to be expected in service.
    - Normal category: 3.8 g to -1.52 g
    - Utility category: 4.4 g to -1.76 g
    - Acrobatic: 6.0 g to -3.0 g
    - On aircraft the safety factor is 1.5

- The V-g diagram is a diagram of how many g's an airplane can produce at a specific airspeed, without causing structural damage.

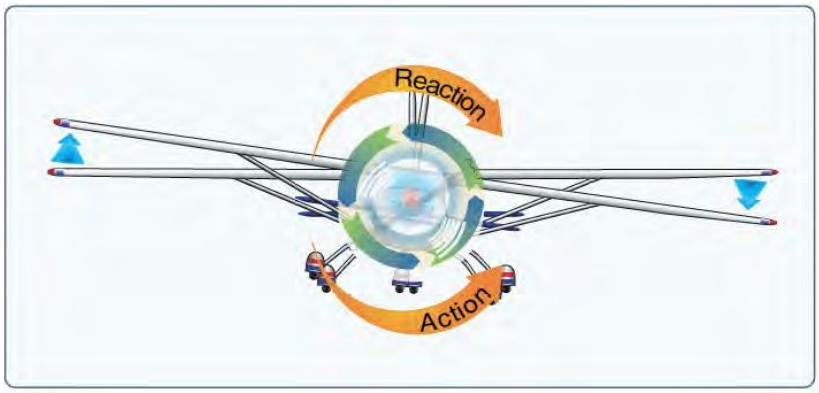


Turning Tendencies

While the propeller generates the thrust required to move the aircraft, it also generates some undesirable side effects affecting the control of the aircraft.

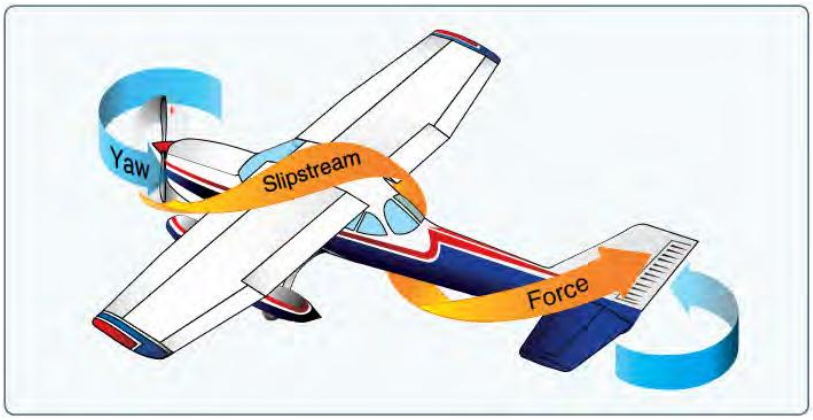
Torque

- Newton's 3rd law.
- Engine rotates propeller through the air in one direction, equal reaction in opposite direction creating a roll moment around the longitudinal axis.



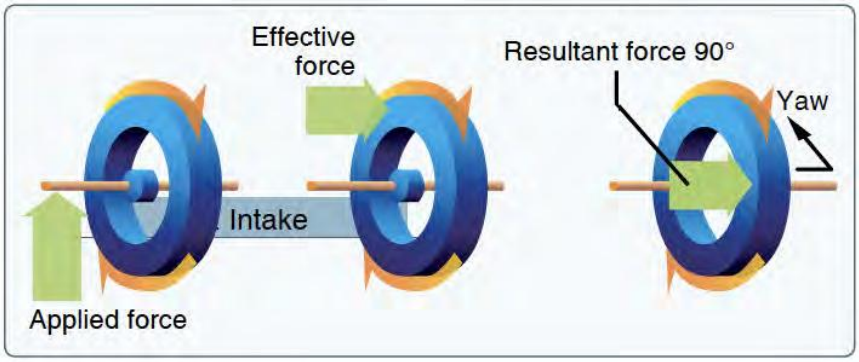
Spiraling Slipstream

- The rotation of the propeller will give the slipstream a spiraling motion, affecting the aerodynamics of the aircraft, especially when the airstream hits the fin.



Gyroscopic Precession

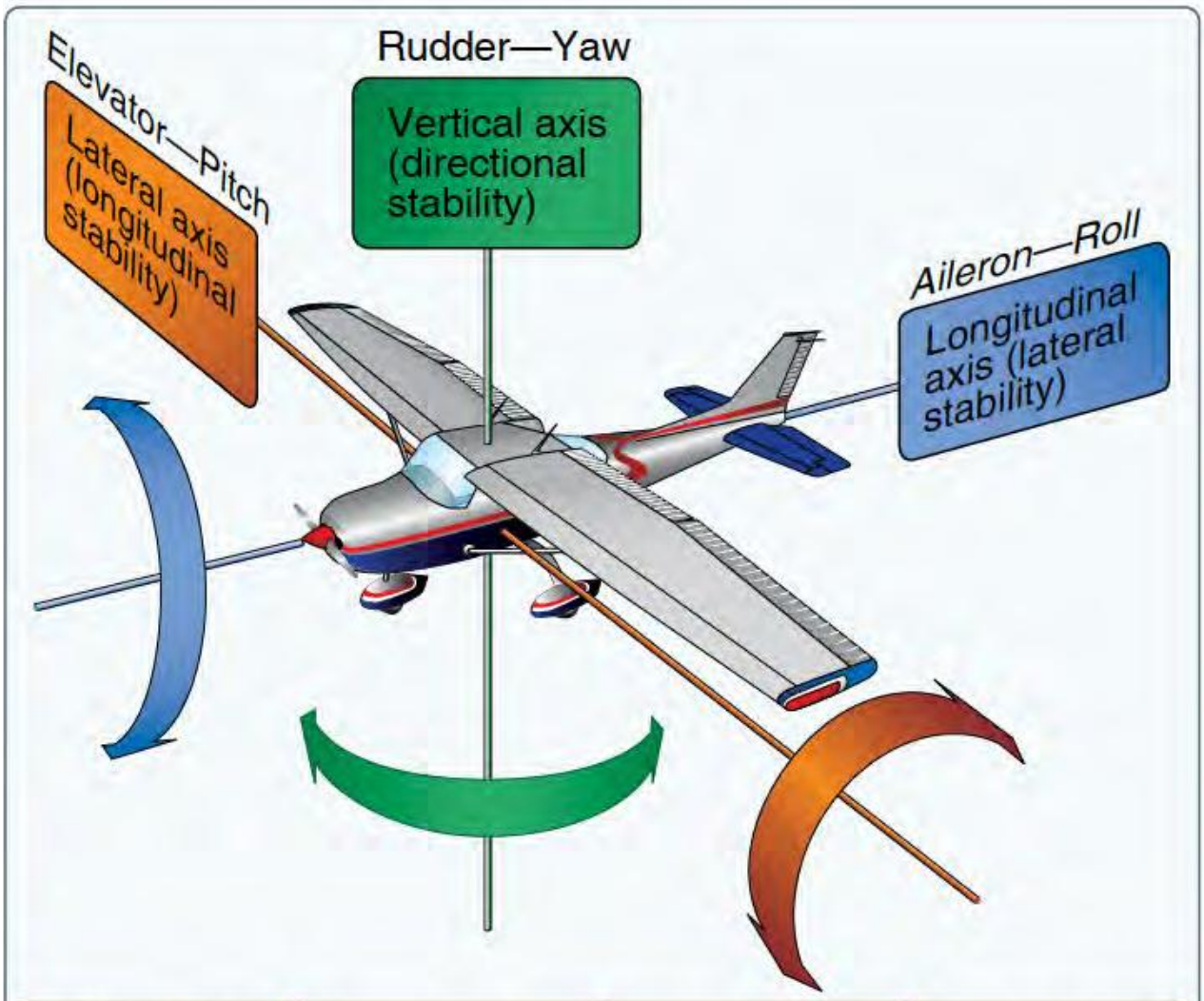
- When a force is applied to a spinning gyro that force will act from 90 degrees in the direction of the gyro spin. This is called gyroscopic precession.


Effective force
Resultant force 90°
Yaw
Intake
Applied force

AERODYNAMICS LESSON 4

Flight controls: How an airplane is controlled

Primary Flight Controls

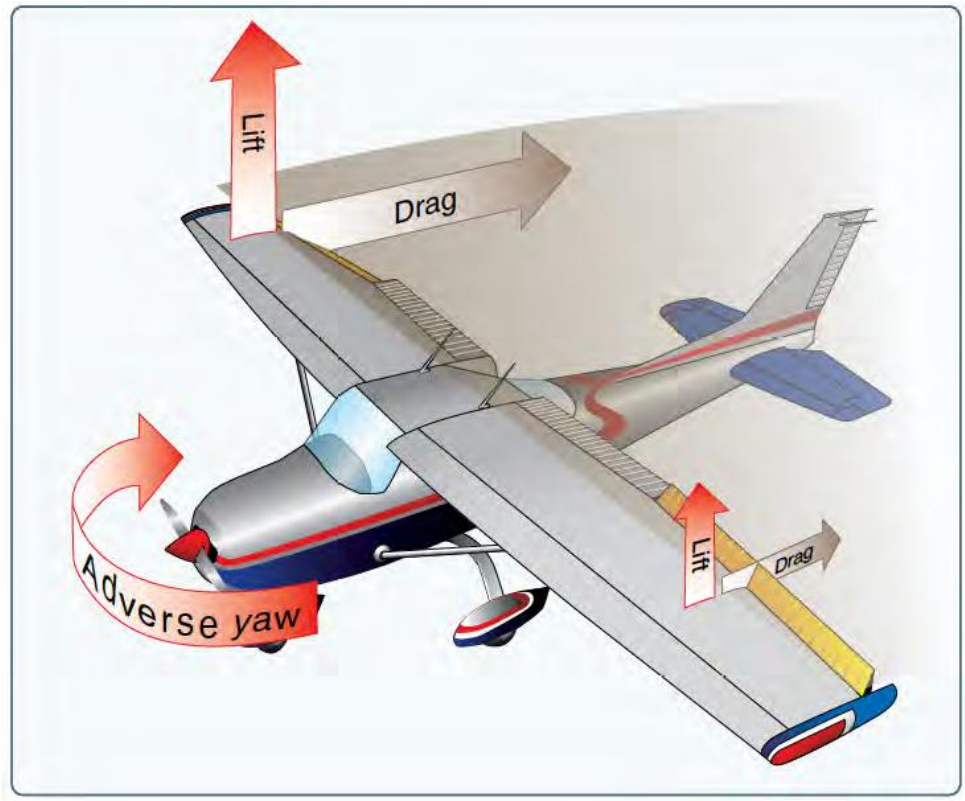


Primary Control Surface	Airplane Movement	Axes of Rotation	Type of Stability
Aileron	Roll	Longitudinal	Lateral
Elevator/ Stabilator	Pitch	Lateral	Longitudinal
Rudder	Yaw	Vertical	Directional

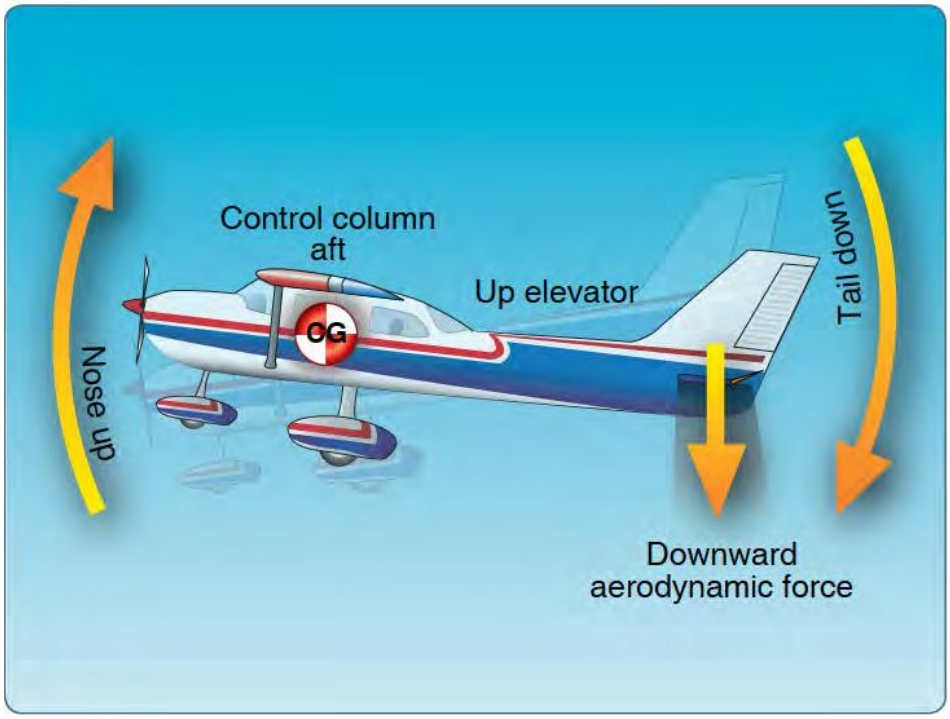
Primary Flight Controls

Rudder and Ailerons

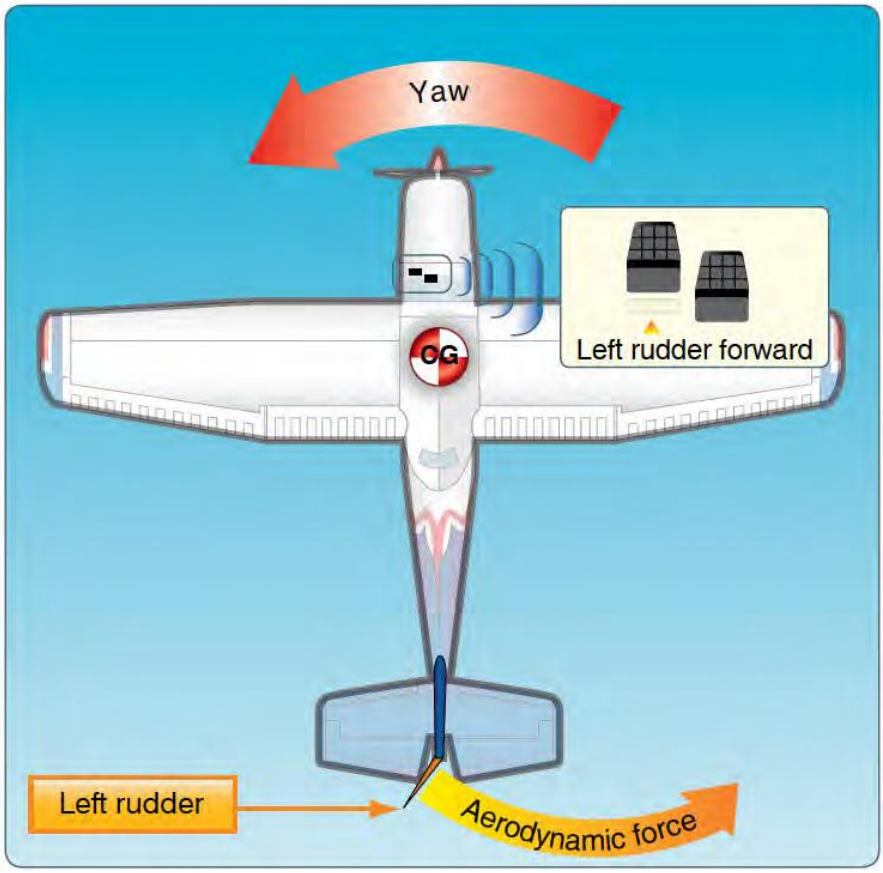




Elevator



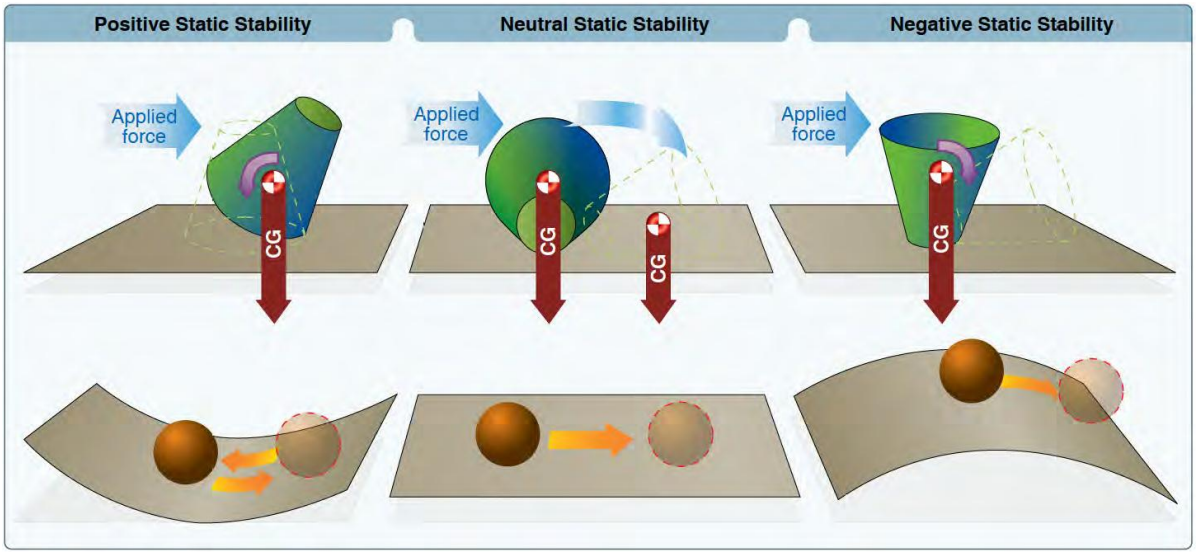
Rudder



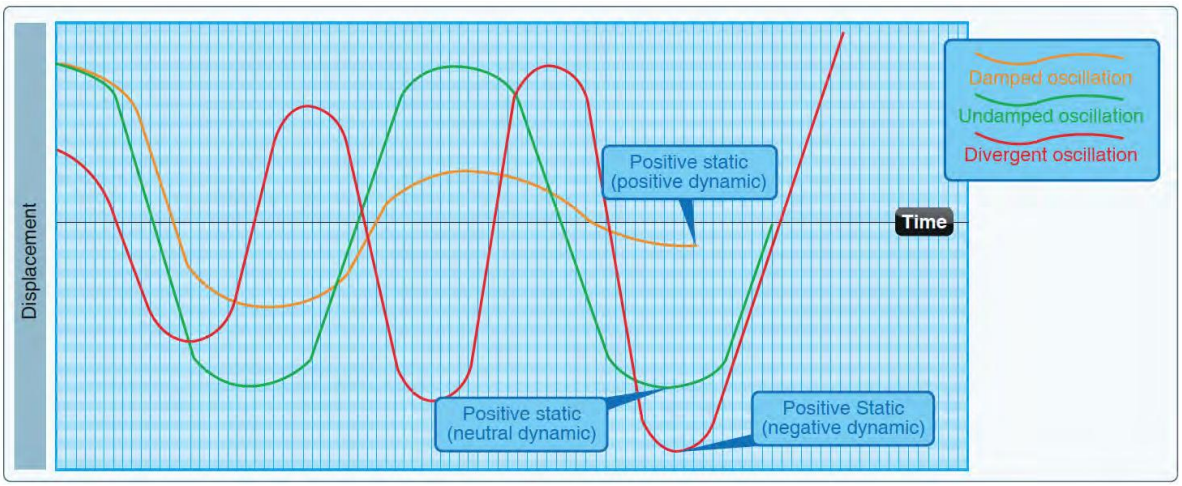
Stability, Controllability and Maneuverability

- Stability – "The inherent quality of an airplane to correct for conditions that may disturb its equilibrium, and to return or to continue on the original flight path".

Static Stability

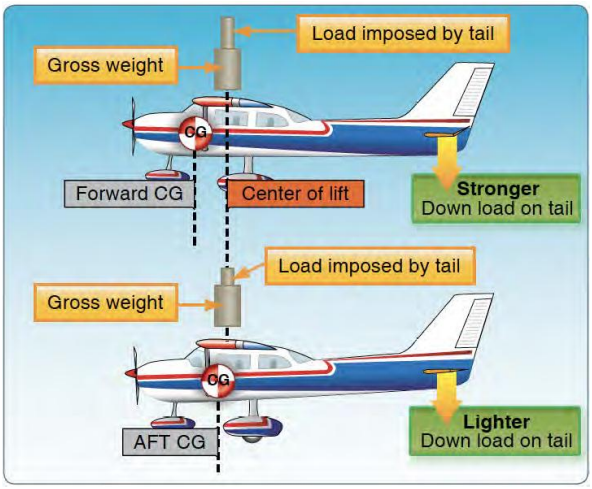


Dynamic Stability

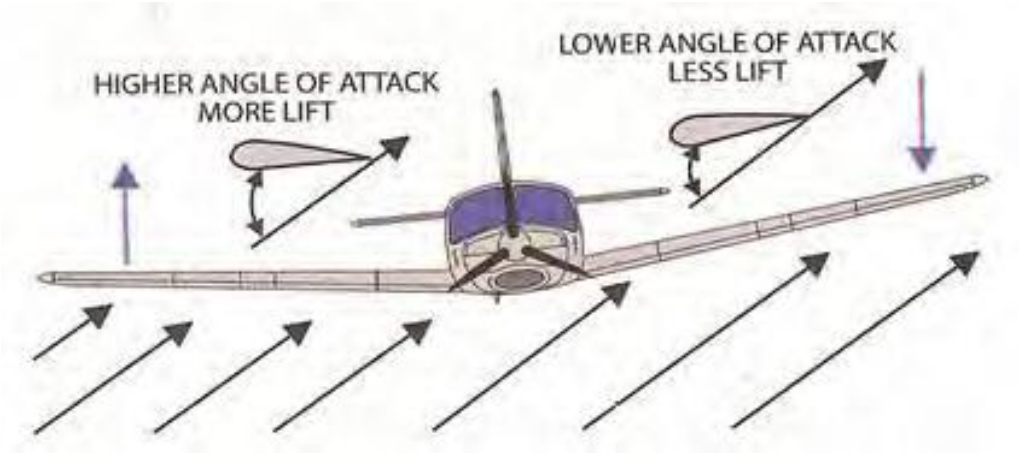


How do we achieve stability in an airplane?

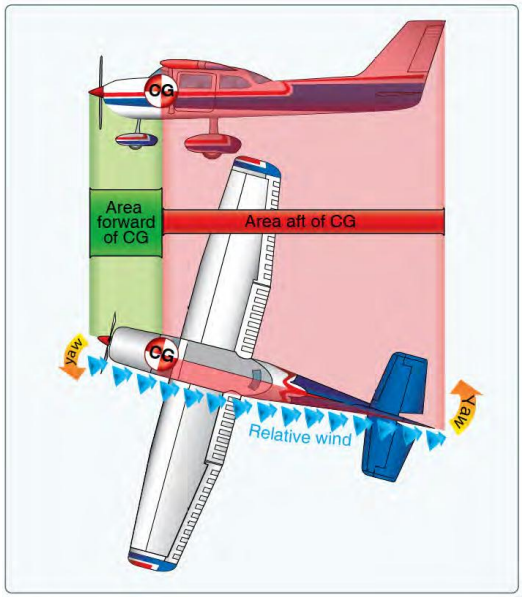
Pitch Stability



Roll Stability



Yaw Stability



XXX

LESSON: AIRWORTHINESS REQUIREMENTS

OBJECTIVE:

To be able to determine the airworthiness of an airplane using the airplane logbooks and other records and to understand what it means for an airplane to conform to its type certificate.

MOTIVATION:

The Pilot in Command is responsible for determining the aircraft's airworthiness prior to teach flight. With practice using the aircraft maintenance records this task can easily accomplished.

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate with models, and instructional aids, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate understanding to the instructor by describing the key points, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

The student will be able to use the aircrafts maintenance records to demonstrate the airworthiness of an airplane. The student determines if an aircraft can be operated with inoperative instruments and equipment from a scenario given by the flight instructor. The student will also determine how an aircraft can be flown if not airworthy from a scenario given by the flight instructor.

REFERENCES / EQUIPMENT NEEDED:

FAR 14 CFR 91, POH/AFM

IMAGES / MEDIA / LINKS:

CFI Notebook | AOPA.org |

AIRWORTHINESS REQUIREMENTS TIME: [1:30] HOURS

All aircraft are certified by their type certificate. This document contains the limitations, performance etc. of the airplane when the airplane was first certificated.
All aircraft must conform to their type certificates in order for the airplane to be airworthy. Missing screws, missing paint etc. are some examples of an airplane not conforming to its type certificate.

KEY POINTS:

Check MEL, KOL
91.205
ADs
Personal limitations

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE

COMMON ERRORS:

Recurring ADs — know what they are for your aircraft

QUESTIONS FOR THE STUDENT:

What Aircraft Documents are required to be on board for any flight operation?
[ARROW]
[Airworthiness Certificate]
[Registration Certificate]
[Radio Station License]
[Operating Handbook]
[Weight and Balance]
[External Data Plate]
[Compass Deviation Card]

What are the required Aircraft Inspections?
[AV1ATES]
[Annual Inspection]
[VOR Check]
[100 Hour Inspection]
[Altimeter Inspection]
[Transponder Inspection]
[ELT Functional and Battery Checks]
[Static/Encoder Inspection]

What are Airworthiness Directives (ADs)?
[Essentially recalls on aircraft parts. // They are mandatory and may not be overflown.]

What are Form 337s?
[Major Alterations or Repairs made to an aircraft.]

What are the required Day VFR Equipment Items?
[Airspeed Indicator]
[Tachometer]
[Oil Pressure Gauge]
[Manifold Pressure Gauge]
[Altimeter]
[Temperature Gauge]
[Oil Temperature Gauge]
[Fuel Quantity Indicators]
[Landing Gear Position Indicators
[Anti-Collision Lights]
[Magnetic Compass]
[ELT]
[Safety Belts]

What are the required Night VFR Equipment Items?
[ATOMATOFLAMES + FLAPS(Add Day VFR Equipment, plus:)]
[Fuses (spares)]
[Landing Light]
[Anti-Collision Lights]
[Position Indicator Lights]
[Source of Electricity]

AIRWORTHINESS REQUIREMENTS

DETERMINGING AIRWORTHINESS

- Documents
- Inspections
- Equipment

Documents - ARROW

1. **A**irworthiness Certificate (Valid as long as the airplane is conforming to its type certificate)
2. **R**egistration (Valid for 3 years)
3. **R**adio License (required only outside the US)
4. **O**perating Limitations (Usually in the POH or AFM)
5. **W**eight & Balance (In the airplane, either with the other documents or in the POH)

Inspections – AV1ATE-D

1. **A**nnual (12 calendar months - 91.409)
2. **V**OR (30 days - 91.171 - IFR Flight Only)
3. **1**00 Hour (required if aircraft is used for hire or flight instruction for hire-91.409(b))
4. **A**ltimeter/static (24 calendar months - 91.411 - IFR Flight Only)
5. **T**ransponder (24 calendar months - 91.413)
6. **E**LT
    - (12 calendar months inspection - 91.207(d) NOT RELATED TO THE BATTERY
    - ELT Battery replacement: ½ battery, 1hr cumulative use, if neither then on or before the battery expiration date on the battery and transmitter MUST be recorded in the Mx records - 91.207 (c)
7. A**D**'s - Airworthiness Directives - Located on an AD compliance record - 91.417(a)(2)(v)
    - AD's are used to notify aircraft owners and other interested persons of unsafe conditions and to specify the conditions under which the product may continue to be operated. AD's are regulatory and shall be complied with unless a specific exemption is granted
    - 91.417(a)(2)(v) requires a record to be maintained that shows the current status of applicable Ads and details to include
    - AD's are divided into two categories
        a) Those of an emergency nature requiring immediate compliance prior to further flight
        b) Those of a less urgent nature requiring compliance within a specified period of time The two basic types
            1) One-time - Must be recorded in the mx logbook with AD number, date of compliance and method of compliance)
            2) Recurring - Must be recorded in the mx logbook with AD number, date of compliance, method of compliance and when the AD is due again)

Required Equipment - TOMATO FLAMES + FLAPS 14 CFR 91.205
Day VFR Required equipment for - **TOMATO FLAMES** - 91.205

1. **T**achometer
2. **O**il pressure
3. **M**anifold pressure
4. **A**ltimeter
5. **T**emperature sensor
6. **O**il temperature

7. **F**uel gauge
8. **L**anding gear position indicator
9. **A**irspeed indicator
10. **M**agnetic compass
11. **E**LT
12. **S**eat belts

AIRWORTHINESS REQUIREMENTS

Night VFR Required equipment for - TOMATO FLAMES + **FLAPS**- 14 CFR 91.205
1. **F**uses or circuit breakers (spare)
2. **L**anding lights (if for hire)
3. **A**nti-collision lights
4. **P**osition lights
5. **S**ource of electricity

Minimum Equipment List (MEL)
1. Unique for each airplane - approved by FAA local office
2. Lists the items that DO NOT have to be working and what to do about them
3. Becomes a required document part of AROW

Procedures and limitations for determining airworthiness of the airplane with inoperative instruments and equipment without Minimum Equipment List (MEL)
- When inoperative equipment is found during preflight or prior to departure, you should:
    1. Cancel the flight, or
    2. Obtain maintenance prior to flight, or
    3. Defer the item or equipment

Procedures for deferring maintenance on aircraft without an approved MEL
- If the inoperative equipment is NOT required by the type design, 14 CFR, or AD's, and the aircraft can be safely operated without it, then the deferral may be made (explained by 91.213(d))
- The inoperative item shall be deactivated or removed, and an INOPERATIVE placard placed near the appropriate switch, control, or indicator.
- Removal must be accomplished by certified maintenance personnel and recorded according to part 43.
- Item must be repaired to pass next inspection according to 91.405(c) or it may be reinspected, and a logbook entry made that it does not represent a hazard to flight.
- Requirements and procedures for obtaining a special flight permit - 21.199
    - Special Flight Permit: allows the aircraft to be flown to another location for maintenance; allows an aircraft that may not currently meet applicable airworthiness requirements, but is capable of safe flight, to be operated under the restrictive special terms and conditions attached to the special flight permit.

Preventative Maintenance - 14 CFR 43.3 (g)
1. Replacing tires
2. Adding Oil
3. Replenishing hydraulic fluid
4. Replacing Safety belts
5. Cleaning

XXX
XXX

MANEUVERS



LESSON:	NORMAL TAKE-OFF

OBJECTIVE:

To transition the airplane from maneuvering on the ground to achieving flight.

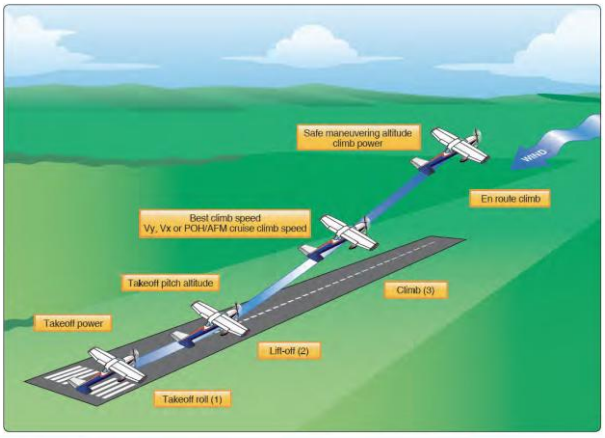
MOTIVATION:

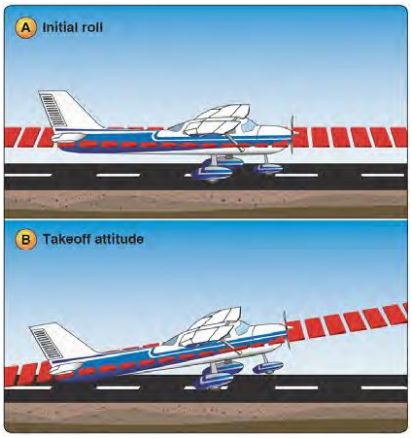
A safe transition from the ground to air is required on every flight.

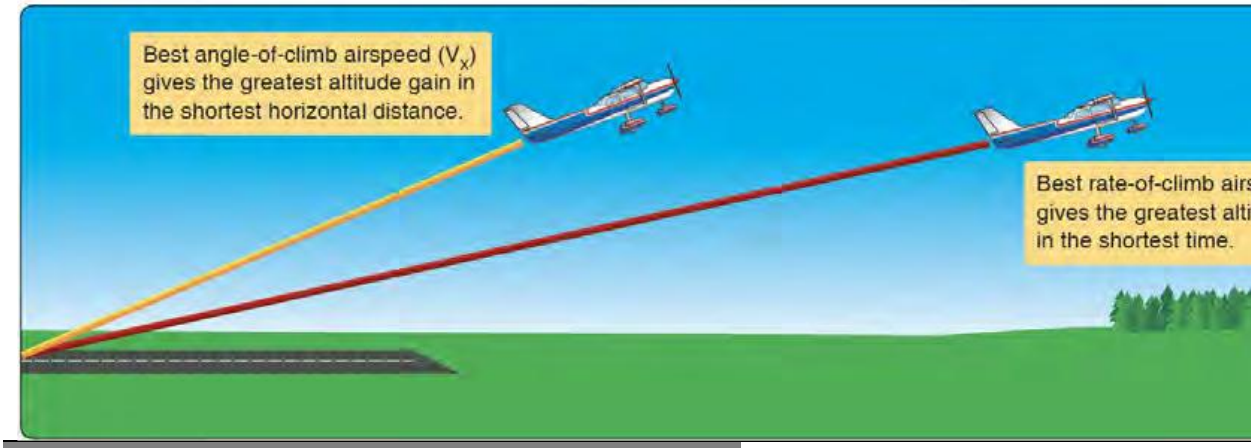
REFERENCES / EQUIPMENT NEEDED:

AIM; FAA-H-8083-2 RMH, FAA-H-8083-3 AFH, FAA-H-8083-25 PHAK POH/AFM
Aircraft

IMAGES / MEDIA / LINKS:







NORMAL TAKE-OFF	TIME:	[15] Minutes

1. Takeoff distance using POH, current weather. X-wind component. Safety briefing
2. Takeoff power and static RPM requirement (from limitations section of POH)
3. Position flight controls for wind. Clear area, Taxi on runway, nose wheel straight
4. Apply full power in 3 to 5 seconds to avoid swerving and engine hesitation.
5. Compensate for torque, P-factor and slipstream - controls get firmer with speed
6. Elevator becomes firmer - Rotate at Vr.
7. Set initial climb about 10 deg, tires will unstick, and the airplane will accelerate.
8. Pick a point well ahead to track to, wings level with aileron, stop yaw with rudder.

A safe transition from the ground to air is required on every flight.

KEY POINTS:

- Compensate for torque and P-factor. Keep one hand on throttle.
- Rotate at appropriate speed. - controls firm - set attitude.
- Climb at appropriate speed by adjusting pitch attitude and trim.

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE & CH 6-4 Flying Skills
Risk Management: Teach how to identify, assess and mitigate risks encompassing the following:
1. Selection of runway based on wind, pilot capability, and aircraft limitations.
2. The demonstrated crosswind component for the aircraft.
3. Wind shear.
4. Tailwind.
5. Wake turbulence.
6. Go/no-go decision-making.
7. Task management.
8. Low altitude maneuvering.
9. Wire strikes.
10. Obstacles on the departure path.
11. A rejected takeoff and predetermining takeoff abort criteria.
12. Handling engine failure during takeoff and climb.
13. Criticality of takeoff distance available.
14. Plans for engine failure after takeoff.

FLIGHT MANEUVERS GUIDE:

1. Configure aircraft for normal take-off.
a. Flaps up, proper trim, elevator neutral.
2. Line up on runway centerline.
3. Apply full power smoothly and fully. (3-5 seconds until full power from idle)
4. Confirm proper engine operation.
5. Compensate for the left turning tendencies - anticipate rudder required.
6. Rotate to initial climb attitude (Approximately 10 degrees) at Vr 55 KIAS.
7. Climb out at 80 KIAS.
8. Adjust for drift by tracking to a point well ahead that is in line with the runway

COMMON ERRORS:

• Failure to adequately clear the area prior to taxiing into position on the runway
• Abrupt use of throttle
• Failure to check engine instruments for signs of malfunction after applying take- off power
• Failure to anticipate the aircraft's left-turning tendency on initial acceleration
• Overcorrecting for the aircraft’s left-turning tendency
• Relying solely on the airspeed indicator rather than developed feel for indications of speed and airplane controllability during acceleration and lift-off
• Failure to attain the proper lift-off attitude
• Inadequate compensation for torque and P factor during initial climb, resulting in a sideslip
• Over-control of elevator during initial climb-out
• Limiting scan areas directly ahead of the airplane (pitch attitude and direction) resulting in allowing a wing to drop (usually the left) immediately after take-off
• Failure to attain/maintain an adequate climb-out speed
• Failure to employ the principles of attitude flying during climb-out, resulting in “chasing” the airspeed indicator

QUESTIONS FOR THE STUDENT:

What is the Private Pilot ACS Standards regarding climb Airspeed After Liftoff?
[Vy +10/-5kts]

When should a pilot retract his/her flaps after achieving liftoff?
[At a safe maneuvering altitude and airspeed.]

If a pilot needs to clear obstacles after achieving liftoff, he/she should pitch for an initial climb speed of…:

[Vx]

How should the pilot adjust his/her Wind Correction Inputs during the Takeoff Roll?
[Smoothly decrease Wind Correction Input as airspeed increases.]

If a pilot does not need to clear obstacles after achieving liftoff, he/she should pitch for an initial climb speed of...:
[Vy]

If the aircraft is equipped with Retractable Landing Gear, when should the gear be retracted after liftoff?
[When out of usable runway.]

A pilot should begin adding back pressure to the controls for liftoff when the aircraft reaches...
[Vr]

When should a pilot set the Flaps to the POH Recommendation?
[In the Run-Up Area.]

During the Takeoff Roll the pilot maintains Runway Centerline by...
[Use of the Right Rudder]

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

1. Verify ATC clearance and no aircraft are on final before crossing the hold line.
2. Verify aircraft is on the assigned/correct runway.
3. Ascertain wind direction with or without visible wind direction indicators.
4. Determine if the crosswind component is beyond the pilot's ability or aircraft manufacturer maximum demonstrated value.
5. Position the flight controls for the existing wind conditions.
6. Clear the area; taxi into the takeoff position and align the airplane on the runway centerline/takeoff path.
7. Confirm takeoff power; and proper engine and flight instrument indications prior to rotation:
8. Rotate and lift-off at the recommended airspeed and accelerate to VY (or other speed as appropriate for aircraft).

LESSON:	NORMAL CLIMBS

OBJECTIVE:

To establish a climb at a constant airspeed and direction while keeping the airplane coordinated.

MOTIVATION:

Every flight involves a climb. As one of the four fundamentals of flying, mastering this skill is part of a pilot's basic skills to control the airplane.

