www.GroundSchool.com

COMMERCIAL CERTIFICATE
Everything You Need To Know

Aeronautical Experience Required for Commercial Rating

§ 61.129

- **250** hours of total flight time
  - At least **100** hours in powered aircraft (**50** of which must be in airplanes)
  - At least **100** hours pilot-in-command
    - At least **50** hours in airplanes
    - At least **50** hours cross-country (**10** of which must be in airplanes)
  - At least **10** hours solo flight time in a single engine airplane -or- **10** hours of flight time performing the duties of PIC with an instructor on board.
    - One **cross-country flight** of not less than **300** nautical miles total distance, with landings at a minimum of **3 points**, one of which is a straight-line distance of at least **250** nautical miles. (special circumstances with Hawaii)
    - **5** hours in night VFR conditions with **10** takeoffs and **10** landings (with each landing involving a flight in the traffic pattern) at an airport with an operating control tower.
  - At least **20** hours training in areas of operation listed in *§ 61.127(b)(1)*
    - At least **10** hours of instrument training using a view-limiting device including attitude instrument flying, partial panel skills, recovery from unusual flight attitudes, and intercepting and tracking navigational systems.
    - One **2-hour cross country** flight in daytime conditions that consists of a total straight-line distance of more than **100** nautical miles.
    - One **2-hour cross country** flight in nighttime conditions that consists of a total straight-line distance of more than **100** nautical miles.
    - At least **3** hours in a single-engine airplane with an authorized instructor in preparation for the practical test within the preceding **2** calendar months.
    - At least **10** hours of training in a complex airplane, or a technically advanced airplane (TAA).

Note:

An Instrument rating alone does **NOT** satisfy the training requirements for a Commercial Certificate

Eligibility Requirements For Commercial Pilot Certificate

§ 61.123

- At least **18** years of age
- Be able to read, speak, write, and understand English.
- Receive a logbook endorsement from an authorized instructor who:
  - Conducted the required ground training or reviewed the person's home study on the aeronautical knowledge areas listed in *§ 61.125*
  - Certified that the person is prepared for the required knowledge test
- Pass the required knowledge test on the aeronautical knowledge areas listed in *§ 61.125*
- Receive the required training and a logbook endorsement from an authorized instructor who:
  - Conducted the training on the areas of operation listed in *§ 61.127*
  - Certified that the person is prepared for the required practical test
- Meet the aeronautical experience requirements of this subpart *§ 61.123* that apply to the aircraft category and class rating.
- Pass the required practical test on the areas of operation listed in *§ 61.127*
- Hold at least a private pilot certificate issued under this part or meet the requirements of *§ 61.73*
- Comply with the sections of this part that apply to the aircraft category and class rating sought.

Other Endorsements

Tailwheel Endorsement *§ 61.31(i)*

- Does not require a minimum number of hours.
- Requires specific maneuvers to be demonstrated:
  - Normal and crosswind takeoffs and landings
  - Wheel landings
  - Go-around procedures

Complex Endorsement *§ 61.31(e)*

- For airplanes with retractable landing gear, flaps, & controllable pitch propeller.
- Does not require a minimum number of hours.
- Required to log and receive ground and flight training from authorized instructor.

High-Performance Endorsement *§ 61.31(f)*

- For airplanes with an engine of more than 200 horsepower.
- Required to log and receive ground and flight training from authorized instructor.

High-Altitude Endorsement *§ 61.31(g)*

- For airplanes with a service ceiling or maximum operating altitude, whichever is lower, above 25,000 ft. MSL
- Required to log and receive ground and flight training from authorized instructor. Training must include these subjects:
  - High-altitude aerodynamics and meteorology
  - Respiration
  - Hypoxia & high-altitude sickness
  - Duration of consciousness without supplemental oxygen
  - Effects of prolonged usage of supplemental oxygen
  - Causes and effects of gas expansion
  - Incidents of decompression
  - Other physiological aspects of high-altitude flight

Instrument Time

§ 61.51g (1) - A person may log instrument time only for that flight time when the person operates the aircraft solely by reference to instruments under actual or simulated instrument flight conditions.

§ 61.51g (2) - An authorized instructor may log instrument time when conducting instrument flight instruction in actual instrument conditions.

Logging Instrument Time

§ 61.51 g(3i-ii)(4)

- Location and type of each approach
- Safety pilot name (if required)
- Flight simulator used
  - If used for certificate or rating, add instructor name and number
  - If instrument rated and used for currency, no instructor needed

Instrument Rating Required

- When acting as PIC within IFR weather conditions *§ 61.3*
- When carrying passengers for compensation or hire on cross-country flights in excess of 50 NM or at night *§ 61.133*
- Flight in Class A airspace *§ 91.135*
- Flight in Special VFR between sunset and sunrise *§ 91.157*

Mandatory IFR Reporting

- Any un-forecasted weather conditions *§ 91.183*
- When vacating any previously assigned altitude or flight level *AIM 5-3-3*
- Time and altitude/flight level upon reaching a holding fix *AIM 5-3-3*
- When leaving any assigned holding fix *AIM 5-3-3*
- Compulsory Reporting Points *§ 91.183*
- When unable to climb/descend at a rate of at least 500 feet per minute *AIM 5-3-3*
- When executing a missed approach *AIM 5-3-3*
- A change in average true airspeed (at cruise) when it varies by 5% or 10 knots from the speed filed in the flight plan *AIM 5-3-3*
- Loss of navigation *AIM 5-3-3*
- Any information relating to safety of flight *§ 91.183*

To act as PIC under IFR

- Current Medical Certificate *(or Basic Med with restrictions)*
- Current Instrument Rating

IFR Minimum Fuel Requirements

§ 91.167

Fuel from **departure** to **destination** + Fuel from **Destination** to most distant **Alternate** (If alternate is required) + **45 Minutes** calculated at normal cruise speed/alt.

Required Personal Documents

- Pilot Certificate
- Medical Certificate
  (or operating under Basic Med)
- Authorized Photo ID
- Radio Operator Permit
  (for flight outside the US)

Required Aircraft Documents

§ 21.5, 91.103, 91.1, 91.203

"**ARROW**"

A - Airworthiness Certificate
R - Registration
R - Radio Operator License *(for international flights)*
O - Operating Limitations & Information *(in AFM)*
W - Weight and Balance Data *(aircraft specific)*

Preflight Self Assessment

§ 91.17, AIM 8-1-1

"**IM SAFE**"

I - Illness
M - Medication
S - Stress
A - Alcohol
F - Fatigue
E - Emotion/Eating

Preflight General

"**PAVE**"

P - Pilot
A - Aircraft
V - EnVironment
E - External Factors

Decision Making & Risk Management

"**DECIDE**"

D - *Detect* a change has occurred
E - *Estimate* the need to counter the change
C - *Choose* what is the desired outcome
I - *Identify* the solutions
D - *Do* the necessary actions
E - *Evaluate* the effects of the actions

Required Aircraft Maintenance Inspections

"**AV1ATES**"

A - Annual Inspection *§ 91.409*
- Every 12 Calendar Months

V - VOR Check *§ 91.171*
- Every 30 Days

1 - 100 Hour Inspection *§ 91.409*
- Required if flying for hire

A - Altimeter *§ 91.411*
- Every 24 Calendar Months

T - Transponder *§ 91.413*
- Every 24 Calendar Months

E - ELT *§ 91.207*
- Every 12 Calendar Months
- Battery must be replaced after more than 1 hour of cumulative use

- or -

If 50% of the usable battery life is expired

S - Static System *§ 91.411*
- Every 24 Calendar Months

Confirmation of airworthiness is the responsibility of the Pilot-In-Command

Minimum Required Equipment for VFR Flight

§ 91.205

"**A TOMATO FLAMES**"

A - Altimeter
T - Tachometer for each engine
O - Oil Temp indicator for each engine
M - Manifold pressure gauge for each engine
A - Airspeed Indicator
T - Temp gauge for each liquid cooled engine
O - Oil pressure gauge for each engine
F - Fuel quantity gauge for each fuel tank
L - Landing gear position lights
A - Anticollision lights *(aircraft certified after 03/11/96)*
M - Magnetic compass
E - ELT
S - Safety belts/shoulder harnesses

Minimum Required Equipment for VFR Night Flight

All day VFR + "**FLAPS**"

F - Fuses *(spare set)*
L - Landing light *(if for hire)*
A - Anticollision light
P - Position lights *(navigation lights)*
S - Source of power *(such as battery)*

Minimum Required Equipment for INSTRUMENT Flight

All day VFR (+ FLAPS if at night) "**GRABCARD**"

G - Generator/Alternator
R - Radios *(two way and nav.)*
A - Altimeter *(pressure sensitive)*
B - Ball *(slip-skid indicator)*
C - Clock *(Installed & shows hrs. min. and sec with a sweep-second pointer or digital presentation)*
A - Attitude indicator
R - Rate of turn indicator
D - Directional gyro *(Heading indicator)*

Preflight Info Required for IFR

§ 91.103

"**NW KRAFT**"

N - NOTAMs
W - Weather reports and forecasts
K - Known traffic delays
R - Runway length of intended use
A - Alternatives available
F - Fuel requirements
T - Takeoff and landing performance data

Types of 30 Day VOR Checks

§ 91.171
(with acceptable tolerances)

VOT - ±4°
Repair Station - ±4°
VOR Ground Checkpoint - ±4°
VOR Airborne Checkpoint - ±6°
Dual VOR Cross-Check - ±4°
Above a Prominent Ground Landmark
On a selected radial at least 20 NM from a VOR flying at a "reasonably low altitude" ±6°

Operating with inoperative equipment

§ 91.213

- Is the equipment required by:
  - An Airworthiness Directive (AD)
  - Regulations for type of flight operation
  - VFR Day certification requirements
  - An operational equipment list

Yes
Flying is NOT PERMITTED without a special flight permit

No
Flying is PERMITTED, so long as:
- equipment is removed
  - or -
- deactivated and placarded "inoperative"
- pilot/mechanic determines safe to fly

If the aircraft has a Minimum Equipment List (MEL), refer to the MEL guidance.