REFERENCES / EQUIPMENT NEEDED:

FAA-H-8083-2 RMH, FAA-H-8083-3 AFH, FAA-H-8083-15 IFH, FAA-H-8083-25 PHAK
Aircraft

IMAGES / MEDIA / LINKS:

CFI NOTEBOOK



NORMAL CLIMBS	TIME:	[10] Minutes

1. Constant Airspeed or Rate? - Explain Vx and Vy
2. Attitude - Cowling to horizon - Target Airspeed with pitch
3. Sequence to start a climb - Power, attitude, trim.
4. Wings level with aileron, track straight ahead with rudder. ASI, ALT, HI, Ball
5. Anticipate and correct for left turning tendencies. - No side to side motion.

KEY POINTS:

Airspeed is KING

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE & CH 6-4 Flying Skills

FLIGHT MANEUVERS GUIDE:

1. Clear the area in the direction of the climb.
2. Determine desired climb airspeed.
3. Apply full throttle.
4. Apply elevator back-pressure.
    - o Cowling on the horizon.
5. Level wings with aileron - Horizon not tilted
6. Stop yaw (heading change) with appropriate rudder.
7. ASI to determines airspeed, HI for direction, Inclinometer for coordination.
    - o Adjust airspeed with pitch
8. Eliminate control pressure with trim.

COMMON ERRORS:

• Attempting to establish climb pitch attitude by referencing the airspeed indicator, resulting in chasing the airspeed

• Applying elevator pressure too aggressively, resulting in an excessive climb angle
• Inadequate or inappropriate rudder pressure during climbing turns
• Allowing the airplane to yaw in straight climbs, usually due to inadequate right rudder pressure
• Fixation on the nose in straight climbs, resulting in climbing with one wing low
• Improper coordination, resulting in a slip which counteracts the effect of the climb, resulting in little or no altitude gain
• Attempting to exceed the airplane's climb ability.

QUESTIONS FOR THE STUDENT:

What is the Private Pilot ACS Standards regarding climb Airspeed After Liftoff?
[Vy +10/-5kts]

When should a pilot retract his/her flaps after achieving liftoff?
[At a safe maneuvering altitude and airspeed.]

If a pilot needs to clear obstacles after achieving liftoff, he/she should pitch for an initial climb speed of...:
[Vx]

How should the pilot adjust his/her Wind Correction Inputs during the Takeoff Roll?
[Smoothly decrease Wind Correction Input as airspeed increases.]

If a pilot does not need to clear obstacles after achieving liftoff, he/she should pitch for an initial climb speed of...:
[Vy]

If the aircraft is equipped with Retractable Landing Gear, when should the gear be retracted after liftoff?
[When out of usable runway.]

A pilot should begin adding back pressure to the controls for liftoff when the aircraft reaches...
[Vr]

When should a pilot set the Flaps to the POH Recommendation?
[In the Run-Up Area.]

During the Takeoff Roll the pilot maintains Runway Centerline by...
[Use of the Right Rudder]

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

At the end of this lesson the student should understand the basic concepts of normal climbs. The student should be able to perform this maneuver with the assistance of a flight instructor.
There are no required Airman Certification Standards (ACS) identified normal climbs.
A proficient student pilot should be able to maintain airspeed +/- 10 knots and maintain a heading of +/- 10 degrees. Coordinated flight should be maintained. The pilot should also understand how to properly trim the airplane for a constant airspeed climb.

LESSON:	GO AROUNDS

OBJECTIVE:

To ensure the student understands the purpose, decision-making process, and proper execution of a go-around to safely abort a landing and climb back to safety.

MOTIVATION:

To avoid a dangerous scenario on the ground, A go-around is the standard procedure to discontinue an unsafe approach and regain a safe landing configuration.

REFERENCES / EQUIPMENT NEEDED:

AFH: FAA 8083-3A
POH
Airplane

IMAGES / MEDIA / LINKS:

AOPA Link : https://www.aopa.org/training-and-safety/students/presolo/skills/go-around
FAASafety: GO AROUNDS:
https://www.faasafety.gov/files/events/SW/SW17/2024/SW17132882/GoArounds.pdf

AFH H-8083-3C CH9-10: Go-Arounds (Rejected Landings)

GO AROUNDS	TIME:	[60] Minutes

Recognizing when to execute a Rejected Landing:

Unstable Approach: If you are not on speed, on glide path, or on centerline by 500 feet AGL, it's time to go around.

Runway Hazards: Any foreign object debris (FOD), wildlife (like gators in Florida), or other unexpected obstacles on the runway.

Traffic: Another aircraft on the runway or another conflicting traffic situation.

Wind Conditions: Sudden gusts, wind shear, or conditions exceeding your personal minimums that destabilize your approach.

Wake Turbulence: Encountering and being affected by wake turbulence from a preceding aircraft.

Mechanical Issues: Experiencing a mechanical failure or malfunction during the approach.

Instructor/ATC Guidance: If your flight instructor or air traffic control tells you to go around.

========== ==========

The GO AROUND sequence for all aircraft:
-POWER

-PITCH

-RECONFIGURATION: (FLAPS, GEAR, Cowl Flaps or Carb Heat)

-RADIO CALL

KEY POINTS:

AOPA:
A handy reminder for a go-around or missed approach is: "C.C.C.C."

Cram it: refers to adding full power.
Clean it: refers to retracting flaps (in increments) and landing gear.
Cool it: is a reminder to open the cowl flaps.
Call it refers to announcing your action to ATC, or CTAF

You don't have to wait until the aircraft is sliding sideways off the runway or bouncing 10 feet into the air before deciding that a particular landing is not worth the aggravation.
Good go-arounds start early in a bad landing sequence.
If it's not looking good halfway down final approach, go against your basic instincts and start on the road to recovery right then.

The AOPA Says: If every pilot did just one go-around for practice every 90 days, we could eradicate this accident cause.

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE & CH 6-4 Flying Skills

FLIGHT MANEUVERS GUIDE:

POWER:
Full power is the first thing needed to get the aircraft climbing, but how it's applied is just as important as when.
-Remember, All the torque and left-turning tendencies kick in.
--Right Rudder sooner is much better than less rudder later.
-Reminder to Remove Carb Heat or Ajust the Cowl Flaps to the "Take Off" Position.

PITCH:
Pitch attitude must be adjusted from landing to climb;
With a transition through level.
If the go-around occurs prior to the flare, raising the nose to "level flight" should arrest the descent.

In many aircraft you'll need to hold the nose level with -forward pressure- in order to keep the airplane from attaining too high an Angle of Aattack as power is added.
Another tricky thing about go-arounds — we want to go up but have to hold the nose down.

RECONFIGURATION:

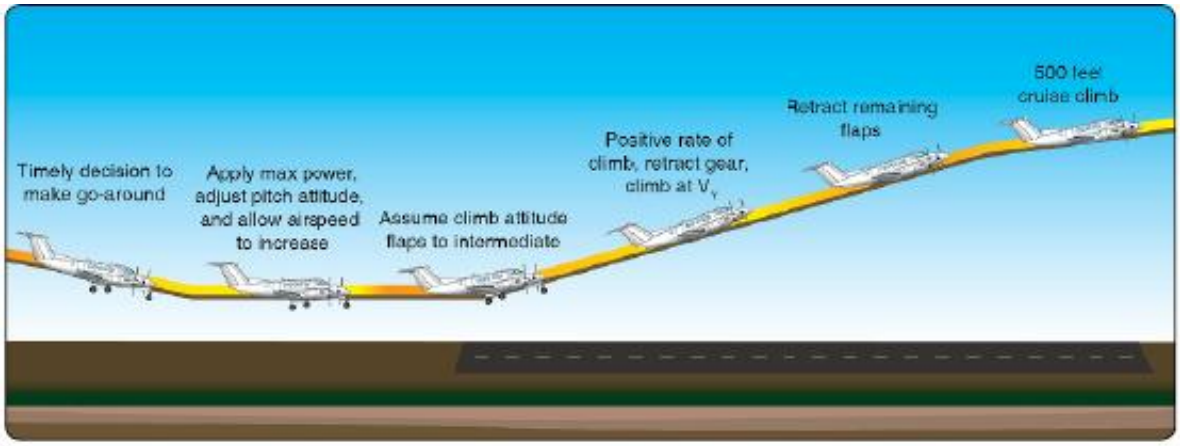


Figure 9-12. *Go-around procedure.*

Flaps:
Retract the flaps as recommended by the manufacturer.
This usually means going to half or "approach" flaps.
-Single-engine Cessnas such as the 150 or 172 sometimes won't climb with 40 degrees of flap.
-On the later models, Cessna limited the travel to 30 degrees to give the pilot a little more performance, and that's usually all you will get — a little more.
The procedure is to retract the flaps immediately to 20 degrees:
- then go for climb airspeed.
Remember that the pitch attitude, will be much lower than the "normal" no-flaps climb attitude.
Once the aircraft has cleared the obstacle AND has adequate speed,
-then retract the remainder of the flaps.
-AFTER the power, pitch attitude, and flaps are set; RE-TRIM to take pressure off the control yoke.

Gear:
Raise the landing gear, if it's retractable.
This is done only when the vertical speed indicator shows a positive climb; so that if the aircraft should settle to the runway despite our best efforts, there's a only a minor delay in getting airborne again, which is preferable to experiencing a belly slide.

Cowl Flaps or Carb Heat:
Verify that Cowl Flaps or Carb Heat is in the TAKEOFF Position. This should be done, when you are applying full power, as per the aircraft's POH, however, you want to verify it here.

Radio Call:
Make a radio call to Air Traffic Control (ATC) or announce your intentions to other pilots in the area, but remember that aircraft control is the priority, not making the call.

COMMON ERRORS:

Pre-Initiation Errors
Indecision:
Hesitating to initiate the go-around when a situation warrants it, wasting valuable altitude and runway space.

Unstable Approach:
Not recognizing the instability of an approach (e.g., not on speed, not aligned, or not configured) and attempting to salvage a poor landing instead of going around.

Delayed Decision:
Waiting too long to start the go-around, making it difficult to clear obstacles off the end of the runway.
Power and Pitch Control Errors

Improper Pitch Attitude: Abruptly or violently pitching up, which can lead to a stall, especially at low airspeeds.

Delayed Power Application: Failing to add maximum allowable power quickly and smoothly.

Incorrect Sequence: Retracting flaps or gear before adding sufficient power, causing the aircraft to lose lift and sink.
Control and Coordination Errors

Failure to Control Yaw:
Not applying enough right rudder to counteract the left-turning tendencies (P-factor and spiraling slipstream) that occur when power is added.

Stalling the Aircraft:
Performing a violent pitch-up or failing to maintain airspeed can lead to a stall during the climb.

Loss of Directional Control:
Allowing the airplane to drift to the left or lose control during the climb-out.

Configuration and Airspeed Errors
Improper Flap/Gear Retraction: Retracting flaps too early or too quickly, causing the aircraft to sink.

Premature Climb Out of Ground Effect: Attempting to climb out before sufficient speed and altitude are gained, leading to a stall.

Incorrect Airspeed: Failing to maintain recommended airspeeds, which can lead to a stall or sink during the climb.

Post-Go-Around Errors

Improper Trim:
Neglecting to re-trim the aircraft for the new climb configuration, making it harder to control.

Inadequate Climb Path:
Not pitching the aircraft for the best rate of climb, essentially "hovering" above the runway instead of gaining altitude and distance.

Multiple Go-Arounds:
Attempting a go-around multiple times, which can be a symptom of a larger problem or lead to increased risk and potential accident.

QUESTIONS FOR THE STUDENT:

Why Go Around? (Situations & Scenarios)
How to Go Around? (Procedure)

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

Rejected landings/Go-Arounds are listed in all landing scenarios in the ACS:
Ground (Knowledge & Risk Management)

Purpose of the Go-Around:
You should be able to explain why and when a go-around is necessary, and the basic procedure.

Risk Management:
You must identify the risks involved, such as delaying the decision or executing the maneuver improperly.
Overpitching:
You must understand the tendency to overpitch after applying power and know how to counter it.

Flight (Skills)
Decision: The decision to go around must be made in a timely manner.
Application of Power: Immediately apply full power smoothly.
Carburetor Heat: Turn off carburetor heat to ensure maximum allowable takeoff power, if applicable.

Attitude & Airspeed: Maintain a climb at the appropriate speed for the conditions (Vx or Vy). The speed must be maintained within a specific tolerance, typically +/-10 knots for Private Pilots.
Climb Gradient: Achieve the required climb gradient for your aircraft, ensuring a positive rate of climb is established and verified.
Configure the Aircraft: After a positive rate of climb is verified, complete the appropriate checklist to configure the aircraft as per manufacturer instructions.

Resist Overpitching: You must actively resist the impulse to pitch up excessively if airspeed is insufficient.
Key Components of the ACS

Flight Checklists:
When preparing for the go-around, you may be asked to refer to the appropriate checklist for the system or equipment malfunction.

LESSON: STRAIGHT AND LEVEL FLIGHT

OBJECTIVE:

To maintain a constant altitude and constant direction while keeping the airplane coordinated.

MOTIVATION:

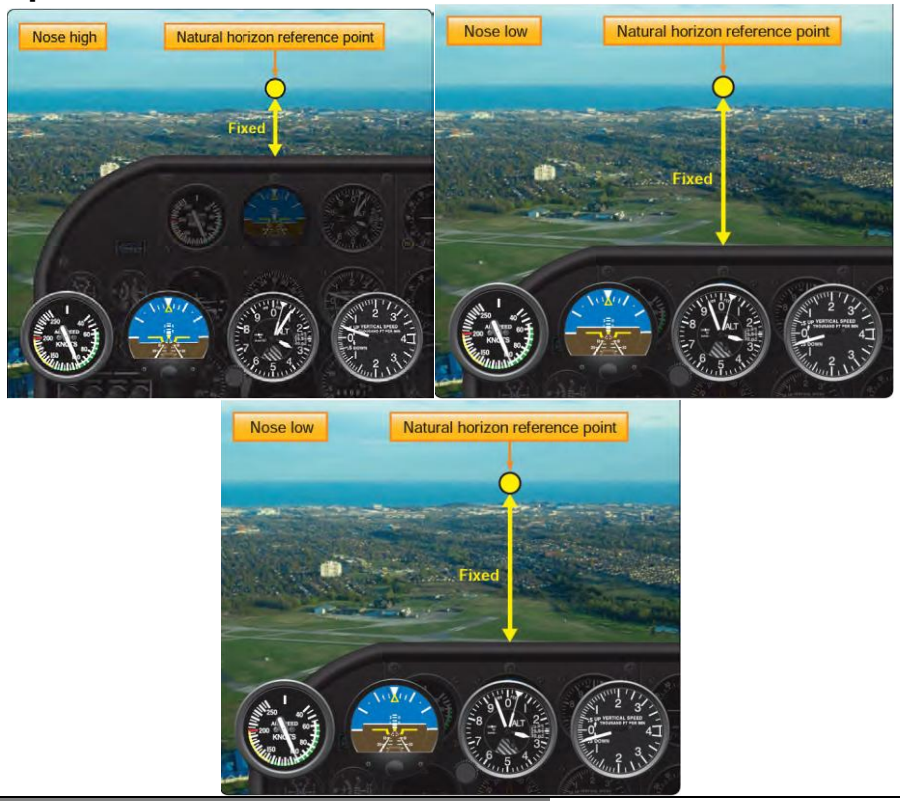
On most flights the majority of the time the airplane needs to be in straight and level flight, so it's an essential skill.

REFERENCES / EQUIPMENT NEEDED:

FAA-H-8083-2 RMH, FAA-H-8083-3 AFH, FAA-H-8083-15 IFH, FAA-H-8083-25 PHAK
Aircraft

IMAGES / MEDIA / LINKS:

[CFI NOTEBOOK]



STRAIGHT AND LEVEL FLIGHT TIME: [10] Minutes

On most flights the majority of the time the airplane needs to be in straight and level flight, so it's an essential skill.

1. Definition - Constant altitude, constant direction, coordinated.
2. Setting the cowling 3 to 4 inches below the horizon - Constant Altitude.
3. Level horizon - No banking, equal spacing under left/right wingtips -Constant direction.
4. Not sliding left or right in the seat - Coordinated.
5. Altimeter = Altitude, Heading Indicator = Direction, Inclinometer = Coordination
6. Trim to eliminate aerodynamic pressure - Set attitude then trim.

KEY POINTS:

- After setting the attitude - Cross check the altimeter so measures the results
- The cowling won't be on the horizon in level flight - 4 inches below

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE & CH 6-4 Flying Skills

FLIGHT MANEUVERS GUIDE:

1. Lower pitch attitude until the cowling is at 3-4 inches below the horizon.
2. Verify that the altimeter is at the target altitude and not moving.
3. Observe that the wing tips are parallel to the horizon and each one is the same distance above the horizon.
4. Set the throttle for 2,100 RPM. - Approximately 90 Kts
5. Observe whether the airplane is yawing, and if so correct with appropriate rudder input.
6. Verify that the heading indicator is not moving.
7. Verify that the ball in the middle on the Inclinometer.
8. Remove control pressure with trim.

COMMON ERRORS:

- Failure to adequately clear the area
- Failure to adequately anticipate the level-off
- Failure to coordinate the flight controls
- Failure to use visual cues and instrument indication in combination to achieve straight and level flight
- Failure to scan for traffic

QUESTIONS FOR THE STUDENT:

Select all of the cockpit instruments that can be used to determine and control and aircraft's pitch:
[Vertical Speed Indicator]
[Airspeed Indicator]
[Attitude Indicator]
[Altimeter]

If an aircraft's lift becomes greater than it's weight, the aircraft will...
[Climb]

Select all of the cockpit instruments that can be used to determine and control an aircraft's bank:
[Magnetic Compass]
[Turn Coordinator]
[Attitude Indicator]
[Heading Indicator]

If an aircraft's drag becomes greater than it's thrust, the aircraft will...
[Decelerate]

Straight and Level Flight is achieved when...
[Thrust = Drag & Lift = Weight]

If an aircraft's thrust becomes greater than it's drag, the aircraft will...
[Accelerate]

Integrated Flight Instruction Means using outside references in conjunction with inside flight instruments to achieve and maintain desired flight attitudes.:
[True]

If an aircraft's weight becomes greater than it's lift, the aircraft will...:
[Descend]

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

At the end of this lesson the student should understand the basic concepts of straight and level flight. The student should be able to perform this maneuver with the assistance of a flight instructor.
There are no required Airman Certification Standards (ACS) identified for straight and level flight. A proficient student pilot should be able to maintain altitude at +/- 100 feet and maintain a heading of +/- 10 degrees. Coordinated flight should be maintained.
The pilot should also understand how to properly trim the airplane for straight and level flight.

LESSON:	POWER ON STALLS

OBJECTIVE:

To develop recognition of an impending stall or stalled condition in the take- off configuration, and prevent a stall from occurring or un-stall the airplane if stalled.

MOTIVATION:

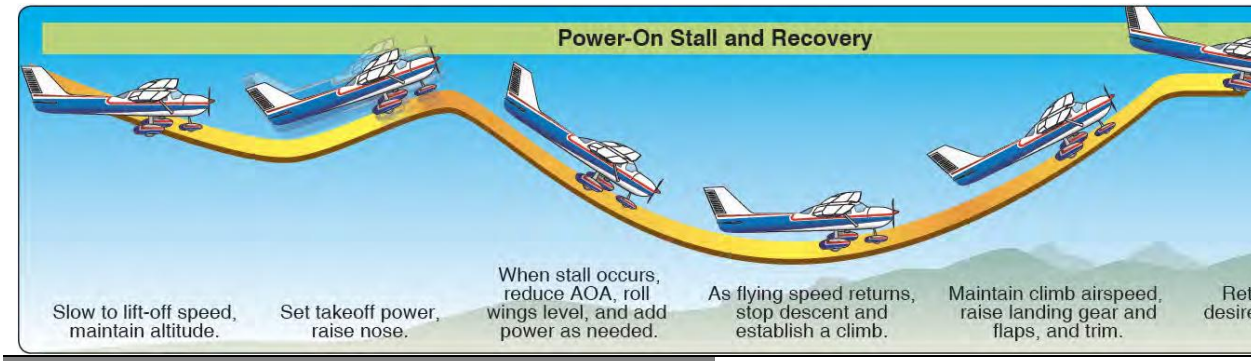
Recognizing, preventing and recovering a power-on stall prevents takeoff and departure stalls.

REFERENCES / EQUIPMENT NEEDED:

AC61-67 Stall and Spin Awareness Training; FAA-H-8083-2 RMH, FAA-H-8083-3 AFH, FAA-H-8083-25 PHAK
POH/AFM
Airfraft

IMAGES / MEDIA / LINKS:

CFI Notebook



POWER ON STALLS	TIME :	[15] Minutes

1. Stall aerodynamics - Critical AOA, not airspeed dependent, flight path vs relative wind.
2. Angle of attack vs lift - Can generate lift at low speeds but not more than the critical angle
3. Airplane configured in the take-off configuration, clean, 55 KIAS, climbing.
4. How to induce the stall - Power 65% or more - raise the nose to a stalling attitude.
5. Importance of coordination - Avoid a stall with Yaw (Describe spin basics)
6. Approach to stall indications. Loss of control effectiveness, stall warning horn, buffeting.
7. Full stall indications - Un-commanded nose down attitude and possible wing drop.
8. The stall recovery procedure - Reduce AOA with elevator until the stall symptoms are gone, use full power to minimize altitude loss and rudder to stop yaw.
9. If a wing drops, prevent it from dropping further with rudder. Un-stall the wing with elevator, then level with wing with aileron. Do NOT level the wings with rudder.
(Possible spin - Stall with Yaw.)

KEY POINTS:

- Airplane will be in the takeoff configuration at a higher than normal attitude. The speed will be Vr.
- To un-stall an airplane the only thing necessary to do is reduce the AOA with elevator.
- If full power is not used, ensure you have use full power to minimize altitude loss.
- Wing drop during the power on stall more likely due to enhanced left turning tendencies.

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE & CH 6-4 Flying Skills
Risk Management: Teach how to identify, assess and mitigate risks encompassing the following:
1. Aerodynamic factors (angle of attack (AOA), airspeed, load factor, aircraft configuration, aircraft weight, and aircraft attitude.)
2. The range and limitations of stall warning indicators.
3. The effect of environmental elements on aircraft performance.
4. Required actions for aircraft maximum performance and the consequences of failing to do so.

5. Accelerated stalls.
6. Collision avoidance, scanning, obstacle and wire strike avoidance.
7. Failure to follow the stall recovery procedure.
8. Failure to maintain coordinated flight during the maneuver.
9. Secondary stalls.
10. Inadvertent stall or spin.

FLIGHT MANEUVERS GUIDE:

1. Clear the area.
2. 1700 RPM. 55 KIAS.
3. Recovery must be made not lower than 1,500 feet AGL.
4. Apply full throttle.
5. Pitch up to an attitude that will induce a stall (20deg) by applying elevator.
6. Maintain coordination with increased right rudder pressure.
7. Continue to apply increasing elevator back-pressure to maintain the stall attitude.
8. Maintain wings level with aileron and coordinated with rudder.
9. Recognize and announce the symptoms of an approaching stall, announce buffeting (Commercial Pilot Standards).
10. Allow the airplane to stall.
11. After nose pitches down, reduce elevator back-pressure to un-stall the wing and add full power to minimize altitude loss.
12. Once un-stalled, level the wings using coordinated rudder and aileron. Resume normal flight attitude, power, and airspeed with a minimum loss of Altitude.

COMMON ERRORS:

• Failure to clear area
• Inability to recognize an approaching stalled condition by the feel of the airplane
• Premature recovery
• Over-reliance on the airspeed indicator while excluding other cues
• Inadequate scanning resulting in wing-low or un-coordinated condition during entry
• Excessive elevator back pressure resulting in an exaggerated nose-up attitude during entry
• Inadequate rudder control
• Inadvertent secondary stall during recovery
• Failure to maintain a constant bank angle during turning stalls
• Excessive forward elevator pressure during recovery, resulting in negative load on the wings and potential secondary stall
• Excessive airspeed build-up during recovery
• Failure to take timely action to prevent a full stall while conducting imminent stalls

QUESTIONS FOR THE STUDENT:

1. What is a power-on stall?
[A power-on stall, also known as a departure stall, simulates a stall that might occur during takeoff, departure, or a go-around, where the aircraft is at a high power setting. In this maneuver, you intentionally induce a stall at a higher power setting and pitch attitude than a power-off stall.]

2. Why are power-on stalls practiced?
[Power-on stalls are practiced to help pilots recognize the signs and conditions that lead to a stall in a high-power, high-angle-of-attack scenario, and to develop the habit of taking prompt preventative or corrective action to recover. This skill is critical for situations like an over-rotation during takeoff or a go-around.]

3. How do you recognize the signs of an impending power-on stall?
Several cues indicate an approaching stall during a power-on scenario:
Reduced Airspeed: As the pitch attitude increases, the airspeed will naturally decrease.
High Pitch Attitude: The nose of the aircraft will be noticeably higher than usual.

Stall Warning Horn: Most aircraft are equipped with a stall warning horn (or light) that activates as the stall speed is approached.
Buffeting: The airframe or controls may begin to shake or vibrate due to the turbulent airflow over the wings.
Poor Control Feel: The controls, particularly the ailerons, will feel less effective or "mushy" as the wings lose lift.]

4. What are the key steps for recovering from a power-on stall?
[The recovery from a power-on stall is similar to any other stall recovery and involves a four-step process: Push, Roll, Power, Pull.]
[Reduce the Angle of Attack (Push): The first and most critical step is to lower the nose (reduce backpressure on the controls) to decrease the angle of attack and get the wings flying again.]
[Level the Wings (Roll): Use coordinated rudder and aileron inputs to maintain coordinated flight and level the wings.]
[Add Power (Power): Apply maximum available power smoothly and decisively. Be prepared to use significant right rudder to counteract the left-turning tendency caused by the increased power.]
[Return to Straight and Level Flight (Pull): Gently pitch the nose up to a climb attitude (Vx or Vy, as desired) once the aircraft has regained sufficient airspeed and a positive rate of climb is established.]

5. What are some common errors during power-on stall recovery?
[Common errors during stall recoveries include inadequate clearing of the area, failing to set the correct configuration, improper control inputs (pitch, heading, yaw, and bank), rough or uncoordinated control use, not recognizing the start of the stall, failure to actually stall, incorrect torque correction, delayed recovery, excessive altitude or airspeed during recovery, and secondary stalls.]

6. How does flap use affect power-on stall recovery?
[While typically practiced with little or no flaps, if flaps were used during entry, they should be retracted gradually as speed increases and a climb is established. Incremental retraction helps prevent a secondary stall and avoids significant pitch changes, as fully extended flaps increase stall speed and can alter pitching moment.]

7. What is the recommended altitude for practicing power-on stalls?
[The FAA recommends practicing stalls no lower than 1,500 feet AGL for single-engine airplanes. This altitude may vary based on the aircraft type and its performance, so always check the Pilot Operating Handbook (POH) for specific recommendations.]
[Important considerations:
Practice power-on stalls with a certified flight instructor (CFI) until you are comfortable.
Always perform clearing turns beforehand to check for other aircraft.
Pay attention to the aircraft's cues to anticipate and react quickly to a stall.
Use smooth and coordinated control inputs, especially when using rudder to counteract torque.
The goal is to effectively recognize and recover from a stall, minimizing altitude loss and returning to safe flight.]

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

1. Select an entry altitude that will allow the Task to be completed no lower than 1,500 feet AGL.
2. Establish the takeoff, departure, or cruise configuration as specified by the evaluator.

3. Set power (as assigned by the evaluator) to no less than 65 percent available power.
4. Transition smoothly from the takeoff or departure attitude to the pitch attitude that will induce a stall.
5. Maintain a specified heading, ±10°, if in straight flight, and maintain a specified angle of bank not to exceed 20°, ±10°, if in turning flight, while inducing the stall or as recommended by the aircraft manufacturer to a safe maneuvering altitude.
6. Recognize and recover promptly after a fully developed stall occurs.
7. Retract the flaps to the recommended setting.
8. Execute a stall recovery in accordance with procedures set forth in the AFM/POH.
9. Accelerate to VX or VY speed before the final flap retraction; return to the altitude, heading, and airspeed specified by the evaluator.

LESSON:	POWER-OFF STALLS

OBJECTIVE:

Develop recognition of an impending stall or stalled condition in the landing configuration and prevent a stall or un-stall the airplane after a stall occurs.

MOTIVATION:

Recognizing, avoiding, recovery from stalls avoids stall/spin accidents.

REFERENCES / EQUIPMENT NEEDED:

AC61-67 Stall and Spin Awareness Training; FAA-H-8083-2 RMH, FAA-H-8083-3 AFH, FAA-H-8083-25 PHAK; POH/AFM
Aircraft

IMAGES / MEDIA / LINKS:



Stall Recovery Template	
1. Wing leveler or autopilot	1. Disconnect
2. a) Pitch nose-down b) Trim nose-down pitch	2. a) Apply until impending stall indications are eliminated b) As needed
3. Bank	3. Wings Level
4. Thrust/Power	4. As needed
5. Speed brakes/spoilers	5. Retract
6. Return to the desired flight path	



POWER-OFF STALLS	TIME:	[15] Minutes

1. Stall aerodynamics - Critical AOA, not speed dependent, flight path vs relative wind, how load factor and weight affect stall speed.
2. AOA vs lift - Can generate lift at low speeds but not more than the critical angle.
3. Airplane in the landing configuration, full flaps on approach speed, descending.
4. Inducing the stall - Power idle (like the flare) raise the nose to landing attitude.
5. Importance of coordination - Avoid a stall with Yaw (Describe spin basics)
6. Approach to stall indications. Loss of control effectiveness, stall warning horn, buffeting.
7. Full stall indications - Un-commanded nose down attitude due to loss of lift Possible wing drop.
8. Stall recovery procedure. Reduce AOA with elevator until the stall symptoms are gone, use full power to minimize altitude loss and rudder to stop yaw.
9. If a wing drops, prevent it from dropping further with rudder. Unstall the wing with elevator, then level with wing with aileron. Do NOT level the wings with rudder (Possible spin - Stall with Yaw.)

KEY POINTS:

- Airplane will be in the landing configuration, on approach speed, descending.
- Stall recovery can always be made by reducing the AOA with elevator.
- Power is only necessary to minimize altitude loss.

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE & CH 6-4 Flying Skills
Risk Management : Teach how to identify, assess and mitigate risks encompassing the following:
1. Aerodynamic factors AOA to airspeed, Load factor, weight, configuration
2. The range and limitations of stall warning indicators
3. Actions for maximum performance and the consequences of failing to do so.
4. Collision avoidance, scanning, and obstacle avoidance.
5. Failure to follow the stall recovery procedure.
6. Failure to maintain coordinated flight during the maneuver.
7. Secondary stalls and inadvertent stalls or spins

FLIGHT MANEUVERS GUIDE:

1. Clear the area - Pick a reference point - Recovery altitude by 1500 AGL
2. Carb Heat ON - 1700 RPM - 80 KIAS.
3. Apply flaps incrementally.
4. Trim airplane for level flight.
5. Establish 65 KIAS and then throttle to idle.
6. Slowly apply elevator back-pressure to raise the nose to just above the horizon
7. Continue applying back-pressure until symptoms of a stall appear.
8. Allow airplane to fully stall before recovery (private). Buffeting for Commercial
9. Begin stall recovery when stall symptoms appear (Buffeting for Commercial) Recover from the stall by lowering the angle of attack.
10. Apply full throttle and stop yaw with rudder. - carb heat off.
11. Retract flaps to 20 degrees.
12. Observe a positive rate of climb.
13. Retract remaining flaps incrementally.
14. Return to normal cruise configuration.

COMMON ERRORS:

- Failure to clear area
- Inability to recognize an approaching stall condition through feel for the airplane
- Premature recovery
- Over-reliance on the airspeed indicator while excluding other cues
- Inadequate scanning resulting in wing-low condition during entry
- Excessive elevator back pressure, resulting in an exaggerated nose-up attitude during entry
- Inadequate rudder control
- Inadvertent secondary stall during recovery
- Failure to maintain a constant bank angle during turning stalls
- Excessive forward elevator pressure during recovery, resulting in negative load on the wings and potential secondary stall.
- Excessive airspeed build-up during recovery
- Failure to take timely action to prevent a full stall during the conduct on imminent stalls

QUESTIONS FOR THE STUDENT:

1. What is a power-off stall and why is it practiced?
[A power-off stall occurs when the wing's angle of attack (AOA) exceeds its critical angle, causing a loss of lift.]
[It's practiced to train pilots to recognize the signs of an impending stall in a landing configuration (low power, full flaps, gear down, gradual descent) and to execute a prompt and effective recovery with minimal altitude loss.]

2. What are the key steps in performing a power-off stall?
[Clear the Area: Perform clearing turns to ensure no other aircraft are in the vicinity.]
[Select a Safe Altitude: Choose an entry altitude that allows for recovery no lower than 1,500 feet Above Ground Level (AGL) for single-engine aircraft.]
[Choose a Heading: Select a heading to maintain throughout the maneuver, using a visual reference point or aligning with a road.]
[Reduce Power and Slow Down: Smoothly reduce power to a moderate setting (e.g., 1,400 RPM) while maintaining altitude and gradually deploy flaps to the landing configuration (below Vfe).]
[Simulate Approach Descent: Reduce power to idle and initiate a descent, simulating a landing approach.]
[Induce the Stall: Apply back pressure to increase the angle of attack until the aircraft stalls. Maintain heading using rudder.]

3. What are the signs of an impending stall?
[Stall warning horn activation]
[Airframe buffeting]
[Mushy or unresponsive controls]

4. How do you recover from a power-off stall?]
[Reduce Angle of Attack: Simultaneously release back pressure on the controls and apply maximum power.]
[Maintain Control and Increase Airspeed: Use right rudder to counteract left-turning tendencies and prevent yaw. As airspeed increases, establish a positive rate of climb.]
[Retract Flaps and Landing Gear (if applicable): Retract flaps incrementally as airspeed builds (e.g., in notches) and retract landing gear after a positive rate of climb is established, according to the POH/AFM.]
[Accelerate to Climb Speed: Establish a climb at Vx or Vy to regain the starting altitude.]

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

1. Select an entry altitude that will allow the Task to be completed no lower than 1,500 feet AGL.
2. Establish a stabilized descent in the approach or landing configuration, as specified by the evaluator.
3. Transition smoothly from the approach or landing attitude to a pitch attitude that will induce a stall.
4. Maintain a specified heading, ±10°, if in straight flight, and maintain a specified angle of bank not to exceed 20°, ±10° if in turning flight, while inducing the stall or as recommended by the aircraft manufacturer to a safe maneuvering altitude.
5. Recognize and recover promptly after a full stall has occurred.
6. Retract the flaps to the recommended setting.
7. Execute a stall recovery in accordance with procedures set forth in the AFM/POH.
8. Accelerate to VX or VY speed before the final flap retraction and return to the altitude, heading and airspeed specified by the examiner.

LESSON: GROUND REFERENCE MANEUVERS - INTRODUCTION

OBJECTIVE:

To develop subconscious, coordinated flight control while dividing attention between ground references, flight instruments, and hazard scanning. And teach student pilots to control the aircraft's ground track while compensating for wind drift.

Ground reference maneuvers reveal how wind continuously influences an aircraft's path across the surface of the Earth.

MOTIVATION:

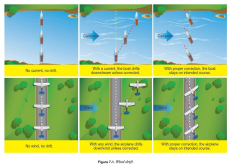
To learn wind drift correction, improve aircraft handling, and sharpen spatial awareness by requiring a constant, intentional track over the ground.

Understanding ground reference maneuvers helps pilots develop the coordination needed to maintain a precise track over the ground while compensating for changing wind drift.

REFERENCES / EQUIPMENT NEEDED:

FAA-H-8083-3 - Airplane Flying Handbook CH 3
FAA-H-8083-25 - PHAK Load Factors
Calculator / E6B Flight Computer

IMAGES / MEDIA / LINKS:



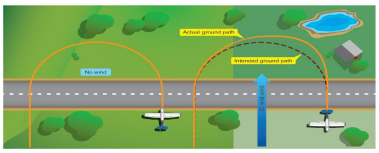


Figure 7-2. *Effect of wind during a turn.*



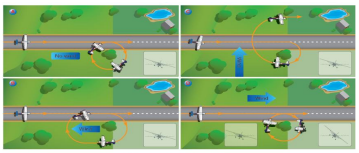
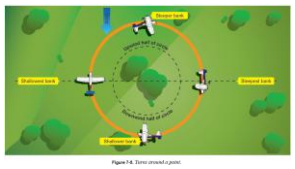
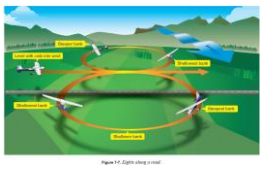
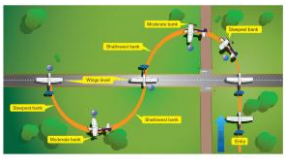
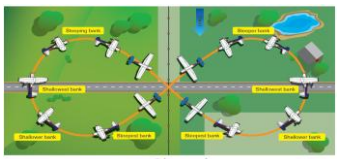


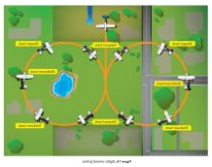
Figure 7-3. *Effect of wind during turn.*

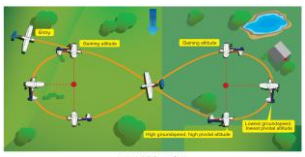








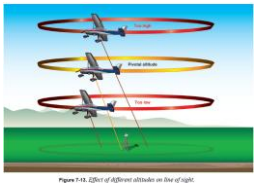


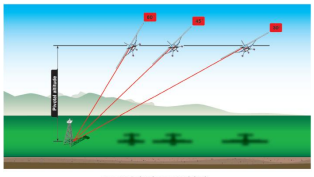




Groundspeed		Approximate Pivotal Altitude
Knots	MPH	
87	100	670
91	105	735
96	110	810
100	115	885
104	120	960
109	125	1050
113	130	1130

Figure 7-12. *Speed versus pivotal altitude.*





INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

GROUND REFERENCE MANEUVERS - INTRODUCTION TIME: 15 Minutes

INTRODUCTION TO GROUND REFERENCE MANEUVERS

Ground reference maneuvers develop basic pilot skills, using the ground to gauge deviations, as well as serve as the basis for follow-on maneuvers.

To begin, pilots must understand wind and wind drift.
To demonstrate an understanding of wind and wind drift, pilots must first select suitable areas above which to perform each ground reference maneuver.
Performing the wind drift circle takes those principles and demonstrates them in flight.
With the effects of winds understood, pilots can practice correcting for it by performing turns around a point and S-turns.
These training exercises ultimately prepare a pilot for the rectangular course, which trains the pilot for the next phase of training, the traffic pattern.
Later, if/when working toward a commercial pilot certificate, eights along a road, eights across a road, eights around pylons, and finally eights on pylons expand upon the previously introduced ground reference maneuvers to demonstrate increasingly proficient control while making corrections throughout the maneuver.

As with water flowing down a river, air is a fluid in motion.
To maintain the airplane's desired path across a surface, pilots must correct for wind (wind correction angle) in the same way a boat must do for current. [Figure 7-1]

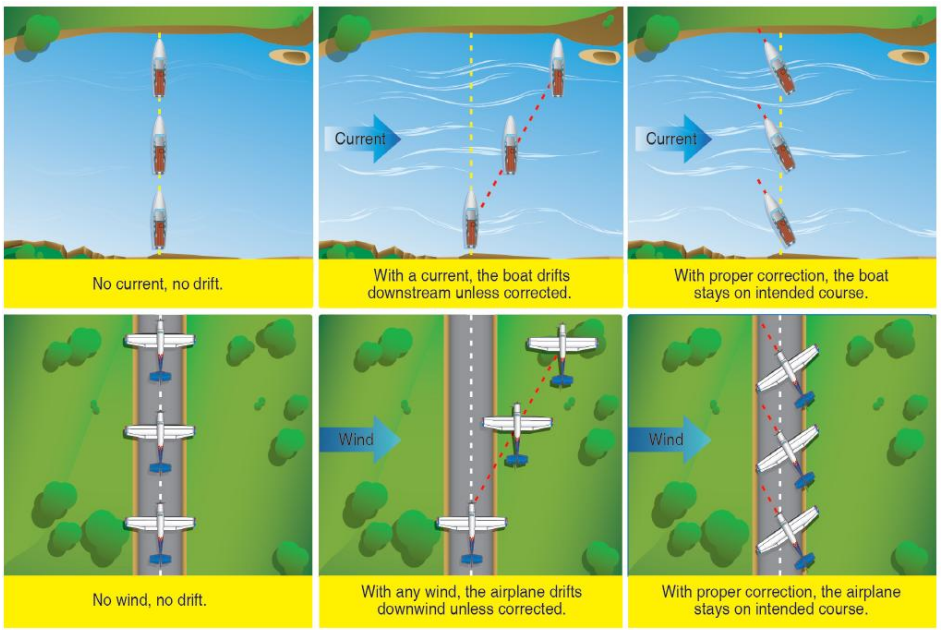


Figure 7-1. *Wind drift.*

The principles and techniques for varying the angle of bank to change the rate of turn and the wind correction angle for controlling wind drift during a turn are the same for all ground-track maneuvers involving changes in direction of flight.

Wind Drift When Straight and Level:
Consider a flight with a wind velocity of 30 knots (knot=nautical mile per hour) from the left and 90° to the direction the airplane travels.
After 1 hour, the parcel of air the airplane is flying through will have moved 30 nautical miles to the right.
Since the airplane is moving within this body of air, it too will have drifted 30 NM to the right.
In relation to the air, the airplane moved forward; in relation to the ground, it moved forward as well as 30 NM to the right.
To correct for this, the pilot applies a wind correction angle (into the wind), which is proportional to the wind velocity.
When the pilot neutralizes the drift, the airplane will follow the desired ground track.

Wind Drift During A Turn:
The effects of wind are different when turning. [Figure 7-2]

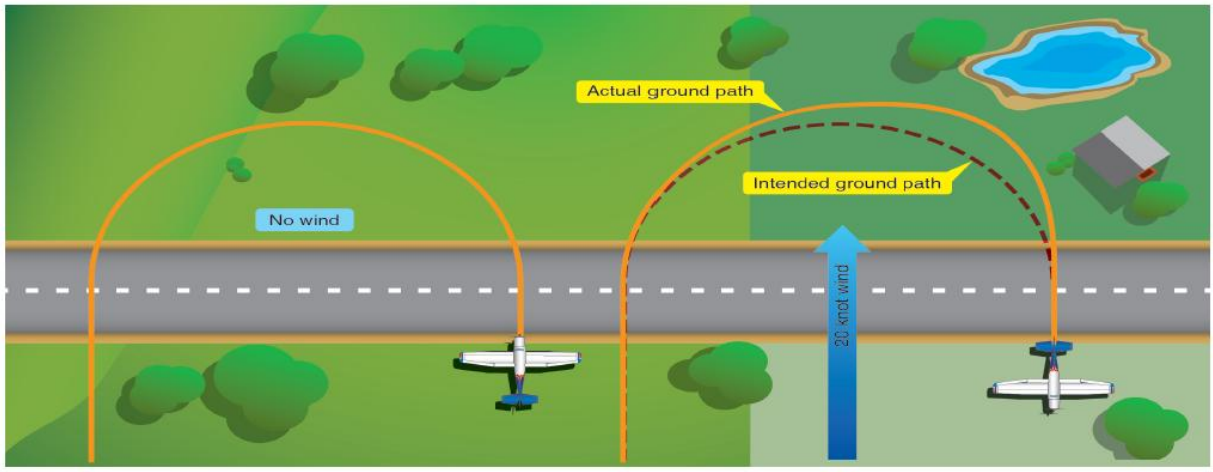


Figure 7-2. *Effect of wind during a turn.*

Speed impacts turn performance, specifically the angle of bank regarding a constant radius turn:
The faster the airplane, the greater the angle of bank is required to maintain a fixed radius of turn.
The slower the airplane, the smaller the angle of bank required to maintain the same fixed radius of turn.
Since the relative wind angle is constantly changing, so does ground speed, which impacts the ground track and the time it takes the airplane to progress through any part of a turn.
The amount of wind correction to follow a desired circular ground track is dependent upon ground speed. [Figure 7-3]

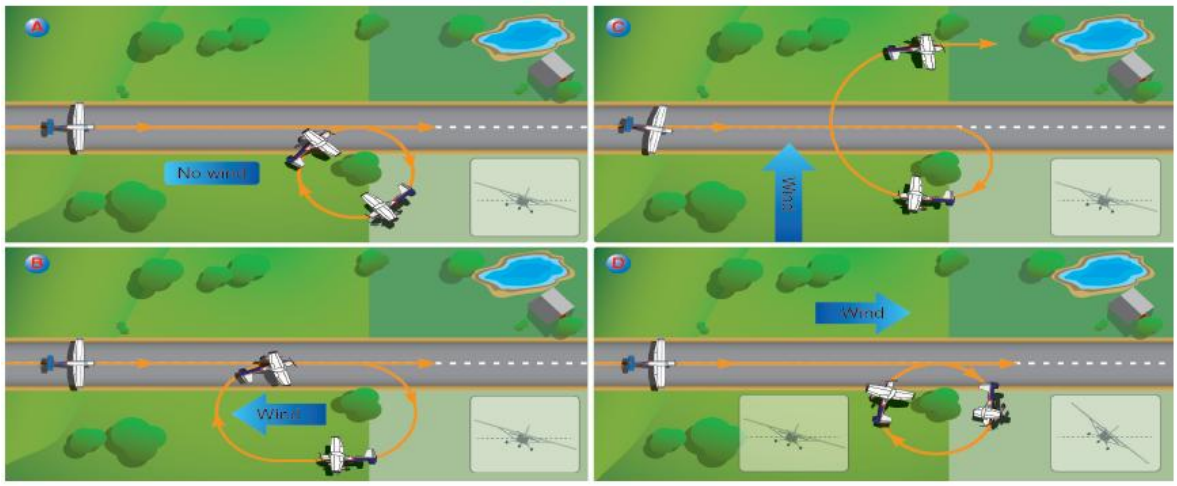


Figure 7-3. *Effect of wind during turn.*

When flying into the wind, the ground speed decreases, reducing the required bank angle.
When flying away from the wind, the ground speed increases, increasing the required bank angle.

Wind velocity also plays a factor in maintaining a desired circular ground track:
The higher the groundspeed, the more quickly the pilot must establish the appropriate bank angle.
The slower the groundspeed, the slower the pilot must establish the appropriate bank angle.
The steepest bank and fastest rate of turn is on the downwind portion of the turn, and the shallowest bank and slowest rate of turn is on the upwind portion.
When there is no wind, it should be simple to fly along a ground track with an arc of exactly 180° and a constant radius, since the flight path and the ground track would be identical.
To determine the direction of the wind, pilots can observe flags, water, or perform a wind drift circle.

Selecting Suitable Ground Reference Points/Lines/Areas
When selecting ground reference points, lines, or areas, consider:
Location of probable traffic transiting the area.
Collision hazards, including aircraft, terrain, obstacles, and wires.
Ease of recognition/uniqueness of reference so as not to mistake it for another, similar feature mid-maneuver.
When selecting a point from which to perform a wind drift circle or turn around a point, consider:
Select static points like towers, intersections, or buildings.
Avoid moving objects such as vehicles, generic/ill-defined areas.
When selecting a reference line from which to perform maneuvers such as S-turns, rectangular course, and eights along a road, across a road, around pylons, or on pylons, consider:
Length of ground reference line, such as a road, river, or tree line.

Wind Drift Circle
The wind drift circle helps pilots determine wind direction and strength (velocity) while in flight and recognize the effect of wind on the airplane's ground track.
Primarily a training maneuver, the effects of wind during a turn are demonstrated by referencing a road, railroad, or other ground references that form straight lines parallel to the wind while flying a constant medium angle of bank for a 360° turn. [Figure 7-3]
The airplane will return to a point directly over the line, but slightly downwind of the starting point, depending on the wind velocity and the time required to complete the turn.
The path on the ground will be an elongated circle, even though it is a perfect circle in the air.

Straight and level flight during the upwind segment after completing the turn is necessary to return the airplane to the starting position.

Wind Drift Circle Procedure:
Perform clearing turns, looking for traffic and ground obstructions.
Select a reference point in an area where you could make an emergency landing if necessary.
Establish and maintain traffic pattern speed and 600-1,000' AGL.
Enter the maneuver from any direction to the reference point.
Over the reference point, roll into a 30° bank and perform a 360° turn, maintaining a constant bank angle.
Any error in angle of bank or coordination will have an effect, depending on its severity.
Initiate a roll-out at a point where the wings will be level when completing the turn.
Note any difference in position between the starting and finishing positions.
The airplane will finish the maneuver downwind from the initial starting point, depending on the wind.
Determine the approximate wind direction and strength based on any differences in the starting and finishing positions.
Upon completion of the maneuver, resume normal cruise and trim as necessary.
Complete cruise flow/checklist.
Wind Drift Circle Common Errors:
Failure to adequately clear the area.
Skidding or slipping turns.
Excessive gain or loss of altitude.
Not entering the pylon turns into the wind.
Failure to assume a heading that will compensate sufficiently for drift.
Abrupt control usage.

The Following Lessons will cover the following Ground Reference Maneuvers: Rectangular Course, Turns Around a Point, S-Turns, Elementary Eights, Eights along a Road, Eights across a Road, Eights around Pylons, Eights-on-Pylons.

KEY POINTS:

Ground reference maneuvers are foundational exercises designed to teach pilots how to correct for wind drift and maintain a specific ground track by adjusting bank angles according to ground speed. Key takeaways include mastering the relationship between wind velocity and necessary drift correction, understanding that higher groundspeed requires a steeper bank for constant radius turns, and applying these skills to prepare for traffic pattern operations. Instructors emphasize that these maneuvers develop essential, real-time spatial awareness and control.

Ground reference maneuvers are low-altitude exercises (600–1,000 feet AGL) designed to teach you how to maintain a specific ground track by correcting for wind drift.

Whether flying a Rectangular Course, S-Turns across a road, or Turns Around a Point, the core challenge is managing your groundspeed.

To maintain a constant radius or straight path, you must use a steep bank angle when flying downwind (highest groundspeed) and a shallow bank angle when flying upwind (lowest groundspeed), always while keeping the aircraft coordinated and scanning for traffic.

Success depends on looking outside 90% of the time to track your reference points rather than fixating on instruments. Before starting, always perform clearing turns and identify a suitable emergency landing field to ensure safety while operating close to the ground.

RISK MANAGEMENT:

FAA-H-8083-2A RMH 1-2 PAVE

COMMON ERRORS:

Crabbing Improperly: Failing to crab into the wind (nose pointing towards the wind) to maintain a straight line on the upwind leg.

Incorrect Bank Angles: Using too shallow a bank downwind or too steep a bank upwind, leading to an irregular, non-circular shape.

Altitude Deviations: Inability to maintain feet due to focusing too heavily on ground tracking.

QUESTIONS FOR THE STUDENT:

"If you are flying the downwind leg of a rectangular course, will your bank angle be steeper or shallower than on the upwind leg, and why?"

Goal: To see if they understand how groundspeed dictates the required rate of turn and bank angle to maintain a constant radius.

"We are looking for a spot to practice S-turns. Aside from the wind direction, what are the three most important things we need to look for on the ground before we start?"

Goal: To check their risk management regarding emergency landing spots, collision hazards (wires/towers), and the uniqueness of the reference line.

"If we carry out a 360-degree Wind Drift Circle with a perfectly constant 30-degree bank, where will the airplane be in relation to our starting point when the turn is complete?"

Goal: To confirm they understand that a circular path in the air results in an elongated ground track that finishes downwind of the start point.

"How does our 'Wind Correction Angle' change as we transition from a direct crosswind to a direct tailwind during a turn?"

Goal: To verify they understand that the correction angle is proportional to the wind velocity and must be constantly adjusted as the heading changes relative to the wind.

"Why do we specifically perform these maneuvers at 600 to 1,000 feet AGL rather than at a higher altitude like 3,000 feet?"

Goal: To ensure they realize that lower altitudes make drift and ground track deviations much easier to see and serve as direct preparation for the traffic pattern.

ACS COMPLETION STANDARDS:

Area of Operation V. Performance Maneuvers and Ground Reference Maneuvers
Task A. Steep Turns
Knowledge: The applicant demonstrates understanding of:
How to conduct a proper steep turn.
The Aerodynamics associated with steep turns, including:
a. Maintaining coordinated flight
b. Overbanking tendencies
c. Maneuvering speed, including the impact of weight changes
d. Load factor and accelerated stalls

e. Rate and radius of turn

Risk Management: To be able to identify, assess, and mitigate risk associated with:
Division of attention between aircraft control and orientation.
Collision hazards.
Low altitude maneuvering, including stall, spin, or controlled flight into terrain (CFIT).
Distractions, task prioritization, loss of situational awareness, or disorientation.
Uncoordinated flight.

Skills: The applicant exhibits the skill to:
Clear the area.
Establish the manufacturer's recommended airspeed; or if one is not available, an airspeed not to exceed the maneuvering speed (VA).
Roll into a coordinated 360° steep turn with approximately a 45° bank.

Perform the Task in the opposite direction, as specified by evaluator.
Maintain the entry altitude ±100 feet, airspeed ±10 knots, bank ±5°, and roll out on the entry heading ±10°

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Task B. Ground Reference Maneuvers
rectangular course,
S-turns,
turns around a point.

Knowledge: The applicant demonstrates understanding of: Purpose of ground reference maneuvers.
The Effects of wind on ground track and relation to a ground reference.
The Effects of bank angle and groundspeed on rate and radius of turn.
The Relationship of rectangular course to airport traffic pattern.

Risk Management: The applicant is able to identify, assess, and mitigate risk associated with:
The Division of attention between aircraft control and orientation, Collision hazards, Low altitude maneuvering, including stall, spin, or controlled flight into terrain (CFIT), Distractions, task prioritization, loss of situational awareness, or disorientation.
Uncoordinated flight.

Skills: The applicant exhibits the skill to:
Clear the area.
Select a suitable ground reference area, line, or point as appropriate.

Plan the maneuver:
a. Rectangular course: enter a left or right pattern, 600 to 1,000 feet above ground level (AGL) at an appropriate distance from the selected reference area, 45° to the downwind leg

b. S-turns: enter perpendicular to the selected reference line, 600 to 1,000 feet AGL at an appropriate distance from the selected reference area

c. Turns around a point: enter at an appropriate distance from the reference point, 600 to 1,000 feet AGL at an appropriate distance from the selected reference area

Apply adequate wind-drift correction during straight and turning flight to maintain a constant ground track around a rectangular reference area, or to maintain a constant radius turn on each side of a selected reference line or point.

If performing S-Turns, reverse the turn directly over the selected reference line; if performing turns around a point, complete turns in either direction, as specified by the evaluator.
Divide attention between airplane control, traffic avoidance and the ground track while maintaining coordinated flight.
Maintain altitude ±100 feet; maintain airspeed ±10 knots.

LESSON:	GROUND REFERENCE MANEUVERS - RECTANGULAR COURSES

OBJECTIVE:

To maintain a fixed distance from a rectangular course by compensating for wind drift.

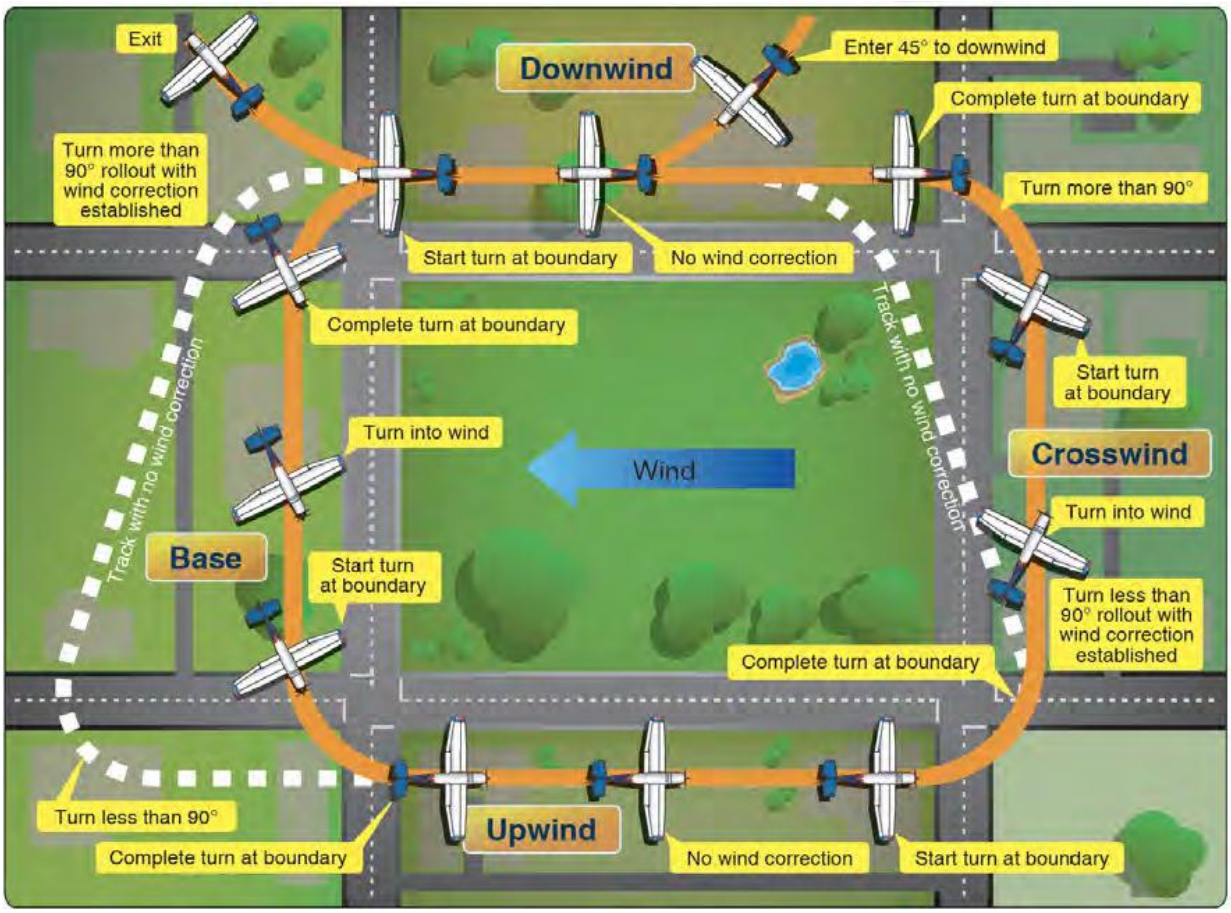
MOTIVATION:

These are the basic techniques to stop drift in the traffic pattern.

REFERENCES / EQUIPMENT NEEDED:

14 CFR part 61 - Certification: Pilots and Flight Instructors
FAA-H-8083-2 - Risk Management Handbook
FAA-H-8083-3 - Airplane Flying Handbook
FAA-H-8083-25 - PHAK Load Factors

IMAGES / MEDIA / LINKS:



GROUND REFERENCE MANEUVERS - RECTANGULAR COURSES	TIME:	[15] Minutes

1. Determining wind direction and velocity - Dust, smoke, water, crops, wind circle.
2. The effects of wind on ground track and relation to a ground reference point.
3. Selection of features on the ground for the rectangular course, Adequate dimensions, (approx. 1nm legs), boundaries etc. Fly 1/4 to 1/2 mile from the boundaries and preselect emergency landing locations.
4. Entry/exit location, altitude (600- 1000 ft. AGL) and airspeed requirements of the maneuver. (Below Va and slow enough to see wind drift)

5. The effects of bank angle and ground speed on rate and radius of turn. Relate this to each turn and straight and level segment in the maneuver.
(Demonstrate with a model airplane)
6. The relationship of rectangular course to airport traffic pattern.

KEY POINTS:

• Should be taught right after tracking a straight line. Has 4, 90 degree turns and a good amount of straight flight between turning
• Reduce airspeed if the wind is less than 15 knots to better see the effect of drift.
• Don't fly over the course boundaries.

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE & CH 6-4 Flying Skills
Risk Management - Teach how to identify, assess and mitigate risk encompassing the following:
1. Collision avoidance, scanning, and obstacles.
2. Low altitude maneuvering.
3. Task management.
4. Failure to maintain aircraft control.
5. Failure to select a suitable emergency landing area.

FLIGHT MANEUVERS GUIDE:

1. Clear the maneuvering area.
2. 2100 RPM, 90 KIAS, between 600 and 1,000 AGL.
3. Enter the course on a left 45 entry to the downwind leg.
4. Stay ¼ - ½ mile from the course boundary.
5. Base turn: highest groundspeed, greatest bank angle, more than 90 degree turn.
6. Base leg: crabbed to the inside of the course.
7. Upwind turn: medium bank becoming shallow, slowest ground speed, less than 90 degree turn.
8. Upwind leg: into the wind, little correction, maintain distance.
9. Crosswind turn: Shallow turn becoming medium bank, prevent drift by crabbing, less than a 90 degree turn.
10. Crosswind leg: continue crab, nose away from the course line, into wind.
• Downwind turn: medium bank turn becoming steep; ground speed will increase.
• Exit the course on a 45 angle to the downwind leg.

COMMON ERRORS:

• Failure to adequately clear area
• Failure to establish proper altitude prior to entry
• Failure to establish proper wind correction angle, resulting in drift
• Gaining or losing altitude
• Poor coordination. Slipping or skidding in turns.
• Abrupt control usage
• Inability to divide attention between airplane control and maintaining ground track
• Inadequate visual look out for other aircraft

QUESTIONS FOR THE STUDENT:

1. What is the purpose of the rectangular course?
[To replicate the airport traffic pattern and prepare pilots for real-world approaches and landings.]
[To practice maintaining a specific relationship between the airplane and ground references.]
[To divide attention between flight path, ground references, aircraft controls, and scanning for hazards.]
[To understand and compensate for wind drift and ground speed changes.]

2. How do you select a suitable rectangular area?
[Choose a prominent rectangular shape on the ground (fields, intersections, roads).]
[Ensure the area has suitable emergency landing areas nearby.]
[The major axis of the rectangle should be roughly parallel to the wind direction at flight altitude.]
[Fly at an appropriate distance from the boundaries, typically 1/4 to 1/2 mile out, notes Mark Berry - CFI Notebook.]

3. What are the key elements of flying a rectangular course?
[Altitude: Maintain a constant altitude between 600 and 1,000 feet AGL (above ground level), adhering to a tolerance of ±100 feet.]
[Airspeed: Maintain a constant airspeed, typically around 100 knots in a Cessna Skyhawk, staying within ±10 knots.]
[Wind Correction: Accurately assess wind direction and apply the appropriate wind correction angle (crabbing into the wind) during turns and straight-and-level flight to maintain a constant ground track.]
[Bank Angle: Vary the bank angle (not exceeding 45°) to maintain a constant radius during turns, adjusting for changes in groundspeed.]
[Turns: Commence and complete turns abeam the field boundaries. Bank angles will vary depending on ground speed: steepest on the downwind-to-base turn, shallowest on the upwind-to-crosswind turn.]
[Entry: Enter the maneuver at a 45° angle to the downwind leg.]
[Exit: Exit the maneuver at a 45° angle to the downwind leg.]

4. How does it relate to the airport traffic pattern?
[The rectangular course directly prepares you for flying a standard airport traffic pattern. While the rectangular course is flown at a constant altitude, the traffic pattern involves climbs, descents, and configuring the aircraft for landing. The skills honed during the rectangular course (wind correction, coordinated turns, maintaining altitude and airspeed, dividing attention) are directly transferable to the traffic pattern.]

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

1. Determine the area is clear of terrain, obstacles, and other aircraft and the aircraft will remain in the appropriate airspace.
2. Select a suitable ground reference.
3. Identify a suitable emergency landing area.
4. Plan the maneuver:
• Rectangular course: enter a left or right pattern, 600 to 1,000 feet above ground level (AGL) at an appropriate distance from the selected reference area, 45° to the downwind leg
5. Apply adequate wind drift correction during straight and turning flight to maintain a constant ground track if around a rectangular reference area or to track a constant radius turn on each side of the selected reference line or a selected point.
6. Divide attention between airplane control, traffic avoidance and the ground track while maintaining coordinated flight.
7. Maintain altitude ±100 feet; maintain airspeed ±10 knots or as recommended by aircraft manufacturer to a safe maneuvering altitude.

LESSON:	S-TURNS ACROSS A ROAD

OBJECTIVE:

To perform two opposite direction 180 degree turns of equal radius across a road, with the wings becoming level when crossing the road.

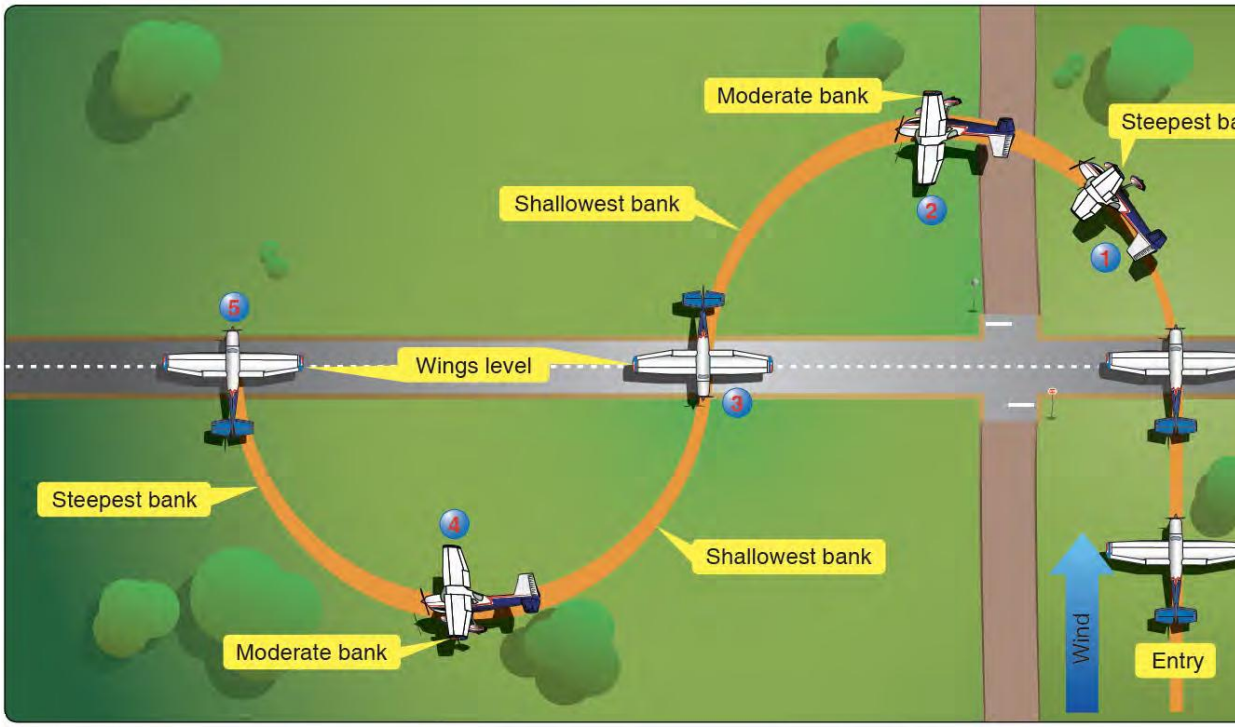
MOTIVATION:

This maneuver provides a greater understanding of wind correction during non-straight and level conditions

REFERENCES / EQUIPMENT NEEDED:

FAR 14 CFR 61; FAA-H-8083-2 RMH, FAA-H-8083-3 AFH, FAA-H-8083-25 PHAK
Airfraft

IMAGES / MEDIA / LINKS:



S-TURNS ACROSS A ROAD	TIME:	[30] Minutes

1. Determine wind direction and velocity - Dust, smoke, water, crops, wind circle
2. Selection of a road perpendicular to the wind of adequate length.
(Long enough to do at least two 180 degree turns). Preselect emergency landing locations
3. Define two half circles on each side of the road. Enter downwind first turn to the left
• (Steepest bank). Radius should be enough to allow the plane to be level just as it passes over the road.
4. Entry/exit location, altitude (600- 1000 ft. AGL) and airspeed requirements of the maneuver.
• (Below Va and slow enough to see wind drift)
5. Show effects of bank angle and ground speed on rate and radius of turn. Relate this to each turn and straight and level segment in the maneuver. Wings should just becoming level as the road is crossed.
• (Demonstrate with model airplane)
6. Where to exit the maneuver. (after at least two turns have been made)

KEY POINTS:

• The higher the ground speed, the greater the bank angle needed.
• Bank angle is used to produce the necessary wind-drift correction.
• Bank angle and roll rates will always be changing.

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE & CH 6-4 Flying Skills
Risk Management - Teach how to identify, assess and mitigate risk encompassing the following:
1. Collision avoidance, scanning, and obstacles.
2. Low altitude maneuvering.
3. Task management.
4. Failure to maintain aircraft control.
5. Failure to select a suitable emergency landing area.

FLIGHT MANEUVERS GUIDE:

1. Clear the airspace and identify emergency landing areas.
2. Select a straight line reference at least 1½ miles in length that is perpendicular to the wind
3. Establish an altitude between 600 and 1,000 AGL.
4. RPM 2100, 90 KIAS (below Va). Lower if the wind is light.
5. Enter downwind.
6. First turn: Steep bank angle and high roll rate. Fastest ground speed.
7. Establish appropriate wind correction angle by banking more or less
8. Banking will become shallower as the turn progresses.
9. Time arrival over the road so that wings are level.
10. Second turn: Begin a shallow turn in the opposite direction.
11. Establish the appropriate wind correction angle.
12. Bank angle will steepen as the turn progresses due to increased ground speed. Exit maneuver downwind.

COMMON ERRORS:

- Failure to clear the area adequately: This includes scanning for other aircraft and obstacles on the ground.
- Not establishing level flight before entry: Begin the maneuver from straight and level flight.
- Failure to maintain altitude: Keep the aircraft within the prescribed altitude range throughout the maneuver.
- Improper assessment of wind direction: Correctly identifying wind is crucial for calculating bank angle adjustments.
- Not executing constant radius turns: The turns on each side of the road should be symmetrical.
- Not manipulating controls smoothly: Abrupt control inputs can lead to slips or skids.
- Not establishing the appropriate wind correction angle: Adjust the crab angle throughout the maneuver to maintain the desired ground track.
- Not applying coordinated aileron and rudder pressure: Slipping or skidding turns can result from poor coordination.
- Selecting a reference line without suitable emergency landing areas nearby: Always prioritize safety, especially at low altitudes.

QUESTIONS FOR THE STUDENT:

1. What are S-turns across a road, and what's their purpose?
S-turns across a road involve flying a series of coordinated turns in opposite directions across a straight line on the ground, such as a road, railroad track, or power line.
The goal is to maintain a constant radius ground track on each side of the reference line, effectively drawing an "S" pattern on the ground.
This maneuver helps pilots:
Learn to compensate for wind drift by adjusting the bank angle during turns.
Maintain a specific relationship between the aircraft and the ground.
Develop the ability to divide attention between aircraft control, ground references, and scanning for hazards.

2. What's the proper entry and execution for S-turns?
Clearing Turns & Wind Assessment: Before starting, perform clearing turns to ensure no other aircraft or hazards are present.
Accurately determine wind direction and speed using visual cues or weather information.
Altitude & Airspeed: Maintain an altitude between 600 and 1,000 feet AGL and an airspeed within 10 knots of your chosen airspeed, ensuring it's below maneuvering speed (\(V_{A}\)).
Reference Line: Select a suitable straight line (road, etc.) roughly perpendicular to the wind direction, ideally with suitable emergency landing areas nearby.

Downwind Entry: Enter the maneuver flying straight and level, perpendicular to the reference line, on the downwind side.
First Turn (Downwind):Immediately begin a 180° turn as you cross the reference line.
Since your ground speed is highest on the downwind side, use a steeper bank angle and gradually decrease it as you turn upwind.
Maintain coordinated flight throughout the turn using aileron and rudder.
Crossing the Road & Reversing Turn:
Rollout from the first turn wings level and perpendicular to the road, ideally at a right angle.
As you cross, immediately begin a 180° turn in the opposite direction.

CONT...>>>
Second Turn (Upwind):
Since your ground speed is lowest on the upwind side, start with a shallow bank and gradually increase it as you turn downwind to maintain a constant radius.
Maintain coordinated flight and adjust the bank as ground speed changes.

3. How do you compensate for wind during the turns?
Downwind Side (High Ground Speed): Use a steeper bank angle to maintain the desired radius as your ground speed is highest.
Upwind Side (Low Ground Speed): Use a shallower bank angle as your ground speed is lowest.
Wind Correction Angle (Crab): Apply a wind correction angle (crabbing into the wind) as necessary to maintain the desired ground track, adjusting it dynamically as your orientation to the wind changes.

4. What are the private pilot practical test standards (PTS) for S-turns?
Clearing the Area & Safety: Adequately clear the area for hazards and perform pre-maneuver checklists.
Altitude & Airspeed: Maintain altitude ±100 feet and airspeed ±10 knots within the 600-1000 ft AGL range.
Entry: Enter perpendicular to the reference line, 600-1000 ft AGL, at an appropriate distance.
Wind Correction: Apply appropriate wind correction by continuously adjusting the bank angle to maintain symmetrical loops and reverse direction directly over the reference line.
Coordination & Attention: Divide attention between aircraft control, traffic avoidance, and ground track while maintaining coordinated flight.

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

1. Determine the area is clear of terrain, obstacles, and other aircraft and the aircraft will remain in the appropriate airspace.
2. Select a suitable ground reference.
3. Identify a suitable emergency landing area.
4. Plan the maneuver.
• S-turns: enter perpendicular to the selected reference line, 600 to 1,000 feet AGL at an appropriate distance from the selected reference area
5. Apply adequate wind drift correction during straight and turning flight to track a constant radius turn on each side of the selected reference line or a selected point.
6. Reverse the turn directly over the selected reference line.
7. Divide attention between airplane control, traffic avoidance and the ground track while maintaining coordinated flight.
8. Maintain altitude ±100 feet; maintain airspeed ±10 knots or as recommended by aircraft manufacturer to a safe maneuvering altitude.

LESSON:	TURNS AROUND A POINT

OBJECTIVE:

To maintain a fixed distance from a point on the ground during a 360 degree turn.

MOTIVATION:

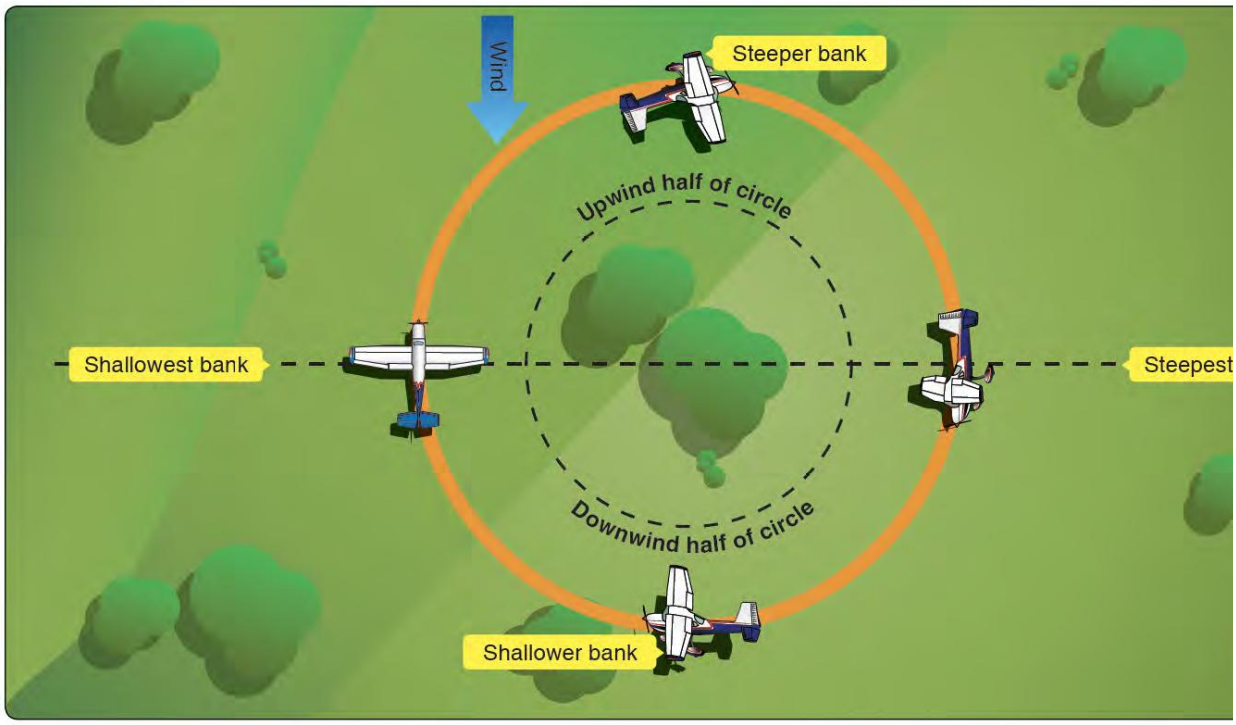
To gain a better understanding of wind drift while turning.

REFERENCES / EQUIPMENT NEEDED:

FAR 14 CFR 61, FAA-H-8083-2 RMH, FAA-H-8083-3 AFH, FAA-H-8083-25 PHAK
Airfraft

IMAGES / MEDIA / LINKS:

CFI Notebook



TURNS AROUND A POINT	TIME:	[30] Minutes

1. Determine wind direction and velocity - Dust, smoke, water, crops, wind circle.
2. Selection of a pylon. (point on the ground - easy to distinguish) Preselect emergency landing locations
3. Enter downwind first turn to the left (Steepest bank). Radius should approximately 1/2 mile.
• The radius is determined by bank used when turning downwind. If the wind is strong the maximum 45-degree bank angle sets the radius
4. Entry/exit location, altitude (600- 1000 ft. AGL) and airspeed requirements of the maneuver.
• (Below Va and slow enough to see wind drift)
5. Show effects of bank angle and ground speed on rate and radius of turn. Point out that the wing will only be on the pylon when directly downwind or upwind. The plane will be crabbing by banking at other times so the wing will either be in front of or behind the pylon.
• (Demonstrate with model airplane)
6. Where to exit the maneuver. (Downwind the 360-degree turn has been made)

KEY POINTS:

• Higher ground speed necessitates steeper bank angle and higher roll rate.
• The point on the ground is referred to as a “pylon”.
• The wing position in relation to the pylon will change throughout the maneuver.