Required Test Flight

§ 91.407 (b)

No person may carry any person (other than crewmembers) in an aircraft that has undergone maintenance affecting flight characteristics unless a test flight has been completed and logged by someone with at least a private pilot certificate.

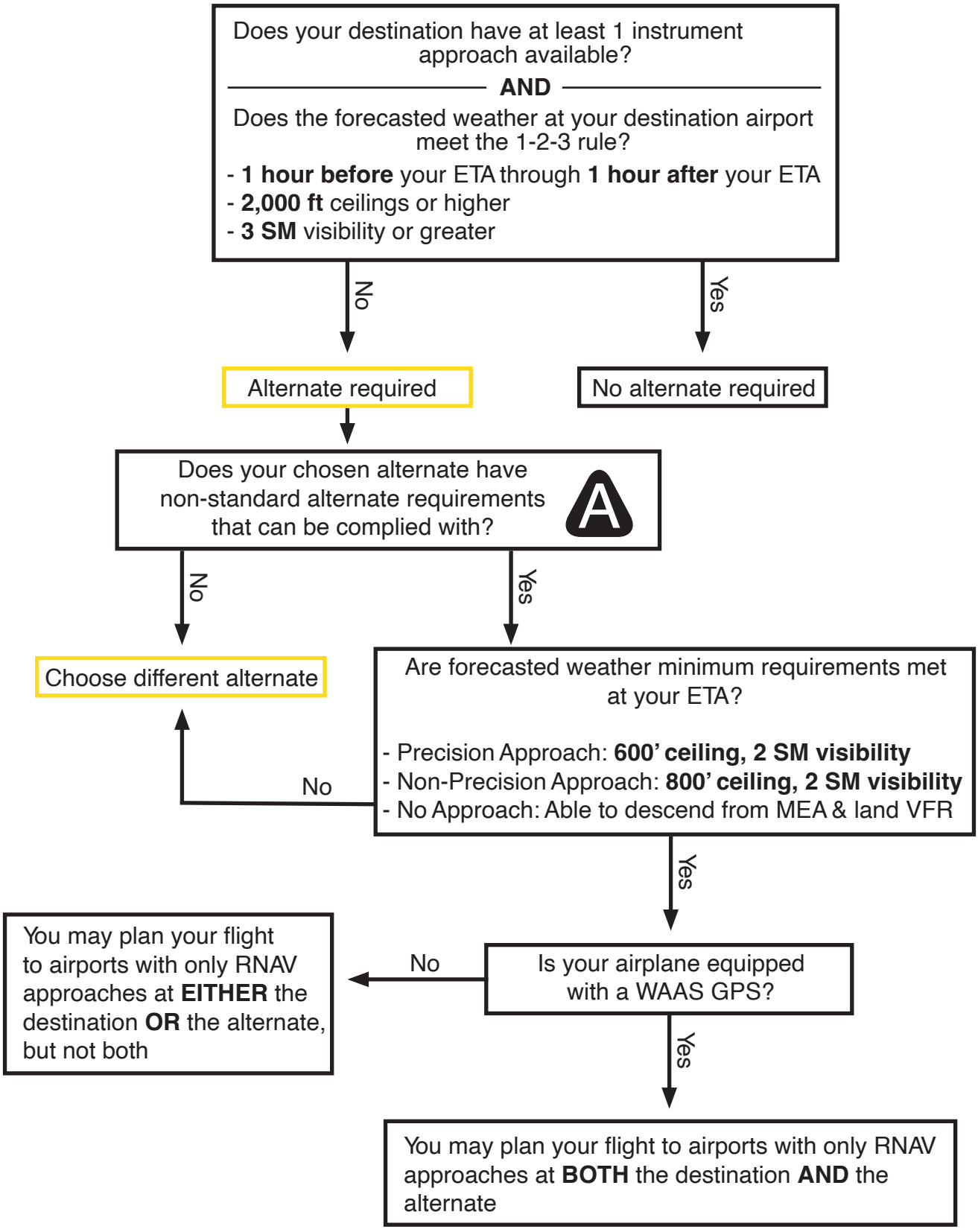
Magnetic Compass Errors

"**DV MONA**"

D - Deviation
V - Variation
M - Magnetic dip
O - Oscillation
N - North/South turn errors **"UNOS"**
  - **U**ndershoot **N**orth/**O**vershoot **S**outh
A - Acceleration errors **"ANDS"**
  - **A**ccelerate **N**orth/**D**ecelerate **S**outh

Do you need an Alternate?

§ 91.169



Airspeed Indicator Markings

White Arc -
Flap operating range.
Starts at V_{SO} and ends at V_{FE}

Green Arc -
Normal operating range.
Starts at V_{S1} & ends at V_{NO}

Yellow Arc -
Caution range.
Fly only in smooth air with caution.
Relative to V_A

Red Line -
Warning range. V_{NE}.
Structural damage possible.

Types of Speeds

- **Indicated Airspeed (IAS)** - Speed indicated on the airspeed indicator
- **Calibrated Airspeed (CAS)** - Indicated airspeed corrected for instrument and position errors
- **Equivalent Airspeed (EAS)** - Calibrated airspeed corrected for compressibility error
- **True Airspeed (TAS)** - Actual speed through the air. Equivalent Airspeed corrected for non-standard temperature and pressure
- **Mach number** - The ratio of True Airspeed relative to the local speed of sound
- **Groundspeed** - Actual speed across the ground. True Airspeed corrected for wind conditions.
- **Critical Mach** - Lowest Mach number at which the airflow over any part of the aircraft reaches the speed of sound.

Speed Review

V-Speeds

- **V_A** - Design maneuvering speed
- **V_S** - Stall speed, clean configuration
- **V_{SO}** - Stall speed, landing configuration
- **V_{S1}** - Stall speed, specific configuration
- **V_F** - Design flap speed
- **V_{LE}** - Max landing gear extended speed
- **V_{FE}** - Max flap extended speed
- **V_{NO}** - Max structural cruise speed
- **V_{NE}** - Never exceed speed
- **V_X** - Best angle of climb
- **V_Y** - Best rate of climb
- **V_G** - Best glide speed
- **V_{REF}** - Calculated final approach speed

Max Airspeeds in the United States

§ 91.117

- **Mach 1.0** - (speed of sound) above 10,000 ft MSL
- **250 kts** - Below 10,000 ft MSL
- **200 kts** - Under Class B airspace, or inside a VFR corridor through Class B
- **200 kts** - At or below 2,500 ft within 4 NM of Class C or D airport

Types of Altitudes

- **Indicated Altitude** - Uncorrected altitude indicated on the altimeter when barometric pressure is set to current pressure setting
- **Pressure Altitude** - Altitude corrected for non-standard pressure
- **Density Altitude** - Pressure altitude corrected for non-standard temperature
- **True Altitude** - Altitude above Mean Sea Level (MSL)
- **Absolute Altitude** - Altitude above ground level (AGL)

Recency Requirements

Instrument Currency

§ 61.57(c)

6 Months

- Conducted 6 instrument approaches
- Intercepted and tracked courses using navigation systems
- Performed holding procedures

Note: The FAA doesn't specify how many holds. Just more than one.

These can be completed in an approved FFS, ATD, or FTD provided the device is of the same category and type aircraft and the pilot performs them in simulated instrument conditions. A flight instructor is not required.

Additional 6 Months

- Additional time to accomplish the 3 tasks with...
  - A safety pilot in simulated instrument conditions
  - A CFI or examiner

Safety Pilot

- Must have at least a Private Pilot Certificate *(does not have to be current)*
- Must be rated in the same category and class aircraft
- Must have a current medical
- Aircraft must have dual controls
- Must have adequate visibility of front and each side of the aircraft

IPC Required

Instrument Proficiency Check

- Administered by a CFII, examiner, or FAA approved official
- Some IPC tasks can be conducted in an Approved Aviation Training Device (AATD)

Helpful Tip

Use the acronym "**6 HITS**" to remember the IFR recency requirements

6 - 6 Instrument Approaches

H - Holding procedures
I - Intercepted a course
T - Tracked a course
S - Using navigational systems

Flight Review

- Within the last 24 calendar months
  - Min 1 hr flight instruction
  - Min 1 hr ground instruction
  - Conducted by authorized instructor
- May be substituted by...
  - A proficiency check
  - A practical test for a new rating or certificate
  - Completion of one or more phases of FAA sponsored pilot proficiency award program (WINGS)
  - Flight Instructor Renewal *§ 61.197 (substitutes ground portion only)*

Passenger Carrying

- 3 takeoffs and landings in the preceding 90 days in the same aircraft category, class, and type *(Full stop with a tail dragger)*

Passenger Carrying At Night

- 3 takeoffs and landings in the preceding 90 days in the same aircraft category, class, and type
- Full Stop
- 1 hour after sunset to 1 hour before sunrise

Additional ADS-B Out Requirements

- Class E airspace at or above 10,000 feet MSL, excluding airspace at and below 2,500 feet AGL
- Within 30 nautical miles of a Class B primary airport (the Mode C veil)
- Above the ceiling and within the lateral boundaries of Class B or Class C airspace up to 10,000 feet MSL
- Class E airspace over the Gulf of Mexico, at and above 3,000 feet MSL, within 12 nm of the U.S. coast

---

Missing or Broken Transponder

- Prior to operating an aircraft **NOT** equipped with a transponder in Class B airspace, a request for a deviation must be submitted to the controlling ATC facility at least 1 hour before the proposed flight.
- If the transponder fails during the flight in Class B airspace, a request must be immediately made and a transponder requirement deviation may be issued to allow the flight to continue through the airspace.