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE & CH 6-4 Flying Skills
Risk Management - Teach how to identify, assess and mitigate risk encompassing the following:
1. Collision avoidance, scanning, and obstacles.
2. Low altitude maneuvering.
3. Task management.
4. Failure to maintain aircraft control.
5. Failure to select a suitable emergency landing area.

FLIGHT MANEUVERS GUIDE:

1. Select an obvious point on the ground (Water tower, intersection, etc.).
2. Clear the maneuvering area and select emergency landing areas.
3. Establish an altitude between 600 and 1,000 AGL.
4. RPM 2100, 90 KIAS (below Va).
5. Enter downwind, ½ mile away and abeam the pylon.
6. Begin the turn downwind to the left, steep bank angle, highest ground speed.
7. Base turn segment, medium bank, nose crabbed inside of the circle, wing behind the pylon.
8. Upwind turn segment, shallowest bank, lowest ground speed.
9. Crosswind turn segment, medium bank, nose crabbed outside the circle, wing in front of the pylon.
10. Exit maneuver on the downwind.

COMMON ERRORS:

• Failure to adequately clear area
• Failure to establish appropriate bank angle upon entry
• Failure to recognize wind drift
• Excessive bank angle and/or inadequate wind correction angle on the downwind side of the circle, resulting in drift towards the reference point
• Inadequate bank angle and/or excessive wind correction angle on the upwind side of the circle, resulting in drift away the reference point
• Skidding turns when turning from downwind to crosswind
• Slipping turns when turning from upwind to crosswind
• Gaining or losing altitude
• Inadequate visual lookout for other aircraft
• Inability to direct attention outside the airplane while maintaining precise airplane control

QUESTIONS FOR THE STUDENT:

1. What is the purpose of Turns Around a Point?
[To develop the ability to control the airplane while maintaining a constant radius turn around a single point on the ground, despite the effects of wind.]
[To train in dividing attention between the flight path, ground references, aircraft control inputs, and scanning for hazards.]
[To develop proficiency in adjusting the bank angle to correct for changes in groundspeed caused by wind.]
[To develop an understanding that the radius of a turn is correlated to the bank angle.]

2. What are the key elements of the maneuver?
[Altitude: Maintain between 600 and 1,000 feet AGL (Above Ground Level).
[Airspeed: Maintain within ±10 knots of the selected entry speed, generally below maneuvering speed (Va).]
[Bank Angle: The bank angle should constantly change throughout the maneuver, but should not exceed 45 degrees.]
[Steepest bank will be on the downwind side (fastest groundspeed).]
[Shallowest bank will be on the upwind side (slowest groundspeed).]
[Constant Radius: The goal is to fly a constant radius circle over the ground, as if a pen attached to the wingtip was drawing a perfect circle on the ground.]

[Wind Correction: The pilot must constantly adjust the bank angle and apply appropriate wind correction (crabbing) to maintain the constant radius, compensating for the wind's effect on groundspeed.]
[Clearing the Area: Before entering the maneuver, perform clearing turns to check for traffic and hazards above, below, and on all sides.]

3. How do you select a suitable ground reference point?
[Choose a prominent and easily identifiable point on the ground.]
[Ensure the area around the point is free from ground hazards and obstructions.]
[It should be in an unpopulated area.]
[Road intersections or isolated trees can be good choices, while houses or other structures should be avoided to prevent nuisance.]
[The point should also be near a suitable emergency landing area, as flying at low altitude (below 1,000 ft AGL) minimizes gliding distance in case of an engine emergency.]

4. How do you enter the maneuver?
[Determine the wind direction.]
[Position the aircraft to enter the maneuver on the downwind side, approximately ¼ to ½ mile abeam of the reference point.]
[Establish and maintain the desired altitude and airspeed.]
[As the airplane passes abeam the point, begin a coordinated turn, rolling in rapidly to the steepest bank necessary for the fastest groundspeed on the downwind leg.]

5. How do you maintain a constant radius around the point?
[Adjusting bank angle: The key is to constantly adjust the bank angle throughout the turn to compensate for the changing groundspeed as the wind affects the aircraft. Steeper bank angles are needed when flying downwind (faster groundspeed), and shallower bank angles are required when flying upwind (slower groundspeed).]
[Crabbing: Apply wind correction angle (crab) to prevent being blown away from or towards the reference point.]
[On the downwind side (high groundspeed), crab towards the reference point.]
[On the upwind side (low groundspeed), crab away from the reference point.]
[Visual cues: Use the sight picture of the reference point relative to the wingtip to maintain the desired distance and track.]
[Smooth control inputs: Manipulate flight controls (ailerons and rudder) smoothly and continuously for coordinated flight.]
[Dividing attention: While keeping your eyes outside as much as possible, periodically glance at your altimeter and airspeed indicator to ensure you are maintaining the required parameters.]

6. How do you recover from Turns Around a Point?
[After completing the required number of circles (typically two), recover to straight and level flight, usually by continuing straight ahead on the entry heading.]
[Resume normal cruise RPM and trim as necessary.]

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

1. Determine the area is clear of terrain, obstacles, and other aircraft and the aircraft will remain in the appropriate airspace.
2. Select a suitable ground reference.
3. Identify a suitable emergency landing area.

4. Plan the maneuver:
• Note: Turns around a point: enter at an appropriate distance from the reference point, 600 to 1,000 feet AGL at an appropriate distance from the selected reference area
5. Complete turns in either direction around the selected reference point.
6. Divide attention between airplane control, traffic avoidance and the ground track while maintaining coordinated flight.
7. Maintain altitude ±100 feet; maintain airspeed ±10 knots or as recommended by aircraft manufacturer to a safe maneuvering altitude.

LESSON: GROUND REFERENCE MANEUVERS – ELEMENTRY EIGHTS

OBJECTIVE:

The primary objective is to develop a pilot's flight control coordination skills, strengthen their awareness relative to the selected ground references, and enhance division of attention so that flying becomes more instinctive than mechanical.

MOTIVATION:

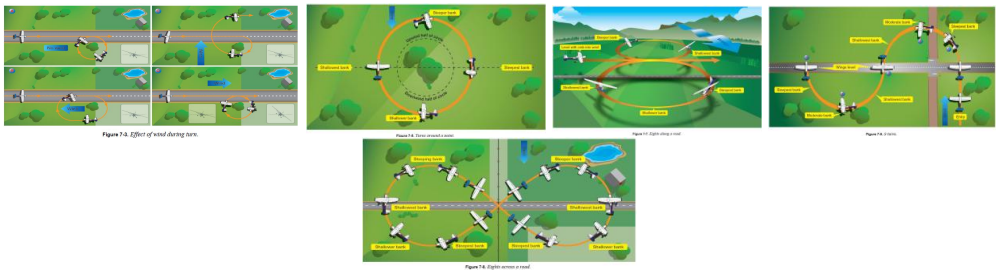
Eights require a greater degree of focused attention to the selected ground references; however, the real significance of eights is that the pilot develops the ability to fly with precision.

REFERENCES / EQUIPMENT NEEDED:

FAA-H-8083-3C - Airplane Flying Handbook CH 7:10-14
FAA-H-8083-25 - PHAK Load Factors
Calculator / E6B Flight Computer
Aircraft

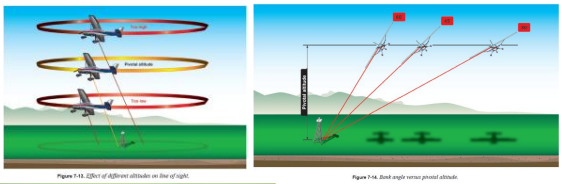
IMAGES / MEDIA / LINKS:

Keeping Your Distance





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





GROUND REFERENCE MANEUVERS – ELEMENTRY EIGHTS	TIME:	2 Hours

ELEMENTARY EIGHTS

Building on [Maneuvering by Reference to Ground Objects], [Drift and Ground Track Control], [Correcting Drift During Straight and Level Flight], [Constant Radius During Turning Flight], [Tracking Over and Parallel to a Straight Line], [Rectangular Course], [Turns Around a Point, S-Turns], we move forward with All the maneuvers in ELEMENTARY EIGHTS including: [eights along a road], [eights across a road], [eights around pylons], and [Eights-on-Pylons].

As described in the AFH, Elementary eights are a family of maneuvers in which each individual maneuver is one that the airplane tracks a path over the ground similar to the shape of a figure eight. There are various types of eights, progressing from the elementary to advanced types.

This lesson will continue to build on what you have learned so far and continue into:
Eights along a road, Eights across a road, and eights on AND around pylons.

The student will be able to fine tune their flying skills by being able to successfully perform All Elements of Elementary Eights (eights along, and across a road, and around pylons.).

EIGHTS ALONG A ROAD 7-11

Consists of two complete adjacent circles of equal radii on each side of a straight road or other reference line on the ground. [Figure 7-7]

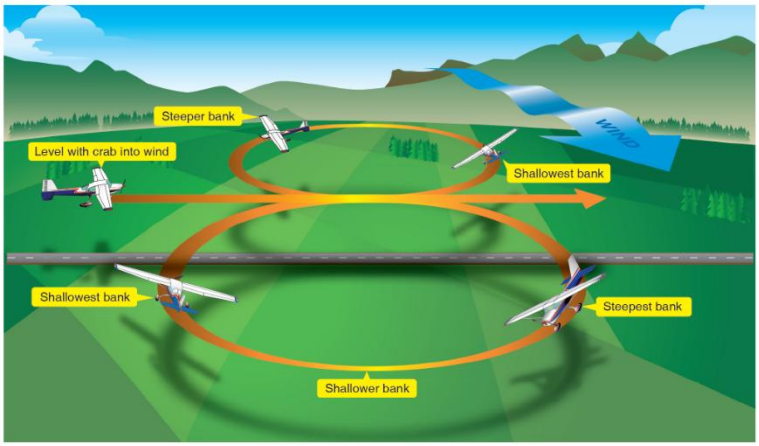


Figure 7-7. *Eights along a road.*

Develops the ability to maneuver the airplane accurately while dividing your attention between the flight path and the selected points on the ground.
Should not be introduced until the student has a complete grasp on fundamentals (Rectangular Course, S-Turns, Turns Around a Point).
Perfects the knowledge of the effect of the angle of bank on the radius of turn.
Demonstrate how wind affects the path of the airplane over the ground.
To gain experience in the visualization of the results of planning before the execution of the maneuver.
Trains the student to think and plan ahead of the airplane.
Performed with the wind either perpendicular or parallel to the reference line.
The measure of progress in the performance of eights along a road is the smoothness and accuracy of the change in the bank used to counteract drift.
The sooner the drift is detected and correction applied, the smaller will be the required changes.
The more quickly the student can anticipate the corrections needed, the less obvious the changes will be, and the more attention can be diverted to the maintenance of altitude and operation of the airplane.
Errors in coordination must be eliminated, and a constant altitude maintained.

Procedure
EIGHTS ALONG A ROAD Common Errors:
Failure to adequately clear the area.
Skidding or slipping turns.
Excessive gain or loss of altitude.

Overconcentration on the pylon and failure to observe traffic.
Abrupt control usage.

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EIGHTS ACROSS A ROAD 7-12
Once the fundamentals of Rectangular Course, S-Turns, and Turns Around a Point are understood, next comes eights across a road.
The maneuver is a variation of eights along a road and involves the same principles and techniques
The primary difference is that at the completion of each loop of the figure eight, the airplane should cross an intersection of roads or a specific point on a straight road.
Wind should be perpendicular to the road.
Consists of two complete adjacent circles of equal radii on each side of a straight road or other reference line on the ground. [Figure 7-8]

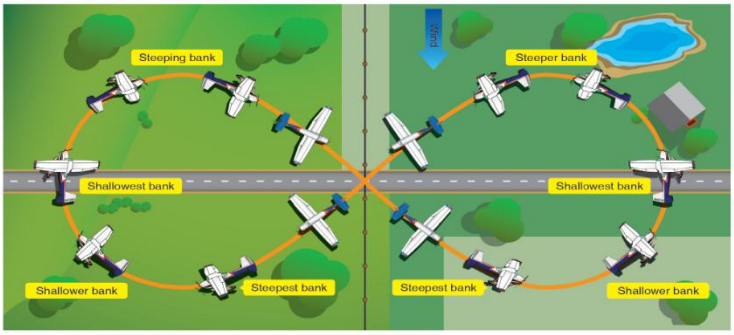


Figure 7-8. *Eights across a road.*

Develops the ability to maneuver the airplane accurately while dividing your attention between the flight path and the selected points on the ground.
Perfects the knowledge of the effect of the angle of bank on the radius of turn.
Demonstrate how wind affects the path of the airplane over the ground.

To gain experience in the visualization of the results of planning before the execution of the maneuver.
Trains the student to think and plan ahead of the airplane.
The measure of progress in the performance of eights along a road is the smoothness and accuracy of the change in the bank angle used to counteract drift.
The sooner the drift is detected and correction applied, the smaller will be the required changes.
The more quickly the student can anticipate the corrections needed, the less obvious the changes will be, and the more attention can be diverted to the maintenance of altitude and operation of the airplane.
Errors in coordination must be eliminated, and a constant altitude maintained.

EIGHTS ACROSS A ROAD Procedure:
Determine wind direction.
This is important for the entry heading and reference point.
Perform clearing turns, looking for traffic and ground obstructions.
Select 2 reference points on either side of the reference line in an area where an emergency landing can be made if necessary.
Establish and maintain an appropriate airspeed (generally 100 KIAS) and 1,000' AGL.
Enter the maneuver ~30° to the road.
You may need to establish a crab to maintain a straight ground path.
Abeam the first point, roll into a 30° to 40° angle of bank.
Usually, the first turn is made toward a downwind heading.
As ground speed increases, the angle of bank will need to increase to increase the rate.
As ground speed decreases after the first half of the turn, shallow the bank to arrive over the reference line on the entry heading.
Perform the second turn.
Ground speed will slow, requiring a shallow angle of bank.
After 180° of turn, ground speed will increase, requiring an increase in the angle of bank.
Depart the maneuver on the entry heading.
Complete cruise checklist.

EIGHTS ACROSS A ROAD Common Errors:
Failure to adequately clear the area.
Skidding or slipping turns.
Excessive gain or loss of altitude.
Overconcentration on the pylon and failure to observe traffic.
Abrupt control usage.

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EIGHTS AROUND PYLONS 7-13*
Consists of a figure eight pattern at a pivotal altitude as two points, or pylons, are used as references for turns.
[Figure 7-9]

Involves flying downwind between the pylons and upwind outside of the pylons.
Develops the ability to maneuver the airplane accurately while dividing your attention between the flight path and the selected points on the ground.
The most advanced and most difficult of the low-altitude flight training maneuvers.
Should not be introduced until the student has a complete grasp on fundamentals (Rectangular Course, S-Turns, Turns Around a Point).
Perfects the knowledge of the effect of the angle of bank on the radius of turn.
Demonstrate how wind affects the path of the airplane over the ground.
To gain experience in the visualization of the results of planning before the execution of the maneuver.
Trains the student to think and plan ahead of the airplane.

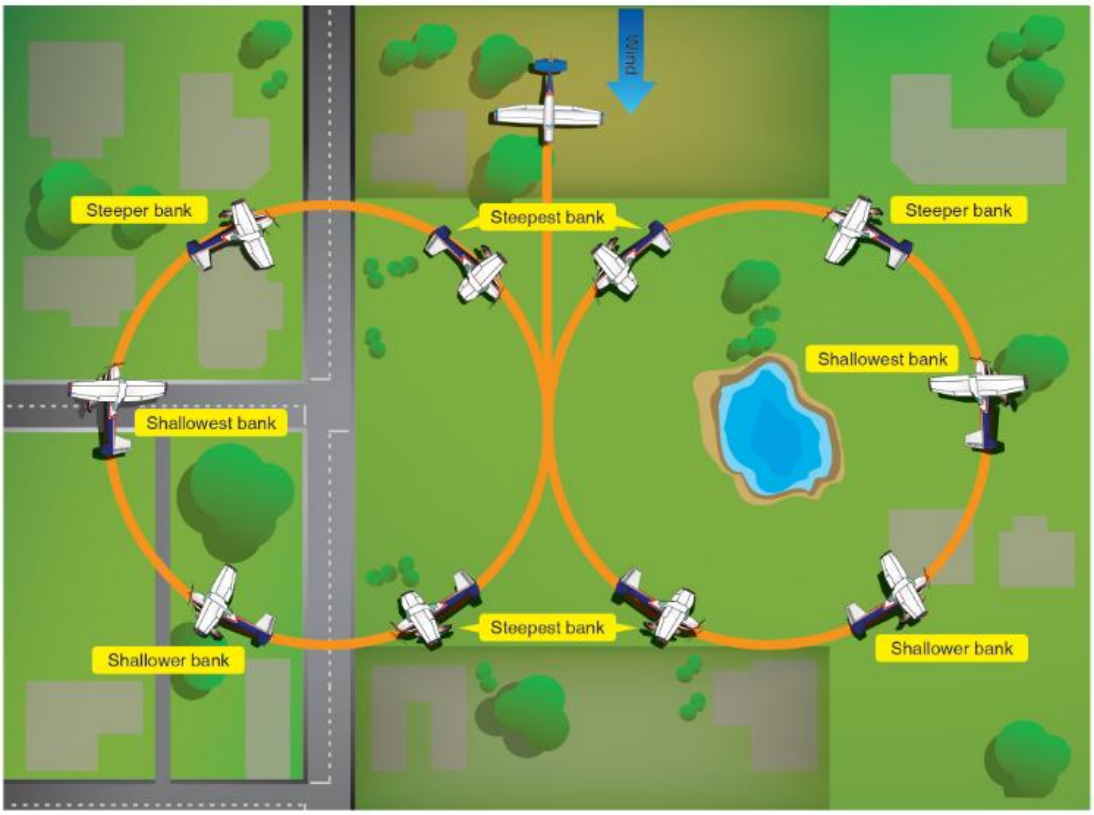


Figure 7-9. *Eights around pylons.*

EIGHTS AROUND PYLONS Procedure:
Determine wind direction.
This is important for the entry heading and reference point.
Perform clearing turns, looking for traffic and ground obstructions.
Select 2 reference points in an area where an emergency landing can be made if necessary.
The pylons selected should be on a line 90° to the direction of the wind and should be in an area away from communities, livestock, or groups of people to avoid possible annoyance or hazards to others.
Establish and maintain 100 KIAS (approx. 2200 RPM) and 1,000' AGL.
Enter the maneuver on a downwind heading when passing between the pylons.
Abeam the first point, roll into a 30° to 40° angle.
The distance between the pylons and the wind velocity will determine the initial angle of bank required to maintain a constant radius from the pylons during each turn.
Steepest banks will be required just after entry and just before roll-out from each turn, as ground speed is highest with the tailwind.
The bank will shallow as you continue through the 180° point where it will be the shallowest, gradually increasing.
Perform the second turn.
The roll-out from each turn must be completed on the proper heading with sufficient wind correction angle to ensure that after the brief straight-and-level flight, the airplane will arrive at the point where a turn of the same radius can be made around the other pylon.
The straight-and-level flight segments must be tangent to both circular patterns.
Depart the maneuver on the entry heading.
Complete cruise checklist.

EIGHTS AROUND PYLONS Common Errors:
Failure to adequately clear the area.
Poor choice of pylons.
Improper entry to the maneuver.
Incorrect initial bank.
Skidding or slipping turns.
Excessive gain or loss of altitude.
Overconcentration on the pylon and failure to observe traffic.
Not entering the pylon turns into the wind.
Failure to roll out of turns on proper heading.
Failure to assume a heading when flying between pylons that will compensate sufficiently for drift.
Failure to time the bank so that the turn entry is completed with the pylon in position.
Abrupt control usage.
Loss of orientation.

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EIGHTS ON PYLONS 7-14*

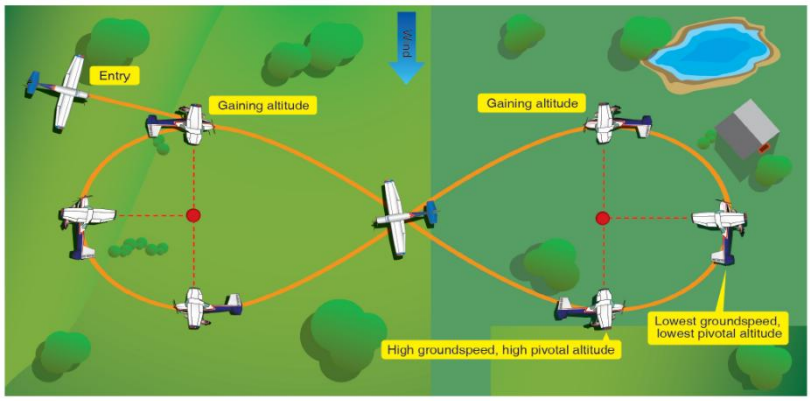


Figure 7-10. *Eights on pylons.*

Eights on Pylons Purpose:
Eights on Pylons is a Commercial Pilot maneuver that develops the ability to maneuver the airplane accurately while dividing your attention between the flight path and the selected points on the ground, perfecting the knowledge of the effect of the angle of bank on the radius of turn.

Eights on Pylons Description:
Consists of a figure eight pattern at a pivotal altitude as two points, or pylons, are used as references for turns. [Figure 7-10]

The most advanced and most difficult of the low-altitude flight training maneuvers.

Should not be introduced until the student has a complete grasp on fundamentals (Rectangular Course, S-Turns, Turns Around a Point).

Demonstrate how wind affects the path of the airplane over the ground.
To gain experience in the visualization of the results of planning before the execution of the maneuver.
Trains the student to think and plan ahead of the airplane.
Elevators are the primary control for holding the pylons.
As the airplane approaches a position where the pylon appears to be just ahead of the wingtip, the turn should be started by lowering the upwind wing to place the pilot's line of sight reference on the pylon.
As the turn is continued, the line of sight reference can be held on the pylon by gradually increasing the bank.
The roll-out must be completed with the proper wind correction angle to correct for wind drift so that the airplane will arrive at a point downwind from the second pylon at the same distance it was from the first pylon at the beginning of the maneuver.
Upon reaching that point, a turn is started in the opposite direction by lowering the upwind wing to again place the pilot's line of sight reference on the pylon.
The turn is then continued just as in the turn around the first pylon but in the opposite direction.
Corrections for temporary variations, such as those caused by gusts or inattention, may be made by shallowing the bank to fly relatively straight to bring forward a lagging wing or by steepening the bank temporarily to turn back a wing that has crept ahead.
As proficiency is gained, increase the complexity of the maneuver by entering at a distance from the pylon that will result in a specific bank angle at the steepest point in the pylon turn.

Pivotal Altitude:

Pivotal altitude: A height above ground at which, from the pilot's line of sight, the extended lateral axis of an aircraft doing a 360° level turn [in nil wind conditions] would appear to be fixed to one ground point, and the aircraft's wingtip, thus pivoting on that point.
Governed by the ground speed.
GS^2 / 11.3 = Pivotal Altitude in Knots.
GS^2 / 15 = Pivotal Altitude in Miles Per Hour.

Since the headings throughout the turns continually vary from directly downwind to directly upwind, the ground speed will constantly change.

This will result in the proper pivotal altitude varying slightly throughout the eight.

Adjustment is made for this by climbing or descending, as necessary, to hold the reference line or point on the pylons.

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.*

Pivotal altitude is not always correct;
high-wing, low-wing, swept-wing, and so on will show different angles; therefore, you must have a lateral reference.

Since different airplanes fly at different airspeeds, the ground speed will be different.
Therefore, each airplane will have its own pivotal altitude. [Figure 7-12]
At any altitude above that pivotal altitude, the projected reference line will appear to move rearward in a circular path in relation to the pylon.
Conversely, when the airplane is below the pivotal altitude, the projected reference line will appear to move forward in a circular path.
Distance from the pylon affects the angle of bank.
The pivotal altitude does not vary with the angle of bank being used unless the bank is steep enough to affect the ground speed.

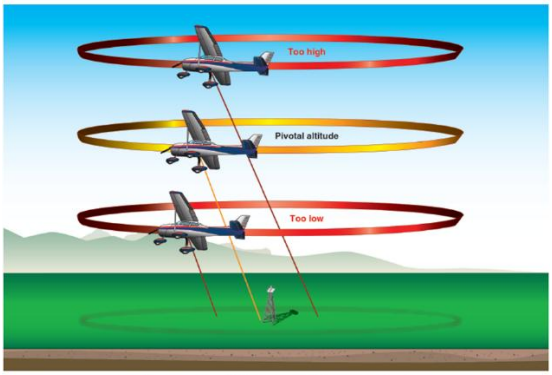


Figure 7-13. *Effect of different altitudes on line of sight.*

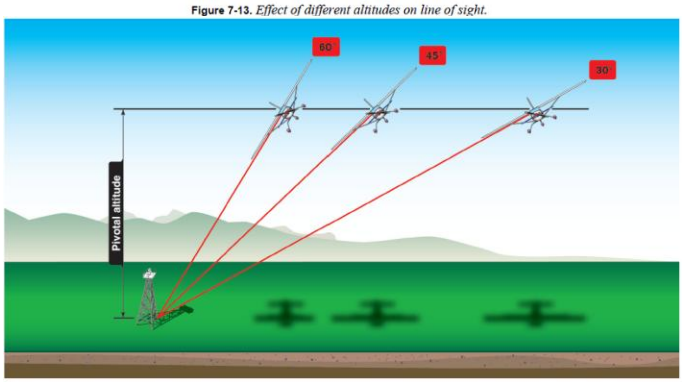


Figure 7-14. *Bank angle versus pivotal altitude.*

Pivotal Altitude Demonstration:
Fly the airplane at normal cruising speed and at an altitude estimated to be below the proper pivotal altitude, and then begin a medium-banked turn.



Figure 7-11. *Line of sight.*

It will be seen that the projected reference line of sight appears to move forward along the ground (the pylon moves back) as the airplane turns.

A climb is then made to an altitude well above the pivotal altitude, and when the airplane is again at normal cruising speed, it is placed in a medium-banked turn.
At this higher altitude, the projected reference line of sight now appears to move backward across the ground (the pylon moves forward) in a direction opposite that of flight.
After the high altitude extreme has been demonstrated, the power is reduced, and a descent at cruising speed begins by continuing medium bank around the pylon.
The apparent backward travel of the projected reference line with respect to the pylon will slow down as altitude is lost, stop for an instant, then start to reverse itself, and would move forward if the descent were allowed to continue below the pivotal altitude.
The altitude at which the line of sight apparently ceased to move across the ground was the pivotal altitude.

EIGHTS ON PYLONS Procedure:
Determine wind direction.
This is important for the entry heading and reference point.
Perform clearing turns, looking for traffic and ground obstructions.
Select 2 reference points in an area where an emergency landing can be made if necessary.
Select the first point.
Turn downwind, fly for 15-20 seconds, and select a second point.
They should be sufficiently prominent to be readily seen by the pilot when completing the turn around one pylon and heading for the next, and should be adequately spaced to provide time for planning the turns and yet not cause unnecessary straight-and-level flight between the pylons (usually about a mile apart).
The selected pylons should also be at the same elevation since differences of over a very few feet will necessitate climbing or descending between each turn.
Establish and maintain airspeed and pivotal altitude.
Enter the maneuver on a 45° to the downwind between the two points
Abeam the first point, roll into a 30° to 40° angle.
Keep the point under the wingtip.
The reference line should appear to pivot on the pylon.
If the point moves forward, push forward, reducing some power.
Said differently, if the lateral axis of the aircraft drifts backwards (point moves forward), the pilot should decrease altitude.
If the point moves backward, pull back, adding some power.
Said differently, if the lateral axis of the aircraft drifts forwards (point moves backward), the pilot should increase altitude.
Since a constant distance from the pylon is not required on this maneuver, no correction to counteract drifting should be applied during the turns.
Continue turn and level off 3/4 through the turn straight-and-level.
Fly for 3-5 seconds in level flight.

Perform the second turn.
Ground speed will be slowest.
Depart the maneuver on the entry heading.
Should be at your pivotal altitude on exit.
Complete cruise checklist.

EIGHTS ON PYLONS Common Errors:
Failure to adequately clear the area.
Improper entry to the maneuver.
Skidding or slipping turns.
Excessive gain or loss of altitude.
Overconcentration on the pylon and failure to observe traffic.
Poor choice of pylons.
Not entering the pylon turns into the wind.
Failure to assume a heading when flying between pylons that will compensate sufficiently for drift.
Failure to time the bank so that the turn entry is completed with the pylon in position.
Abrupt control usage.
Inability to select pivotal altitude.
The most common error in attempting to hold a pylon is incorrect use of the rudder.

KEY POINTS:

Each of these maneuvers is a variation of a turn around a point. Each eight uses two ground reference points about which the airplane turns first in one direction and then the opposite direction—like a figure eight.

Entry: Always enter downwind (with a tailwind) to establish the highest groundspeed and steepest bank angle early.

Wind Correction: You must vary your bank angle based on groundspeed. High groundspeed requires a steeper bank; low groundspeed (upwind) requires a shallower bank.

Altitude and Airspeed: Maintain a constant altitude (typically 600–1,000 feet AGL) and a consistent indicated airspeed throughout the maneuver.

Division of Attention: The goal is to move beyond mechanical control, training your brain to split focus between the ground path, clearing for traffic, and instrument monitoring

RISK MANAGEMENT:

FAA-H-8083-2A RMH 1-2 PAVE
The applicant is able to identify, assess, and mitigate risk associated with: Division of attention between aircraft control and orientation.
Collision hazards.
Low altitude maneuvering, including stall, spin, or controlled flight into terrain (CFIT).
Distractions, task prioritization, loss of situational awareness, or disorientation.
Uncoordinated flight.

FLIGHT MANEUVERS GUIDE:

Determine wind direction.
This is important for the entry heading and reference point.
Perform clearing turns, looking for traffic and ground obstructions.
Select 2 reference points in an area where an emergency landing can be made if necessary.

EIGHTS ACROSS A ROAD Procedure:

Establish and maintain an appropriate airspeed (generally 100 KIAS) and 1,000' AGL.
Enter the maneuver ~30° to the road.
You may need to establish a crab to maintain a straight ground path.
Abeam the first point, roll into a 30° to 40° angle of bank.
Usually, the first turn is made toward a downwind heading.
As ground speed increases, the angle of bank will need to increase to increase the rate.
As ground speed decreases after the first half of the turn, shallow the bank to arrive over the reference line on the entry heading.
Perform the second turn.
Ground speed will slow, requiring a shallow angle of bank.
After 180° of turn, ground speed will increase, requiring an increase in the angle of bank.
Depart the maneuver on the entry heading.
Complete cruise checklist.

EIGHTS AROUND PYLONS Procedure:

The pylons selected should be on a line 90° to the direction of the wind and should be in an area away from communities, livestock, or groups of people to avoid possible annoyance or hazards to others.
Establish and maintain 100 KIAS (approx. 2200 RPM) and 1,000' AGL.
Enter the maneuver on a downwind heading when passing between the pylons.
Abeam the first point, roll into a 30° to 40° angle.
The distance between the pylons and the wind velocity will determine the initial angle of bank required to maintain a constant radius from the pylons during each turn.
Steepest banks will be required just after entry and just before roll-out from each turn, as ground speed is highest with the tailwind.
The bank will shallow as you continue through the 180° point where it will be the shallowest, gradually increasing.
Perform the second turn.
The roll-out from each turn must be completed on the proper heading with sufficient wind correction angle to ensure that after the brief straight-and-level flight, the airplane will arrive at the point where a turn of the same radius can be made around the other pylon.
The straight-and-level flight segments must be tangent to both circular patterns.
Depart the maneuver on the entry heading.
Complete cruise checklist.

EIGHTS ON PYLONS Procedure:

Select the first point.
Turn downwind, fly for 15-20 seconds, and select a second point.
They should be sufficiently prominent to be readily seen by the pilot when completing the turn around one pylon and heading for the next, and should be adequately spaced to provide time for planning the turns and yet not cause unnecessary straight-and-level flight between the pylons (usually about a mile apart).
The selected pylons should also be at the same elevation since differences of over a very few feet will necessitate climbing or descending between each turn.
Establish and maintain airspeed and pivotal altitude.
Enter the maneuver on a 45° to the downwind between the two points
Abeam the first point, roll into a 30° to 40° angle.
Keep the point under the wingtip.
The reference line should appear to pivot on the pylon.
If the point moves forward, push forward, reducing some power.

Said differently, if the lateral axis of the aircraft drifts backwards (point moves forward), the pilot should decrease altitude.
If the point moves backward, pull back, adding some power.
Said differently, if the lateral axis of the aircraft drifts forwards (point moves backward), the pilot should increase altitude.
Since a constant distance from the pylon is not required on this maneuver, no correction to counteract drifting should be applied during the turns.
Continue turn and level off 3/4 through the turn straight-and-level.
Fly for 3-5 seconds in level flight.
Perform the second turn.
Ground speed will be slowest.
Depart the maneuver on the entry heading.
Should be at your pivotal altitude on exit.
Complete cruise checklist.

COMMON ERRORS:

ALL COMMON ERRORS
*Failure to adequately clear the area.
*Skidding or slipping turns.
*Excessive gain or loss of altitude.
*Overconcentration on the pylon and failure to observe traffic.
*Abrupt control usage.

EIGHTS ALONG A ROAD Common Errors:
*
EIGHTS ACROSS A ROAD Common Errors:
*
EIGHTS AROUND PYLONS Common Errors:*
Poor choice of pylons.
Improper entry to the maneuver.
Incorrect initial bank.
Not entering the pylon turns into the wind.
Failure to roll out of turns on proper heading.
Failure to assume a heading when flying between pylons that will compensate sufficiently for drift.
Failure to time the bank so that the turn entry is completed with the pylon in position.
Loss of orientation.

EIGHTS ON PYLONS Common Errors:*
Improper entry to the maneuver.
Poor choice of pylons.
Not entering the pylon turns into the wind.
Failure to assume a heading when flying between pylons that will compensate sufficiently for drift.
Failure to time the bank so that the turn entry is completed with the pylon in position.
Inability to select pivotal altitude.
The most common error in attempting to hold a pylon is incorrect use of the rudder.

QUESTIONS FOR THE STUDENT:

"Why do we enter elementary eights on a downwind heading instead of upwind?" (Verifies understanding of groundspeed and starting with the steepest bank).

"If your groundspeed decreases while turning into the wind, what must you do to your bank angle to keep your distance from the pylon constant?" (Tests the relationship between groundspeed and bank).

"While flying 'Eights Along a Road,' you notice your path over the ground is becoming asymmetrical. What is the most likely cause?" (Probes for failure to apply proper wind correction during the transition between turns).

"What is the danger of fixating on the pylon during the steepest part of your turn?" (Addresses the critical CFI topic of 'Division of Attention' and the risk of losing altitude or missing traffic).

"How does the wind correction required for a 'Rectangular Course' differ from the corrections we make during 'Eights Around Pylons'?" (Forces the student to compare crabbing in straight flight vs. varying bank in turning flight)

INSTRUCTOR AND STUDENT ACTIONS:

Phase: Pre-flight Briefing
Instructor Actions:
Explains the "why" (wind correction/division of attention). Defines the ground references to be used and the entry altitude (600–1,000' AGL).
Student Actions:
Verbalizes the maneuver steps. Identifies the wind direction using surface indicators (smoke, water ripples).

Phase: Setup & Entry
Instructor Actions:
Clears the area for traffic. Demonstrates the selection of a suitable pylon or road. Verbally confirms "Downwind Entry."
Student Actions:
Performs a thorough clearing turn. Selects references and configures the aircraft for maneuvering speed (\(V_{A}\)) or recommended cruise.

Phase: During the Maneuver
Instructor Actions:
Observes & Coaches: Watches for uncoordinated flight (ball centered). Reminds student to look at the horizon and clear for traffic, not just stare at the pylon.
Student Actions:
Execution: Varies bank angle to maintain a constant radius. Maintains altitude within ±100' and airspeed within ±10 knots.

Phase: Correction of Errors
Instructor Actions:

Identifies "fixation." If the student loses altitude during a steep bank, the instructor prompts a scan of the altimeter.
Student Actions:
Self-Correction: Recognizes when the wind is "pushing" the ground track and adjusts the bank angle accordingly without prompting.

Phase: Post-Maneuver
Instructor Actions:
Guides the student back to level flight. Provides immediate feedback on the symmetry of the eights and coordination.
Student Actions:
Transitions to cruise flight. Critiques own performance, specifically noting where the wind correction was strongest or weakest.

ACS COMPLETION STANDARDS:

Task B. Ground Reference Maneuvers

Objective: To determine the applicant exhibits satisfactory knowledge, risk management, and skills associated with ground reference maneuvering which may include... turns around a point.

Purpose of this ground reference maneuver.
Effects of wind on ground track and relation to a ground reference.
Effects of bank angle and groundspeed on rate and radius of turn.

Risk Management: The applicant is able to identify, assess, and mitigate risk associated with: Division of attention between aircraft control and orientation.
Collision hazards.
Low altitude maneuvering, including stall, spin, or controlled flight into terrain (CFIT).
Distractions, task prioritization, loss of situational awareness, or disorientation.
Uncoordinated flight.

Skills:
The applicant exhibits the skill to: Clear the area.
Select a suitable ground reference area, line, or point as appropriate.
Plan the maneuver:
c. Turns around a point: enter at an appropriate distance from the reference point, 600 to 1,000 feet AGL at an appropriate distance from the selected reference area Apply adequate wind-drift correction during straight and turning flight to maintain a constant ground track around a rectangular reference area, or to maintain a constant radius turn on each side of a selected reference line or point.

if performing turns around a point, complete turns in either direction, as specified by the evaluator.
Divide attention between airplane control, traffic avoidance and the ground track while maintaining coordinated flight.

Maintain altitude ±100 feet; maintain airspeed ±10 knots.

LESSON: STEEP TURNS

OBJECTIVE:

To perform a 360-degree level turn using between 45 - 50 degrees bank while maintaining altitude, airspeed and coordination.