Supplemental Oxygen Requirements

§ 91.211

25,001’ MSL - **Unlimited**

Required to satisfy all requirements below + an additional 10 minutes of oxygen for each person on board

25,000’ MSL

Required to be used by flight crew
- and -
Must be provided to every occupant

15,001’ MSL

15,000’ MSL

Required to be used by flight crew

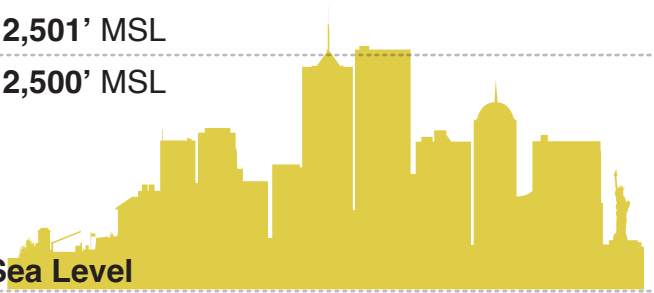
14,001’ MSL

14,000’ MSL

Required by required crew if over 30 minutes at this altitude

12,501’ MSL

12,500’ MSL



No supplemental oxygen required

Sea Level

Note: All MSL altitudes listed here are “Cabin Pressure Altitudes”

Electronic Devices

§ 91.21

No person may operate, nor may any operator or pilot in command of an aircraft allow the operation of, any portable electronic device on any civil aircraft:

- Does not apply to -

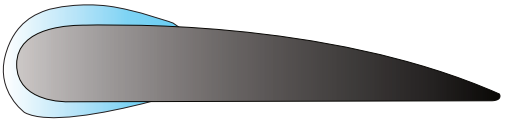
1.) Portable voice recorders
2.) Hearing aids
3.) Heart pacemakers
4.) Electric shavers
5.) Any other portable electronic device that the operator of the aircraft has determined will not cause interference with the navigation or communication system of the aircraft in which it is to be used.

Types of Aircraft Icing

- **Rime Ice**
  - Rough, milky, opaque ice
  - Formed by the instantaneous or very rapid freezing of super cooled droplets as they strike the leading edges
  - Rough surface can decrease aerodynamic efficiency, but it is lighter than clear ice

- **Clear Ice**
  - Glossy, transparent ice formed by the relatively slow freezing of super cooled water
  - Denser, harder, and sometimes more transparent than the rime ice
  - Harder to remove than rime ice

- **Mixed Ice**
  - Combination of clear and rime ice
  - Roughness and weight can have an effect on aerodynamics



Icing Intensities

Trace	Light	Moderate	Severe
Icing perceptible. Not hazardous unless encountered for an extended period of time.	Icing clearly visible. Anti-icing/deicing equipment removes/ prevents accumulation.	Even short encounters can be hazardous. Anti-icing/deicing equipment must be used, or diversion.	Rate of accumulation is such that deicing/ anti-icing equipment fails to reduce the hazard. Diversion mandatory.

- **Ignition System**
  - *Detonation:*
    - An uncontrolled, explosive ignition of the fuel-air mixture within the cylinder's combustion chamber.
    - Could be caused by a lower fuel grade than recommended
    - Operation of the engine with extremely high manifold pressures in conjunction with low RPM.
    - Operation of the engine at high power settings with an excessively lean mixture.
  - *Preignition:*
    - Occurs when the fuel-air mixture ignites prior to the engine's normal ignition event.
    - Usually caused by a residual hot spot in the combustion chamber.
    - Causes the engine to lose power and produces high operating temperatures.
  - *Spark Plug Fouling:*
    - Occurs when low engine operating temperatures are coupled with running a rich mixture.

- **Propellers**
  - *Fixed-Pitch:*
    - Blade angle is built into the blade itself.
    - Once the propeller has been built, the Angle can't be changed.
  - *Constant-Speed Propeller:*
    - Controllable-pitch propeller whose pitch is automatically varied in flight by a governor.
    - Two controls: The throttle and the propeller control.
    - Once an RPM is selected, a governor automatically adjusts the propeller blade.

- **Magnetos**
  - An electrical generator that uses permanent magnets to produce periodic pulses of alternating current.
  - Generates an electrical current completely independent of the aircraft's electrical system.
  - Operates whenever the crankshaft is rotating.

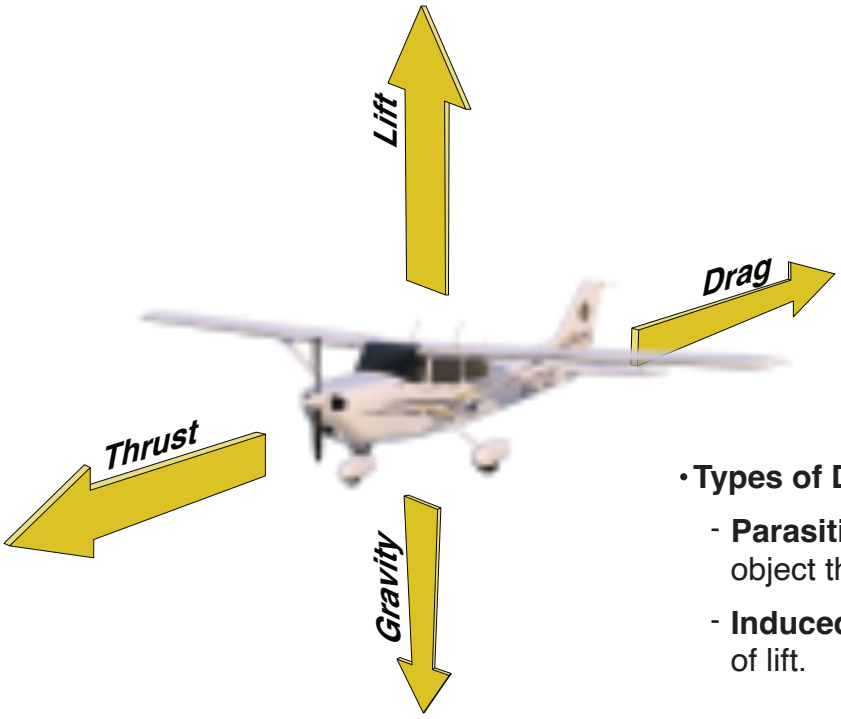
Note:

Even with the ignition switch in the **OFF** position, if the ground wire between the magneto and the ignition becomes disconnected or broken, the engine **could accidentally start** if the propeller is moved with residual fuel in the lines.

- **Fuel-Air Mixture**
  - The ratio of the "weight" of fuel to the "weight" of air in the mixture to be burned.
  - Leaning the fuel mixture at cruise altitude promotes optimal engine performance.
  - Leaning before taxiing prevents spark plugs from fouling.

Light Gun Signals

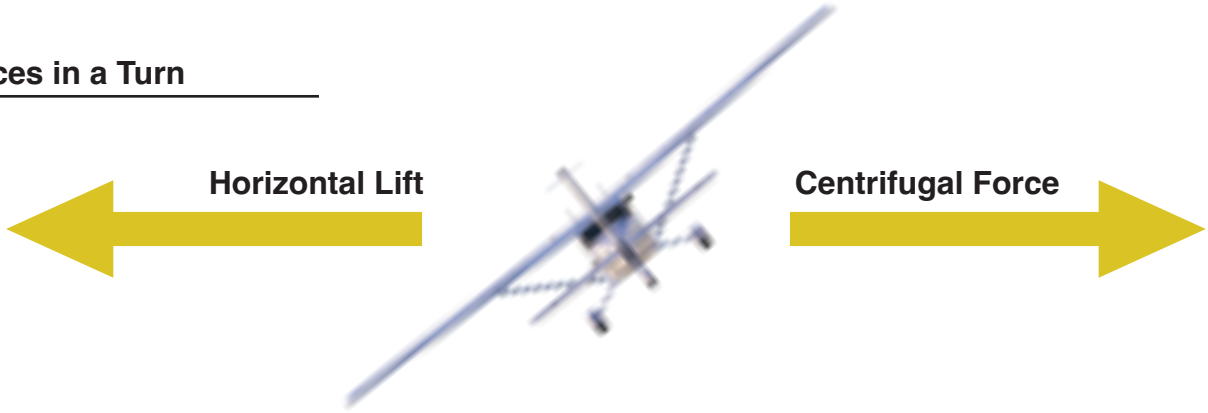
	Aircraft on the Ground	Aircraft in Flight	Vehicles and Ground Personnel
Steady Green	Cleared for Takeoff	Cleared to Land	Cleared to cross; Go
Flashing Green	Cleared to Taxi	Return for Landing	N/A
Steady Red	Stop	Give way to other aircraft and continue circling	Stop
Flashing Red	Taxi clear of landing area - or - Runway in use	Airport unsafe DO NOT LAND	Clear the taxiway/runway
Flashing White	Return to starting point on airport	N/A	Return to starting point on airport
Alt. Red and Green	General warning signal exercise extreme caution	General warning signal exercise extreme caution	General warning signal exercise extreme caution

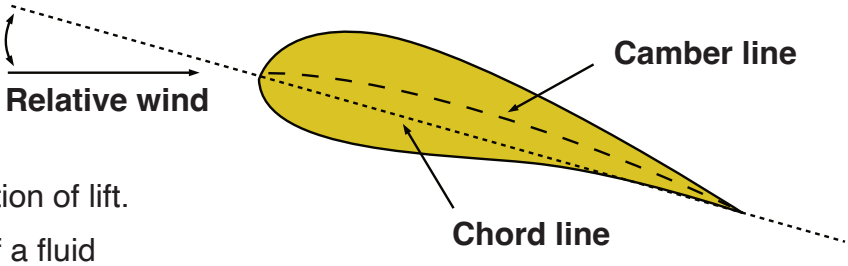


Four Forces Of Flight

- **Types of Drag**
  - **Parasitic:** Drag produced by the motion of an object through a fluid.
  - **Induced:** Drag that arises from the development of lift.