MOTIVATION:

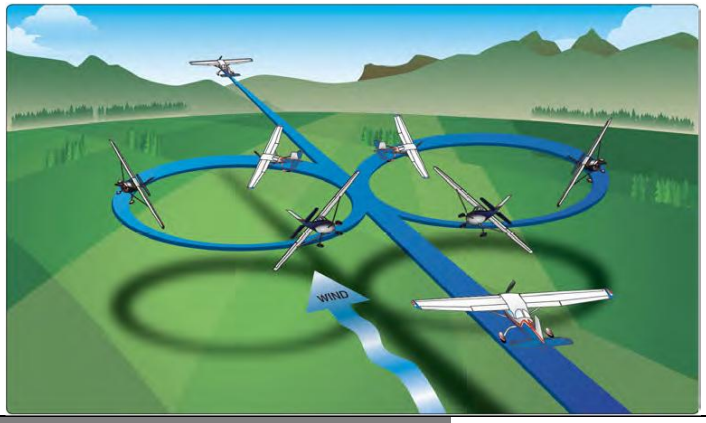
Develops smoothness, coordination, orientation, division of attention and control techniques to control the increase in load factor and stall speed. This maneuver can be used to avoid an encounter with clouds, terrain or other aircraft.

REFERENCES / EQUIPMENT NEEDED:

FAA-H-8083-2A RMH, FAA-H-8083-3 AFH, FAA-H-8083-25 PHAK POH/AFM; POH/Flight Manual

IMAGES / MEDIA / LINKS:

CFI Notebook



STEEP TURNS TIME: [20] Minutes

1. Aerodynamics review of turning flight including increases in Load factor and stall speed and accelerated stalls.
2. How load factor increases with bank angle - Note how after bank angles of greater than 45 degrees load factor increases substantially with even small increases in bank angle.
3. Determining maneuvering speed, including changes in weight.
4. Identification of reference points and heading.
5. Adverse Yaw and using rudder to stop it.
6. Use of horizon to determine bank and the different site pictures in left / right turns.
7. Maintaining altitude with elevator and airspeed with power.
8. Use of trim in a turn.
9. Overbanking tendency.
10. Left turning tendencies and the use of rudder in the turn.
11. Anticipating rolling out (1/2 bank angle in degrees)
12. Control inputs required to maintain altitude and airspeed when level

KEY POINTS:

- Load factor and stall speed increases quickly over banks angles of 50 degrees.
- Adverse yaw happens anytime the ailerons are deflected.
- Elevator controls altitude and power controls airspeed.
- During the turn right rudder will be needed to stop the left turning tendencies.

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE & CH 6-4 Flying Skills
Teach how to identify, assess and mitigate risks encompassing the following:
1. Failure to divide the attention between airplane control and orientation.
2. Task management.
3. Energy management.

4. Accelerated stalls.
5. Spins.
6. Failure to maintain situational awareness.
7. Collision avoidance, scanning, and obstacle avoidance.
8. Failure to maintain coordinated flight.

FLIGHT MANEUVERS GUIDE:

1. Clear the airspace and identify emergency landing areas
2. 2100 RPM, 90 KIAS
3. Altitude no lower than 1500 feet AGL
4. Identify a reference point in front of the aircraft and note the heading
5. Roll into a 45 - 50 degree bank turn - Stop adverse yaw with rudder.
6. Maintain bank, altitude, and airspeed
7. Elevator maintains altitude, throttle maintains airspeed, aileron - angle of bank
8. Remain coordinated
9. Begin the roll out 25 degrees before the 360 degree point - Stop adverse yaw
10. Wings level at entry airspeed and altitude at the 360-degree point
11. Reduce elevator to maintain altitude and decrease throttle for airspeed.
12. Roll into a 45 - 50 degree bank turn in the opposite direction.
13. Repeat maneuver in the opposite direction.

COMMON ERRORS:

- Failure to adequately clear area
- Excessive pitch changes during entry or recovery
- Attempts to start recovery prematurely
- Failure to stop the turn on a precise heading
- Excessive rudder during recovery, resulting in skidding
- Inadequate power management
- Inadequate airspeed control
- Poor coordination
- Gaining altitude in right turns and losing altitude in left turns
- Failure to maintain a constant bank angle
- Disorientation
- Attempting to perform the maneuver by instrument reference rather than visual reference
- Failure to scan for other traffic during the maneuver

QUESTIONS FOR THE STUDENT:

General knowledge

1. What is the purpose of performing steep turns?

[To understand the effects of increased load factors, overbanking tendency, and the need for greater control pressures at steeper bank angles.]
[To develop smoothness, coordination, orientation, division of attention, and control techniques necessary for executing maximum performance turns.]

2. What are the key elements to remember when performing a steep turn?

[Maintain a coordinated turn.]
[Control altitude within ±100 feet.]
[Control airspeed within ±10 knots.]
[Roll out on the entry heading within ±10°.]

3. What are some potential hazards associated with steep turns?

[Accelerated stalls, which can occur at higher angles of attack and increased load factors.]

[Overbanking, which can lead to loss of control.]
[Losing altitude due to insufficient back pressure or power.]
[Becoming disoriented due to focusing too much on instruments rather than visual references.]

Performance and technique
4. What's the required bank angle for a private pilot steep turn?
[Approximately 45 degrees.]

5. What is a "clearing turn" and why is it important before performing steep turns?
[It involves a visual scan of the airspace to ensure no other aircraft are in the intended maneuvering area.]

6. Why is it necessary to add power during a steep turn?
[To compensate for the increased induced drag caused by the higher angle of attack required to maintain altitude, according to CFI Notebook.]

7. How do you maintain altitude in a steep turn?
[Primarily by adjusting back pressure on the yoke (elevator control).]
[Small adjustments to bank angle can also help manage altitude deviations.]

8. When should you begin rolling out of a steep turn?
[Approximately 20 degrees before reaching the desired heading.]
[A rule of thumb is to begin the rollout at half the number of degrees of bank prior to reaching the terminating heading.]

9. How does trim affect the steep turn maneuver?
[Trim can reduce the need for large control inputs, allowing the pilot to maintain a lighter feel on the controls.]
[Trim adjustments may be necessary during the entry, turn, and rollout phases to maintain altitude and airspeed.]

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

1. Establish the manufacturer's recommended airspeed or if one is not stated, a safe airspeed not to exceed VA.
2. Roll into a coordinated 360° steep turn with a 45° bank.
3. Perform the Task in the opposite direction, as specified by the evaluator.
4. Maintain the entry altitude ±100 feet, airspeed ±10 knots, bank ±5°; and roll out on the entry heading, ±10° or as recommended by aircraft manufacturer to a safe maneuvering altitude.

LESSON: MEDIUM BANK TURNS

OBJECTIVE:

To make a level turn at bank angles between 20 – 45 degrees while maintaining constant altitude, airspeed and coordination

MOTIVATION:

Mastering this skill is part of a pilot's basic skills to control the airplane.

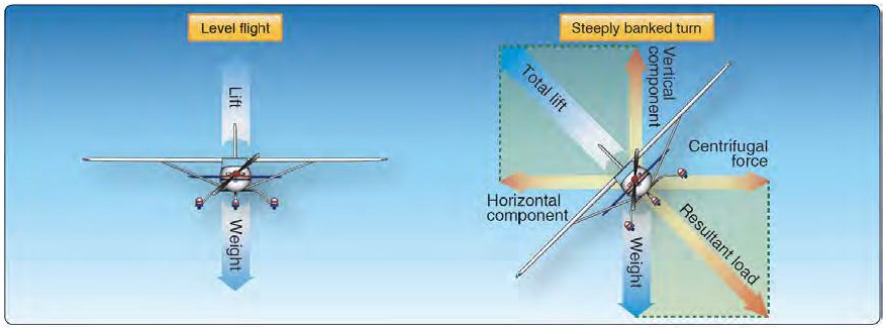
REFERENCES / EQUIPMENT NEEDED:

FAA-H-8083-2 RMH, FAA-H-8083-3 AFH, FAA-H-8083-25 PHAK, POH/AFM
Aircraft

IMAGES / MEDIA / LINKS:









MEDIUM BANK TURNS TIME: [20] Minutes

1. Aerodynamics of turning - VCL vs HCL, Load Factor, Need for additional lift.
2. Aileron controls bank angle. Relationship of horizon to cowling.
3. Elevator controls altitude - Needed to restore VCL. Measured with the ALT
4. Throttle controls airspeed - Added elevator slows speed due to induced drag
5. Rudder for coordination - Explain adverse yaw and rudder use in the turn.
6. If Yaw starts before bank established - SKID, Yaw opposite the turn - SLIP
7. Pilot's outside view will be different between a right turn and a left turn.

KEY POINTS:

- Adverse yaw will be present during roll in and roll out. Stop it with rudder
- Use Elevator to control altitude and power to control airspeed
- The site picture from a left and right turn are different

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE & CH 6-4 Flying Skills

FLIGHT MANEUVERS GUIDE:

1. Clear the area.
2. 2100 RPM; 90 KIAS
3. Begin turn with coordinated aileron and rudder inputs.
4. Use aileron to establish desired bank angle.
5. Use elevator to maintain altitude.
6. Use rudder: to stop adverse yaw and in turn to stop left turning tendencies
7. Apply throttle to maintain airspeed.
8. Lead the roll-out by ½ of the bank angle used.
9. Roll-out of the turn using coordinated aileron and rudder.
10. Use elevator to maintain altitude.
11. Adjust throttle to maintain airspeed.

COMMON ERRORS:

Fixating on a single reference: Avoid concentrating solely on a point on the ground or the nose, and scan multiple references to gauge your turns accurately.

Not adequately clearing the area: Before initiating any turn, always ensure the area is clear of other traffic.

Not establishing a constant altitude: Start and maintain a consistent altitude throughout the maneuver.

Improperly assessing or correcting for wind: Adjust bank angle and rudder as needed to compensate for wind drift and maintain a constant turn radius.

Failing to coordinate controls smoothly: Avoid abrupt control inputs, especially when transitioning into and out of turns.
Additional considerations

Speed: Maintain the recommended entry speed (Va or Vo) and avoid exceeding maneuvering speed during the turn.

Trim: While trim can be beneficial, be prepared to adjust both trim and control inputs during rollout.

Scan: Continuously scan outside and inside the cockpit to monitor the turn, including bank angle, attitude, altitude, airspeed, and balance.

QUESTIONS FOR THE STUDENT:

1. What defines a medium bank turn?
A medium bank turn is generally defined as a turn with a bank angle between 20 and 45 degrees.
At these bank angles, the aircraft tends to maintain a constant bank without sustained aileron pressure, due to the airplane's inherent lateral stability.

2. How do you enter a medium bank turn?
Initiate the turn by applying coordinated aileron and rudder pressure in the desired direction.
As the desired bank angle (within the 20-45 degree range) is reached, gradually neutralize the aileron input, according to AOPA.

3. What control inputs are essential during a medium bank turn to maintain altitude?
Apply slight back pressure on the elevator to counteract the loss of vertical lift component that occurs with banking and maintain a constant altitude.
Rudder adjustments may be needed to maintain coordinated flight as adverse yaw decreases once the aileron input is neutralized.

4. Why might you use trim during a medium bank turn?
Some pilots choose to use nose-up trim to reduce the back pressure needed to maintain altitude in a turn, which can improve comfort and focus on other aspects of coordination.
However, remember to re-trim the aircraft as you roll out of the turn to avoid an unwanted climb.

5. How do you roll out of a medium bank turn?
Start the rollout before reaching the desired heading, leading by approximately half the bank angle (e.g., 15 degrees lead for a 30-degree bank).
Apply coordinated aileron and rudder pressure in the direction of the rollout, or toward the high wing.
As the bank angle decreases, smoothly relax elevator back pressure to maintain altitude, according to the Federal Aviation Administration.

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

At the end of this lesson the student should understand the basic concepts of medium bank turns. The student should be able to perform this maneuver with the assistance of a flight instructor.
There are no required Airman Certification Standards identified for medium bank turns. A proficient student pilot should be able to maintain altitude at +/- 100 feet, bank angle +/- 5 degrees, and roll out on the desired heading within +/- 10 degrees. Coordinated flight should be maintained throughout.

LESSON: SLOW FLIGHT

OBJECTIVE:

To maintain coordinated airplane control at speeds other than cruise speed while using different drag devices while straight and level, turning, climbing or descending.

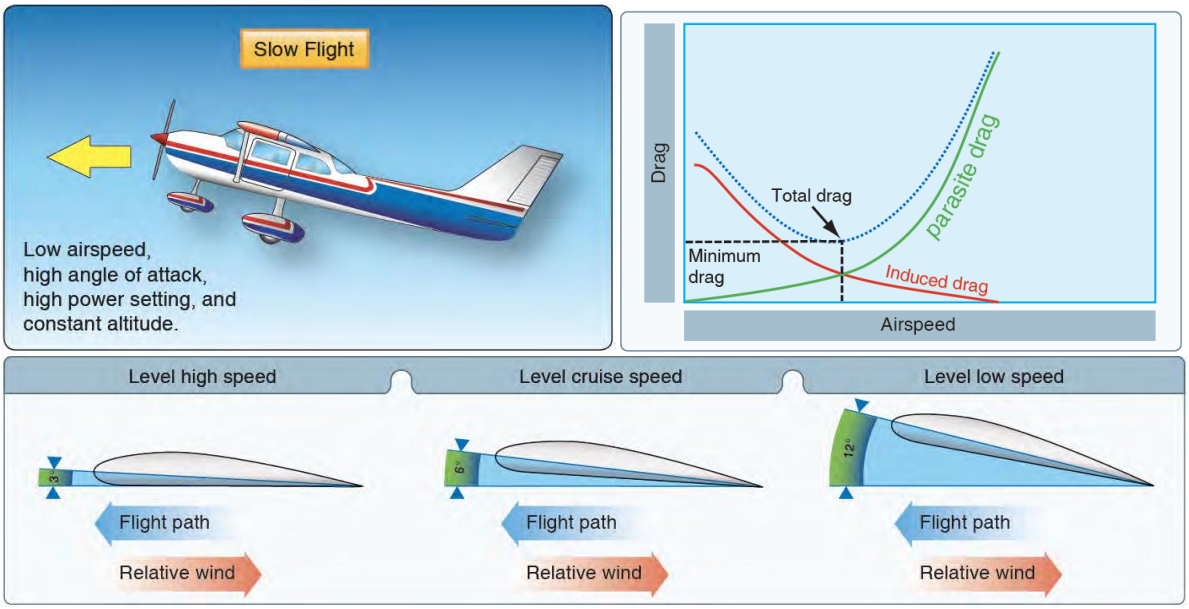
MOTIVATION:

Develops control at slow speeds that will be used for landing.

REFERENCES / EQUIPMENT NEEDED:

FAA-H-8083-2 RMH, FAA-H-8083-3 AFH, FAA-H-8083-25 PHAK POH/AFM
Aircraft

IMAGES / MEDIA / LINKS:



$$L = C_L \cdot \rho \cdot \frac{V^2 \cdot S}{2}$$

SLOW FLIGHT TIME: [XXMinXX] Minutes

1. How this maneuver applies to different phases of flight. (Takeoff/Landing)
2. Review aerodynamics, Lift/drag (induced and parasite)
3. Why AOA increases when airspeed decreases (Lift equation/drag vs speed charts)
4. Show power available vs power required charts - at high and at low speeds the power required is high (Climb not possible)
5. Therefore: At very low speeds - PITCH FOR AIRSPEED AND THROTTLE FOR ALTITUDE
6. As speed is reduced AOA must increase - Induced drag increases so power must be also increased. This causes high torque, P-factor and slipstream causing the airplane to yaw left.
7. Prevent Yaw with rudder.
8. At slow speeds controls are not as effective, stall warning horn 5-10 kts above stall.
9. Recognize the stall horn and take corrective action if activated.

KEY POINTS:

- Throttle controls altitude at low speeds.
- Pitch controls airspeed at low speeds. Pitching for altitude only increases drag.
- Rudder must be applied to keep the airplane from yawing - maintain fixed heading
- Flight controls will be less responsive and less effective at slower airspeeds
- Turns should be shallow. Climbs may not be possible.

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE & CH 6-4 Flying Skills

Teach how to identify, assess and mitigate risks encompassing the following:
1. Proper understanding of Angle of Attack
2. Collision avoidance and scanning for traffic while at high nose attitudes.
3. Failure to avoid a stall or react appropriately to a stall warning
4. Failure to remain coordinated

FLIGHT MANEUVERS GUIDE:

1. Clear the area.
2. Reduce power to 1500 RPM.
3. Maintain altitude with elevator back-pressure as the airspeed slows.
4. Lower flaps to full in stages. 10 degrees below 110, the rest below Vfe.
5. Anticipate necessary elevator pressure changes.
6. Slow to 50 KIAS. Apply throttle as necessary to maintain altitude..
7. Apply necessary pitch to maintain airspeed..
8. Apply rudder to keep the heading with the wings level with ailerons.
9. Perform a level 90 degree turn to the left. Additional throttle will be required to maintain altitude.
10. Perform a level 90 degree turn to the right.
11. Return to straight and level flight at cruise speed by applying full power first.
12. As airspeed increases, retract the flaps in stages while maintaining altitude.
13. When the airspeed is 90 KIAS reduce throttle to 2100 RPM and trim.

COMMON ERRORS:

• Failure to adequately clear the area
• Inadequate elevator back-pressure as power is reduced, resulting in a loss of altitude
• Excessive elevator back-pressure as power is reduced resulting in a climb, followed by a rapid reduction in airspeed, and mushing of the flight controls
• Inadequate compensation for adverse yaw during turns
• Fixation on the airspeed indicator
• Failure to anticipate changes in lift as flaps are extended or retracted
• Inadequate power management
• Inability to adequately divide attention between airplane controls and orientation

QUESTIONS FOR THE STUDENT:

1. What is the purpose of practicing slow flight?

[Slow flight training helps pilots develop a nuanced understanding of aircraft aerodynamics at slow speeds and develop the skills to control the aircraft confidently in these conditions. It helps pilots understand the relationship between angle of attack, airspeed, load factor, power setting, aircraft attitude, and yaw effects during slow flight.]

2. What is the key aerodynamic principle at play during slow flight?

[During slow flight, the aircraft operates on the backside of the power curve, meaning that increasing power decreases airspeed, while increasing pitch (angle of attack) and maintaining altitude requires more power due to increased induced drag. This is contrary to normal cruise flight where pitching up increases altitude and power controls airspeed.]

3. How do you maintain control of the aircraft during slow flight?

[Pitch for Airspeed, Power for Altitude: Unlike normal cruise, in slow flight, pitch adjustments primarily affect airspeed, while power adjustments mainly control altitude.]
[Rudder Control: Rudder inputs are crucial for maintaining coordinated flight and counteracting the increased left-turning tendencies (due to P-factor, torque, and spiraling slipstream) encountered at low speeds and high power settings.]
[Smooth and Coordinated Control Inputs: Abrupt or rough control inputs can lead to a stall. Slow, deliberate movements are key to maintaining control at these lower speeds.]

4. What are the private pilot Airman Certification Standards (ACS) for slow flight?

[The ACS requires the pilot to establish and maintain an airspeed approximately 5 to 10 knots above the 1-G stall speed, at which the aircraft can maintain controlled flight without activating a stall warning.]
[The maneuver should be performed no lower than 1,500 feet AGL (above ground level), or 3,000 feet AGL for multi-engine airplanes. During the maneuver, the pilot must maintain:]
[Altitude: ±100 feet // Heading: ±10 degrees // Airspeed: +10/-0 knots // Angle of bank: ±10 degrees (or as recommended by the aircraft manufacturer)]

5. What are some common mistakes pilots make during slow flight?
[Not clearing the area: Neglecting proper clearing turns before initiating the maneuver is a common error.]
[Fixating on instruments: Overreliance on instruments can lead to poor outside scanning and delayed recognition of changes in aircraft attitude and surroundings.]
[Not maintaining altitude: Failing to adequately control altitude through proper pitch and power management can result in unwanted climbs or descents.]
[Not maintaining airspeed within tolerance: Flying too fast or too slow can result in not meeting the required standards.]
[Improper use of rudder: Inadequate compensation for adverse yaw and left-turning tendencies can lead to uncoordinated flight and potentially a spin.]
[Not recognizing or reacting to stall indications: Ignoring or delaying appropriate recovery actions at the first sign of a stall can be dangerous.]

6. How do flaps affect slow flight?
[Flaps increase wing camber and lift, which allows for a lower stall speed and enables slower flight. However, flaps also increase drag, requiring more power to maintain altitude in slow flight. Flap extension also changes the aircraft's pitch attitude and stall speed, requiring adjustments to pitch and power inputs to maintain control.]

7. How do you recover from slow flight?
[To transition from slow flight back to normal cruise flight, gradually increase power, maintain coordinated flight, raise the flaps incrementally as airspeed increases, and adjust pitch and trim for the desired cruise speed and altitude. Remember to remain attentive to the yawing tendency caused by adding power at low speeds and counteract it with rudder input.]

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

1. Select an entry altitude that will allow the Task to be completed no lower than 1,500 feet AGL.
2. Establish and maintain an airspeed at which any increase in angle of attack, increase in load factor or reduction in power would result in a stall warning (e.g., aircraft buffet, stall horn, etc).
3. Accomplish coordinated straight-and-level flight, turns, climbs, and descents with flap configurations specified by the evaluator without activating
a stall warning. (e.g., aircraft buffet, stall horn, etc.)
4. Divide attention between airplane control, traffic avoidance and orientation.
5. Maintain the specified altitude, ±100 feet; specified heading, ±10°; airspeed +10/-0 knots; and specified angle of bank, ±10° or as recommended by aircraft manufacturer to a safe maneuvering altitude.

LESSON:	EMERGENCY APPROACH AND LANDING

OBJECTIVE:

To get the airplane safely on the ground after a partial or complete power plant failure.

MOTIVATION:

While no one ever expects to make an emergency landing. Practice and preparation for this event will greatly improve the final outcome.

REFERENCES / EQUIPMENT NEEDED:

FAA-H-8083-2A RMH, FAA-H-8083-3 AFH, FAA-H-8083-25 PHAK POH/AFM
Airplane

IMAGES / MEDIA / LINKS:

CFI Notebook



EMERGENCY APPROACH AND LANDING	TIME:	[15] Minutes

1. Landing distance needed at 9G deceleration: 100mph requires 38 ft., 50mph -10 ft.
2. At altitude - Establish best glide, identify a landing area, plan your approach.
3. Picking a landing area: Size, Shape, Surface, Slope, Surroundings.
4. Stabilized approach. How to judge glide path. If possible plan to make a normal pattern with a shortened base turn.
5. Energy management - Better to overshoot than undershoot usually
6. Wind conditions and effects.
7. Selecting an altitude at which a checklist can be used.
8. Using the Emergency checklist. (Brief failure after takeoff actions vs at altitude)
9. Communications.
10. ATC clearance deviations.
11. ELTs and/or other emergency locating devices. Radar assistance to VFR aircraft.

KEY POINTS:

• Configure airplane for best glide speed.
• Use the "Five S's" to evaluate landing areas (Size, Shape, Surface, Slope, Surroundings, Plus Wind and Wires).

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE & CH 6-4 Flying Skills
Risk Management - Teach how to identify, assess and mitigate risk encompassing the following:
1. Wind.
2. Failure to select a suitable landing area.
3. Failure to plan and follow a flight pattern to the selected landing area considering altitude, wind, terrain, and obstructions.
4. Improper management of tasks associated with an emergency approach and landing.
5. Low altitude maneuvering.

6. Startle response.
7. Collision avoidance, scanning, obstacle and wire strike avoidance.
8. Having the right-of-way in an emergency.
9. Obstacles on approach and landing Low altitude stall/spin.
10. Failure to maintain the appropriate airspeed (e.g., best glide speed, minimum sink speed) or configuration during the descent.

FLIGHT MANEUVERS GUIDE:

1. Clear the area. Identify emergency landing areas.
2. Establish best glide speed Vg 68 KIAS.
3. Determine gliding distance limitations.
4. Select a suitable landing area:
- Five S's: Size, shape, surface, slope, surroundings.
5. Determine wind direction.
6. Set up to arrive over the landing area at the high-key position.
7. Arrive at the high key position (crosswind) at 2,000-1,500 feet AGL.
8. Arrive at the normal key position (touchdown point abeam) at 1,000 feet AGL.
9. Configure airplane for landing, as appropriate for conditions.
10. Consult appropriate checklist as time allows.

COMMON ERRORS:

- Failure to adequately clear the area
- Failure to identify emergency landing area
- Failure to maintain best glide speed
- Poor selection of landing area
- Poor pattern management resulting in a or long short approach

QUESTIONS FOR THE STUDENT:

Scenario 1: Engine failure at altitude

1. You're cruising at 5,000 feet AGL when your engine suddenly quits. What's your immediate reaction?
[Maintain control of the aircraft, pitch for best glide speed, and immediately establish the best glide speed for your aircraft to maximize your glide range.]

2. How do you select the best emergency landing area? What factors should you consider?
[Look for an open, flat field, considering wind direction, terrain, and potential obstacles. Avoid built-up areas and power lines if possible.]

3. What's the importance of the best glide speed and how does it relate to glide distance?
[Best glide speed provides the maximum horizontal distance for every foot of altitude lost, crucial for reaching a suitable landing site.]

4. You've selected a field. How will you plan and execute the approach?
[Fly a normal pattern to the field, making necessary adjustments for altitude and wind, and use flaps judiciously to control your descent rate and airspeed for a safe landing.]

5. When would you attempt to restart the engine?
[Only if you have sufficient time and altitude after establishing a safe glide and a committed landing site.]

6. When do you declare an emergency with ATC or on 121.5 MHz?
[As soon as you've established a glide and chosen a landing area, but prioritize flying the plane.]
==

Scenario 2: Engine failure after takeoff

7. Your engine fails immediately after takeoff at 300 feet AGL. Should you turn back to the runway? Why or why not?
[Typically, no, turning back to the runway at low altitude is extremely dangerous due to the potential for stall-spin accidents, according to Safer Skies Through Education. Land straight ahead or slightly to the side in a suitable area.]

8. If you decide to land straight ahead, what are your immediate actions?
[Maintain aircraft control, lower the nose to establish a safe glide, select a landing site directly in front or slightly to the side, and prepare for a landing.]

9. How does density altitude affect your engine-out performance?
[High density altitude (hot, high, humid) reduces engine power and aircraft performance, impacting climb rate, best glide speed, and glide distance, according to the Federal Aviation Administration.]
==

General questions
10. What are the common errors during emergency approaches and landings, and how can you avoid them?
[Common errors include inadequate wind drift correction, failure to establish proper approach configuration, poor trim technique, and unstabilized approaches. Avoid these errors by practicing emergency procedures regularly, including simulated engine failures, and focusing on maintaining aircraft control, according to CFI Notebook.]

11. What's the importance of using a checklist during an emergency?
[Checklists ensure critical steps are not missed during a high-stress situation, improving safety and the likelihood of a successful outcome.]

12. What's the recommended procedure for securing the aircraft after a forced landing?
[Once committed to landing, turn off the fuel and master switch to reduce the risk of fire and unlatch the doors.]

13. When practicing simulated emergency approaches, at what altitude should you terminate the exercise if landing off-airport?
[Terminate the exercise at 500 feet AGL to avoid real dangers.]

14. What are the risks associated with emergency landings in different terrains, such as water or mountainous areas?
[Water landings often result in aircraft overturning and potential injuries, while mountainous terrain can pose challenges with uneven surfaces, cliffs, and unpredictable winds. Careful selection of a landing site is crucial, and landing with the fuselage between trees is often more survivable than a free fall into them.]

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

1. Analyze the situation, select an appropriate course of action, and select a suitable landing area.
2. Establish and maintain the recommended best glide airspeed, ±10 knots.
3. Plan and follow a flight pattern to the selected landing area considering altitude, wind, terrain, and obstructions that would allow a safe landing.
4. Prepare for landing, or go-around, as specified by the evaluator.
5. Complete the appropriate checklist.
6. Make appropriate radio calls, when conditions allow.

LESSON: EMERGENCY DECENTS

OBJECTIVE:

To descend as quickly as possible during emergency conditions within the structural limitations of the airplane.

MOTIVATION:

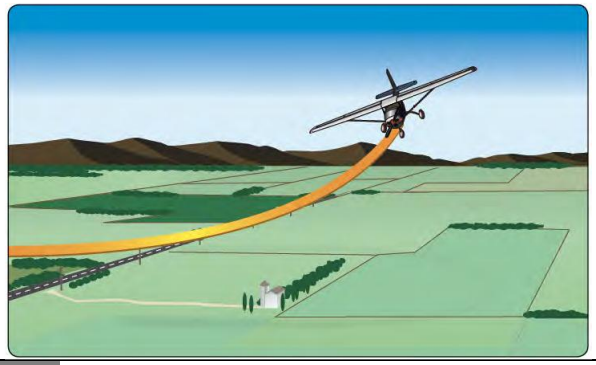
Fire, depressurization, or smoke of unknown origin will all necessitate a rapid descent

REFERENCES:

FAA-H-8083-3C AFH: 18-8 Emergency Descents | 18-21 Inadvertent VFR Flight Into IMC
POH/AFM

IMAGES / MEDIA / LINKS:

CFI Notebook



EMERGENCY DECENTS TIME: [15] Minutes

1. Situations, such as depressurization, cockpit smoke and/or engine fire that require an emergency descent.
2. Landing area.
3. Recommended speed - Va, Vfe, Vne depending upon conditions.
4. Technique - Pressurization problem - Vne straight ahead without banking.
5. Technique - Fire/Smoke - 45-degree bank and pitch for Va, Vfe or Vne depending upon the conditions - Reason for bank = Load Factor.
6. Memory items prior to checklist - Cessna S models use bold text for memory items.
7. Communications and ATC clearance deviations.
8. ELTs and/or other emergency locating devices.
9. Radar assistance to VFR aircraft.
10. Transponder.

KEY POINTS:

• Descend at the airspeed appropriate for the airplane configuration and situation Vne, Va, or Vlo/Vfe

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE & CH 6-4 Flying Skills
Risk Management - Teach how to identify, assess and mitigate risk encompassing the following:
1. Failure to select a suitable landing area.
2. Failure to plan and follow a flight pattern to the selected landing area considering altitude, wind, terrain, and obstructions.
3. Improper aircraft configurations.
4. Improper management of tasks associated with an emergency descent.
5. Low altitude maneuvering.
6. Collision avoidance, scanning, obstacle and wire strike avoidance.
7. Having the right-of-way in an emergency.
8. Failure to maintain situational awareness during an emergency descent.
9. Low altitude stalls/spins.
10. Difference between using Vne & Vfe and when each is appropriate.

FLIGHT MANEUVERS GUIDE:

1. Clear the area. Identify emergency landing areas.
2. 2,000 feet AGL minimum altitude.
3. Identify the emergency.
4. Establish a 45-degree descending turn.
5. Throttle to idle.
6. Establish appropriate airspeed. (Vne, Va, Vfe, Vle)
7. With flaps: Vfe 85 KIAS.
8. Without flaps: Vne 163 KIAS.
9. If making an emergency landing, confirm landing area.
10. At appropriate altitude, configure airplane for landing. Consult appropriate checklist.

COMMON ERRORS:

- Failure to adequately clear the area
- Failure to identify the emergency
- Failure to identify an emergency landing area
- Inappropriate airspeed management
- Airspeed above Vfe with flaps extended
- Airspeed above Vle with gear extended
- Airspeed above Va in turbulent conditions
- Airspeed above Vne at any time
- Failure to maintain a constant airspeed
- Failure to scan for other traffic

QUESTIONS FOR THE STUDENT:

1. When is an emergency descent necessary?
[Fires: Uncontrollable engine, electrical, or cabin fires, according to Binns Flight Services.]
[Depressurization: A sudden loss of cabin pressure, requiring a descent to an altitude where supplemental oxygen is not needed.]
[Medical Emergency: A situation where an immediate landing is necessary for a medical reason affecting a pilot or passenger.]
[Hazardous Weather: Penetrating severe weather phenomena like icing or intense turbulence.]

2. What are the immediate actions for an emergency descent?
[Follow POH/AFM: Always consult the manufacturer's procedures outlined in the Pilot's Operating Handbook/Airplane Flight Manual (POH/AFM) for specific aircraft.]
[Reduce Power: Immediately reduce throttle to idle.]
[Propeller Control (If equipped): Set propeller control to the low pitch (high RPM) position.]
[Increase Drag: Extend landing gear and flaps as recommended by the manufacturer, to maximize drag and increase descent rate without exceeding airspeed limitations.]
[Clear the Area: Perform clearing turns to ensure no traffic or terrain below before initiating the descent.]
[Establish Bank: A bank of 30-45 degrees should be established to maintain positive load factors.]
[Aim for Safe Airspeed: Maintain the maximum allowable airspeed consistent with the procedure, without exceeding Vne, Vle, Vfe, or Va (if turbulence is a factor).]

3. How to perform the descent and recovery?
[Steep Turn: A common technique involves establishing a steep turn (30-45 degree bank) and pitching the nose down to achieve the desired descent rate.]
[Monitor Airspeed and Altitude: Continuously monitor airspeed to remain within limitations and altitude to plan the recovery.]
[Passenger Briefing: Brief passengers about the situation and what to expect (e.g., turbulence, securing loose items, pressurization changes).]

[Level Off: Begin leveling off at a predetermined altitude, typically 100-200 feet above the target altitude, by increasing pitch and adding power to smoothly transition back to level flight.]
[Checklists: Complete the appropriate emergency descent checklist(s).]
[Radio Calls: Make radio calls as appropriate to alert other aircraft and ATC.]

4. What are common errors in emergency descents?
[Failure to Clear the Area: Not adequately checking for traffic and terrain below.]
[Excessive Pitch Changes: Entering or recovering with abrupt pitch changes.]
[Premature Recovery: Attempting to level off too early.]
[Poor Airspeed Control: Allowing the airspeed to become excessive or too slow.]
[Lack of Coordination: Failure to coordinate controls, leading to skidding or slipping.]
[Failure to Maintain Orientation: Losing track of position and heading during the maneuver.]

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

1. Analyze the situation and select an appropriate course of action.
2. Establish and maintain the appropriate airspeed and configuration for the emergency descent.
3. Establish appropriate propeller pitch (if constant speed), flap deployment, and gear position
   • (if retractable) relative to the distance and altitude to the selected landing area.
4. Exhibit orientation, division of attention and proper planning.
5. Maintain positive load factors during the descent.
6. Complete the appropriate checklist.

LESSON:	NORMAL LANDINGS

OBJECTIVE:

To safely transition the airplane from the air to the ground.

MOTIVATION:

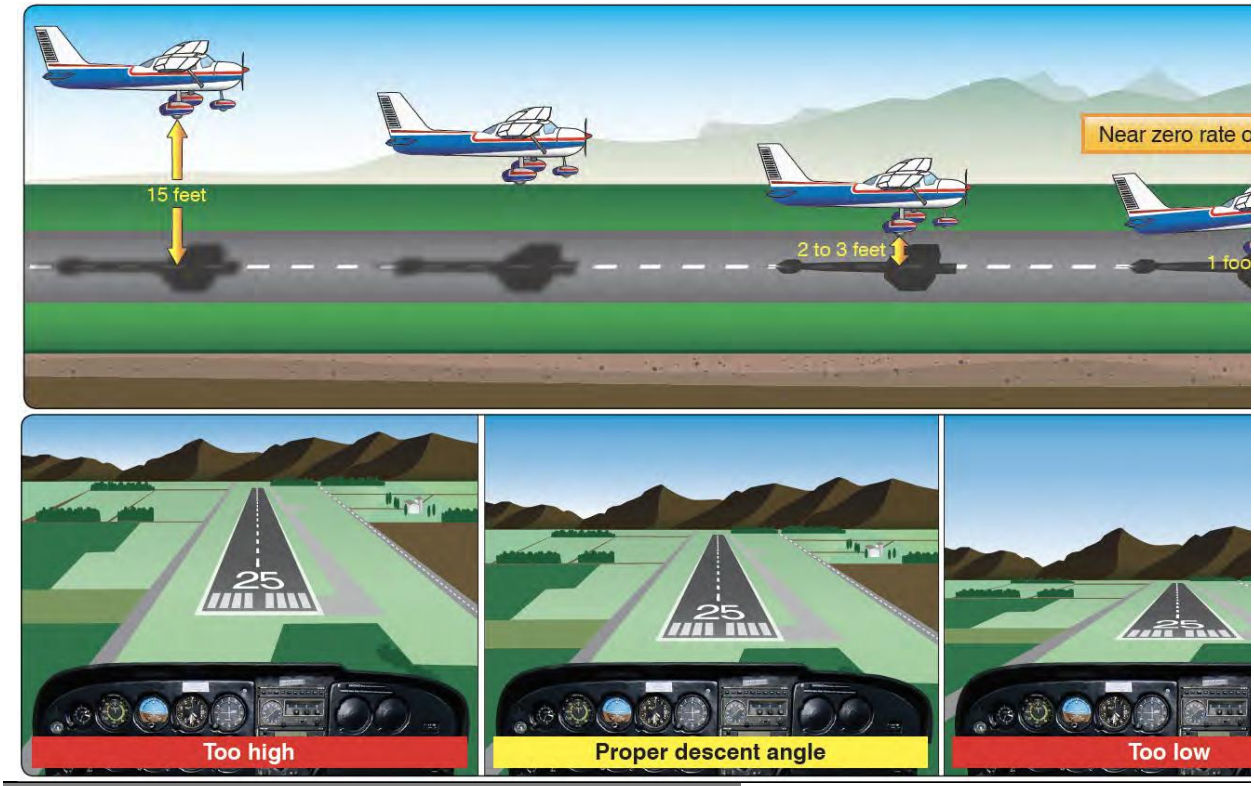
Every takeoff requires a landing.

REFERENCES / EQUIPMENT NEEDED:

AIM; FAA-H-8083-2A RMH, FAA-H-8083-3 AFH, FAA-H-8083-25 PHAK POH/AFM
AFD
Aircraft

IMAGES / MEDIA / LINKS:

CFI Notebook



NORMAL LANDINGS	TIME:	[20] Minutes

1. Available landing distance - importance of landing within the first 1/3 of runway
2. Landing distance from POH considering atmospheric conditions including wind
3. Stabilized approach and interpretation and use of visual glide scope indicators. Looking between the cowling and the touchdown point on approach
4. Energy management. - Airspeed and glide path control - effect of flaps. Changing glide path with a combination of power and pitch.
5. Determining the round-out altitude and flare - Looking down the runway. When the runway expands exponentially being the round out. Nose to horizon.
6. Managing the flare - maintaining directional control throughout the landing
7. Dissipating speed - ballooning or bouncing - when to go around Every takeoff requires a landing.

KEY POINTS:

- Stabilized approach.
- Power controls altitude, pitch controls speed at very slow speeds
- Keep hand on throttle.

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE & CH 6-4 Flying Skills
Risk Management - Teach how to identify, assess and mitigate risk encompassing the following:
1. Failure to select the appropriate runway based on wind, pilot capability, and airplane limitations.
2. Exceeding the manufacturer's maximum demonstrated crosswind component.
3. Wind shear.
4. Tailwind.
5. Wake turbulence.
6. Task management.
7. Low altitude maneuvering.
8. Collision avoidance, scanning, obstacles.
9. Failure to follow the right-of-way rules.
10. Obstacles on approach and landing paths.
11. Failure to recognize the need to perform a go-around/rejected landing. Low altitude stall/spin.