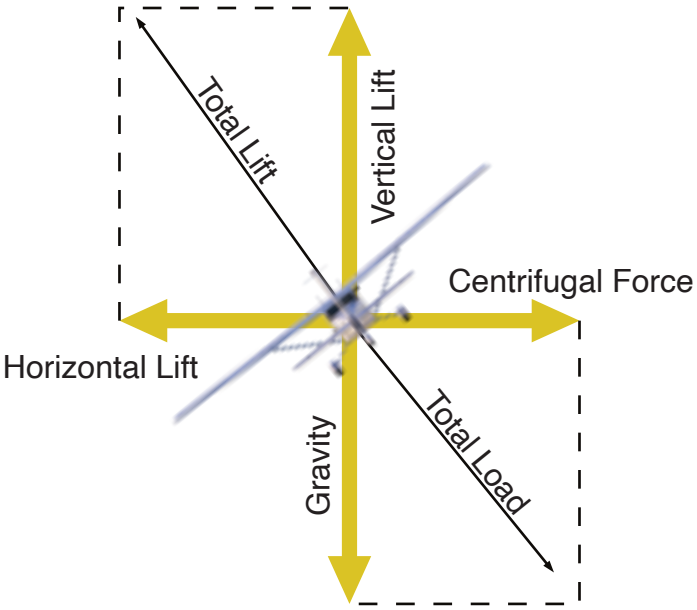
Forces in a Turn





(Elements of an airfoil)

- **Bernoulli's Principle**
  - Basic principle that allows for the creation of lift.
  - States that an increase in the speed of a fluid occurs simultaneously with a decrease in pressure or a decrease in the fluid's potential energy.
  - As air passes above the wing it speeds up and creates an area of low pressure. As the air passes below the wing it slows down and creates increased pressure.
  - The pressure difference creates an upward lifting force.

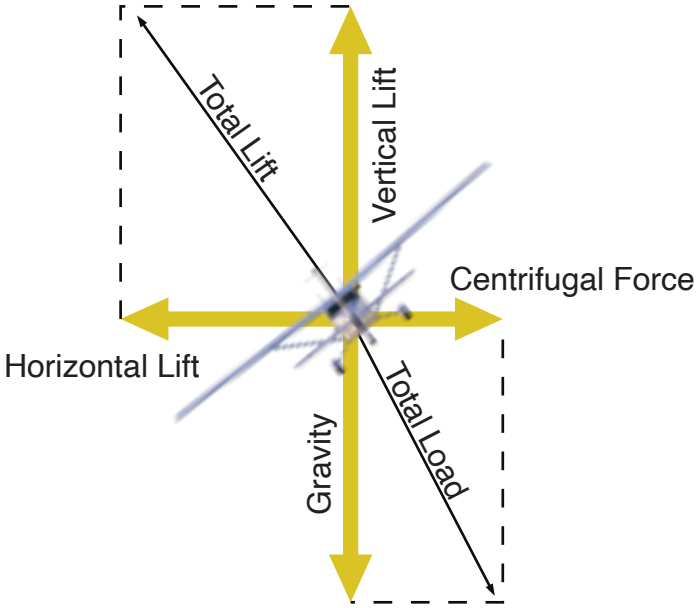


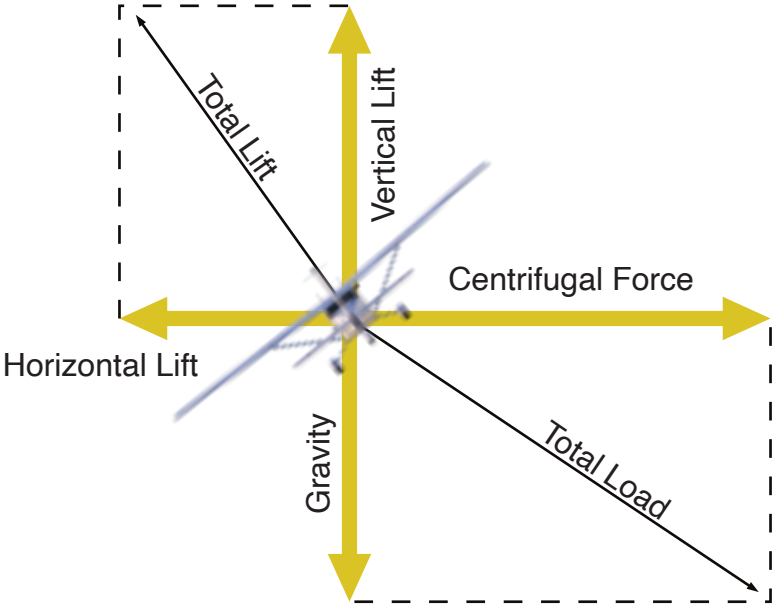
Normal Turn

Centrifugal force equals horizontal lift

Slipping Turn

Centrifugal force is less than horizontal lift

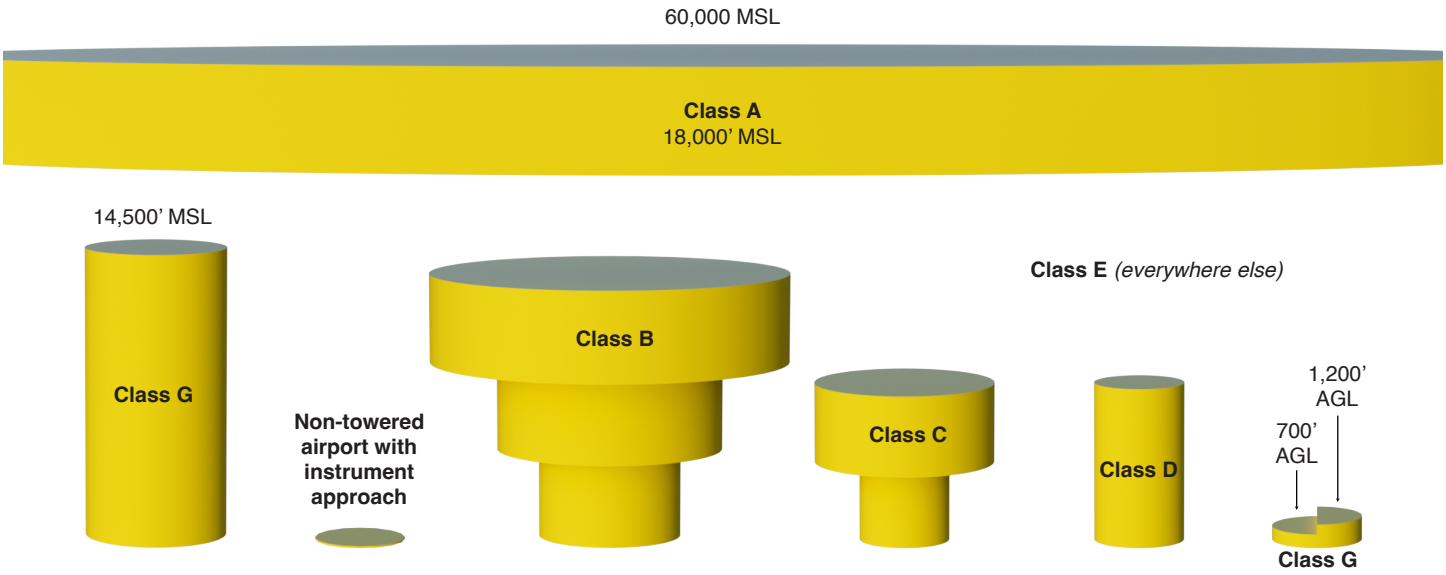




Skidding Turn

Centrifugal force is greater than horizontal lift

National Airspace System



VFR Cloud Clearances

Class A			**None**	**None**
Class B			**3 SM**	**Clear of Clouds**
Class C			**3 SM**	**500 ft. below 1,000 ft. above 2,000 ft. horizontal**
Class D			**3 SM**	
Class E	**Less than 10,000 MSL**		**3 SM**	
	At or above 10,000 MSL		**5 SM**	**1,000 ft. Above, 1,000 ft. below 1 statute mile horizontal**
Class G	**Up to 1,200 AGL**	**Day**	**1 SM**	**Clear of Clouds**
		Night	**3 SM**	**500 ft. below 1,000 ft. above 2,000 ft. horizontal**
	More than 1,200 AGL Less than 10,000 MSL	**Day**	**1 SM**	
		Night	**3 SM**	
	More than 1,200 AGL And at or above 10,000 MSL		**5 SM**	**1,000 ft. Above, 1,000 ft. below 1 statute mile horizontal**

Aeromedical Factors

- **Hypoxia**
  - A condition of the body in which the tissues are starved of oxygen.

    Hypoxic Hypoxia: Insufficient oxygen available to the body as a whole.

    Hypemic Hypoxia: Occurs when the blood is not able to take up and transport a sufficient amount of oxygen to the cells in the body.

    Stagnant Hypoxia: Results when the oxygen-rich blood in the lungs is not moving, for one reason or another. Blood is not moving, so oxygen is not delivered to the tissues.

    Histotoxic Hypoxia: The inability of the cells to effectively use oxygen.

  Solution: *Don an oxygen mask if one is available and descend immediately to the lowest practical altitude.*

- **Hyperventilation**
  - The excessive rate and depth of respiration leading to abnormal loss of carbon dioxide from the blood.
  - Symptoms of hyperventilation are similar to those of hypoxia. It is important to correctly diagnose and treat the proper condition. But when in doubt, treat it as hypoxia and get to a lower altitude as soon as possible.

  Solution: *Slow your breathing and increase carbon dioxide intake by breathing into some kind of bag.*

- **Carbon Monoxide Poisoning**
  - Exposure to a colorless, odorless, tasteless deadly gas caused by the combustion of carbon based materials. Usually airplane exhaust getting into the cabin.
  - Symptoms usually start with drowsiness and come on quickly.

  Solution: *Turn the cabin heat off, ventilate the cabin as much as possible, open a window if you're able, land as soon as possible.*

Types of Medicals *§* 61.23

- **First Class Medical:**
  - Required for Airline Transport Pilot
  - Valid for **12** calendar months if the pilot is **under age 40**
    - It then reverts to **3rd** Class privileges
  - Valid for **6** months if the pilot is **40 and over**
    - It then reverts to **2nd** Class privileges for **6** months
    - After that **6** months lapses, it reverts to **3rd** class privileges
- **Second Class Medical:**
  - Required for Commercial Pilot Certificate
  - Valid for **12** calendar months regardless of age
  - Once this time period lapses, it reverts to **3rd** class privileges.
- **Third Class Medical:**
  - Required for Private Pilot, Flight Instructor, or Student Pilot
  - Valid for **60** calendar months (**5** years) if the pilot is under age **40**
  - Valid for **24** calendar months if the pilot is **40** and over

- **BasicMed:**
  - Alternate way for pilots to fly without holding an FAA medical certificate as long as they meet certain requirements;

    Eligibility Requirements:

    - Possess a U.S. Driver's license, have held a medical after July 14, 2006
    - Get a physical exam with a state-licensed physician, using the Comprehensive Medical Examination Checklist
    - Complete a BasicMed medical education course

    Aircraft Requirements:

    - Any aircraft authorized under federal law to carry not more than 7 occupants
    - Max certificated takeoff weight of not more than 12,500 pounds

    Operating Requirements:

    - Carries not more than 6 passengers
    - Operates under VFR or IFR, within the United States, at less than 18,000 ft. and not exceeding 250 knots.
    - Flight not operated for compensation or hire

Spatial Disorientation and Illusions

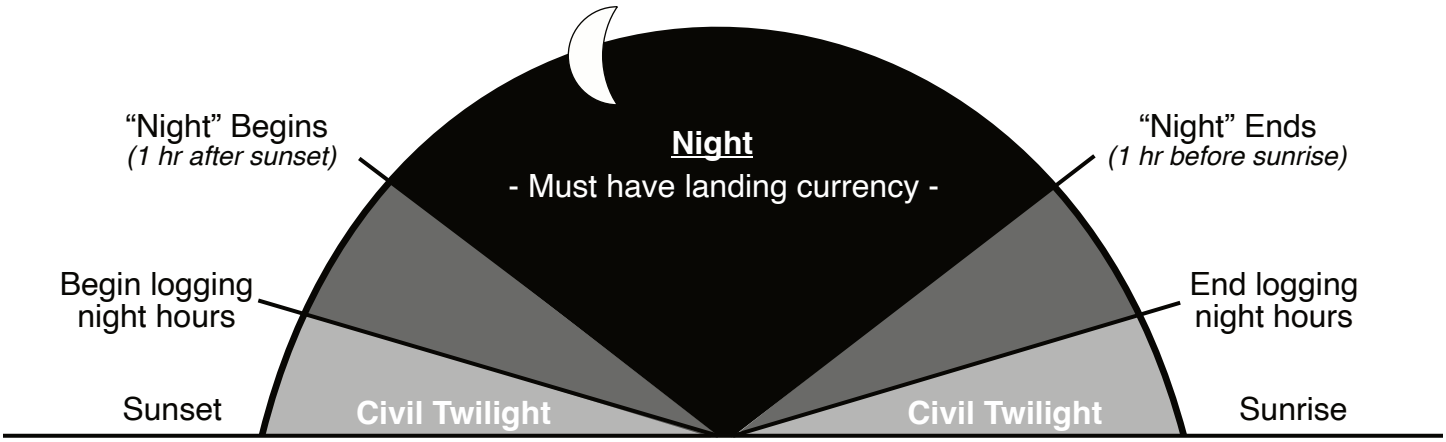
- **The Leans**
  - Most common illusion during flight.
  - Caused by a sudden return to level flight following a gradual and prolonged turn that went unnoticed by the pilot.
  - The pilot may lean in the direction of the original turn in a corrective attempt to regain the perception of a correct vertical posture.
- **Coriolis Illusion**
  - Occurs when a pilot has been in a turn long enough for the fluid in the ear canal to move at the same speed as the canal. This creates the illusion of turning or accelerating on an entirely different axis.
  - The disoriented pilot may maneuver the aircraft into a dangerous attitude in an attempt to correct the aircraft's perceived attitude.
- **Graveyard Spiral**
  - Occurs in a prolonged coordinated, constant-rate turn. As the fluid in the ear settles, the pilot forgets they are turning.
  - When the disoriented pilot recovers to level flight, the pilot will then experience the sensation of turning in the opposite direction. The pilot then returns the plane to its original turn, losing altitude in the process.

- **Somatogravic Illusion**
  - A rapid acceleration, such as experienced during takeoff, creates the illusion of being in a nose-up attitude.
  - The disoriented pilot may push the aircraft into a nose-low or dive attitude.
- **Inversion Illusion**
  - An abrupt change from climb to straight-and-level flight can create the illusion of tumbling backward.
  - The disoriented pilot may push the aircraft abruptly into a nose-low attitude, which may intensify the illusion.
- **Elevator Illusion**
  - An abrupt upward vertical acceleration, as can occur in an updraft, can create the illusion of being in a climb.
  - The disoriented pilot may push the aircraft into a nose-low attitude.
- **False Horizon**
  - Attempting to the align the aircraft with either a sloping cloud formation, an obscured horizon, an Aurora Borealis, a dark scene spread with ground lights and stars, or certain geometric patterns.
  - The disoriented pilot may place the aircraft in a dangerous attitude.
- **Autokinesis**
  - When flying in the dark, a stationary light may appear to move if it is stared at for a prolonged period of time.
  - The disoriented pilot may attempt to align the aircraft with the perceived moving light, potentially causing them to lose control of the aircraft.

Effects of Alcohol

- **Regulations**
  - Part 91 requires that blood alcohol level be less than **.04 percent** and that **8 hours** pass between drinking alcohol and piloting an aircraft. “8 hours bottle to throttle.”
    - Alcohol can greatly impair the efficiency of the human body.
    - As little as one ounce of alcohol can decrease the speed and strength of muscular reflexes, lessen the efficiency of eye movements while reading, and increase the frequency at which errors are committed.
    - The body requires about 3 hours to rid itself of all the alcohol contained in one mixed drink or one beer.

- **Definition of "Night"**
  - The time between the end of evening civil twilight and the beginning of morning civil twilight, as published in the Air Almanac, converted to local time.
- **Definition of "Civil Twilight"**
  - Morning civil twilight begins when the geometric center of the sun is 6 degrees below the horizon and ends at sunrise. Evening civil twilight begins at sunset and ends when the geometric center of the sun reaches 6 degrees below the horizon. Usually between 20-35 minutes after sunset or before sunrise.
- **Definition of "Sunrise and Sunset"**
  - Sunset occurs when the upper edge of the sun - called the "upper limb" - sinks just under the horizon.
  - Sunrise occurs when the upper limb rises just above the horizon.



- **Night Takeoff and Landing Experience** *§ 61.57 (b)*
  - No person may act as PIC carrying passengers during the period of **1 hour after** sunset and ending **1 hour before** sunrise, unless within the preceding **90 days** that person has made:
    - At least **3** takeoffs and **3** landings to a full stop within that time period
    - That person acted as sole manipulator of the flight controls
    - In aircraft of the same category, class, and type
- **Logging Night Flying**
  - You can log night time anytime between the end of evening civil twilight and the beginning of morning civil twilight. Plane must be night VFR equipped.
- **Lighting Rules**
  - From sunset to sunrise position lights and anti-collision lights (if installed) are required to be turned on.

Stalls

- **Definition of "Stall"**
  - A rapid decrease in lift caused by the separation of airflow from the wing's surface brought on by exceeding the critical angle of attack. It can occur at any pitch attitude or airspeed.
- **Stalls in Different Flight Situations**
  - There are 3 different flight situations in which the critical angle of attack is most commonly exceeded:

    Low Speed: As airspeed decreases, the angle of attack must be increased to retain the lift required for maintaining altitude. Eventually, an angle of attack is reached which results in the wing not producing enough lift to support the aircraft.

    High Speed: Critical angle of attack can be reached at any speed. With abrupt changes to angle of attack, the critical angle of attack can be exceeded and a stall becomes imminent.

    Turning: Centrifugal force is added to the aircraft's weight and the wing must produce sufficient additional lift to counterbalance the load imposed by the combination of centrifugal force and weight. Since angle of attack must be increased as bank increases, careful consideration must be made not to exceed the critical angle of attack in the turn.

Aircraft Stability

- **Static Stability**
  - Initial tendency, or direction of movement, back to equilibrium.

    Positive Static Stability: Initial tendency of the aircraft to return to the original state of equilibrium after being disturbed.

    Neutral Static Stability: Initial tendency of the aircraft to remain in a new condition after it's equilibrium has been disturbed.

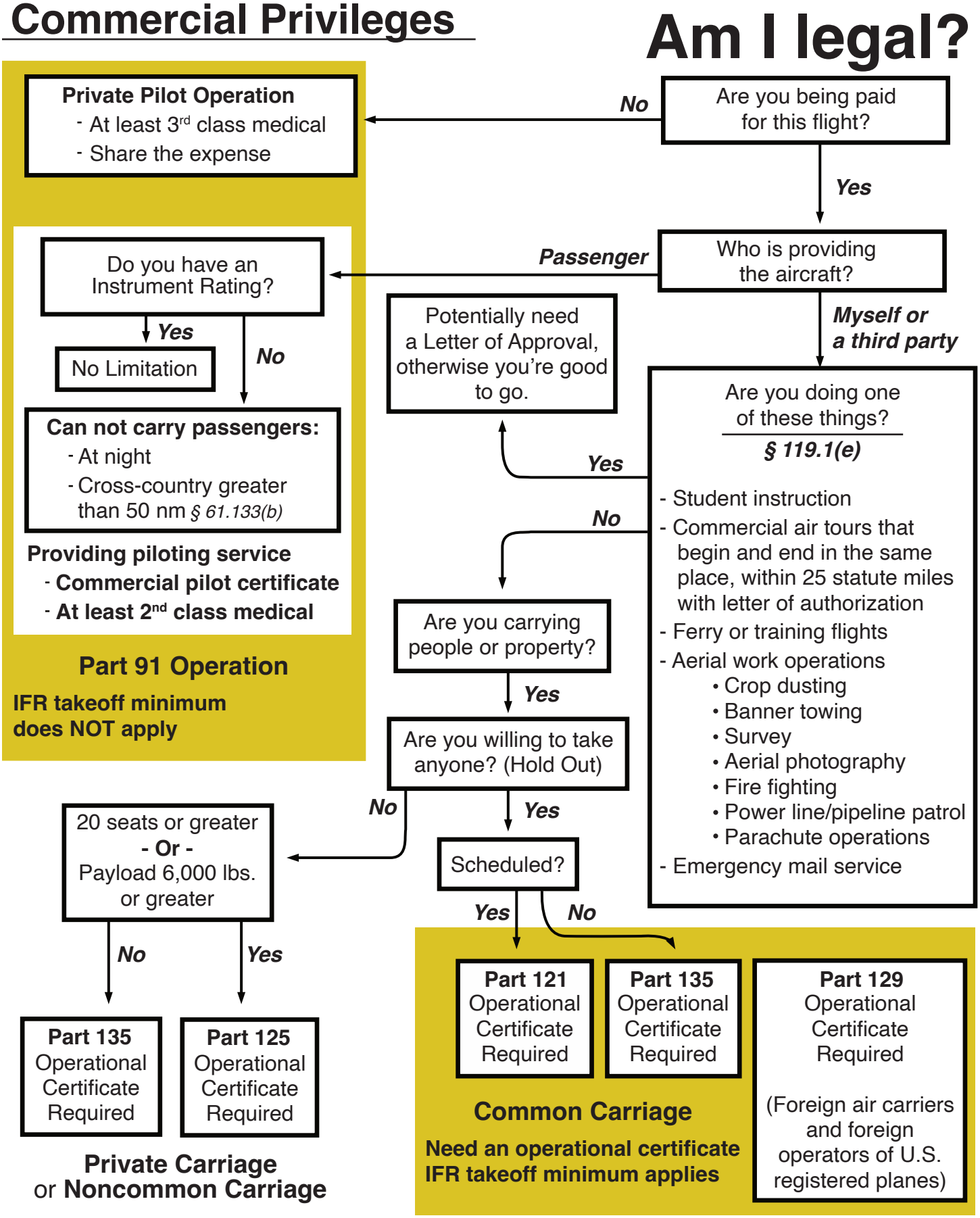
    Negative Static Stability: Initial tendency of the aircraft to continue away from the original state of equilibrium after being disturbed.
- **Dynamic Stability**
  - Initial tendency to return to equilibrium that the aircraft displays after being disturbed from its trimmed condition.

    Positive Dynamic Stability: Over time, the motion of the displaced object decreases in amplitude and, because it is positive, the object displaced returns toward the equilibrium state.

    Neutral Dynamic Stability: Once displaced, the displaced object neither decreases nor increases in amplitude. A worn automobile shock absorber exhibits this tendency.

    Negative Dynamic Stability: Over time, the motion of the displaced object increases and becomes more divergent.

Commercial Privileges



Common and Private Carriage

Reference AC 120-12A

Holding Out:

- Essentially, "holding out" is advertising yourself as a pilot for hire.
- Holding out can be done through:
  - Agents
  - Word of mouth
  - Advertising and signs
  - Internet and Social media

Common Carriage:

- A carrier becomes a common carriage carrier when it "holds itself out" to the public as willing to furnish transportation to those who want it.
- Common Carriage generally consists of 4 elements.

  1.) Holding out a willingness to

  2.) Transport persons or property

  3.) From place to place

  4.) For Compensation

Private Carriage:

- Carriage for hire which does NOT involve "holding out."
- This is carriage for one or a select few customers. Think one aircraft operator working for 1 or 2 contracted clients.

Operational Control

- The authority to initiate, conduct, or terminate a flight.

Compensation:

Reference AC 61-142

- Anything of value, including the sharing of expenses. *(Not to be confused with the § 61.113 (c) Private pilot rules about your pro rata share.)*
- Profit or profit motive *(Actual exchanging of funds is **not** required to be considered compensation.)*
- Good will in the form of expected future economic benefits.
- Accruing flight time. *(Yes. In certain situations this **can** be considered compensation.)*
- Value for a third party recipient.

Note:

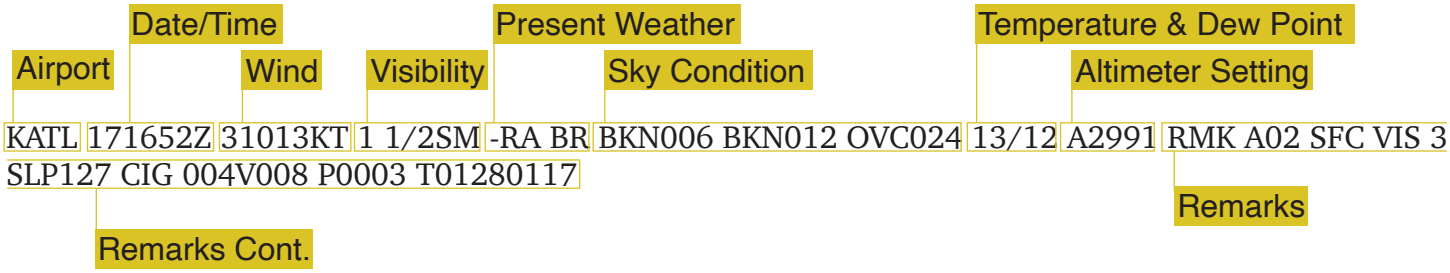
Basically anything that would get you to do the flight when you otherwise would not, can be considered compensation in the eyes of the FAA.

Review of Part 91 shared expense rules *§ 61.113 (c)*

- You're allowed to share expenses with passengers, so long as those expenses are fuel, oil, airport expenditures, or aircraft rental fees.
- You must pay your pro rata share
- You must have a common purpose with your passengers and your own reason for flying.
- If there is any form of "holding out" involved, then sharing expenses becomes "compensation" and now follows under the requirements for "Common Carriage."

Reading a METAR

- Aviation routine weather reports. These provide snapshots in time of terminal weather.
- Issued every hour, usually :55 - :59 past the hour.

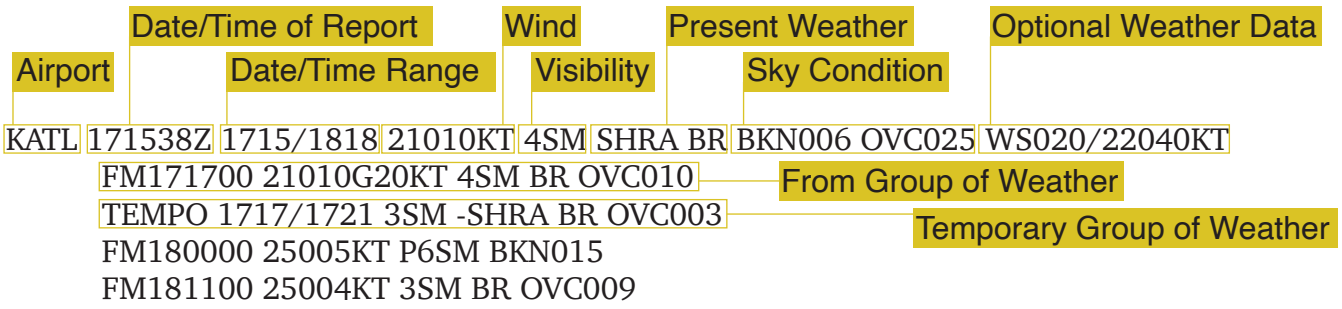


Translated:

- **KATL**
- **17**th of the month at **16:52** Zulu
- Wind is from **310** degrees at **13** knots
- There is **1** ½ statute miles of visibility
- Light rain and mist
- 3 ceiling layers: Broken at **600** ft., Broken at **1,200** ft., and Overcast at **2,400** ft.
- **13** degrees celsius outside temperature and **12** degrees celsius dew point
- Altimeter setting of **29.91** inches of mercury
- ***Remarks***:
    - **A02** - The site is automated and has a precipitation sensor.
    - **SFC VIS 3** - Surface visibility from a predetermined point is **3** statute miles (However, 1 ½ SM is controlling)
    - **SLP127** - Sea Level Pressure in hectopascal. 127 = **1012.7 hPa**
    - **CIG** - Lowest level ceiling layer is **400** ft. but variable to **800** ft.
    - **P0003** - Hourly precipitation amount, **00.03** inches in the last hour
    - "**T**" for temperature (**0** for positive or 1 for negative) **12.8** degrees celsius air temp. / (**0** for positive or 1 for negative) **11.7** degrees celsius dew point

Reading a TAF

- Terminal Aerodrome Forecast
- Expected weather conditions at an airport
- Issued at at least 4 times per day
- Valid for a 24 or 30 hour period



Translated:

- **KATL**
- **17**th of the month at **15:38** Zulu
- Report is from the **17**th at **15:00** Zulu to the **18**th at **18:00** Zulu
- Wind is from **210** degrees at **10** knots
- Visibility is **4** statute miles
- Showering rain and mist
- Ceilings are broken at **600** ft. and overcast at **2,500** ft.
- Low level wind shear at **2,000** ft. from **220** degrees at **40** knots

Weather Change Indications:

- **From** the **17**th at **17:00** Zulu - wind **210** degrees at **10** knots gusting **20** knots, visibility **4** statute miles, mist, cloud layer overcast at **1,000** ft.
- **Temporarily** from the **17**th at **17:00** Zulu to the **17**th at **21:00** Zulu, visibility **3** statute miles, light showering rain and mist, cloud layer overcast at **300** ft.
- **From** the **18**th at **00:00** Zulu - wind **250** degrees at **5** knots, visibility greater than **6** statute miles, cloud layer broken broken at **1,500** ft.
- **From** the **18**th at **11:00** Zulu - wind **250** degrees at **4** knots, visibility **3** statute miles, mist, cloud layer overcast at **900** ft.

Other Codes in a TAF or METAR

Intensity Symbols:

- " - " Light
- "No Sign" Moderate
- " + " Heavy

Precipitation:

- DZ - Drizzle
- IC - Ice Crystals
- RA - Rain
- PL - Ice Pellets
- SN - Snow
- GR - Hail
- SG - Snow Grains
- GS - Small hail/Snow pellets

Descriptor:

- MI - Shallow
- BL - Blowing
- BC - Patches
- SH - Showers
- PR - Partial
- DR - Drifting
- TS - Thunderstorm
- FZ - Freezing

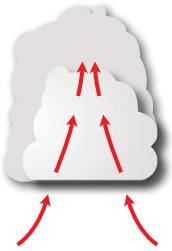
Other:

- SQ - Squall
- FC - Funnel Cloud
- SS - Sandstorm
- +FC - Tornado/Waterspout
- DU - Dust Storm
- PO - Well Developed Dust/Sand Swirls

Obscuration:

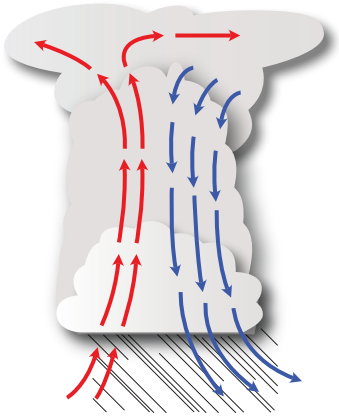
- BR - Mist
- SA - Sand
- FG - Fog
- HZ - Haze
- FU - Smoke
- PY - Spray
- VA - Volcanic Ash
- DU - Widespread Dust

Phases of a Thunderstorm



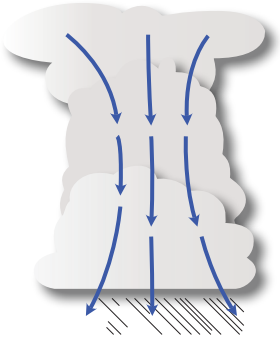
Cumulus

- Air that is warmer than its environment starts to rise.
- As the warm, moist air rises, it cools and condenses to form cumulus clouds.
- Creates strong updrafts.
- If the cloud reaches the freezing level, supercooled water molecules form.



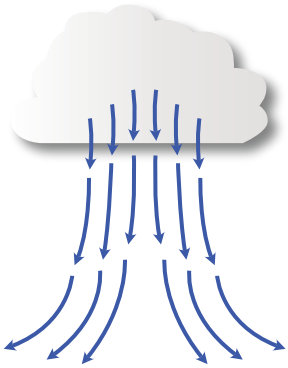
Mature

- Characterized by the presence of both updrafts AND downdrafts.
- The downdrafts cause evaporative cooling.
- When the downdraft hits the ground, it has nowhere to go so it spreads out in all directions.
- Anvil shape forms when water molecules are pushed into the higher parts of the cloud.
- Hail can be formed and intense cloud-to-ground lightning is present.



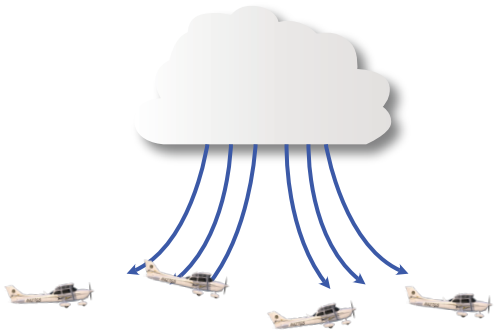
Dissipating

- Downdrafts prominent in this phase.
- Anvil top begins to weaken.
- Towering cumulonimbus clouds turn into wispy, non-threatening clouds.
- Downdrafts of cool air reduce temperature and convection from below.



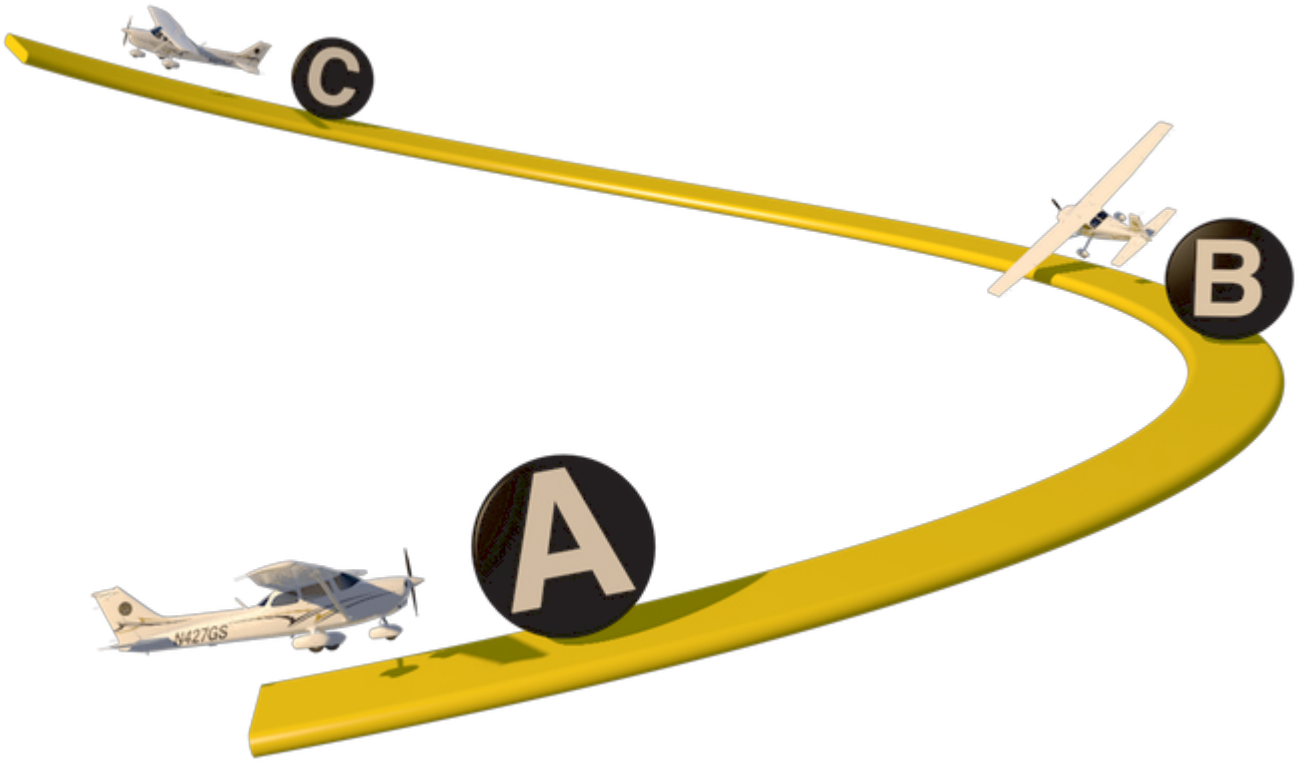
Microburst

- Localized column of sinking air (downdraft) within a thunderstorm and is usually less than or equal to 2.5 miles in diameter.
- Winds can reach speeds of 100 mph or higher.
- Pilots should avoid these at all costs.



Wind Shear

- A change in wind speed and/or direction over a short distance.
- Causes headwind and tailwind change which quickly alters the flight path of an airplane.
- Most dangerous at low levels near the ground.



Chandelles

Execution

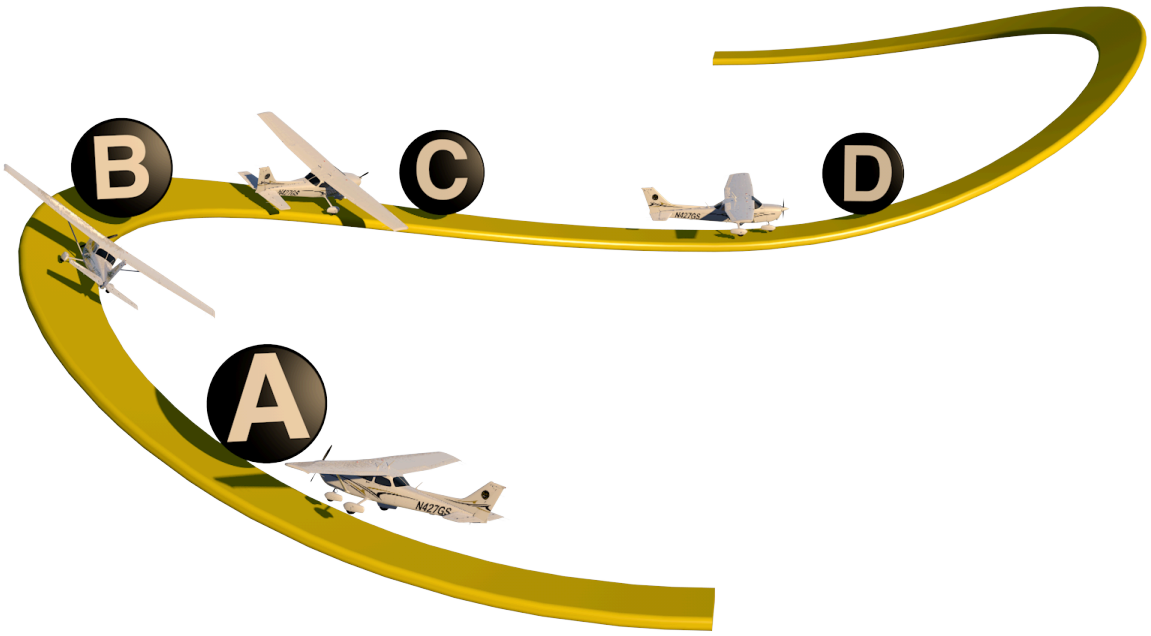
A - Entry - Establish a 30° bank angle. Simultaneously apply pitch and power to maintain a smooth, coordinated turn with constant bank and increasing pitch.

B - During the Maneuver - Begin a coordinated constant rate rollout. Maintain power and a constant pitch attitude that will allow the airspeed to decrease just above stall speed.

C - Completion - Complete the 180° turn, just above Stall speed, momentarily avoiding a stall.

ACS Standards

- Establish bank angle of approximately 30°
- Complete rollout at 180° point just above stall speed.
- Roll out on specified heading ±10°
- Perform maneuver no lower than 1,500' AGL



Lazy Eights

Execution

A - Entry - Power set for an airspeed at or below maneuvering speed and establish a gradual climbing turn toward the 45° point.

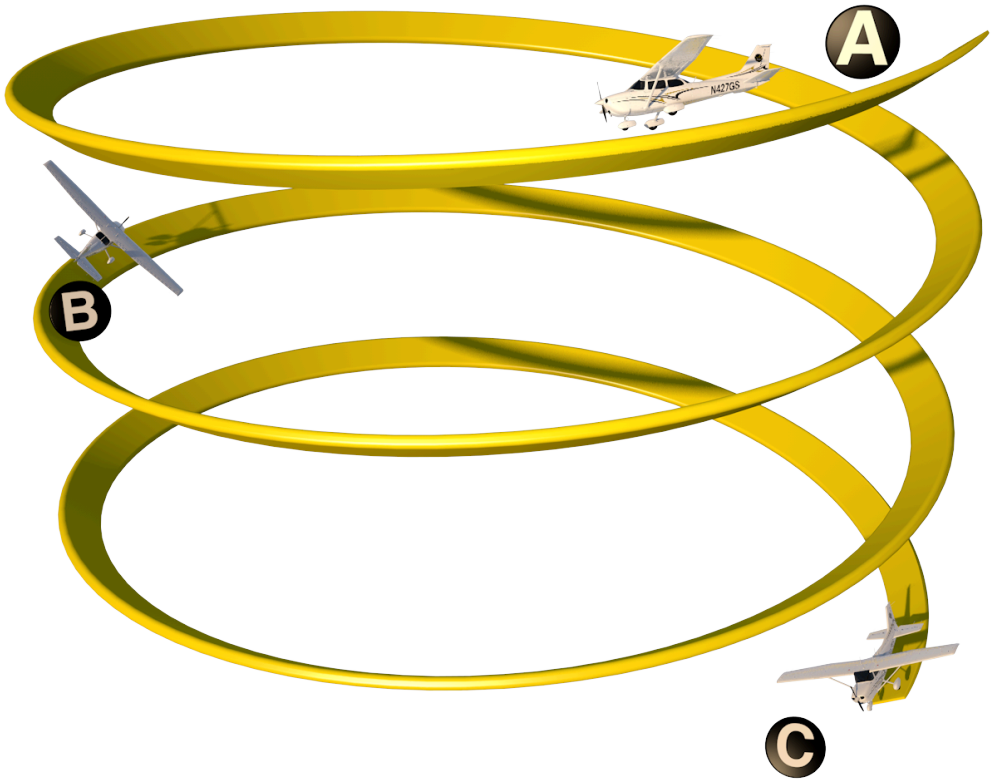
B - Approaching the 90° point - Decrease pitch and increase bank to maximum of 30° bank angle and slowest airspeed.

C - Approaching the 135° point - Slowly roll out of the bank while gradually lowering the nose to reach its lowest pitch attitude.

D - Arrive at the 180° point - Straight and level at the original heading, altitude and airspeed.

ACS Standards

- Approximately 30° bank at the steepest point.
- Altitude ±100' at the 180° point.
- Airspeed ±10 kts at the 180° point.
- Heading ±10° at the 180° point.
- Perform maneuver no lower than 1,500' AGL.
- Maintain coordination throughout the maneuver.



Steep Spirals

Execution

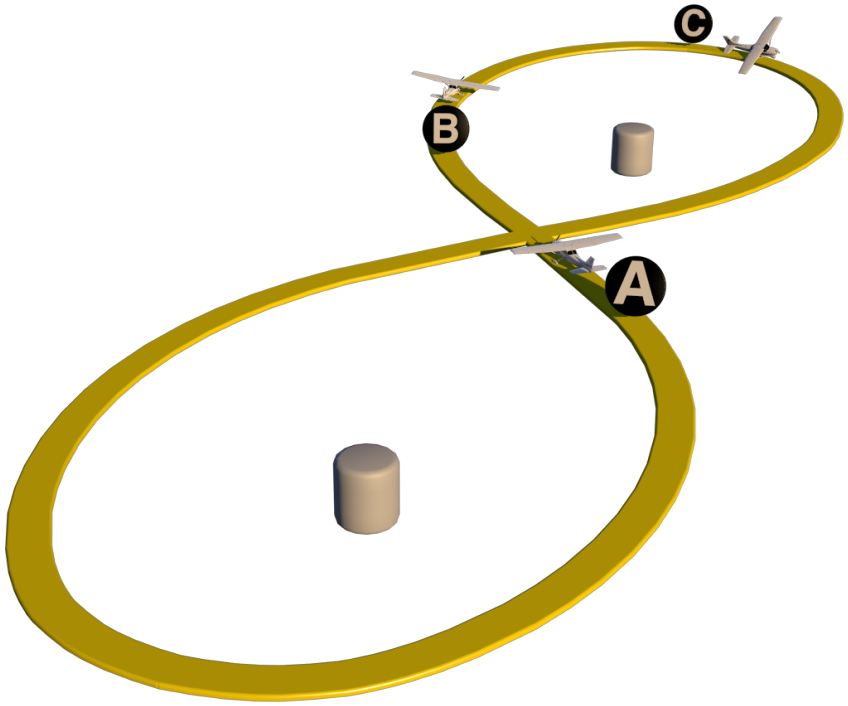
A - Entry - Power idle and establish best glide airspeed. Establish a constant radius circle around a selected ground reference.

B - During the maneuver - Apply wind drift correction to track a constant radius circle around the reference point by adjusting bank angle.

C - Completion - After 3 complete turns, roll out toward an object or specified heading.

ACS Standards

- 3 complete 360° turns.
- Maximum allowable bank of 60°
- Maintain specified airspeed ±10°
- Complete maneuver no lower than 1,500' AGL.



Eights on Pylons

Execution

A - Entry - Fly a downwind 45° angle between the two selected pylons at the approximate pivotal altitude.

B - Bank onto the pylon - Roll into a 30° to 40° bank when abeam the first pylon.

C - During the maneuver - Adjust pivotal altitude to maintain wingtip reference on the pylon. As groundspeed decreases, so a descent will likely be required heading back into the wind. After rolling out to straight and level flight, repeat the same procedure on the opposite pylon.

ACS Standards

- Determine approximate pivotal altitude.
  (Groundspeed ^{2} ÷ 11.3) + MSL of ground reference
- Select suitable pylons (distance between, orientation to the wind)
- Bank angle not to exceed 40°
- Apply corrections so that the line-of-sight reference line remains on the pylon.
- Divide attention between accurate, coordinated airplane control and outside visual reference.

Terms and Definitions

A/FD	Airport/Facility Director
AAF	Army Airfield
AC	Advisory Circular
ACL	Aeronautical Chart Legend
ADM	Aeronautical Decision Making
AFB	Air Force Base
AFH	Airplane Flying Handbook
AGL	Above Ground Level
AIM	Aeronautical Information Manual
AIRMET	Airman's Meteorological Information
AME	Aviation Medical Examiner
ATC	Air Traffic Control
ATCO	Air Taxi/Commercial Operator
AVW	Aviation Weather
AWS	Aviation Weather Service
BHP	Brake Horsepower
CAT	Clear Air Turbulence
CDI	Course Deviation Indicator
CFI	Certificated Flight Instructor
CG	Center of Gravity
DUATS	Direct User Access Terminal
ELT	Emergency Locator Transmitter
ETE	Estimated Time Enroute
FA	Area Forecast
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FBO	Fixed-Based Operator
FL Comp	Flight Computer
FSDO	Flight Standards District Office
FSS	Flight Service Station
GPH	Gallons Per Hour

Hg	Mercury
HSI	Horizontal Situation Indicator
IAP	Instrument Approach Procedure
IFH	Instrument Flying Handbook
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IR	Instrument Route
ISA	International Standard Atmosphere
L/D	Lift-to-drag ratio
L/D Max	Maximum Lift-to-drag ratio
Mb	Millibar
MB	Magnetic Bearing
MEF	Maximum Elevation Figure
METAR	Aviation Routine Weather Report
MH	Magnetic Heading
MOA	Military Operations Area
MSL	Mean Sea Level
MTR	Military Training Routes
MVFR	Marginal VFR
NAS	National Airspace System
NM	Nautical Mile
NMAC	Near Midair Collision
NOTAM	Notice To Air Mission
NTSB	National Transportation Safety Board
OAT	Outside Air Temperature
OBS	Omnibearing Selector
PHAK	Pilots Handbook of Aeronautical Knowledge
PIC	Pilot In Command
PIREP	Pilot Weather Report
PPH	Pounds Per Hour

RB	Relative Bearing
RMI	Radio Magnetic Indicator
RNAV	Area Navigation
SD	Radar Weather Report
SFC	Surface
SIGMET	Significant Meteorological Information
SL	Sea Level
SM	Statute Miles
ST	Standard Temperature
SVFR	Special VFR
TACAN	Tactical Air Navigation
TAF	Terminal Aerodrome Forecast
TAS	True Airspeed
TIBS	Telephone Information Briefing Service
TWEB	Transcribed Weather Broadcast
UTC	Coordinated Universal Time
VFR	Visual Flight Rules
VHF	Very High Frequency
VOR	VHF Omnidirectional Range
VORTAC	Colocated VOR and TACAN
VOT	VOR test facility
WFO	Weather Forecast Office