FLIGHT MANEUVERS GUIDE:

1. Enter traffic pattern at TPA, RPM to 1700, slow to 85 KIAS.
2. Landing checklist.
3. 85 KIAS on downwind, 10 degrees of flaps.
4. 70 KIAS on base, 20 degrees of flaps.
5. 65 KIAS on final, 30 degrees of flaps.
6. Visualize touchdown point.
7. Maintain stabilized approach.
8. Round out.
9. Power slowly to idle.
10. Flare.
11. Keep airplane off the runway with elevator back-pressure. Nose-high attitude.
12. Touchdown.
13. Braking as necessary.
14. Depart runway at a safe speed.
15. After-landing checklist.

COMMON ERRORS:

• Inadequate wind-drift correction on the base leg
• Overshooting or undershooting the turn onto final approach, resulting in too steep or too shallow a turn onto final approach
• Flat or skidding turns from base leg to final approach as a result of overshooting/inadequate wind drift correction
• Poor coordination during turn from base to final approach
• Failure to complete the landing checklist in a timely manner
• Un-stabilized approach
• Failure to adequately compensate for airspeed changes during flap extension
• Poor trim technique on final approach
• Attempting to maintain altitude or reach the runway using elevator alone
• Focusing too close to the airplane resulting in a too-high round-out
• Focusing too far from the airplane resulting in a too-low round-out
• Touching down prior to attaining proper landing attitude
• Failure to hold sufficient back-elevator pressure after touchdown
• Excessive braking after touchdown.

QUESTIONS FOR THE STUDENT:

What indicators will be present in a stabilized approach?

When should the pilot begin the round-out?

What effects should the pilot expect when applying flaps?

If a landing or approach to landing is ever unsafe, or uncontrolled, a pilot should...
[Execute a Go-Around or Rejected Landing Procedure]

According to the Private Pilot ACS Standards, what requirement is given in regards to approach airspeed when performing a Normal Approach and Landing?
[+10/-5knots]

When should a pilot reduce power and begin descent from the traffic Pattern Altitude?
[On the Downwind Leg, abeam the desired Touchdown Point]

After Landing, the Pilot should exit the runway...
[At a safe taxi speed (as soon as practical).]

Prior to entering the Downwind Leg of the Traffic Pattern, a pilot should begin slowing their airspeed for approach.
[True]

When should a pilot configure the aircraft for landing?
[Just prior to, or on the Downwind Leg.]

According to the Private Pilot ACS Standards, what requirement is given in regards to the touchdown point?
[Touchdown within 400' beyond or on the specified point.]

If the Pilot Operating Handbook (POH) does not specify an approach airspeed, the pilot should use...
[1.3 x Vso]

When should a pilot make the turn from the Downwind Leg to the Base Leg?
[When 45 degrees past the desired Touchdown Point.]

Select all the items in the GUMPS check that the pilot should perform on the Base Leg.
[Undercarriage]
[Gas]
[Prop]
[Mixture]
[Safety Belts]

The preferred method for entering the Traffic Pattern is to enter...
[a 45 Degree entry to the Downwind Leg.]

A Stabilized Approach is one in which the pilot establishes and maintains a constant angle glide path toward a predetermined point on the landing runway.
[True]

INSTRUCTOR AND STUDENT ACTIONS:
Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge. **Student**: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:
1. Ensure the aircraft is on the correct/assigned runway. 2. Scan the landing runway/areas and adjoining areas for possible obstructions for landing. 3. Complete the appropriate checklist. 4. Consider the wind conditions, landing surface, and obstructions to select a suitable touchdown point. 5. Establish the recommended approach and landing configuration and airspeed and adjust pitch attitude and power as required. 6. Maintain a stabilized approach and recommended airspeed, or in its absence, not more than 1.3 VSO, with wind gust factor applied +10/-5 knots, or as recommended by the aircraft manufacturer for the aircraft type and gust velocity. 7. Make smooth, timely, and correct control applications: during round out and touchdown. 8. Touch down smoothly at a speed that provides little or no aerodynamic lift. 9. Touch down within the available runway within 400 feet beyond a specified point with no drift, and with the airplane's longitudinal axis aligned with and over the runway centerline. 10. Maintain crosswind correction and directional control throughout the approach and landing sequence. 11. Execute a timely go-around decision when the approach cannot be made within the tolerances specified above or for any other condition that that may result in an unsafe approach or landing. 12. Utilize after landing runway incursion avoidance procedures.

LESSON: DECENTS

OBJECTIVE:

To maintain a descent at a constant airspeed and constant direction to either an altitude or to a point on the ground while keeping the airplane coordinated.

MOTIVATION:

Every flight will have a descent. As one of the four fundamentals of flying, mastering this skill is part of a pilot's basic skills for controlling an airplane.

REFERENCES / EQUIPMENT NEEDED:

FAA-H-8083-2 RMH:
FAA-H-8083-3C AFH: 3-20 Descents and Descending Turns | 18-8 Emergency Descents | 18-21 Inadvertent VFR Flight Into IMC
FAA-H-8083-15B IFH: 4-37 Descents
FAA-H-8083-25 PHAK: 5-24 Forces in descents | 14-28 Clearing procedures | Climbs and descents
Airplane

IMAGES / MEDIA / LINKS:

CFI NOTEBOOK

DESCENTS TIME: [15] Minutes

1. Constant airspeed or constant rate - Using the flight instruments ASI, VSI, ALT
2. Reduction in power causes the airplane to keep the same trimmed airspeed, downwash is reduced, and a descent is started
3. Relationship of the horizon to the cowling while descending
4. Point on the ground that isn't moving (where the airplane is going) and how to change it with flaps, slipping, power.
5. Sequence to start a descent: Power, attitude, trim - Pitch for airspeed power for rate of descent. Maintain no side to side motion with rudder.
6. Describe descending to a point on the ground (aiming) vs descending to an altitude

KEY POINTS:

- Understanding Airspeed and Pitch
- Instrument Scanning
- Trim Adjustment
- Smooth Control Inputs

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE & CH 6-4 Flying Skills

FLIGHT MANEUVERS GUIDE:

1. Clear the area, particularly the area below the airplane in the blind spots.
2. Reduce throttle to 1500 RPM.
3. Apply carb heat if equipped.
4. Reduce pitch attitude to one that will achieve 90 KIAS.
5. Establish a 90 KIAS airspeed descent using pitch.
6. Note the descent rate with the VSI - increase or decrease rate with power
7. Reduce control pressures using trim.
8. The point on the windscreen not moving (This is where the airplane is going).
9. Change descent angle by using flaps. Observe how the point on windscreen changes
10. Retract flaps, if applied, in stages to avoid large losses of lift.
11. Begin to level off at a specified altitude. Lead the level off by 50 ft.
12. Increase throttle to 2100 RPM.
13. Apply elevator back-pressure to achieve level flight.
14. Measured by the Altimeter Eliminate control pressures with trim.

COMMON ERRORS:

- Failure to adequately clear the area
- Inadequate back-elevator control during glide entry, resulting in too steep a glide
- Failure to slow the airplane to the desired airspeed prior to lowering pitch attitude
- Attempting to establish/maintain a descent solely by reference to flight instruments
- Inability to sense changes in airspeed through sound and feel
- Inability to stabilize the descent (chasing the airspeed indicator)
- Skidding or slipping during descending turns due to inadequate appreciation of the different rudder pressure requirements with and without power

QUESTIONS FOR THE STUDENT:

1. How can a pilot determine where the airplane is aimed during a descent?
2. How can the pilot adjust airspeed during a descent?
3. What is the sequence to establish a descent?

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

At the end of this lesson the student should understand the basic concepts of normal descents. The student should be able to perform this maneuver with the assistance of a flight instructor. There are no required Airman Certification Standards (ACS) identified normal descents. A proficient student pilot should be able to maintain airspeed at +/- 10
KIAS and maintain a heading of +/- 10 degrees. The pilot should be able to descend to a point on the ground using an appropriate combination of throttle and flaps.
Coordinated flight should be maintained. The pilot should also understand how to properly trim the airplane for a constant airspeed descent.

LESSON:	FORWARD SLIP TO LANDING

OBJECTIVE:

To quickly and safely lose altitude without gaining airspeed.

MOTIVATION:

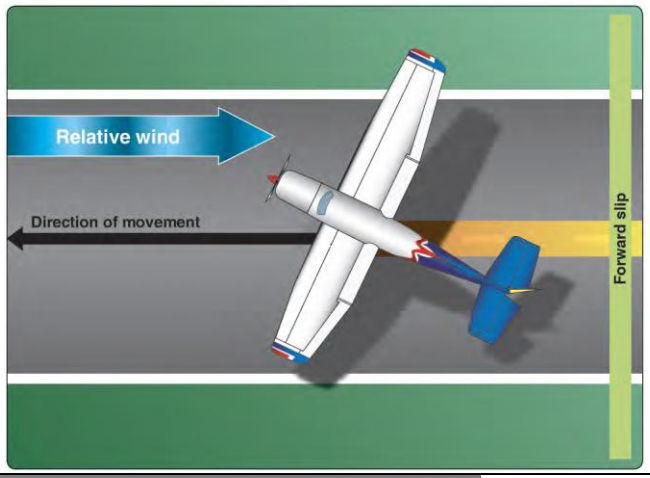
Sometimes due to the environment or just simple misjudgments, altitude needs to be lost at a high rate, but an increase in forward speed is undesirable.

REFERENCES / EQUIPMENT NEEDED:

AIM; FAA-H-8083-2A RMH, FAA-H-8083-3 AFH, FAA-H-8083-25 PHAK POH/AFM
Aircraft

IMAGES / MEDIA / LINKS:

CFI Notebook



FORWARD SLIP TO LANDING	TIME:	[15] Minutes

1. A slip is defined as when the longitudinal axis of the airplane in not aligned with the flight path when the flight path is straight ahead (No change in heading)
2. A slip exposes a large area of the fuselage to the relative wind which dramatically increases drag. (Demonstrate with the model airplane)
3. The basic technique is to use aileron to roll the airplane left or right then use rudder to prevent any heading change. The maximum rate of descent a slip can generate is a function of how much rudder travel is available. (Use Model)
4. A forward slips effect will be more if Aileron is used into the wind.
5. When and why forward slips are used and differences between side and forward slips. Demonstrate with a model and diagram.
6. The effects of forward slips affecting indicated airspeed. Pitot tube not aligned with the relative wind. Limitations of slips i.e. fuel flow, aerodynamics limitations
7. Altitude at which to exit the forward slip depends upon where the touchdown point is. Speed increases after the slip is stopped.

KEY POINTS:

- The rudder is opposite to the aileron input.
- The steeper the bank, the steeper the decent.
- Effectiveness of the forward slip cannot be judged by airspeed.
- Recover with enough time to resume a stabilized approach.
- Airspeed will increase after slip is discontinued.

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE & CH 6-4 Flying Skills
Risk Management - Teach how to identify, assess and mitigate risk encompassing the following:
1. Failure to recognize the need to perform a go-around/rejected landing.
2. Failure to correlate any crosswind effects with direction of forward slip.
3. Failure to transition to a side slip or zero slip for landing.
4. Low altitude stall/spin.
5. Wind shear
6. Tailwind.
7. Low altitude maneuvering.
8. Collision avoidance, scanning, and obstacle avoidance.
9. Aircraft systems affected by performing a forward slip to include airspeed indications and fuel flow.

FLIGHT MANEUVERS GUIDE:

1. Complete the landing checklist.
2. Lower one wing using aileron input in the direction of the wind.
3. Apply opposite rudder to prevent the airplane from turning.
4. Adjust the control inputs to obtain the desired rate of descent.
5. Discontinue the slip at a point above the ground where there is adequate time to resume a stabilized approach.

COMMON ERRORS:

• Pilot hesitant to put in enough aileron input to achieve the desired descent angle
• Pilot does not recover from the forward slip with enough time to resume a stabilized approach before landing.

QUESTIONS FOR THE STUDENT:

1. What is the purpose of a forward slip to landing?
[A forward slip is primarily used to increase the rate of descent without increasing airspeed when you find yourself too high on final approach.]
[It's a useful tool for getting back on the desired glide path and can be especially helpful when faced with obstacles like trees on final approach or in emergency situations like engine-out landings.]

2. How do I enter a forward slip?
[Reduce power to idle: This initiates a descent and is essential for slipping.]
[Configure for landing: Ensure you have the appropriate flap setting for your aircraft and situation, based on your aircraft's Pilot's Operating Handbook (POH).]
[Bank the aircraft: Lower the wing on the side you want to slip. If there's a crosswind, bank into the wind.]
[Apply opposite rudder: Simultaneously apply opposite rudder to prevent the aircraft from turning in the direction of the bank.]
[Maintain straight ground track: Adjust aileron and rudder inputs to maintain a straight ground track towards the runway.]
[Control airspeed: Lower the nose slightly to prevent the airspeed from decaying too much. Aim for a normal approach airspeed.]
[Airspeed indicator inaccuracy: Be aware that the airspeed indicator may be inaccurate during a slip due to airflow around the pitot tube and static ports. Rely more on the aircraft's attitude, sound of airflow, and control feel.]

3. How do I control the rate of descent in a forward slip?
[Bank angle: The steeper the bank, the steeper the descent.]
[Rudder authority: In light airplanes, the steepness of the slip may be limited by available rudder authority.]
[Lowering the nose: If more descent is needed and you've reached the rudder limit, lowering the nose will increase airspeed, providing more rudder authority to steepen the slip.]

4. How do I recover from a forward slip?

[Smoothly release rudder pressure: Avoid abrupt movements to prevent the nose from swinging quickly and avoid gaining excessive airspeed.]
[Gently level the wings: Simultaneously release rudder and level the wings using ailerons.]
[Adjust pitch attitude: Adjust pitch to return to a normal glide path.]
[Increase power: Gradually increase power to your normal final approach setting.]
[Transition to sideslip (if crosswind): If landing with a crosswind, transition the forward slip into a sideslip to maintain alignment with the runway.]

5. What are some common mistakes to avoid?
[Not reducing power to idle: This negates the primary purpose of the slip.]
[Not applying sufficient or appropriate rudder/aileron: This can lead to an ineffective or unstable slip.]
[Failing to maintain proper airspeed: This can lead to a stall, especially dangerous close to the ground.]
[Failing to maintain runway alignment: This can result in drifting or a hard landing.]
[Abrupt recovery: This can cause the aircraft to swing or gain excessive speed.]
[Relying solely on instruments: Since the airspeed indicator might be inaccurate, use other cues like aircraft attitude, sound, and control feel.]
[Trying to salvage an unstabilized approach with a slip: It's safer to go around and try again.]

6. What about crosswind considerations?
[When landing with a crosswind, it's generally best to slip with the airplane banked into the wind.]
[This positions you for a seamless transition into a proper crosswind sideslip during recovery.]
[Rudder authority can be a limiting factor in strong crosswinds, potentially requiring a shallower approach from slightly downwind to gain some leeway.]

7. What else should I keep in mind?
[Practice with an instructor: Mastering forward slips requires practice and guidance.
[Consult your POH: Always refer to your aircraft's POH for specific limitations and recommendations regarding slips.]
[Be prepared to go around: If the approach becomes unstable or unsafe, execute a go-around.]
[Maintain situational awareness: Continuously scan for other traffic, especially in uncontrolled airfields.]

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

1. Select runway/landing area based on wind, landing surface and obstructions, pilot capability and aircraft limitations.
2. Calculate the crosswind component and determine if it is beyond the pilot's ability or aircraft capability.
3. Select the most suitable touchdown point.
4. Establish the slipping attitude at the point from which a landing can be made using the recommended approach and landing configuration and airspeed; adjust pitch attitude as required.
5. Maintain a ground track aligned with the runway/landing path centerline and an airspeed, which results in minimum float during the round out.
6. Make smooth, timely, and correct control application during the recovery from the slip, the round out, and the touchdown.
7. Touch down within 400 feet beyond a specified point with no drift, and with the airplane's longitudinal axis aligned with and over the runway centerline.
8. Maintain crosswind correction and directional control throughout the approach and landing sequence.
9. Complete the appropriate checklist.
10. Execute a timely go-around decision when the approach cannot be made within the tolerances specified above.

LESSON:	SHORT-FIELD TAKE-OFF

OBJECTIVE:

To take off in the shortest possible distance.

MOTIVATION:

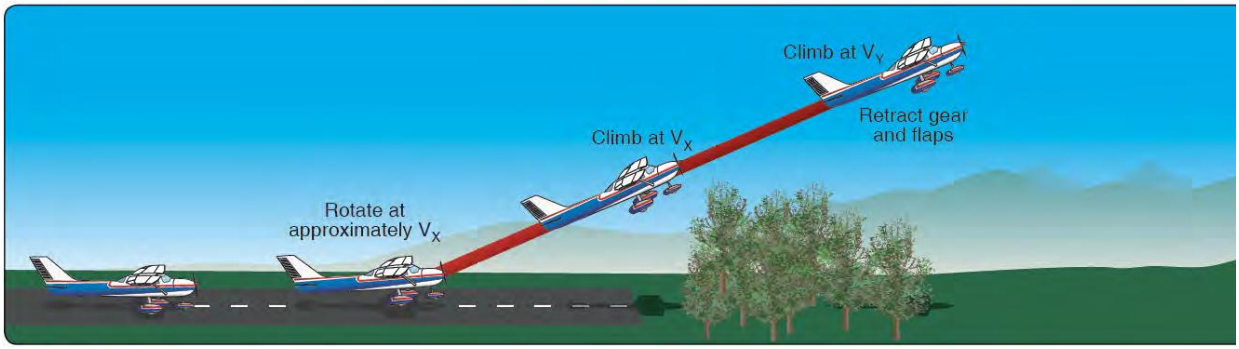
This is a necessary skill to be able to depart smaller airports, unimproved fields, and/or to clear obstacles in close proximity to the runway.

REFERENCES / EQUIPMENT NEEDED:

FAA-H-8083-2A RMH, FAA-H-8083-3 AFH; POH/AFM; AIM
Aircraft

IMAGES / MEDIA / LINKS:

CFI Notebook



SHORT-FIELD TAKE-OFF	TIME:	[15] Minutes Assumes normal & crosswind takeoff proficiency

1. Calculating the takeoff distance using the POH and weather data.
2. The effects of runway surface.
3. Aircraft configuration - Reason for using or not using flaps.
4. Takeoff technique - Using all available runway - Static takeoff at full power -Verification of engine performance.
5. Obstruction clearance. Recommended speed
6. Wind conditions and effects.
7. Minimum safe altitude.
8. Application of VX or VY.
9. Emergency procedures during takeoff and climb.

KEY POINTS:

- Use flaps as required in the POH.
- Climb speed may not always be Vx
- Use all available runway.
- Full power while holding brakes.

RISK MANAGEMENT:

FAA-H-8083-2A RMH XXXX
Risk Management - Teach how to identify, assess and mitigate risk encompassing the following:
1. Failure to select the appropriate runway based on wind, pilot capability, and aircraft limitations.
2. Exceeding the manufacturer's maximum demonstrated crosswind component.
3. Operating from other than a hard-surfaced runway.
4. Obstruction clearance.
5. Climb attitude and stall awareness.
6. Wind shear.
7. Tailwind.
8. Wake turbulence
9. Task management.
10. Low altitude maneuvering.

11. Wire strikes.
12. Obstacles on the departure paths.
13. Recognition of need for rejected takeoff and identification of takeoff abort criteria.
14. Strategies for handling engine failure during takeoff and climb.

FLIGHT MANEUVERS GUIDE:

1. Use POH for short-field take-off performance data calculations.
2. Configure the airplane as recommended in the POH.
3. Flaps 10 degrees.
4. Taxi onto the end of runway and stop.
5. Line up as close to the end of the runway as possible, allowing the greatest amount of runway length to be available for take-off.
6. Apply full brakes.
7. Apply full throttle.
8. When maximum power is reached, release the brakes and begin the take-off roll.
9. Rotate at 57 KIAS and maintain this airspeed until at an altitude of 50 feet. With a positive rate of climb accelerate to over 60 KIAS then retract the flaps. Accelerate to Vy, 74 KIAS.
10. Continue climb to desired altitude.

COMMON ERRORS:

- Failure to adequately clear the area
- Failure to utilize all available runway/take-off area
- Failure to have the airplane properly trimmed prior to take-off
- Premature lift-off resulting in high drag
- Holding the airplane on the ground unnecessarily with excessive forward elevator pressure
- Late rotation resulting in excessive speed after lift-off
- Inability to attain/maintain best angle-of-climb airspeed
- Fixation on the airspeed indicator during initial climb
- Premature retraction of the wing flaps

QUESTIONS FOR THE STUDENT:

1. Why are flaps used for a short-field take-off?
2. When and how should the flaps be retracted?

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

1. Verify proper aircraft configuration.
2. Verify ATC clearance and no aircraft is on final before crossing the hold line.
3. Ensure the aircraft is on the correct takeoff runway.
4. Determine wind direction with or without visible wind direction indicators.
5. Calculate the crosswind component and determine if it is beyond the pilot ability or aircraft capability.
6. Position the flight controls for the existing wind conditions.
7. Clear the area, taxi into takeoff position utilizing maximum available takeoff area and align the airplane on the runway center line.
8. Apply brakes (if appropriate), while configuring aircraft power setting to achieve maximum performance.
9. Confirm takeoff power prior to brake release (if appropriate) and proper engine and flight instrument indications prior to rotation.
10. Rotate and lift-off at the recommended airspeed and accelerate to the recommended obstacle clearance airspeed or Vx.

11. Establish a pitch attitude that will maintain the recommended obstacle clearance airspeed, or VX, +10/-5 knots, until the obstacle is cleared, or until the airplane is 50 feet above the surface.
12. After clearing the obstacle, establish the pitch attitude for VY, accelerate to VY, and maintain VY, +10/-5 knots, during the climb.
13. Retract flaps in accordance with aircraft manufacturer's guidance.
14. Maintain takeoff power and VY +10/-5 knots to a safe maneuvering altitude.
15. Maintain directional control and proper wind drift correction throughout the takeoff and climb.
16. Comply with noise abatement and published departure procedures.
17. Complete the appropriate checklist.
18. Comply with manufacturer's recommended emergency procedures related to the takeoff sequence.
19. Utilize runway incursion avoidance procedures.

LESSON: SHORT-FIELD APPROACH AND LANDING

OBJECTIVE:

To be able to take off from other than a hard-surface runway

MOTIVATION:

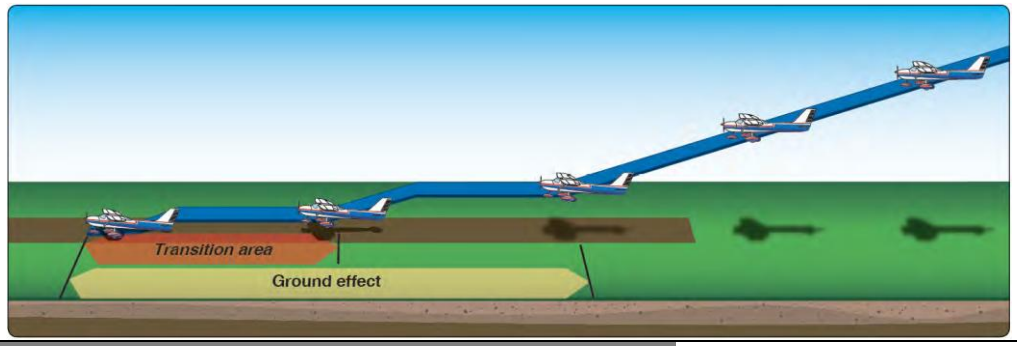
The ability to land on other than ideal surfaces can open many locations to a pilot, as well as provide an additional margin of safety if forced to make an off-airport landing.

REFERENCES / EQUIPMENT NEEDED:

Airplane
POH

IMAGES / MEDIA / LINKS:

CFI Notebook



SHORT-FIELD APPROACH AND LANDING TIME: [15] Minutes

1. Calculating the landing distance using the POH and available weather.
2. Hazards of other than hard surfaced runway.
3. Stabilized approach at Normal or Short Field Landing approach speed
4. Round-out and control the descent to touchdown with power.
5. Transfer the weight to the wheels gently
6. Use power to keep the nose-wheel off the runway until it is no longer necessary.

KEY POINTS:

- Use appropriate speeds. (normal or short field airspeeds)
- Touch down as slow as possible using ground effect.
- Keep nose-wheel off of the ground for as long as possible.
- Keep moving!

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE & CH 6-4 Flying Skills
Risk Management - Teach how to identify, assess and mitigate risk encompassing the following:
1. Failure to select the appropriate runway based on wind, pilot capability, and aircraft limitations.
2. Exceeding the manufacturer's maximum demonstrated crosswind component.
3. Operating from other than a hard-surfaced runway.
4. Losing elevator control, sinking into the soft surface, or striking the prop if moving too slowly.
5. Wind shear avoidance.
6. Tailwind.
7. Wake turbulence.
8. Task management.
9. Low altitude maneuvering.
10. Collision avoidance, scanning, obstacle and wire strike avoidance.
11. Failure to follow the right-of-way rules.
12. Obstacles on approach and landing paths.
13. Failure to recognize the need for a go-around/rejected landing.
14. Low altitude stall/spin.

15. Performing a soft-field landing after an engine failure.

FLIGHT MANEUVERS GUIDE:

1. Slow to 85 KIAS before entering traffic pattern.
2. Enter the traffic pattern at published TPA.
3. Complete before-landing checklist.
4. When ready to descend from TPA, reduce throttle to 1500 RPM.
5. Select 10 degrees of flaps and establish a pitch attitude for a 75 KIAS descent.
6. Use trim to reduce control pressures.
7. On the base leg, select 20 degrees of flaps and establish a pitch attitude for 70 KIAS.
8. On final, select 30 degrees of flaps and establish a pitch attitude for 65 KIAS not lower than 300 feet AGL.
9. Fly the airplane onto the ground, slowly transferring the weight from the wings to the main landing gear.
10. Touchdown at the intended touchdown point at minimum speed and a nose-high attitude.
11. Keep the nose-wheel off the ground as long as possible as the airplane slows by maintaining full aft elevator back-pressure.
12. Maintain elevator back-pressure while taxiing off the runway.
13. Perform appropriate checklist.

COMMON ERRORS:

- Excessive descent rate on final approach.
- Excessive airspeed on final approach.
- Un-stabilized approach.
- Round-out too high above the runway surface.
- Poor power management during the round-out and touchdown.
- Hard touchdown.
- Inadequate control of the airplane weight transfer from wings to wheels after touchdown.
- Allowing the nose-wheel to “fall” to the runway after touchdown rather than controlling its descent.

QUESTIONS FOR THE STUDENT:

1. What are the key elements of a short-field approach and landing?

Stabilized Approach: A stable approach at the appropriate airspeed is crucial. This involves maintaining a consistent descent rate and airspeed, and staying aligned with the runway centerline.
Target Airspeed: Fly at the manufacturer's recommended short-field approach speed, or if not provided, 1.3 times the stalling speed (Vso). Add one-half the gust factor in gusty conditions.
Obstacle Clearance: If there are obstacles on approach, a steeper-than-normal approach may be necessary. Use flaps to help achieve a steeper descent angle while maintaining airspeed and visibility over the nose.
Precise Aiming Point: Choose a specific point on the runway as your aiming point (where you anticipate the aircraft's nose will be directed). This helps ensure you land in the desired location.
Minimal Float: Control the flare to avoid excessive floating down the runway. This ensures a touchdown close to your aiming point and maximizes the available stopping distance.
Timely Touchdown: Touchdown at the minimum controllable airspeed, just above stall speed, to minimize ground speed and maximize braking effectiveness.
Aerodynamic and Wheel Braking: Maximize aerodynamic braking by holding back pressure on the yoke or stick after touchdown to increase drag. Smoothly apply the brakes to slow down without skidding.

2. What factors affect short-field landing performance?
Aircraft Weight: Higher weight increases the landing distance required.
Density Altitude: High density altitude (due to high field elevation, high temperature, and/or high humidity) reduces aircraft performance, increasing landing distance.
Wind: Tailwinds significantly increase landing distance. Crosswinds require specific techniques for maintaining directional control.
Runway Surface Conditions: Wet, slippery, or contaminated runways (e.g., with snow, slush, or ice) reduce braking effectiveness and increase landing distance.
Runway Slope: An uphill slope reduces landing distance, while a downhill slope increases it.
Flap Setting: Using less than maximum landing flaps may increase landing distance.
Obstacles: Obstacles on the approach path necessitate a steeper approach, which can make judging the flare more difficult.

3. How does a short-field landing differ from a normal landing?
The primary differences lie in the approach and touchdown:
Steeper Approach: Short-field landings often require a steeper approach angle to clear obstacles at the beginning of the runway.
Slower Airspeed: Short-field landings emphasize maintaining the appropriate airspeed to minimize floating and maximize braking effectiveness, often using 1.3 Vso.
Precise Touchdown: The goal is to touch down precisely at a designated point on the runway to maximize the available stopping distance. This differs from a normal landing where a slightly longer touchdown zone may be acceptable.

4. What are the short-field landing tolerances for private pilots?
For private pilot check rides, the touchdown point should be within 200 feet beyond or on the specified point, with no side drift and the aircraft's longitudinal axis aligned with the runway centerline.
Remember, practice and precision are key to mastering short-field landings. Always prioritize a stabilized approach and be prepared to execute a go-around if the conditions or approach are not optimal.

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

1. Ensure the aircraft is aligned with the correct/assigned runway.
2. Scan the landing runway/area for possible obstructions for landing.
3. Complete the appropriate approach and landing checklist.
4. Consider the wind conditions, landing surface, and obstructions to select a suitable touchdown point.
5. Establish the recommended approach and landing configuration airspeed and adjust pitch attitude and power as required.
6. Maintain a stabilized approach and recommended airspeed, or in its absence, not more than 1.3 VSO, with wind gust factor applied +10 /-5 knots.
7. Make smooth, timely, and correct control application during the round out and touchdown and, for tricycle gear airplanes, keep the nose wheel off the surface until loss of elevator effectiveness.
8. Touch down softly with minimum sink rate and no drift, with the airplane's longitudinal axis aligned with center of the runway.
9. Maintain full up elevator during roll out and exit the "soft" area at a speed that would preclude sinking into the surface.
10. Maintain crosswind correction and directional control throughout the approach and landing sequence, as required.

11. Execute a timely go-around decision when the approach cannot be made within the tolerances specified above or for any other condition that may result in an unsafe approach or landing.
12. Maintain proper position of the flight controls and sufficient speed to taxi on the soft surface.
13. Utilize after landing runway incursion avoidance procedures.

LESSON:	SOFT FIELD TAKE-OFF

OBJECTIVE:

To be able to take off from other than a hard-surface runway

MOTIVATION:

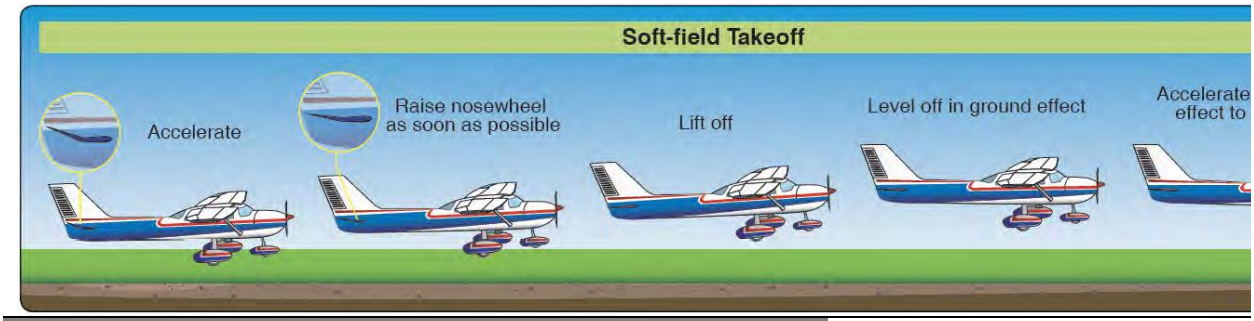
The ability to operate from a variety of surfaces opens up many other destination opportunities beyond the typical hard-paved airport runways.

REFERENCES / EQUIPMENT NEEDED:

AIM; FAA-H-8083-2A RMH, FAA-H-8083-3 AFH, FAA-H-8083-25 PHAK POH/AFM

IMAGES / MEDIA / LINKS:

CFI Notebook



SOFT FIELD TAKE-OFF	TIME:	[15] Minutes

1. The effects of the runway surface on takeoff.
2. Hazards of other than a hard-surfaced runway.
3. Determining the takeoff distance using the POH and weather information.
4. The importance of weight transfer from wheels to wings.
5. Aircraft configuration - Rolling takeoff, verify engine power via instruments.
6. Left turning tendencies - More P-factor.
7. Technique - Use the elevator to keep nose wheel from digging in and at an attitude that will cause the airplane to become airborne prematurely. Keeps weight off the wheels, keep moving don't Stop.
8. The effects of takeoff power, airspeed and elevator to avoid a tail strike.
9. After becoming airborne, stay in ground effect and accelerate to VX or VY.
10. Retract flaps after VY.

KEY POINTS:

- Elevator full aft while taxiing but be careful on takeoff to avoid a tail strike
- Keep moving!
- Accelerate in ground effect.

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE & CH 6-4 Flying Skills
Risk Management - Teach how to identify, assess and mitigate risk encompassing the following:
1. Failure to select the appropriate runway based on wind, pilot capability, and aircraft limitations.
2. Exceeding the manufacturer's maximum demonstrated crosswind component.
3. Operating from other than a hard-surfaced runway.
4. Wind shear.
5. Tailwind.
6. Wake turbulence.
7. Task management.
8. Low altitude maneuvering.
9. Wire strikes.
10. Obstacles on the departure path.
11. Rejected takeoffs and failure to identify a takeoff abort point.
12. An engine failure during takeoff and climb.

13. Failure to use a soft-field takeoff technique on another than hard surfaced runway.
14. Takeoff distance available.

FLIGHT MANEUVERS GUIDE:

1. Complete the before take-off checklist.
2. Flaps 10 degrees.
3. Elevator full aft.
4. Roll onto runway with minimal braking. Do not stop.
5. Smoothly apply full power when lined up on centerline of runway.
6. As nose lifts, release elevator back-pressure to prevent the tail from striking the ground.
7. Keep the nose-wheel off the ground.
8. Lift off at the slowest possible airspeed.
9. When lift-off is achieved, adjust pitch attitude to remain in ground effect.
10. Accelerate airplane to a safe speed while in ground effect.
11. Accelerate to Vy, 79 KIAS and retract the flaps.

COMMON ERRORS:

- Failure to adequately clear the area
- Insufficient back-elevator pressure during initial the take-off roll, resulting in inadequate angle of attack
- Failure to cross-check engine instruments for indications of proper operation after applying power
- Poor directional control
- Climbing too steeply after lift-off
- Abrupt and/or excessive elevator control while attempting to level off and accelerate after lift-off
- Allowing the airplane to “mush” or settle, resulting in an inadvertent touchdown after lift-off
- Attempting to climb out of ground effect before attaining sufficient climb speed
- Failure to anticipate an increase in pitch attitude as the airplane climbs out of ground effect

QUESTIONS FOR THE STUDENT:

1. What are the key objectives of a short-field takeoff?
[A short-field takeoff prioritizes getting airborne in the shortest possible distance and climbing steeply to clear obstacles in the departure path.]

2. What are the main steps involved in performing a short-field takeoff?
[Pre-takeoff planning: Consult the Aircraft Flight Manual (AFM) or Pilot Operating Handbook (POH) for recommended procedures, flap settings, airspeeds (Vx and Vy), and performance charts to determine takeoff distance required based on factors like weight, wind, density altitude, and obstacle clearance.]
[Utilize maximum available runway: Align the aircraft on the earliest part of the runway and use all available length for takeoff.]
[Apply full power while holding brakes: Advance the throttle smoothly to maximum takeoff power while holding the brakes to achieve maximum engine thrust before releasing.]
[Check engine instruments: Verify engine performance (e.g., static RPM, oil pressure) before releasing the brakes.]
[Release brakes and maintain directional control: Release the brakes and use rudder to counter left-turning tendencies and maintain centerline alignment.]
[Attain liftoff attitude: Adjust pitch attitude to allow the aircraft to accelerate to the best angle-of-climb speed (Vx) and then apply back elevator pressure to lift off.]
[Climb at Vx: Maintain Vx speed to achieve the steepest climb angle and clear obstacles, typically a theoretical 50-foot obstacle. Private pilots typically target Vx +/- 5-10 knots.]
[Transition to Vy: After clearing the obstacles, lower the pitch slightly to accelerate to the best rate-of-climb speed (Vy). Private pilots typically target Vy +/- 5-10 knots.]
[Retract flaps: Once established at Vy and a safe maneuvering altitude, gradually retract the flaps as recommended by the manufacturer, advises the FAA.]

3. What are some common errors to avoid during short-field takeoffs?
[Failure to review performance charts: Not using the AFM/POH to calculate takeoff distance and speeds for current conditions.]
[Not utilizing all available runway: Beginning the takeoff roll too far down the runway.]
[Inadequate power application or engine check: Not applying full power or checking engine instruments before releasing brakes.]
[Premature lift-off or insufficient rotation: Lifting off too early, increasing drag, or not rotating at the recommended speed.]
[Inability to maintain Vx: Failing to hold the best angle-of-climb speed during the initial climb, potentially jeopardizing obstacle clearance.]
[Fixation on the airspeed indicator: Focusing solely on the airspeed indicator rather than employing attitude flying principles and looking outside the aircraft.]
[Premature flap retraction: Retracting flaps too soon can cause a sudden loss of lift and settling.]
[Poor directional control: Failing to anticipate left-turning tendencies and maintaining runway alignment with rudder.]

4. What factors impact takeoff performance and need consideration for short-field operations?
[Weight: Higher gross weight requires higher liftoff speed, increases mass to accelerate, and increases drag, thus requiring more takeoff distance.]
[Density Altitude: Higher density altitude (often linked to higher temperatures or field elevation) reduces engine thrust and wing lift, increasing takeoff distance.]
[Wind: Headwinds decrease takeoff distance, while tailwinds significantly increase it.]
[Runway Surface and Condition: Paved runways offer the shortest takeoff rolls, while gravel, grass, or contaminated surfaces (water, snow, ice) increase friction and drag, increasing takeoff distance.]
[Runway Slope: Uphill slopes increase takeoff distance, while downhill slopes decrease it.]
[Obstacles: Obstacles in the departure path necessitate a climb at Vx for obstacle clearance, increasing the required distance to clear them.]

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

1. Verify ATC clearance and no aircraft are on final before crossing the hold line.
2. Ensure the aircraft is properly configured.
3. Ensure the aircraft is on the correct takeoff runway.
4. Ascertain wind direction with or without visible wind direction indicators.
5. Calculate the crosswind component and determine if it is beyond the pilot ability or aircraft capability.
6. Position the flight controls for the existing wind conditions to maximize lift as quickly as possible.
7. Clear the area, taxi into the takeoff position and align the airplane on the runway center line without stopping while advancing the throttle smoothly to takeoff power.
8. Confirm takeoff power, and proper engine and flight instrument indications prior to rotation.
9. Establish and maintain a pitch attitude that will transfer the weight of the airplane from the wheels to the wings as rapidly as possible.
10. Lift-off at the lowest possible airspeed consistent with safety and remain in ground effect while accelerating to VX or VY, as appropriate.
11. Establish a pitch attitude for VX or VY, as appropriate, and maintain selected airspeed +10/-5knots during the climb.
12. Retract flaps in accordance with aircraft manufacturer's guidance.
13. Maintain takeoff power and VY +10/-5 knots to a safe maneuvering altitude
14. Maintain directional control and proper wind drift correction throughout the takeoff and climb.

15. Comply with noise abatement and published departure procedures.
16. Complete the appropriate checklist.
17. Comply with manufacturer's recommended emergency procedures related to the takeoff sequence.

LESSON:	SOFT-FIELD APPROACH AND LANDING

OBJECTIVE:

To be able to take off from other than a hard-surface runway

MOTIVATION:

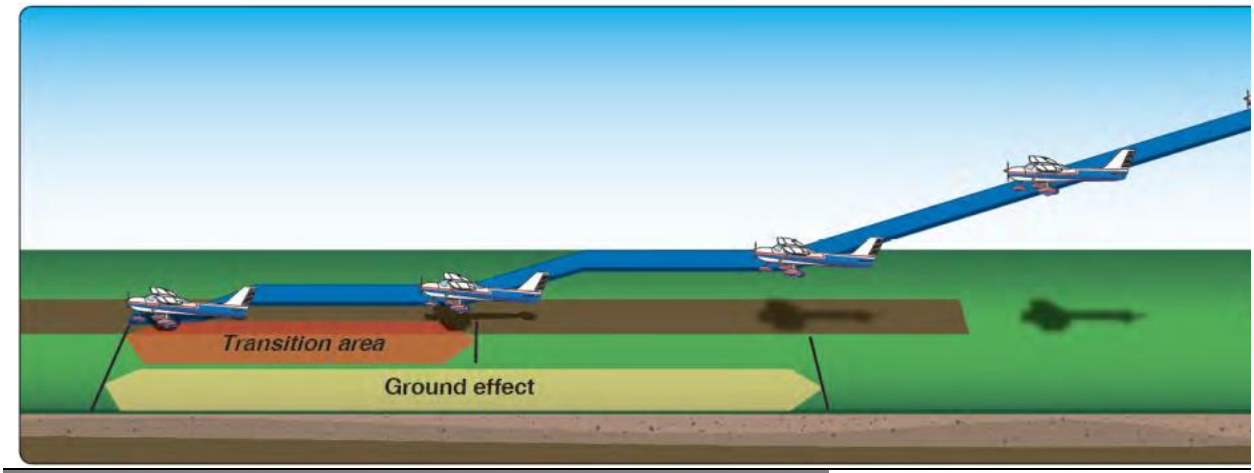
The ability to land on other than ideal surfaces can open many locations to a pilot, as well as provide an additional margin of safety if forced to make an off-airport landing.

REFERENCES / EQUIPMENT NEEDED:

AIM; FAA-H-8083-2A RMH, FAA-H-8083-3 AFH, FAA-H-8083-25 PHAK POH/AFM

IMAGES / MEDIA / LINKS:

CFI Notebook



SOFT-FIELD APPROACH AND LANDING	TIME:	[15] Minutes

1. Calculating the landing distance using the POH and available weather.
2. Hazards of other than hard surfaced runway.
3. Stabilized approach at Normal or Short Field Landing approach speed
4. Round-out and control the descent to touchdown with power.
5. Transfer the weight to the wheels gently
6. Use power to keep the nose-wheel off the runway until it is no longer necessary.

KEY POINTS:

- Use appropriate speeds. (normal or short field airspeeds)
- Touch down as slow as possible using ground effect.
- Keep nose-wheel off of the ground for as long as possible.
- Keep moving!

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE & CH 6-4 Flying Skills

Risk Management - Teach how to identify, assess and mitigate risk encompassing the following:

1. Failure to select the appropriate runway based on wind, pilot capability, and aircraft limitations.
2. Exceeding the manufacturer's maximum demonstrated crosswind component.
3. Operating from other than a hard-surfaced runway.
4. Losing elevator control, sinking into the soft surface, or striking the prop if moving too slowly.
5. Wind shear avoidance.
6. Tailwind.
7. Wake turbulence.
8. Task management.
9. Low altitude maneuvering.
10. Collision avoidance, scanning, obstacle and wire strike avoidance.

11. Failure to follow the right-of-way rules.
12. Obstacles on approach and landing paths.
13. Failure to recognize the need for a go-around/rejected landing.
14. Low altitude stall/spin.
15. Performing a soft-field landing after an engine failure.

FLIGHT MANEUVERS GUIDE:

1. Slow to 85 KIAS before entering traffic pattern.
2. Enter the traffic pattern at published TPA.
3. Complete before-landing checklist.
4. When ready to descend from TPA, reduce throttle to 1500 RPM.
5. Select 10 degrees of flaps and establish a pitch attitude for a 75 KIAS descent.
6. Use trim to reduce control pressures.
7. On the base leg, select 20 degrees of flaps and establish a pitch attitude for 70 KIAS.
8. On final, select 30 degrees of flaps and establish a pitch attitude for 65 KIAS not lower than 300 feet AGL.
9. Fly the airplane onto the ground, slowly transferring the weight from the wings to the main landing gear.
10. Touchdown at the intended touchdown point at minimum speed and a nose-high attitude.
11. Keep the nose-wheel off the ground as long as possible as the airplane slows by maintaining full aft elevator back-pressure.
12. Maintain elevator back-pressure while taxiing off the runway.
13. Perform appropriate checklist.

COMMON ERRORS:

- Excessive descent rate on final approach.
- Excessive airspeed on final approach.
- Un-stabilized approach.
- Round-out too high above the runway surface.
- Poor power management during the round-out and touchdown.
- Hard touchdown.
- Inadequate control of the airplane weight transfer from wings to wheels after touchdown.
- Allowing the nose-wheel to “fall” to the runway after touchdown rather than controlling its descent.

QUESTIONS FOR THE STUDENT:

1. What's the main goal of a soft-field landing?
[To touch down as slowly and softly as possible, while protecting the nosewheel.]
[The objective is to minimize stress on the landing gear and prevent the nose wheel from digging into the soft surface.]

2. How does the approach differ from a normal landing?
[While the initial approach might be similar to a normal landing, Boldmethod says the soft-field technique comes into play as you cross the threshold.]
[You will want to maintain the wings' support of the aircraft's weight for as long as practical, potentially even using a small amount of power in ground effect during the flare to control the descent rate.]
[The FAA's Airplane Flying Handbook says that pilots should establish a speed no more than 1.3 VSO, +10/-5 knots with a gust factor applied if applicable.]

3. What role does ground effect play?
[It helps to cushion the landing and allows for a more gradual dissipation of forward speed before touchdown.]
[Pilots should hold the aircraft 1 to 2 feet off the surface in ground effect to bleed off speed and altitude gently.]

4. Why is keeping the nosewheel off the ground crucial?
[It prevents the nosewheel from digging into the soft surface and minimizing nose-over forces.]
[Maintaining back pressure on the yoke helps to keep the nosewheel elevated after the main wheels touch down.]

5. How should braking be handled?
[Braking should be gentle, if used at all, as the soft surface itself provides significant braking action.]
[Aggressive braking could cause the nosewheel to touch down prematurely and harshly.]

6. What are common errors to avoid?
[Too fast a descent rate.]
[Excessive airspeed, causing floating.]
[Un-stabilized approaches.]
[Allowing the nosewheel to touch down early.]
[Using too much brake after touchdown.]

7. When might a go-around be necessary?
[If the field conditions are unsuitable or the approach becomes unstabilized and a safe landing is in doubt.]

8. What are some safety considerations?
[Performing a pre-landing checklist.]
[Monitoring for other traffic, especially at uncontrolled fields.]
[Selecting a suitable landing spot, avoiding hazards like standing water, holes, or shadows.]
[Estimating field conditions beforehand, potentially with a low approach.]
[Remember, soft-field landings require practice and careful attention to detail to execute them safely and effectively.]

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

1. Ensure the aircraft is aligned with the correct/assigned runway.
2. Scan the landing runway/area for possible obstructions for landing.
3. Complete the appropriate approach and landing checklist.
4. Consider the wind conditions, landing surface, and obstructions to select a suitable touchdown point.
5. Establish the recommended approach and landing configuration airspeed and adjust pitch attitude and power as required.
6. Maintain a stabilized approach and recommended airspeed, or in its absence, not more than 1.3 VSO, with wind gust factor applied +10 /-5 knots.
7. Make smooth, timely, and correct control application during the round out and touchdown and, for tricycle gear airplanes, keep the nose wheel off the surface until loss of elevator effectiveness.
8. Touch down softly with minimum sink rate and no drift, with the airplane's longitudinal axis aligned with center of the runway.
9. Maintain full up elevator during roll out and exit the "soft" area at a speed that would preclude sinking into the surface.
10. Maintain crosswind correction and directional control throughout the approach and landing sequence, as required.
11. Execute a timely go-around decision when the approach cannot be made within the tolerances specified above or for any other condition that may result in an unsafe approach or landing.
12. Maintain proper position of the flight controls and sufficient speed to taxi on the soft surface.
13. Utilize after landing runway incursion avoidance procedures.

LESSON:	CROSSWIND TAKE-OFFS

OBJECTIVE:

To safely transition the airplane from the ground to the air while keeping the airplane tracking down the runway with no drift

MOTIVATION:

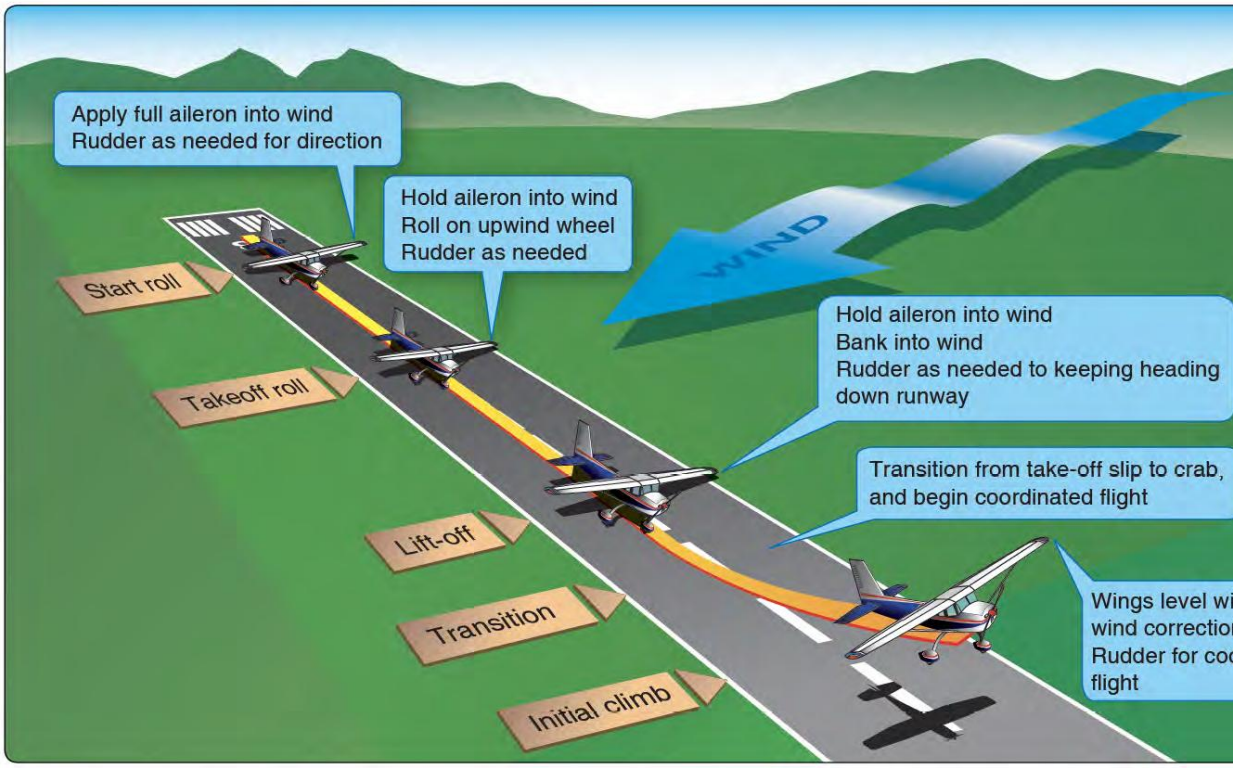
The wind is not always straight down the runway, so crosswind technique is needed to prevent drift.

REFERENCES / EQUIPMENT NEEDED:

AIM; FAA-H-8083-2A RMH, FAA-H-8083-3 AFH, FAA-H-8083-25 PHAK POH/AFM
Airplane

IMAGES / MEDIA / LINKS:

CFI Notebook



CROSSWIND TAKE-OFFS	TIME:	[15] Minutes

1. Determination of crosswind component and maximum demonstrated crosswind component using POH
2. Proper flight controls deflection for the crosswind.
3. Controls become more effective as airspeed increases. Use rudder to maintain centerline and aileron to stop any skidding/skipping.
4. Rotation at Vr with crosswind control inputs.
5. Rotation causes airplane to side-slip - side-slip until out of ground effect.
6. Out of ground effect coordinate the flight controls and turn the airplane to stop drift.

KEY POINTS:

- Maximum cross wind component in POH is not a limitation.
- Aileron must be modified as speed increases to keep the airplane from skidding or skipping.

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE & CH 6-4 Flying Skills
Risk Management - Teach how to identify, assess and mitigate risk encompassing the following:
1. Selection of runway based on wind, pilot capability, and aircraft limitations.

2. The demonstrated crosswind component for the aircraft.
3. Wind shear.
4. Tailwind.
5. Wake turbulence.
6. Go/no-go decision-making.
7. Task management.
8. Low altitude maneuvering.
9. Wire strikes.
10. Obstacles on the departure path.
11. A rejected takeoff and predetermining takeoff abort criteria. Handling engine failure during takeoff and climb.
• Criticality of takeoff distance available.
12. Plans for engine failure after takeoff.

FLIGHT MANEUVERS GUIDE:

1. Complete appropriate checklist.
2. Line up on runway centerline.
3. Select reference point down-range on runway center.
4. Deflect ailerons fully into the wind.
5. Smoothly apply throttle.
6. Track runway centerline with appropriate rudder input.
7. Confirm proper engine operation.
8. Use enough aileron to avoid skidding by keeping upwind wing down.
9. Rotate at Vr = 55 KIAS with current control inputs.
10. Confirm positive rate of climb.
11. Turn airplane into the wind and track toward reference point. .Climb out at 80 KIAS.

COMMON ERRORS:

• Failure to adequately clear the area prior to taxiing onto the active runway.
• Using less than full aileron deflection into the wind initially on the take-off roll.
• Mechanical use of aileron control as the airspeed increases, rather than sensing the need for varying aileron control input through feel for the airplane.
• Premature lift-off resulting in side-skipping.
• Excessive aileron input in the later stage of the take-off roll, resulting in a steep bank into the wind at lift-off.
• Inadequate drift correction after lift-off.

QUESTIONS FOR THE STUDENT:

1. Why is it important to use proper crosswind correction during takeoff?
[It's crucial for maintaining directional control, preventing the airplane from drifting off the runway, and ensuring a safe liftoff.

2. How do you initially position the flight controls for a crosswind takeoff?
[Apply full aileron deflection into the wind and maintain runway alignment with rudder as you begin the takeoff roll. This helps counteract the lifting force of the crosswind on the upwind wing.]

3. What happens to the required aileron input as the aircraft accelerates?
[As airspeed increases, the ailerons become more effective, so you'll need to gradually reduce aileron input to avoid overcompensating and potentially digging a wingtip into the runway.]

4. Why is rudder important during a crosswind takeoff roll?
[The crosswind will attempt to "weathervane" (turn the aircraft into the wind). Rudder is used to counteract this effect and keep the airplane aligned with the runway centerline.

5. Describe the preferred liftoff sequence during a crosswind takeoff.
[The preferred sequence is: nose wheel first, downwind wheel second, and finally, the upwind wheel. This helps prevent side-skipping and potential damage to the landing gear.]

6. What adjustments might be made to the liftoff technique in strong or gusty crosswinds?
[You may want to hold the aircraft on the ground slightly longer, rotating at a slightly higher speed, to ensure a more definite and controlled liftoff.]

7. What is the wind correction angle (WCA) and how is it used after liftoff in a crosswind takeoff?
7After liftoff, you'll establish a crab angle (turning the aircraft into the wind) to maintain a ground track aligned with the extended runway centerline, compensating for the wind's drift effect.]

Crosswind considerations and calculations
8. What is the crosswind component and how do you calculate it?
[The crosswind component is the portion of the wind blowing perpendicular to the aircraft's flight path. It can be estimated using the "Clock Face Technique" or a crosswind component chart.]

9. What is the relationship between the wind direction and runway heading when calculating the crosswind component?
[The angle between the wind direction and the runway heading determines the crosswind component. For example, if the wind is 30 degrees off the runway, the crosswind component is roughly half the wind speed.]

10. Why is it important to know your aircraft's maximum demonstrated crosswind component?
[The maximum demonstrated crosswind is a practical limit to which the manufacturer's test pilot flew the aircraft during the certification process. Exceeding this limit can compromise safety and performance.]

11. What are some factors that influence the maximum crosswind limit for an aircraft?
[Factors include aircraft design, aerodynamic characteristics, structural limitations, wing loading, fuselage design, landing gear configuration, and control surface effectiveness.]

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

1. Verify ATC clearance and no aircraft is on final before crossing the hold line.
2. Verify aircraft is on the assigned/correct runway.
3. Ascertain wind direction with or without visible wind direction indicators.
4. Determine if the crosswind component is beyond the pilot's ability or aircraft manufacturer maximum demonstrated value.
5. Position the flight controls for the existing wind conditions.
6. Clear the area; taxi into the takeoff position and align the airplane on the runway centerline/ takeoff path.
7. Confirm takeoff power; and proper engine and flight instrument indications prior to rotation:
8. Rotate and lift-off at the recommended airspeed and accelerate to VY (or other speed as appropriate for aircraft).
9. Establish a pitch attitude that will maintain VY +10/-5 knots (or other airspeed as appropriate for aircraft).
10. Retract the landing gear and flaps in accordance with manufacturer's guidance.
11. Maintain takeoff power and VY +10/-5 knots or to a safe maneuvering altitude.
12. Maintain directional control and proper wind drift correction throughout the takeoff and climb.
13. Comply with responsible environmental practices, including noise abatement and published departure procedures.
14. Complete the appropriate checklist.
15. Comply with manufacturer's recommended emergency procedures related to the takeoff sequence.

LESSON:	CROSSWIND LANDING

OBJECTIVE:

To compensate for a crosswind condition during landing by maintaining a straight ground track with the longitudinal axis of the airplane aligned with the runway centerline.

MOTIVATION:

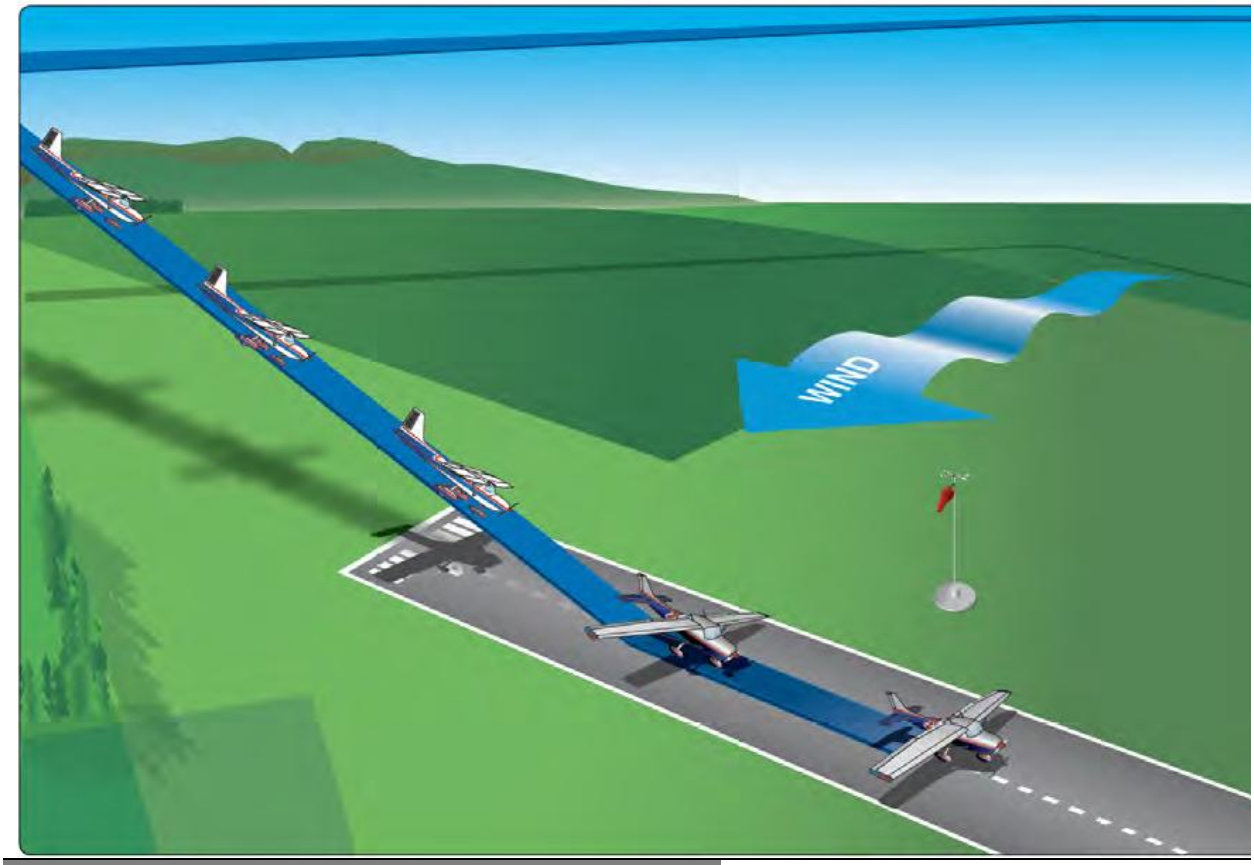
Not all runways will be aligned into the wind. The ability to adjust for crosswind conditions greatly enhances safety and pilot confidence.

REFERENCES / EQUIPMENT NEEDED:

AIM; FAA-H-8083-2A RMH, FAA-H-8083-3 AFH, FAA-H-8083-25 PHAK POH/AFM
Airplane

IMAGES / MEDIA / LINKS:

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CROSSWIND LANDING	TIME:	[20] Minutes Assumes proficient proficiency with normal landings

1. Determining the crosswind component and maximum demonstrated crosswind component from the POH - Approach speed the same as normal landing in no wind conditions.
2. Calculate the available landing distance.
3. Stabilized approach and interpretation and use of visual glide scope indicators.
4. Crab until 100 to 200 feet AGL then transition to a side-slip
5. Airspeed control and factoring for gusts. Applying 1/2 gust factor to Vapp.
6. Use enough rudder to keep the airplane parallel to the runway and enough aileron to maintain the centerline.
7. Amount of aileron and rudder will vary as the controls become less effective.
8. Keep correction for drift throughout the landing and rollout.

KEY POINTS:

• The point to transition from crabbing to the side-slip depends upon the pilot capability and the inertia of the airplane.
• Touchdown will occur with the upwind wheel first.

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE & CH 6-4 Flying Skills
Risk Management - Teach how to identify, assess and mitigate risk encompassing the following:
1. Failure to select the appropriate runway based on wind, pilot capability, and airplane limitations.
2. Exceeding the manufacturer's maximum demonstrated crosswind component.
3. Wind shear.
4. Tailwind.
5. Wake turbulence.
6. Task management.
7. Low altitude maneuvering.
8. Collision avoidance, scanning, obstacles.
9. Failure to follow the right-of-way rules.
10. Obstacles on approach and landing paths.
11. Failure to recognize the need to perform a go-around/rejected landing.
12. Low altitude stall/spin

FLIGHT MANEUVERS GUIDE:

1. Enter traffic pattern at TPA, RPM to 1700; slow to 85 KIAS.
2. Landing checklist.
3. Estimate the amount of crosswind while on downwind leg.
4. Make base turn based on crosswind estimate.
5. Compensate for the crosswind when making the turn to final.
6. Determine final approach speed based on gust factor (65 KIAS + ½ gust speed)
7. Input appropriate crab angle to maintain ground track alignment with runway.
8. At approximately 300 ft. AGL, transition from the crab to a sideslip.
9. Maintain power to maintain airspeed due to drag and fly the airplane onto the runway Allow touchdown of the upwind wheel first.
10. Smoothly close throttle.
11. Allow the other wheels to settle onto the runway.
12. Maintain appropriate control deflections while on roll-out, exit from runway, and taxi.

COMMON ERRORS:

• Attempting to land in crosswinds that exceed the airplane’s maximum demonstrated crosswind component
• Inadequate compensation for wind drift on the turn from base leg to final approach, resulting in undershooting or overshooting
• Inadequate compensation for wind drift on final approach
• Un-stabilized approach
• Failure to compensate for increased drag during sideslip, resulting in excessive sink rate and/or too low an airspeed
• Drifting when touching down
• Excessive airspeed on touchdown
• Failure to apply appropriate flight control inputs during rollout
• Failure to maintain direction control on rollout
• Excessive braking

QUESTIONS FOR THE STUDENT:

Weather and planning

1. What's the maximum demonstrated crosswind limit for a specific aircraft, according to the Pilot's Operating Handbook (POH)?
[This is a guideline for safe operation. It represents the maximum crosswind component the manufacturer's test pilot successfully landed in during certification.]

2. How do you calculate the crosswind component?
[You need to know the wind direction and speed, and the runway heading. You can use a crosswind component chart or estimate it: half the wind speed if the wind is 30 degrees off the runway, three-quarters if 45 degrees, and roughly the full wind speed if it's 60 degrees or more off.]

4. Are the winds within personal comfort level and aircraft's demonstrated crosswind capability?
[If not, consider diverting to another airport with more favorable wind conditions.]

5. Are there any gusts, downdrafts, or wind shear present?
[Gusts require quick and smooth adjustments to controls, and wind shear or downdrafts may necessitate a steeper approach and increased airspeed.]

Approach and landing techniques

6. Which crosswind landing technique should you use: wing-low or crab?
[Wing-low (sideslip): Align the nose with the runway using rudder and use ailerons to correct for drift, keeping the upwind wing low. This is often preferred for light aircraft.]
[Crab: Fly the approach with the aircraft pointed slightly into the wind, maintaining the crab until just before touchdown, then transition to wing-low.]

7. How do you coordinate aileron and rudder inputs?
[Ailerons counteract drift and keep the aircraft on the runway centerline, while the rudder aligns the nose with the runway. Opposite rudder and aileron inputs are typically used during the transition from crab to slip.]

9. What approach speed should you maintain?
[A slightly higher approach speed is often beneficial, especially in gusty conditions, to maintain better control, notes First Flight Aviation. Adjust the approach speed as needed in response to wind changes.]

10. How should you use flaps?
[Flaps generally help stabilize the aircraft during crosswind landings, but in very gusty conditions, using less than full flaps can be advantageous, allowing a slightly higher airspeed and more positive control.]

11. When should you transition from the crab to the slip (if using the crab method)?
[Just before touchdown, align the nose with the runway using rudder and use ailerons to prevent drifting with the wind.]

12. What's the correct touchdown sequence?
Touchdown on the upwind main landing gear first, followed by the downwind main gear, then the nose wheel.]

Post-touchdown

13. How do you maintain directional control during the rollout?
[Keep the ailerons deflected into the wind and use the rudder to stay on the centerline. Gradually increase aileron deflection as the aircraft slows down, as controls become less effective at slower speeds.]

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

1. Ensure the aircraft is on the correct/assigned runway.
2. Scan the landing runway/areas and adjoining areas for possible obstructions for landing.
3. Complete the appropriate checklist.
4. Consider the wind conditions, landing surface, and obstructions to select a suitable touchdown point.
5. Establish the recommended approach and landing configuration and airspeed and adjust pitch attitude and power as required.
6. Maintain a stabilized approach and recommended airspeed, or in its absence, not more than 1.3 VSO, with wind gust factor applied +10/-5 knots, or as recommended by the aircraft manufacturer for the aircraft type and gust velocity.
7. Make smooth, timely, and correct control applications during the round-out and touchdown.
8. Touch down smoothly at a speed that provides little or no aerodynamic lift.
9. Touch down within the available runway within 400 feet beyond a specified point with no drift, and with the airplane's longitudinal axis aligned with and over the runway centerline.
10. Maintain crosswind correction and directional control throughout the approach and landing sequence.
11. Execute a timely go-around decision when the approach cannot be made within the tolerances specified above or for any other condition that that may result in an unsafe approach or landing.
12. Utilize after landing runway incursion avoidance procedures.

LESSON: INSTRUMENT FLYING BASICS

OBJECTIVE:

To develop the essential skills to maintain control of an aircraft solely by reference to instruments in the event of an inadvertent encounter with instrument meteorological conditions (IMC), such as clouds or poor visibility.

MOTIVATION:

To successfully recover from unintentional encounters with instrument meteorological conditions (IMC).

REFERENCES / EQUIPMENT NEEDED:

FAA-H-8083-2 (Risk Management Handbook),
FAA-H-8083-3 (Airplane Flying Handbook),
FAA-H-8083-15 (Instrument Flying Handbook)
FAA-H-8083-25 (Pilot Handbook of Aeronautical Knowledge)
Pilot Controller Glossary
Airplane

IMAGES / MEDIA / LINKS:

CFI Notebook LINK

INSTRUMENT FLYING BASICS TIME: [3] Hours

Core Skills of Attitude Instrument Flying
All successful instrument flying, regardless of technique, is built upon three fundamental skills:

- Instrument cross-check (scan): Systematically and continuously observing the flight instruments to maintain a constant awareness of the aircraft's attitude and performance.

- Instrument interpretation: Understanding what the instrument readings are telling you about the aircraft's current state.

- Aircraft control: Making smooth, precise, and coordinated control inputs based on your interpretation of the instruments.

Two Popular Instrument Scanning Methods
There are two common methods for mastering the instrument scan. Both achieve the same result but use a different mental framework for interpreting the instrument panel.

Control and Performance Method
- This method categorizes instruments into three groups:
- Control instruments: These show immediate attitude and power changes.
    - Attitude Indicator
    - Tachometer / Manifold Pressure Gauge

- Performance instruments: These indicate the aircraft's actual performance after a control input.
    - Altimeter
    - Airspeed Indicator
    - Vertical Speed Indicator (VSI)

- Navigation instruments: These display the aircraft's position relative to navigational aids.

The basic concept is to "set" the attitude and power using the control instruments, "trim" the aircraft to relieve control pressure, then "cross-check" the performance instruments to confirm the desired result.

Primary and Supporting Method

This method designates a "primary" and one or more "supporting" instruments for each control function (pitch, bank, and power), depending on the maneuver.

- Primary instrument: Gives the most pertinent information for a specific control function during a particular maneuver.
- Supporting instrument: Corroborates the information from the primary instrument.

For example, in straight-and-level flight:

- Pitch: The altimeter is primary, as it directly shows if altitude is being maintained. The attitude indicator and VSI are supporting.
- Bank: The heading indicator is primary. The attitude indicator and turn coordinator are supporting.
- Power: The airspeed indicator is primary, confirming the desired airspeed. Engine instruments are supporting.

Fundamental instrument Maneuvers

Mastering basic instrument flight involves practicing fundamental maneuvers solely by reference to instruments.

Straight-and-Level Flight

- Objective: Maintain constant heading, altitude, and airspeed.
- Procedure:
  1. Establish: Set a known power setting for cruise flight and adjust pitch using the attitude indicator to maintain the desired altitude.
  2. Trim: Relieve all control pressures so the aircraft can fly hands-off for a moment.
  3. Cross-Check: Scan the instruments. The altimeter should be stable, the heading indicator should be steady, and the airspeed should be constant.
  4. Adjust: Make small, smooth corrections to pitch and bank to correct for any deviations.

Constant Airspeed Climbs and Descents

- Objective: Climb or descend while maintaining a constant airspeed.
- Procedure for a climb:
  1. Establish: Raise the nose to a pitch attitude known to produce the desired climb speed and simultaneously apply climb power.
  2. Trim: Trim for hands-off flight.
  3. Cross-Check: Scan the instruments, primarily checking the airspeed indicator for pitch and engine instruments for power.
  4. Leveling off: Lead the level-off by 10% of your vertical speed. For example, from a 500 fpm climb, start transitioning to level flight 50 feet before your target altitude.

Turns to a Heading

- Objective: Change heading while maintaining a constant altitude.
- Procedure:
  1. Establish: Apply coordinated aileron and rudder pressure to set a desired bank angle on the attitude indicator.
  2. Cross-Check: Reference the turn coordinator for a standard rate turn, and the altimeter for pitch control.
  3. Rollout: Lead the rollout by an amount equal to approximately half of your bank angle. For example, for a 15-degree bank, begin rolling out 7.5 degrees before the target heading.

Recovering from Unusual Attitudes

- Objective: Return the aircraft to a level, unaccelerated flight path after it enters an unexpected attitude.
- Procedure:

1. Recognize: Identify the unusual attitude using the instruments. Do not trust your bodily senses, as spatial disorientation can be very misleading.
2. Correct:
    - If the attitude indicator shows a steep turn, level the wings first.
    - If airspeed is increasing and altitude is decreasing (nose-low), reduce power and bring the nose up.
    - If airspeed is decreasing and altitude is increasing (nose-high), add power and lower the nose.
3. Cross-Check: Once in a level attitude, re-establish a normal scan to ensure stabilized flight.

KEY POINTS:

The six primary flight instruments
The three fundamental skills
Key maneuvers and techniques

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE & CH 6-4 Flying Skills

FLIGHT MANEUVERS GUIDE:

XXPRESENTATIONHEREXX

COMMON ERRORS:

For private pilots, common errors in basic instrument flying revolve around:
- A poor instrument scan,
- Improper control inputs,
- A lack of understanding of fundamental aerodynamic principles under instrument conditions.
- A solid foundation in these areas is crucial for maintaining control and navigating safely in instrument meteorological conditions (IMC).

QUESTIONS FOR THE STUDENT:

1. What are the three fundamental skills of basic attitude instrument flying?
The three skills are:
Instrument cross-check: A continuous and logical scanning of the flight instruments to determine the aircraft's performance and attitude.
Instrument interpretation: Understanding the information provided by each instrument and its relationship to the others.
Aircraft control: Making appropriate and smooth control inputs to achieve the desired flight path.

2. How do you scan your instruments effectively?
You should use a continuous and systematic scan, such as the "T-scan," which focuses primarily on the attitude indicator while cross-referencing the airspeed, altimeter, and heading indicator. This helps prevent fixation on a single instrument, which can lead to vertigo or loss of control.

3. What is the "primary and supporting" method of instrument scanning?
This method involves identifying which instrument is "primary" for a specific control input (pitch, bank, or power) during a maneuver, and which instruments are "supporting" that indication. For example, during a constant-rate climb, the Vertical Speed Indicator (VSI) is the primary pitch instrument, while the Attitude Indicator and Altimeter are supporting.
Instrument failures and errors

4. During straight-and-level flight, your attitude indicator and turn coordinator show a steady right turn, but your heading indicator is not moving. What instrument has likely failed?
The heading indicator has likely failed. The attitude indicator and turn coordinator are typically powered differently and would agree on the turn. A stationary heading indicator that shows a straight path while the other instruments show a turn is a strong sign of failure.

5. You are flying from a high-pressure area to a low-pressure area without updating your altimeter setting. What will your altimeter read relative to your actual altitude?
Your altimeter will read higher than your actual altitude. The phrase "high to low, look out below" is a helpful memory aid for this error. As you fly into lower pressure, your altimeter, which is set to the higher pressure, will believe you are climbing when you are actually at a lower altitude.

6. You are flying from a colder air mass to a warmer air mass without updating your altimeter setting. What will your altimeter read relative to your actual altitude?
Your altimeter will read lower than your actual altitude. This is because warmer air is less dense and the airplane's true altitude is higher than what the altimeter, calibrated for standard air, indicates.
Basic instrument maneuvers

7. How do you recover from a nose-high unusual flight attitude?
The general recovery sequence is:
Power: Add full power to prevent a stall.
Pitch: Lower the nose to the horizon.
Bank: Level the wings.

8. How do you recover from a nose-low unusual flight attitude?
The general recovery sequence is:
Power: Reduce power to prevent excessive airspeed.
Bank: Level the wings.
Pitch: Raise the nose to the horizon.

9. What is the proper procedure for establishing a constant airspeed climb?
Apply power smoothly.
Raise the nose to the desired pitch attitude, using the attitude indicator.
Adjust power to maintain the desired airspeed, with the airspeed indicator as the primary power instrument.
Trim to relieve control pressures.
Cross-check supporting instruments (VSI, altimeter) to monitor performance.
Instruments and systems

10. What is the pitot-static system responsible for, and which instruments does it power?
The pitot-static system provides the air pressure inputs to the airspeed indicator, altimeter, and vertical speed indicator. The pitot tube provides ram air pressure for the airspeed indicator, while the static port provides ambient air pressure for all three instruments.

11. What is the magnetic compass's largest error during turns, and when is it most pronounced?
The largest error is the northerly turning error, which is most pronounced on a heading of north or south. It causes the compass to lag when turning from a northerly heading and lead when turning from a southerly heading. The acronyms "UNOS" (Undershoot North, Overshoot South) and "LARS" (Lead All Turns South) can be helpful mnemonics.

12. When would a private pilot use basic instrument flight skills?
A private pilot uses these skills to manage an aircraft in situations of reduced visibility. Examples include:
Inadvertently entering clouds.
Flight in haze, rain, or at night.
During a simulated instrument training flight with an instructor.
Maintaining control during visual approaches where external references are lost.

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

Area of Operation VIII.
Basic Instrument Maneuvers Task
Task A. Straight-and-Level Flight
Task B. Constant Airspeed Climbs
Task C. Constant Airspeed Descents
Task D. Turns to Headings
Task E. Recovery from Unusual Flight Attitudes
Task F. Radio Communications, Navigation Systems/Facilities, and Radar Services

LESSON:	UNUSUAL ATTITUDE RECOVERIES

OBJECTIVE:

To be able to take off from other than a To timely return the airplane to straight and level flight from either a potentially dangerous nose down high speed or nose high slow speed attitude. hard-surface runway.

MOTIVATION:

Knowing how to recover from an upset is essential to maintaining control of an airplane.

REFERENCES / EQUIPMENT NEEDED:

FAA-H-8083-2A RMH, FAA-H-8083-3 AFH, FAA-H-8083-15 IFH, FAA-H-8083-25 PHAK POH/AFM; POH/Flight Manual

IMAGES / MEDIA / LINKS:

CFI Notebook



UNUSUAL ATTITUDE RECOVERIES	TIME:	[10] Minutes Assumes proficient with instrument flying proficiency

1. Flight instrument sensitivity, limitations, and potential errors in unusual attitudes.
2. Flight instrument correlation (pitch instruments/bank instruments). Instruments to use in unusual attitude recovery. Airspeed, Turn coordinator, Altimeter. (AI, HI can topple, VSI is delayed in reaction)
3. Vestibular illusions (leans) and spatial disorientation.
4. Aerodynamic factors related to unusual pitch and bank attitudes and returning to level flight.
5. Recovering from nose high unusual attitudes. Nose high low airspeed - Lower attitude, full power, level wings.
6. Recovery from a Nose low high airspeed unusual attitude. Power idle, level wings, return to level flight.
7. The appropriate pitch, power and bank settings for the airplane being flown.

KEY POINTS:

- Use appropriate speeds. (normal or short field airspeeds)
- Touch down as slow as possible using ground effect.
- Keep nose-wheel off of the ground for as long as possible.
- Keep moving!

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3-6 PAVE & CH 6-4 Flying Skills
Risk Management - Teach how to identify, assess and mitigate risk encompassing the following:
1. Lack of proficiency in flight by reference to instruments.
2. Poor cockpit management.
3. Lack of awareness of the direction for the nearest VMC.
4. Failure to descend straight ahead or make level turns under emergency instrument conditions.
5. Operating outside of the normal operating envelope during the recovery.

FLIGHT MANEUVERS GUIDE:

1. Clear the area. Identify emergency landing areas.
2. 2100 RPM; 90 KIAS.
3. Instructor will place the airplane in an unusual attitude.
4. Recognize and evaluate unusual attitude.
5. Evaluate airspeed indicator.
6. Determine if airplane is gaining airspeed or losing airspeed.
7. Evaluate attitude indicator.
8. Determine if airplane is nose-down or nose-up.
9. Determine if and/or how the airplane is banked.
10. Gaining airspeed: Throttle to idle, level the wings, raise the pitch attitude.
11. Losing airspeed: Throttle to full power, lower the pitch attitude, level the Wings.
12. Return airplane to straight and level flight
13. Return throttle to cruise configuration, 2100 RPM at 90 KIAS.

COMMON ERRORS:

- Failure to adequately clear the area
- Failure to correctly interpret instrument indications
- Inappropriate sequence of recovery for the flight conditions present
- Using abrupt control input resulting in excessive positive or negative G forces occurring

QUESTIONS FOR THE STUDENT:

1. What is an unusual attitude?
[An unusual attitude is any airplane attitude not normally required for instrument flight. It's an unintentional or unexpected flight attitude that can result from turbulence, disorientation, or instrument failure. An unusual attitude leading to a loss of control is called an upset.]

2. Why is it important to learn unusual attitude recovery?
[Learning unusual attitude recovery helps pilots understand and overcome spatial disorientation, a major factor in fatal general aviation accidents. It's essential for maintaining aircraft control and preventing Loss of Control-Inflight (LOC-I).]

3. How do you recognize an unusual attitude?
[Rely on your instruments, not your senses, particularly in Instrument Meteorological Conditions (IMC). A nose-high attitude is indicated by rapidly decreasing airspeed and increasing altitude, while a nose-low attitude shows rapidly increasing airspeed and decreasing altitude. While the attitude indicator provides immediate information, use a comprehensive instrument scan including the airspeed indicator, altimeter, VSI, and turn coordinator.]

4. What are the recovery procedures for a nose-high unusual attitude?
[The priority is to prevent a stall. Nearly simultaneously, apply full or proportional power, lower the nose to a level pitch attitude by applying forward elevator pressure, and level the wings with coordinated aileron and rudder. After recovery, return to the original altitude and heading.]

5. What are the recovery procedures for a nose-low unusual attitude?
[The priority is to avoid over-speeding and excessive G-forces. Nearly simultaneously, reduce power to idle or as needed, level the wings with coordinated aileron and rudder, and gently raise the nose to level flight with back elevator pressure. After recovery, increase power and trim.]

6. Why is it important to level the wings before raising the nose in a nose-low attitude?
[Leveling the wings first avoids excessive G-force loading and potential accelerated stalls. Correcting bank before pitch ensures the nose moves directly towards the horizon and improves elevator effectiveness.]

7. What are some common errors during unusual attitude recovery?
[Common errors include incorrect identification of the attitude, improper recovery procedures, moving controls before assessing the situation, neglecting to add power in a nose-high situation, pulling back too abruptly in a nose-low situation, not keeping the aircraft properly trimmed, and slow instrument scanning or fixations.]

9. Where can you find more information about unusual attitude recovery?
[You can find more information in the Airplane Flying Handbook (AFH) Chapter 5 and Advisory Circular (AC) 120-111. Practicing with a Certified Flight Instructor (CFI) in an aircraft or simulator is also recommended.]

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

1. Perform timely recognition of the nature of the unusual attitude.
2. Recognize unusual flight attitudes solely by reference to instruments and perform the correct, coordinated, and smooth flight control application to resolve unusual pitch and bank attitudes while staying within the airplane's limitations and flight parameters.
3. Perform appropriate trimming to relieve control pressures.
4. When level, maintain altitude ±200 feet, heading ±20° and airspeed ±10 knots.

LESSON:	SPIN AWARENESS

OBJECTIVE:

The primary objective of the private pilot airplane spin awareness course is to ensure applicants exhibit satisfactory knowledge of the causes and procedures for recovery from unintentional spins, while clearly understanding the associated risks.

MOTIVATION:

Dan Bongino's Rule #1: Don't get dead. Mastering spin awareness is about transforming a feared "dark voodoo" mystery into a manageable flight regime. For a student pilot, the motivation lies in gaining the ultimate confidence: knowing that you can recognize and prevent the most dangerous stall-related accidents before they ever happen.

REFERENCES / EQUIPMENT NEEDED:

FAA-H-8083-3C - Airplane Flying Handbook CH 5-25
FAA-H-8083-25 - PHAK XX
FAR 14 CFR 23.221(a)

IMAGES / MEDIA / LINKS:

Air Safety Institute: Stall/Spin Classic Facts and Myths (1982)
The Bold Method: What's The Difference Between A Spin And A Graveyard Spiral?

SPIN AWARENESS	TIME:	[60] Minutes – Ground

Spin Awareness:
A spin is an aggravated stall condition that may result after a stall occurs

Spin awareness is a critical safety topic for private pilots focused on recognizing and preventing an aggravated stall that results in a corkscrew-like descent. While actual spin entry and recovery flight training is only required for flight instructor candidates, private pilot applicants must demonstrate theoretical knowledge of spins and risk management during their checkride.

A spin develops when an aircraft stalls asymmetrically and begins rotating around its vertical axis. Understanding spin aerodynamics and recovery techniques helps pilots recognize entry conditions, identify the phases of a spin, and apply proper corrective actions.

Introduction to Spins:
Practicing spins build awareness regarding the recognition of, entry into, and recovery from spins.

An aggravated stall resulting in auto-rotation about the spin axis wherein the aircraft follows a corkscrew path due to one wing being more stalled than another.

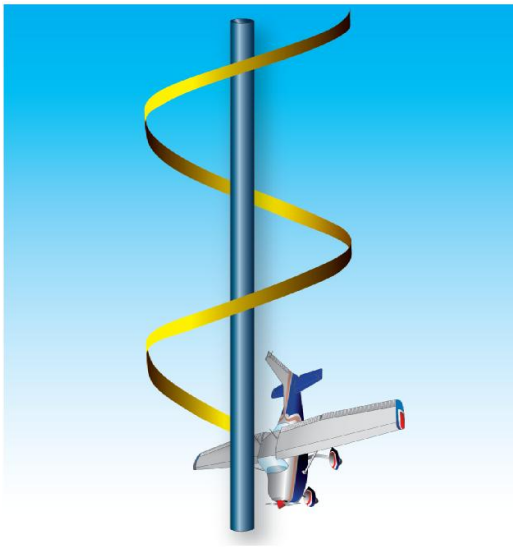


Figure 5-15. *Spin—an aggravated stall and autorotation.*

Characterized by high AoA, low airspeed, and high rate of descent where all aerodynamic and inertial forces are balanced.
It is this balance that must be upset to recover.
Spins can be entered from any flight attitude and from practically any airspeed.

A spin is initiated where the pilot includes or fails to include rudder, aileron, or power individually or in combination during a stall.
Auto-rotation occurs from an asymmetrical stall (think skid).
There is an abrupt loss of control when leaving the stall and entering the spin.

Certification standards require the practice of spin procedures.
Ensure to follow appropriate regulations related to spins throughout the conduct of the maneuver.

WARNING:
All procedures are GENERALIZED.
Use the Pilot Operating Handbook (POH) procedures for specific aircraft performance and limitations. and/or current Standard Operating Procedures (SOPs).
Multiengine Spin Awareness Considerations are a bit more complex, and Covered in Multi Engine Training.

Sources of Inadvertent Stalls Becoming Spins:

- Inadequate rudder application in steep climbs.
- False concept of airspeed when on base to final due to tailwind.
- Having aircraft in "reverse command" area in then pattern.

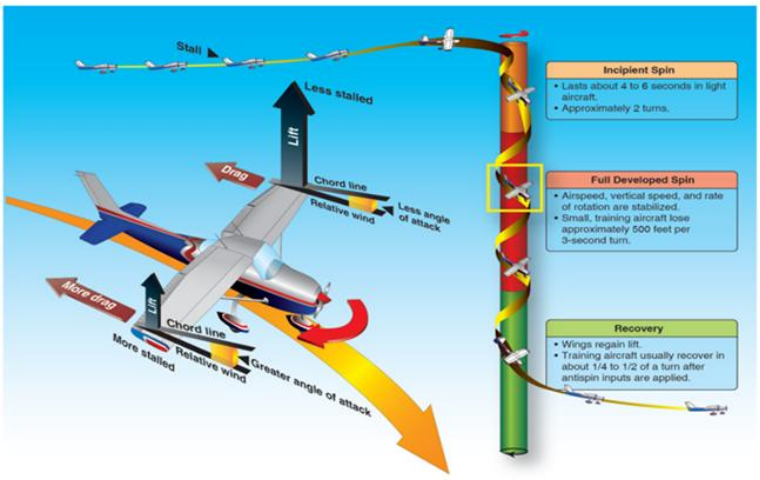


Figure 5-16. *Spin Entry and Recovery.*

Auto-rotation
A combination of roll and yaw about the C.G. That propagates itself and progressively gets worse due to asymmetrically stalled wings.

A combination of roll and yaw about the C.G. That propagates itself and progressively gets worse due to asymmetrically stalled wings.

The inertial forces on the aircraft exceed the aerodynamic control authority.

A control input in any one of the three axes does not affect an immediate response about that axis.

Auto-rotation occurs from an asymmetrical stall (think skid).

There is an abrupt loss of control when leaving the stall and entering the spin.

Spirals

Characterized by low AoA, high airspeed and high rate of descent but neither wing is stalled and the aircraft responds to normal inputs
A spiral is not a spin because in fact neither wings are stalled
Still extremely dangerous
Recovery is simply pushing the stick forward and leveling the wings

Phases of a Spin

The phases of a spin describe spin progression from entry through recovery
There are four distinct phases: **entry, incipient, developed, and recovery**

Entry Phase:

- In the entry phase, the pilot intentionally or accidentally provides the necessary elements for the spin.

Incipient Phase:

- The transition from a stall to a full spin is called the incipient phase.
- The incipient phase occurs from the time the airplane stalls and starts rotating until the spin has fully developed.
- This phase may take two to four turns for most airplanes.
- In this phase, the aerodynamic and inertial forces have not achieved a balance.
- As the incipient phase develops, the indicated airspeed will generally stabilize at a low and constant airspeed and the symbolic airplane of the turn indicator should indicate the direction of the spin.
- The pilot should not use the slip/skid ball (inclinometer) to determine spin direction.
- The location of the instrument in the airplane determines how the ball will move rather than the direction of the spin.
- For example, the ball mounted on the left side of the airplane will always move to the left, even in spin with rotation to the right.

Developed Phase:

- The developed phase begins when the aerodynamic forces are in balance.
- The spin, although chaotic looking from inside the cockpit, has been established and recovery procedures are now necessary to break the spin.
- The developed phase occurs when the airplane's angular rotation rate, airspeed, and vertical speed are stabilized in a flightpath that is nearly vertical.
- In the developed phase, aerodynamic forces and inertial forces are in balance, and the airplane's attitude, angles, and self-sustaining motions about the vertical axis are constant or repetitive, or nearly so.
- Although seemingly chaotic from within the cockpit, the spin is in equilibrium.
- It is important to note that some training airplanes will not enter into the developed phase but could transition unexpectedly from the incipient phase into a spiral dive.
- In a spiral dive the airplane will not be in equilibrium but instead will be accelerating and G load can rapidly increase as a result.

Recovery Phase:

- During the recovery phase, controls are applied to stop spin, recover from the unusual attitude and maintain straight and level.

- The recovery phase occurs when rotation ceases and the AOA of the wings is decreased below the critical AOA.
- This phase may last for as little as a quarter turn or up to several turns depending upon the airplane and the type of spin
- To recover, the pilot applies control inputs to disrupt the spin equilibrium by stopping the rotation and unstalling the wing.
- To accomplish spin recovery, the pilot should always follow the manufacturer's recommended procedures
- In the absence of the manufacturer's recommended spin recovery procedures and techniques, use the six-step spin recovery procedure in Figure 5-17.
- If the flaps and/or retractable landing gear are extended prior to the spin, they should be retracted as soon as practicable after spin entry.

Spiral Dive Recovery Template
1. Reduce power (throttle) to idle
2. Apply some forward elevator
3. Roll wings level
4. Gently raise the nose to level flight
5. Increase power to climb power

Figure 5-18. *Spiral dive recovery template.*

Spin Recovery Template
1. Reduce the power (throttle) to idle
2. Position the ailerons to neutral
3. Apply full opposite rudder against the rotation
4. Apply positive, brisk, and straight forward elevator (forward of neutral)
5. Neutralize the rudder after spin rotation stops
6. Apply back elevator pressure to return to level flight and adjust power (throttle) as appropriate

Figure 5-17. *Spin recovery template.*

Feature	Spin	Spiral Dive (Graveyard Spiral)
Stall Status	**Stalled:** At least one wing is stalled.	**Not Stalled:** Both wings are flying.
Airspeed	**Low and Constant:** Near or below stall speed.	**High and Increasing:** Rapidly approaching V_{NE}.
Rotation	Autorotation about the vertical axis.	A steep, coordinated, descending turn.
Control Feel	Sluggish; ailerons are ineffective.	Heavy and effective; standard response.
G-Load	Relatively low.	High; often increasing as the spiral tightens.

Regulations Related to Spins [14 CFR 91.307]

- Any maneuver that exceeds 60° of bank of 30° of pitch is prohibited unless occupants have parachutes.
- Does not apply if qualified instructor is doing required maneuvers of pilot or certificate rating 14 CFR 91.307
- Solo pilots may perform these maneuvers without parachutes.

- [14 CFR 91.307 only mandates parachutes when an aircraft is carrying any person other than a crewmember (such as a passenger) and performs maneuvers exceeding 60° bank or 30° pitch.].
- Flight instructor applicants must have flight training in stall awareness, spin entry, spins, and spin recovery.
- Parachutes are not required for this training.

Aerodynamics

- All that is required is sufficient yaw rate while an aircraft is stalled.
- In a spin, one or both wings are in a stalled condition, if both are stalled one wing will be in a deeper stall condition than the other.
- The wing that stalls first will drop, increasing its angle of attack and deepening the stall. Both wings must be stalled for a spin to occur.
- The other wing will rise, decreasing its angle of attack, and the aircraft will yaw toward the more deeply-stalled wing. The difference in lift between the two wings causes the aircraft to roll, and the difference in drag causes the aircraft to yaw.

Aircraft Requirements

- Airplane P.O.H. will dictate specific requirements to conduct spin training.
- This includes configurations as well as weight and balance conditions which are required to conduct the maneuver.
- Also essential is a thorough airplane preflight inspection, with special emphasis on excess or loose items that may affect the weight, CG, and controllability of the airplane.
- It is also important to ensure that the airplane is within any CG limitations as determined by the manufacturer.
- Slack or loose control cables (particularly rudder and elevator) could prevent full anti-spin control deflections and delay or preclude recovery in some airplanes.

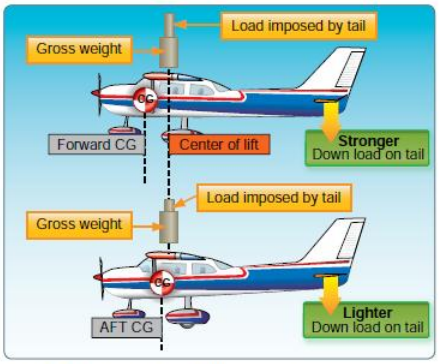


Figure 5-63. *Effect of load distribution on balance.*

KEY POINTS:

PARE

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH 3 " Loss of Control In Flight"

FLIGHT MANEUVERS GUIDE:

Spin recovery is fundamentally performed by performing "PARE"

Power-Idle
Ailerons-Neutral
Rudder-Opposite direction of spin
Elevator-Full forward/down

Spin Recovery Procedure

1. Select a safe location
   - Spins will result in large losses of altitude and so they should be performed free from high traffic areas
   - Always broadcast your intentions over the appropriate deconfliction frequencies, if available
2. Select a safe altitude
   - Generally, this should be no lower than 6000' AGL
   - The intent is to have enough altitude to enter the spin, stabilize, and recover with plenty of safety margin
3. Perform clearing turns
   - You are going to lose a lot of altitude so be sure to check below you in addition to around you
4. Reduce power , adjusting pitch (trimming) to maintain altitude
   - The use of power at the entry will assure more consistent and positive entries to the spin
5. At the first indication of stall (entry phase):
   - During the entry, the pilot should slowly reduce power to idle, while simultaneously raising the nose to a pitch attitude that ensures a stall
   - As the airplane approaches the stall "break," smoothly apply full rudder in the direction of the desired spin rotation while applying full aft (up) elevator to the limit of travel
   - Always maintain the ailerons in the neutral position during the spin procedure unless AFM/POH specifies otherwise
6. As the spin is entered (incipient phase), reduce the throttle to the idle position and ensure that the ailerons are in the neutral position
7. Hold the elevator and rudder controls in full until the spin recovery is initiated (developed phase)
   - Verify that the throttle is in the idle position to avoid over-speeding the aircraft
8. Apply and HOLD full rudder opposite to the direction of the rotation
   - Just after the rudder reaches the stop, move the control wheel briskly forward, far enough to break the stall
   - HOLD these flight control inputs until the rotation stops
9. As the rotation stops, neutralize the rudder
   - You want to stabilize the aircraft's directional control
   - Holding the rudder after the rotation stops could induce a spin in the opposite direction
10. Roll wings level
    - Level wins ensures you are not climbing in a turn
    - Climbing in a turn decreases vertical lift, and causes unnecessary load factors
11. Pull the nose up to the horizon
    - Be careful not to stall the aircraft by being too aggressive but realize that you'll be in a very nose low altitude losing thousands of feet per minute
12. Add power
    - You'll need to add power to accelerate to cruise speed
    - Apply power as necessary to avoid stalling but absolutely apply full power once level
13. As cruise airspeed is attained, set cruise power and re-trim as necessary
14. Complete cruise checklist

COMMON ERRORS:

Common Errors Common errors in the performance of intentional spins are:

1. Failure to adequately clear the area.
2. Failure to apply full rudder pressure (to the stops) in the desired spin direction during spin entry.
3. Failure to apply and maintain full up-elevator pressure during spin entry, resulting in a spiral.
4. Failure to achieve a fully stalled condition prior to spin entry.
5. Failure to apply full rudder (to the stops) briskly against the spin during recovery.
6. Failure to apply sufficient forward-elevator pressure during recovery.
7. Waiting for rotation to stop before applying forward elevator.
8. Failure to neutralize the rudder during recovery after rotation stops, resulting in a possible secondary spin.
9. Slow and overly cautions control movements during recovery.
10. Excessive back-elevator pressure after rotation stops, resulting in possible secondary stall.
11. Insufficient back-elevator pressure during recovery resulting in excessive airspeed.

QUESTIONS FOR THE STUDENT:

Which wing(s) is/are stalled during a spin to the left?
A. Neither wing is stalled.
B. Only the left wing is stalled.
C. Both wings are stalled.
Correct Answer: C. In a spin, both wings are stalled, but they are stalled asymmetrically. The "inside" wing (the left wing in this case) has a higher angle of attack and is more deeply stalled than the "outside" wing.

What is the primary indicator used to differentiate between a fully developed spin and a spiral dive?
A. Altimeter.
B. Airspeed Indicator.
C. Turn Coordinator.
Correct Answer: B. In a spin, the airspeed remains low and constant (near stall speed). In a spiral dive, the wings are not stalled, and the airspeed will rapidly increase toward \(V_{NE}\).

An airplane is most likely to enter an unintentional spin during which phase of flight?
A. High-altitude cruise with a forward CG.B. Uncoordinated base-to-final turns.
C. Accelerated stalls during steep turns at 3,000 feet AGL.
Correct Answer: B. Most accidental stall/spin events occur at low altitudes during high-workload phases like the base-to-final turn, where a pilot may use excessive rudder to compensate for an overshoot.

How does a rearward (aft) Center of Gravity (CG) affect spin characteristics?
A. It makes the spin easier to enter and easier to recover from.
B. It makes the spin harder to enter but much more difficult to recover from.
C. It increases the stall speed but does not affect recovery.

Correct Answer: B. An aft CG decreases stability and makes it much more difficult—and sometimes impossible—to lower the nose and break the stall for recovery.

According to the generic PARE recovery procedure, why is the throttle closed to idle as the first step?
A. To prevent the engine from overspeeding during the dive recovery.
B. To reduce left-turning tendencies and prevent the spin from "flattening."
C. To allow the nose to pitch up more easily.
Correct Answer: B. Power adds airflow over the tail, which can increase the downward force on the elevator and keep the nose high, potentially leading to a dangerous flat spin.

==========

The Scenario:
"You are flying a Piper Archer on a base-to-final turn at 600 feet AGL. You realize you are overshooting the runway centerline. To tighten the turn without increasing your bank angle, you apply significant inside (left) rudder while holding outside (right) aileron to keep the bank from getting too steep. The nose starts to drop, and the airspeed is decaying toward 65 knots."
The Question:
"Based on your control inputs and the aircraft's current state, what specific type of stall/spin entry is developing, and what is your immediate corrective action?"
The Correct Response:Identification: This is a Skidded Turn Stall entry (specifically a "Cross-Control Stall"). Because the airplane is uncoordinated with inside rudder, the inside wing will stall first and drop rapidly, likely resulting in an over-the-top snap into a spin toward the direction of the rudder.
Immediate Action: At this altitude, a spin is likely fatal. The student must immediately reduce the angle of attack (forward elevator), neutralize the rudder, and level the wings. They should recognize that the correct "safe" pilot response to an overshoot is to go around rather than forcing the turn with rudder.

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

Private Pilot (Airplane) Spin Awareness Airman Certification Standards
Private Pilot (Airplane) Spin Awareness Knowledge: The applicant demonstrates an understanding of:
Aerodynamics associated with stalls in various airplane configurations, including the relationship between angle of attack, airspeed, load factor, power setting, airplane weight and center of gravity, airplane attitude, and yaw effects.
What causes a spin and how to identify the entry, incipient, and developed phases of a spin.

Spin recovery procedure.
Private Pilot (Airplane) Spin Awareness Risk Management: The applicant is able to identify, assess, and mitigate risks associated with:
Factors and situations that could lead to inadvertent spin and loss of control.
Range and limitations of stall warning indicators (e.g., aircraft buffet, stall horn, etc.).
Spin recovery procedure.
Effect of environmental elements on airplane performance related to spins (e.g., turbulence, microbursts, and high-density altitude).
Collision hazards.
Distractions, task prioritization, loss of situational awareness, or disorientation.
Private Pilot (Airplane) Spin Awareness Skills: N/A.

LESSON:	SYSTEMS AND EQUIPMENT MALFUNCTIONS

OBJECTIVE:

This lesson introduces pilots to the types of failures that may occur in flight and how they should be handled.

MOTIVATION:

Most pilots will at some point deal with an in-flight malfunction or emergency. This lesson introduces pilots to the types of failures that may occur in flight and how they should be handled.

REFERENCES / EQUIPMENT NEEDED:

FAA-H-8083-3B (AFH) CH17 [Emergency Procedures]
FAA-H-8083-25B (PHAK) CH7 [Aircraft Systems]

IMAGES / MEDIA / LINKS:

CFI Notebook LINK

SYSTEMS AND EQUIPMENT MALFUNCTIONS	TIME:	[25] Minutes

Be the Pilot in Command - Be decisive. Make decisions in the interest of safety. Don't delay decision making.

- DECIDE Model -
  - D- Detect the problem/Determine that an action is necessary
  - E- Estimate the significance of the action
  - C- Choose a desirable outcome
  - I- Identify actions needed in order to achieve the chosen option
  - D- Do the necessary action to achieve change
  - E- Evaluate the effects of the action
- Aviate, Navigate, Communicate - The first responsibility of all pilots is to maintain positive aircraft control at all times. This is more important than troubleshooting problems, communicating with ATC, or navigation.
- Use all available resources - Talk to ATC, ask for assistance, etc.
- Follow Emergency Checklists - Always follow the appropriate emergency checklist!

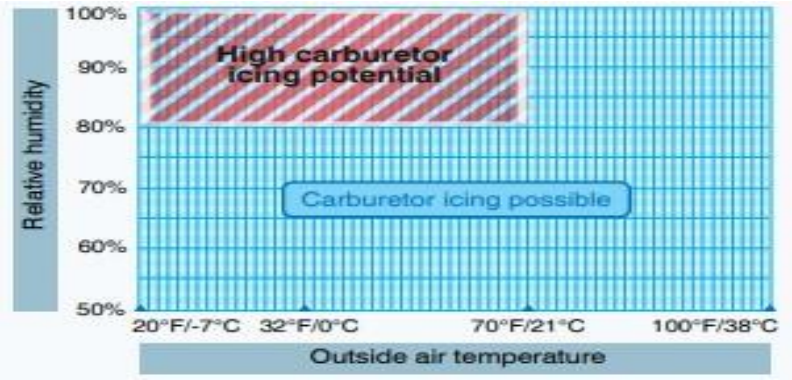
Smoke and Fire - Assume smoke means fire!

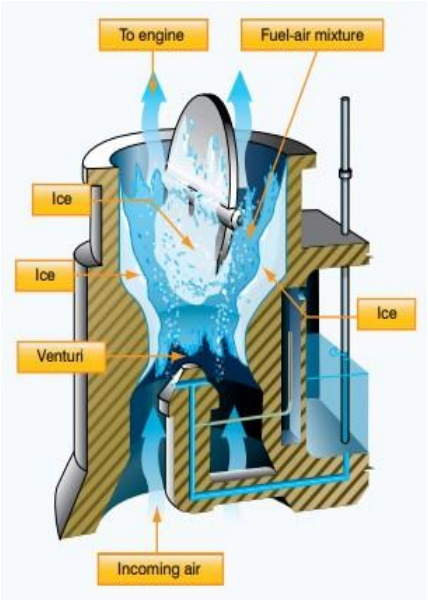
- On the Ground - If during engine start, follow fire during start checklist. May need to evacuate and use a fire extinguisher if available.
- In Flight - Fire in flight is a dire emergency, land immediately!
  - Electrical Fire - Turn off master switch, smoke/fumes in cockpit are a significant danger.
  - Engine Fire - Remove fuel source by cutting off mixture and fuel tanks, perform an emergency descent to increase airspeed and create an incombustible mixture. (Lean)



Engine Issues - Prepare as if an engine failure is imminent.

- Rough running or partial power loss
    - Carb Ice - The venturi effect of a carburetor creates low temperatures that can create carb ice even when outside temperatures are nowhere near freezing. When carb ice is suspected, apply carb heat immediately! If the engine runs rougher and then improves, carb ice was the likely cause.





- Fuel Starvation - As a fuel tank runs dry, the engine may run rough momentarily before failure. Fast action to switch tanks or apply the fuel boost pump may avoid power loss.
- Magneto Failure - A failing magneto is a common cause of a rough running engine. The magnetos can be cycled in flight to determine if one has failed.
- Internal Engine Failure (Stuck valve, etc.) - Internal damage to the engine may cause a partial power loss. A total engine failure may be imminent.

Overheating - Some overheating can be resolved in flight (e.g. by increasing airspeed), but overheating is a dangerous condition that should be monitored closely.

- CHT and Airspeed - Flying at high power settings and low airspeeds can lead to excessively high cylinder head temperatures. Avoid prolonged climbs at Vx or Vy, particularly on hot days.
- Low Oil Pressure - Low oil pressure causes decreased lubrication, increased friction, and can lead to overheating. Rising oil temperature is a sign of imminent engine failure!
- Low Oil Pressure - Low oil pressure can lead to catastrophic failure of an engine and should always be considered an emergency.

Low Oil Level - Low oil level can cause low oil pressure by starving the oil pump.

- Imminent Engine Failure - Low oil pressure will decrease lubrication and is usually an indication that total engine failure is imminent.

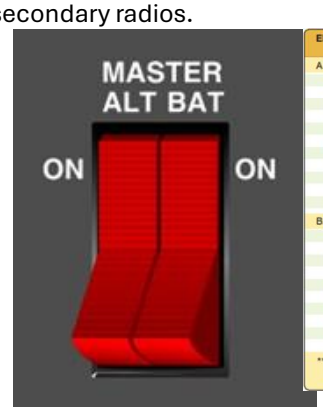
Total Engine Failure

- Fuel Starvation - Fuel starvation is one of the most common causes of engine failure. Be especially cautious when switching fuel tanks and verify that the fuel selector is fully in position! Do not forget to switch tanks!
- Carb Ice - Carburetor ice that is not addressed promptly will lead to a total engine failure, which may not be easily corrected as the engine cools.
- Catastrophic Internal Engine Failure - Total engine failure can also be caused (less commonly) by total failure of internal components.



Electrical Issues

- Alternator Failure - Alternators can fail in flight for a variety of reasons, including excessive load. All airplanes are equipped with a two-sided Master Switch, where cycling the alternator side of the switch resets the circuit breaker for the alternator. Cycling this switch may temporarily 'fix' the alternator, but pilots should assume it will fail again soon.
    - Shed electrical load - If electrical overload is the suspected cause, begin by turning off unnecessary electrical accessories or secondary radios.



Electrical Loads for Light Single	Number of units	Total Amperes
A. Continuous Load		
Pitot Heating (Operating)	1	3.30
Wingtip Lights	4	3.00
Heater Igniter	1	1-20
**Navigation Receivers	1-4	1-2 each
**Communications Receivers	1-2	1-2 each
Fuel Indicator	1	0.40
Instrument Lights (overhead)	2	0.60
Engine Indicator	1	0.30
Compass Light	1	0.20
Landing Gear Indicator	1	0.17
Flap Indicator	1	0.17
B. Intermittent Load		
Starter	1	100.00
Landing Lights	2	17.80
Heater Blower Motor	1	14.00
Flap Motor	1	13.00
Landing Gear Motor	1	10.00
Cigarette Lighter	1	7.50
Transceiver (keyed)	1	5-7
Fuel Boost Pump	1	2.00
Cowl Flap Motor	1	1.00
Stall Warning Horn	1	1.50

** Amperage for radios varies with equipment.
In general, the more recent the model, the less amperage required.
NOTE: Panel and indicator lights usually draw less than one amp.

    - Battery expected runtime- The airplane will run for several minutes to half an hour on battery, but battery power must be conserved to operate flaps, radios, etc!

- Popping Fuses/Circuit Breakers - If circuit breakers are popping, there may be an electrical short, or an overload condition.
    - Shed electrical load by turning off non-critical items and then attempt to reset the breakers. Do not continuously reset breakers if they keep failing, this could be evidence of a short circuit that could lead to an electrical fire!

- Electrical short/fire - Turn off Master Switch entirely!
    - Remember some airplanes need electricity for flaps! Prepare for a flapless immediate landing.

- Night Considerations - Airplane Lights (such as landing lights) may be unavailable, and radios are necessary to control Pilot-Controlled Lighting at non-towered airports. Carrying a portable VHF transceiver may be useful as a backup when making night flights.

Instrument Failure

- Pitot/Static System - Instruments such as the airspeed indicator, altimeter, and VSI depend on the pitot/static system. The failure of the pitot or static system is most commonly caused by blockages, usually in the form of ice or liquid, that collect in the pitot tube and static ports. If a pitot tube blockage is suspected, apply pitot heat. If a static port blockage is suspected, switch to the alternate static source.



Effect of Blocked Pitot/Static Sources on Airspeed, Altimeter, and Vertical Speed Indications	Indicated Airspeed	Indicated Altitude	Indicated Vertical Sp
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 variations in vertical sp
Both static and pitot sources blocked	All indications remain constant, regardless of actual changes in airspeed, altitude, and vertical speed.		

- Vacuum System - In airplanes with vacuum systems, a failure of this system will cause the attitude indicator and directional gyro to indicate unreliably. Monitor the suction or vacuum gauge, and if vacuum failure is likely, cover the attitude indicator and directional gyro to prevent distraction!

Hydraulic Issues

- Brakes - If hydraulic brakes fail, pilots can use aerodynamic braking to partially compensate.
- Landing Gear - Follow emergency extension procedures in the appropriate checklist. If unsuccessful, prepare to touch down at the lowest possible speed, ideally at a towered airport where emergency services will be available.

Door or Window Opening in Flight

- Normally this is a non-emergency! Remember to fly the plane first!
    - Some airplanes must land, some can be closed in flight carefully. It may be necessary to reduce airspeed or gently sideslip the airplane to allow closure of the door.
    - If closure is not possible, land and close the door or window.

Inoperative or “Runaway” Trim - Runaway trim can be extremely dangerous and requires prompt action.

- Runaway trim only occurs with electric trim, so be familiar with the location of the electric trim circuit breaker and be prepared to use it!
- If trim issues are suspected, stop using trim! Most airplanes can be landed safely even when trimmed incorrectly. Be prepared for increased control pressures.

Flap Malfunction - The most dangerous flap malfunction is asymmetric flap extension. This would cause an uncontrollable roll to one side. If this happens, reverse the flap setting immediately!

Flapless landings are simple and should be practiced often. They simply require pilots to fly a slightly faster final approach.
Pressurization / Oxygen System Malfunction - Descend now! The time of useful consciousness is very low, and pilots must descend below 12,500 feet as soon as possible. Consider an emergency descent!

KEY POINTS:

Understanding what it means to be PIC, means decision maker.
THe better you understand the systems, the better decisions you can make in emergency situations.

RISK MANAGEMENT:

FAA-H-8083-2A RMH CH: 1, 2 , 3, 4, 5, 6, 7, & 8

FLIGHT MANEUVERS GUIDE:

Power Off 180 – CAX Maneuver

COMMON ERRORS:

Failure to perform the appropriate emergency checklist.
Failure to attempt to determine the cause of the malfunction.

QUESTIONS FOR THE STUDENT:

Engine systems and performance
Engine rough or partial power loss: What are the possible causes of a rough-running engine, and what is your troubleshooting procedure?
Follow-up: What conditions are most favorable for carburetor icing, and what is the first indication that it is forming?

Total engine failure: Your engine fails immediately after takeoff. What are your immediate actions, and what is your procedure for an emergency landing?
Follow-up: You suspect fuel starvation. What is the difference between fuel starvation and fuel exhaustion?

Engine overheating: You see the cylinder head temperature (CHT) gauge enter the red arc. What are some potential causes, and what actions can you take to cool the engine?

Oil pressure: You observe low oil pressure but normal oil temperature. What might this indicate, and what is your course of action?
Electrical systems

Alternator failure: During a daytime flight, your ammeter shows a discharge, and the low-voltage light illuminates. What does this mean, and what electrical load management should you perform?
Follow-up: If you continue to fly on battery power, what should you keep in mind, especially during a night flight?
Fuses and circuit breakers: You experience an electrical equipment malfunction and notice a popped circuit breaker. What is the proper procedure for resetting it, and when should you avoid doing so?

Total electrical failure: You lose all electrical power in flight. What essential systems do you lose, and how will you communicate and land?
Follow-up: What should you remember about flaps and landing gear with a total electrical failure?
Flight instruments

Vacuum system failure: Your vacuum-driven attitude indicator and heading indicator tumble or become unreliable. What is your immediate action?
Follow-up: Describe how you would maintain straight-and-level flight using only the remaining instruments (partial panel).

Pitot-static system blockage: Your airspeed indicator, altimeter, and vertical speed indicator (VSI) become unreliable. What might be the cause, and how can you troubleshoot it?
Follow-up: If you suspect a static port blockage, how can you resolve the issue, and what are the effects on your instruments?
Aircraft structure and controls

Inoperative or runaway trim: How do you recognize a trim malfunction, and what are your immediate actions?

Flap malfunction: What is the procedure for a flapless landing? How do you manage an asymmetric flap extension?
Door opening in flight: A cabin door or window unexpectedly opens in flight. What is your first priority, and what is the typical procedure to handle this situation?

Landing gear malfunction: Your retractable landing gear (if equipped) fails to extend. What is the emergency procedure, and how do you prepare for a landing with unsafe gear?
Structural icing: You encounter ice accumulating on your wings. What is your immediate action, and why is this a significant hazard?

Communications and navigation
Lost communications (VFR): While on a VFR flight in a controlled airspace, you lose radio contact. What is the procedure you must follow?
Follow-up: If you are near a towered airport, what should you look for?

GPS failure: Your GPS unit fails mid-flight. What is your backup plan for navigation?
General emergency procedures

Cabin fire: You smell smoke in the cabin. What are the steps for an electrical fire versus an engine fire?

Emergency equipment: What emergency and survival equipment is on board your aircraft, and do you know how to use it?

Pilot-in-command decision-making: How would you use the "DECIDE" model to manage an inflight emergency?

INSTRUCTOR AND STUDENT ACTIONS:

Instructor: Present the lesson, demonstrate the maneuver with the model airplane, and ask the student questions to assess their knowledge.
Student: Take notes on the presentation, demonstrate the maneuver to the instructor describing the key points of how to do it, and state any completion standards for today's lesson.

ACS COMPLETION STANDARDS:

- **Ground**: Student can explain the proper procedure for handling the following types of failures:
    - Suspected Carb Ice, Rough Running Engine/Partial Power Loss
    - Fuel Exhaustion, Low Oil Pressure, Total Power Loss
    - Smoke/Fire
    - Electrical System Failure
    - Door opening in flight, trim or flap malfunctions
- **Flight**: Student can perform the appropriate steps for each type of system failure in flight by:
    - Correctly identifying the problem
    - Following the appropriate emergency checklist or troubleshooting steps
    - Communicating (simulated) with ATC, as needed

Demonstrating Pilot-in-Command decision making

NOTES: