



# Private Pilot Study Guide

Pilots Handbook of Aeronautical Knowledge  
Airplane Flying Hand Book  
AIM  
CFRs

## AERODYNAMICS

- **Four Forces Of Flight** in constant airspeed constant direction or straight-and-level flight, lift equals weight, and thrust equals drag. **Phak 3-1**
  1. **Lift, 3-6**
  2. **Weight, 3-5**
  3. **Thrust 3-2**
  4. **Drag: 3-3** acts parallel to and in the same direction as the relative wind
- **Parasite Drag 3-3:** is the resistance of the air produced by any part of the airplane that does not produce lift.
  - Parasite drag is proportional to the square of airspeed
  - The more streamlined an object, the LESS parasite drag
  - The more dense the air, the GREATER parasite drag
    - Form Drag: is the frontal area of the airplane exposed to the airstream.
    - Skin Friction Drag: caused by air passing over the surface.
      - increases if rough and dirty
    - Interference Drag: caused by interference of the airflow between adjacent parts of the airplane.
- **Induced Drag 3-3:** a by product of greater AOA (lift)
  - rearward component to the lift vector which is induced drag.
  - (Induced drag is inversely proportional to the square of airspeed (more speed less induced drag))
- **Lift/Drag Ratio: 3-4** establishing the proper glide attitude and airspeed is critical to ensure the best possibility of reaching a suitable landing area.
- **Relative Wind:** the direction of the airflow produced by an object moving through the air; the actual flight path of the airplane determines the direction of the relative wind.
- **Cord line-** line from leading edge to trailing edge.
- **Angle Of Attack: 2-8** the angle between the wing chord line and the relative wind.



1. The angle of attack at which an airplane wing stalls will remain the same regardless of gross weight.
  2. Critical angle of attack- angle of attack at which a wing will stall (determined by the design of the wing usually between 14 and 20 degrees)
- **Stalls** occurs when the critical angle of attack is exceeded
  - **Horizontal Component of lift: 3-17** (centripetal force) is what make an airplane turn.
  - **Pitch** movement about the lateral axis. **Elevator.**
  - **Roll** Movement about the longitudinal axis. **Ailerons.**
  - **Yaw: 3-9; 4-5** Movement about the vertical axis. Rudder.
  - **Flaps: 4-6**
    1. high lift/ high drag device that enables the pilot to
    2. make steeper approaches to a landing while
    3. decreasing landing airspeed & ground roll
    4. decreased stall speed
  - **Maneuverability: 3-10** an aircraft that readily permits changes in pitch roll and yaw and direction while withstanding the resulting stresses imposed on it, is considered to be Maneuverable.
  - **Controllability: 3-10** the capability of an aircraft to respond to the pilots inputs, especially with regard to flight path and altitude.
  - **Stability: 3-10** the tendency of an aircraft to develop forces which restore it to its original condition, when disturbed from a condition of steady flight.
    - An aircraft that is inherently stable will
      1. require less effort to control.
      2. More effort to maneuver.
    - No airplane is completely stable but, all airplanes must have desirable handling characteristics.
  - **Static Stability: 3-10** is the initial tendency that the airplane displays after its equilibrium is disturbed
    - Positive Static Stability –goes back to original condition
    - Neutral Static Stability- stays at its new condition
    - Negative Static Stability
  - **Dynamic Stability: 3-11** is the overall tendency that the airplane displays after its equilibrium is disturbed.
    - Positive Dynamic Stability
    - Neutral Dynamic Stability
    - Negative Dynamic Stability
  - **Positive Dynamic Oscillatory Longitudinal Stability: 3-11** Pitch stability about the lateral axis
    1. The CG being forward of the Center of Lift
    2. negative lift component of horizontal stabilizer.
      - An aft CG reduces stability and can be difficult to recover from a stall condition.
  - **Load Factor: 3-26** is the ratio of the aerodynamic load on the airplanes wings (Lift) to the actual weight of the aircraft and its contents. (Load/weight)
    - To determine load on the wing structure, multiply the airplanes weight by the number of G's.
    - An increased load factor will cause the airplane to stall at a higher airspeed.



- Stall speed increases by the square root of load factor.
- The amount of additional aerodynamic load available depends on its speed.
- Level Turns increase the load factor and stall speed of an airplane, as compared to straight-and-level flight.
- Dramatic Flares from steep approaches increase load factor and stall speed
- At 60 degrees of bank, 2 G's are required to maintain level flight.
- **Maneuvering Speed (V<sub>A</sub>): 3-28** the speed which abrupt control movement may be applied without causing structural damage to the aircraft.
  - The speed that the aircraft will stall before it over stresses.
  - The speed that you would use in severe turbulence.
  - Is not on the airspeed indicator.
  - As weight decreases, V<sub>A</sub> decreases.
  - Adjusted V<sub>A</sub> =  $(\sqrt{\text{total weight/Max gross weight}}) \times V_A$
- **Ground Effect: 3-7** within a wingspan's distance- the ground interferes with the airflow patterns about the wing increasing pressure below the wing and reducing the following:
  1. wing tip vortices
  2. down wash
  3. induced drag
  4. angle of attack
  5. required power
  6. airspeed required for flight.
- The slower airspeed requirement may dangerously result in becoming airborne before reaching recommended takeoff speed and inability to clear an obstacle.
- **Conventional Horizontal Stabilizer v.s. T-tail**
  - affected by prop wash and flap position more 4-3,5
    - when power is reduced, the aircraft pitches nose down because the reduced induced flow on the stabilizer reduces its negative component of lift.
    - flap extension directs airflow from the wing downward to the stabilizer increasing its downward lift component. (pitch up)
  - **Spins:** occurs when, after a full stall, in uncoordinated flight the inside wing that drops, continues in a fully stalled condition while the outside partially stalled wing regains and continues to produce some lift, causing and continuing the rotation.
  - The difference between a spin and a steep spiral is that in a spin, the wings are stalled.
- **Wingtip vortices 3-6** Spillage of air from the bottom to the top of the wing causes vortices that trail the tips of the wings for relatively long distances behind and downward from the wings.
- **TURNING TENDENCIES 3-23**
  - **Greatest at low airspeeds, high power setting and high angles of attack**
    - **Torque: PHAK 3-23** based on Newton's third Law of Action " Every action has an equal and opposite reaction". The clockwise rotation (as seen from the rear) of the prop torque rolls the aircraft counterclockwise causing a bank to the left. Requires right aileron!
    - **Spiraling (cork screwing) Slipstream: PHAK 3-24** is based on the reaction of the air to the rotating propeller blade forces it rearward in a spiraling clockwise direction of flow



around the fuselage and striking the left side of the vertical stabilizer. Pushes a conventional tail down (yaw left). Requires right rudder to compensate.

- **Gyroscopic Precession: PHAK 3-24** When a force is applied to a spinning object (the propeller) the result of that force occurs 90 deg. later in the direction of rotation, and in the direction of the applied force.
  - the “**yaw causes pitch, pitch causes yaw**” phenomenon: as the nose of the airplane is raised, a deflective force is applied to the spinning propeller which results in a yawing force known as precession. pitch up=yaw right=pitch down=yaw left=pitch up etc.
- “**P**” **Factor: PHAK 3-25** (asymmetric propeller loading): occurs when the airplane is flown at a high power and angle of attack. The downward moving blade which is on the right side of the propeller arc, as seen from the rear, has a higher angle of attack, and therefore higher thrust than the upward moving blade on the left.
- **Kinetic energy increases by the square of airspeed (doubling the airspeed increases kinetic energy by four times).**

## AIRPLANE SYSTEMS

### Engines:

- **Four components of combustion: Fuel; Air; Compression, Spark**
- **Four Stoke operating cycle**
  1. Intake(suck)
  2. Compression(squeeze)
  3. Power(bang)
  4. Exhaust(blow)

### Abnormal Combustion:

1. **Detonation** occurs when the unburned charge in the cylinders explodes instead of burning normally.
  2. If the grade of fuel used in an engine is lower than specified for the engine, it will most likely cause detonation.
  3. If a pilot suspects detonation during climb-out, the initial corrective action would be to lower the nose slightly to increase airspeed.
  4. **pre-ignition-** The uncontrolled firing of the fuel/air charge in advance of normal spark ignition timing
- **Mixture:** the purpose of adjusting the air/fuel mixture is to decrease fuel flow to compensate for decreased air density.
    1. Takeoff at high-elevation airports may require leaning the engine during run-up for best power.
    2. The mixture must be enriched prior to a descent
    3. and low power settings regardless of altitude.

- Alternate source of air

**Carburetor:** the operating principle of float-type carburetors is based on the difference in air pressure between the venture throat and the air inlet.

- **Carburetor ice:** sharp temperature drop due to fuel vaporization and the decrease in air pressure in the venturi, can condense and freeze water vapor in the venture throat and the throttle valve
- Float-type carburetors are more susceptible to icing than fuel-injected systems.
- Conditions most favorable to icing include an outside air temperature between -7° and 22° C (20° and 70° F) and high humidity.
- In a normally aspirated engine with a fixed-pitch propeller, the first indication of carburetor ice is a loss of RPM
- **Applying carburetor heat will:**
  1. Enrich the fuel/air mixture



2. Cause a decrease in engine performance
  3. Cause a temporary decrease in RPM, followed by a gradual increase.
- **Dual Magneto system:** two purposes of dual ignition systems on aircraft is to provide for
    1. improved engine performance.
    2. redundancy
  - Magnetos are a self-contained, engine-driven unit that supplies electrical current to the spark plugs and is completely independent of the electrical system.

#### **Electrical System:**

- **Alternator;** light weight, lower maintenance, uniform output even at low RPMs
  1. Alternators produce alternating current (AC) first, and then convert it to direct current (DC)
  2. Direct current is delivered to a bus bar which distribute the current to various electrical components.
  3. Circuit breakers protect various components from overloads
  4. Ammeter or Load meter
- **Battery**
  5. Main purpose is to start the engine
  6. Also used as a standby or emergency electrical power
- **Oil Systems**
  - For internal cooling, reciprocating aircraft engines rely on the circulation of lubricating oil.
  - An abnormally high oil temperature indication may be caused by the oil level being too low.
- **Fuel System:**
  - On aircraft equipped with fuel pumps, the practice of running a fuel tank dry before switching tanks is unwise because the engine-driven or electric boost fuel pump may draw air into the fuel system and cause vapor lock.
  - Using fuel of a lower than specified grade may cause cylinder head and engine oil temperature gauges to exceed their normal operating ranges.
  - Fuel of the next higher octane can be substituted if the recommended octane is not available.
  - Filling the fuel tanks after the last flight of the day will prevent moisture condensation by eliminating air space in the tanks.
- **Cooling System:**
  - Excessively high engine temperatures will cause loss of power, excessive oil consumption, and possible permanent internal engine damage.
  - If the engine oil temperature and cylinder head temperature gauges have exceeded their normal operating range, the pilot may be operating with too much power and the mixture set too lean.
  - To aid engine cooling in a climb, the pilot can lower the nose, reduce the rate of climb and increase airspeed.
  - To cool an engine that is overheating, the pilot can enrich the fuel mixture.
- **Propellers:** two basic types; fixed-pitch and constant-speed
  - Constant Speed;
    1. Permits the pilot to select an RPM for the most efficient performance
    2. Engine operation on an aircraft equipped with a constant-speed propeller is conducted with the throttle controlling power output, as registered on the manifold pressure gauge, and the propeller control regulating engine RPM.
    3. The pilot must avoid high manifold pressure settings with low RPM.

#### **Pitot-Static Instruments:**

- Supplies static ambient air pressure to operate the **altimeter** and **vertical speed indicator**,
- and both static ambient and ram air pressure to the **airspeed indicator**.
- If the pitot tube becomes clogged, the airspeed indicator is affected; if the static vents are clogged,



the altimeter, airspeed indicator, and vertical speed indicator are affected.

- **Standard Temperature and Pressure** values for sea level are 15 degrees C and 29.92" Hg.
  - **V-Speeds**
    - Red line = never exceed speed  $V_{ne}$
    - Yellow line = indicates the caution range  $V_{ne}-V_{no}$
    - Green line = normal operating range  $V_{no}-V_s$
    - White arc = normal flap operating range  $V_{so}-V_{fe}$
    - Maneuvering speed
    - **Indicated, Calibrated, True, and Ground Speed.**
- **Altimeter setting** is the value to which the barometric pressure scale of the altimeter is set so that the altimeter indicated true altitude at field elevation.
  - **Altitude Errors "High to low watch out below"**
    - warm days indicate lower altitude than the true altitude. Aircraft will be higher
    - Cold days indicate higher altitude than true altitude. Aircraft will be lower
    - Higher barometric pressures indicate lower altitude than true altitude. Aircraft will be higher
    - Lower barometric pressures indicate higher altitude than true altitude. Aircraft will be lower
      - One inch of barometric change causes 1000 ft of altitude change in the same direction if the altimeter is not reset.

#### Types of Altitude

- **True-**, above sea level
- **Absolute-** AGL,
- **Pressure-**, above standard datum plane 29.92
- **Density-**, pressure altitude corrected for non- standard temperature
  - Higher temperature raises barometric air pressure levels decreasing air density and increasing density altitude
- **Indicated-**, on the dial

#### Gyroscopic Instruments:

- Include the turn coordinator, attitude indicator and heading indicator. They operate off of a gyro's tendency to remain rigid in space.
  - **Turn Coordinator**
    - Provides an indication of the aircraft's rate of movement about the yaw and roll axes.
  - **Attitude Indicator**
    - A pilot determines the direction of bank from the attitude indicator by the relationship of the miniature airplane to the deflected horizon bar.
  - **Heading Indicator**
    - Must be periodically realigned with the magnetic compass as the gyro precesses.

**Magnetic Compass;** contains a bar magnet, which swings freely to align with the Earth's magnetic field. Points toward Nova scotia and deep into the earth accounting for acceleration and turning errors

- **Deviation;** caused by the magnetic field in the aircraft distorting the lines of magnetic force.
- **Variation;** angular difference between the true and magnetic poles (Isogonic + Agonic)
- **Acceleration Errors** (ANDS); on a East or West heading the compass will show a turn towards the north if accelerated and a turn toward the south if decelerated.
- **Turning Errors (Roll out Before North After South)** (UNOS); on a North heading a turn to the right will indicate a turn to the left and on a south heading a turn to the right will indicate an accelerated turn to the right. There are no turning errors on the east west heading.





## PERFORMANCE

### Factors Affecting Performance:

- **Weight of the aircraft**
- **Wind**
- **Altitude**
- **Runway conditions and obstacles.**
- **Temperature**
- **Pressure**

**Density Altitude:** is air density expressed in terms of height above standard Sea Level condition.

- If the outside air temperature at a given standard pressure altitude is warmer than standard, the density altitude is higher than pressure altitude.
- High temperature, high relative humidity, and high density altitude all reduce aircraft takeoff and climb performance and increase density altitude.
- Use the chart to find Density Altitude.
- Density altitude and pressure altitude are the same value at standard temperature.
- Approach Airspeed should be used regardless of temperature and altitude combinations.

**Runway Gradient:** refers to the amount of change in runway height over its length.

- A gradient of 2% means the runway height changes 2 ft. for each 100 ft of runway length.
- A positive gradient indicates the height of the runway increases, while a negative value means it decreases.

**Braking Effectiveness:** refers to how much braking power you can apply without skidding the tires

**Hydroplaning:** happens when a thin layer of water separates the tires from the runway.

### Takeoff and Landing Performance

1. Find the headwind and crosswind components
2. Determine the total distance required to land (Graph and Table)
3. Determine takeoff distance

### Climb Performance:

- **$V_x$**  = is the best angle of climb, and it provides the greatest gain in altitude over the shortest distance during climb after takeoff.
- **$V_Y$**  = is the best rate of climb, and it provides the greatest gain in altitude over a given period of time.
- **Cruise Climb** = is generally higher than  $V_x$  and  $V_Y$ , and rate of climb is slower; it improves forward visibility and gives better engine cooling.
- An aircrafts operating limitation are found in several places, including the current, FAA-approved flight manual, approved manual material, markings, placards, or any combination thereof.
- **Absolute ceiling** = when an airplane is unable to climb any further.
- **Service Ceiling** = refers to the altitude where a single-engine airplane is able to maintain a maximum climb of only 100 ft. per minute.
- As altitude increases, the speed for best angle-of-climb increases, and the speed for best rate-of-climb decrease. The point at which these two speeds meet is the absolute ceiling of



the airplane.

### **Cruise Performance:**

1. Determine the TAS
  2. Determine the expected fuel consumption
  3. Determine the manifold pressure setting
- **Maximum Level Flight Speed:** when the force of total drag equals the force of full thrust;
  - **Maximum Range Speed:** lets you travel the greatest distance for a given amount of fuel
  - **Maximum Endurance Speed:** the speed and power setting which allows the airplane to remain aloft for the longest possible time.

## **Weight & Balance**

### **Weight and Balance Terms:**

**Center of Gravity**—which is the imaginary point where the aircraft would balance if suspended.

**CG Limits**—are the forward and aft center of gravity location within which the aircraft must be operated at a given weight. (Normal + Utility Category)

**Reference Datum**—is an imaginary vertical plane from which all horizontal distance are measured for balance purposes.

**Basic Empty Weight**—includes the weight of the standard airplane, optional equipment, unusable fuel, and full operating fluids including full engine oil.

**Unusable Fuel**—is the small amount of fuel in the tanks that cannot be safely used in flight or drained on the ground.

**Licensed Empty Weight**—(used in older airplanes) is similar to basic empty weight except that it does not include full engine oil. Only un-drainable oil.

**Ramp Weight**—airplane loaded for flight prior to engine start. (includes taxi and run-up)

**Takeoff Weight**—the airplane weights just before you release the brakes to begin the takeoff roll.

**Landing Weight**—is the takeoff weight minus the fuel burned en-route

**Useful Load**—includes the weight of the flight crew and usable fuel, as well as any passengers, baggage, a cargo.

**Payload**—weight of only the passengers baggage and cargo.

**Maximum Ramp Weight**—is the maximum allowed for ground operations, such as taxiing.

**Maximum Landing Weight**—is based on the amount of stress the landing gear can handle.

**Usable Fuel**—the fuel available during flight.

**Arm**—the name of a distance from the datum.

**Moment**—weight x arm (expressed as a station). (total force of the weight)

- Few airplanes can handle a full cabin and full fuel tanks.

### **Principles of Weight and Balance**

- The CG is the total moment divided by the total weight.
- To calculate aircraft moment, multiply the weight at a station by the arm. Positive CG values are aft of datum, negative CG value are ahead of datum.
- Determine aircrafts weight and balance

### **Weight Shift Formula**

- Use the weight shift formula to determine how for the center of gravity shifts when weight is added to or removed from the aircraft:
- [moment+ Δmoment](#)





weight +  $\Delta$ weight

**Effects of Operating at High Total Weight:** more weight added means the wings need to generate more lift.

#### **To Far AFT**

1. Less stable
2. May be impossible to recover from a stall or spin.
3. Fly Faster

#### **To Far Forward**

1. Requires a greater tail down force, this force is equivalent to adding weight.
2. Must fly a higher angle of attack to generate the lift to counteract the greater tail-down force, it is closer to its stalling angle of attack for any given speed.
3. Increase stability
4. The elevator may not have sufficient force to raise the nose for landing
5. Fly Slower

## **Flight Planning**

### **Notices To Airmen (NOTAM's)**

Notice to Airman Publication (NTAP) issued every 28 days

Time critical aeronautical information which could affect your decision to make a flight.

#### **NOTAM (D) or distant**

navigational facilities, public use airports, seaplane bases, and heliports listed in the Airport/Facility Directory (A/FD).

Distributed automatically via Service A telecommunications so placed like FSS can have access to them.

Remain Available via Service A for the duration of their validity or until published, then the information is deleted from the system

Think of NOTAM (D)'s as things that could be "Deadly" to your planned flight

#### **NOTAM (L) or local**

taxiway closures, personnel and equipment near or crossing runways, airport beacon outages, lighting aids that do not affect instrument approach criteria, such as VASI.

Distributed locally only, meaning the FSS only have information for their area. You must specifically request information for other FSS areas generally enroute.

#### **FDC NOTAM's**

information that is regulatory - amendments to published IAP's - current aeronautical charts. - temporary flight restrictions - congestion of air traffic Distributed automatically via Service A telecommunications.

Remain Available via Service A for the duration of their validity or until published, then the information is deleted from the system

FSS's are responsible for FDC Notams concerning conditions within 400 miles of their facilities. FDC information concerning conditions that are more than 400 miles from the FSS, or that is already published, must be requested by the pilot



## Publications and Charts

- **Aeronautical Charts**
  - Latitude and Longitude; in the U.S. latitude increases as you travel north, and longitude increases as you travel west. Each tick mark on the sectional chart represents one minute of latitude or longitude.
  - Revise every 6 months. must accompany A/FD published every 56 days
  - scale TAC 1"=3.43 miles sectional 1" = 6.86 miles
- **Airport/Facility Directory**
  - Reissued every 56 days
  - Items in the back of the A/FD

Seaplane bases  
Notices  
LAHSO  
FAA Phone  
ARTCC/FSS  
FSDO  
Routes/Waypoints  
VOR Check  
Parachute  
Chart Bulletin  
Airport Diagrams

### Look up and read the following entries

Brownsville  
San Antonio  
Lit  
Amarillo  
Navasoto  
Nacagdoches  
Hot Springs  
Abilene  
Shreveport

- **Federal Aviation Regulation**
  - Part 43 Maintenance
  - Part 61 Certification
  - Part 91 Rules of the road
  - NTSB 830 Accident reporting

### Aeronautical Information Manual

- Revised twice a year



## WEATHER DATA

**METAR** (Aviation Routine Weather Report): METAR taken every hour & **(SPECI)** unscheduled.

- Winds reported are referenced to true north. **0000KT** = Calm; if the wind direction varies 60 degrees or more and speed is above six knots direction is separated by a **V**, if less than 6 knots **"VRB"**
- Peak gust are denoted by a number following a **"G"** after the wind direction and base speed.
- Visibility is reported in statute miles, **"SM"**
- Ceiling is defined as the height above the Earth's surface of the lowest broken or overcast layer or vertical visibility into an obscuration.
- Definition of VFR is visibility of at least 5 miles and ceilings of at least 3000 ft.

**PIREP** (Pilot Weather Reports): confirm information on height of bases and tops of cloud layers, in-flight visibility, icing conditions, wind shear, and turbulence.

### PRINTED WEATHER FORECAST

**TAF** (Terminal Aerodrome Forecast); your best sources for an estimate of what the weather will be in the future.

- Usually valid for a 24-hour period and are scheduled four times a day (0000Z, 0600Z, 1200Z, 1800Z)
- **"BECMG"** = a gradual change in the weather
- **"FM"** = a rapid change in the forecast is expected.
- **"TEMPO"** = expected to last less than an hour at a time
- **"PROB"** = used when a probability of occurrence is between 30 and 49 %
- **"NSW"** means that no significant weather change is forecast to occur. Only appears in BECMG or TEMPO groups.
- Cumulonimbus clouds are the only cloud type included. **"CB"**
- **"WS"** = low-level wind shear not associated with convective activity; WS015/30045kt = wind shear is expected at 1,500 ft with wind from 300 at 45 kts.

**FA** (Aviation Area Forecast): conditions over a wide region (several states) and is a good source of information for enroute weather. FA's are issued three times a day.

- **"OTLK"** = the outlook for a specific period of time.
- **"SIG CLDS AND WX"** = is the section that contains a summary of cloudiness and weather significant to flight operations broken down by states or other geographical areas.
- The **HAZARDS** section lists hazards to aviation, such as turbulence and icing, for selected areas.
  1. **FD** (Winds & Temperatures Aloft Forecasts): wind direction in relation to true north, wind speed in knots, and temperature in degrees Celsius, for nine levels between 3,000 and 39,000 ft.
- Temperatures are assumed negative above 24,000ft
- FD does not include levels within 1,500 ft of the stations elevation, and temperatures are not forecast for the 3,000-foot level or for a level within 2,500 ft. of the stations elevation.
- Winds of 100 to 199 kts have 50 added to the direction.
- **"9900"** = light & variable and less than 5 kts.

### SEVERE WEATHER REPORTS AND FORECAST

**AIRMETS** (Airmen's Meteorological Information): issued every 6 hours w/ amendments as necessary. Moderate icing, turbulence, sustained winds of 30 kts or more at the surface, ceilings less than 1,000 ft and/or visibility less than 3 miles affecting over 50 percent of an area at any one time, and extensive mountain obscurement.

**Sierra:** for IFR conditions and mountain obscuration.

**Tango:** for turbulence, strong surface winds, and low-level wind shear.



**Zulu:** for icing for freezing levels.

- After the first issuance of the day, AIRMETs are numbered sequentially.

**SIGMET (WSs):** issued for hazardous weather (other than convective activity) to all aircraft.

- Sever icing, sever or extreme turbulence, dust-storms, sandstorms, volcanic eruption and volcanic ash lowering visibility to less than three miles.
- Use alphanumeric designators November through Yankee

**Convective SIGMET (WSTs):** always imply sever or greater turbulence, sever icing, and low-level wind shear.

- Tornadoes, lines of thunderstorms, thunderstorms over a wide area, embedded thunderstorms, hail greater than or equal to 3/4 inch in diameter, and/or wind gust to 50 knots or greater.
- Issued for the eastern (E) central (C), and western (W) and are numbered sequentially for each area (01-99) each day. Bulletins are issued 55 minutes past each hour and valid for 2 hours from the time of issuance or until it is superseded by the next hourly issuance.

### GRAPHIC REPORTS

**Surface Analysis Chart:** shows weather conditions as of the valid time shown on the chart

- You can get a picture of atmospheric pressure patterns at the earth's surface.
- Transmitted every three hours
- Station Models—round station symbols depict stations where observations are taken by human observers and square symbols indicate automated sites.

**Weather Depiction Chart:** chart is derived from aviation routine weather reports (METARs)

- Transmitted every 3 hours, and is valid at the time of the plotted data.
- Pressure patterns and wind information are not provided (areas of adverse weather)
- Station Models—depicted as circles; a bracket ( ] ) to the right indicates an automated station.

**Radar Summary Chart (SDs) :** data depicts the location, size, shape, intensity, and intensity trend and direction of movement. Also shows echo heights of the tops and bases of precipitation areas.

- Produced 35 minutes past each hour. Conditions that existed at the valid time.
- Only detects precipitation and does not detect all cloud formations.

**Satellite Weather Pictures:** two types, Visible and Infrared (IR)

- Both are transmitted every 30 minutes except for nighttime when visible photos are n/a.
- Visible pictures are used to determine the presence of clouds, the shape and texture.
- IR photos depict the heat radiation emitted by the cloud tops and earth's surface.

### GRAPHIC FORECASTS

**U.S. Low-Level Significant Weather Prog Chart:** helps you avoid areas of low visibility and ceilings as well as where turbulence and icing may exist.

- Valid from the surface up to the 400-millibar pressure level (24,000 ft)
- Consists of four panels, is issued at 0000Z, 0600Z, 1200Z, 1800Z; the two lower panels are 12 and 24 hour forecasts of surface weather conditions, the two upper panels are 12 and 24 hour forecasts of weather between the surface and 24,000 ft. (surface Prog Panels)
- The upper panels show areas of non-convective turbulence and freezing levels as well as IFR and Marginal VFR (MVFR) weather
- The lower panels show fronts and pressure centers, and forecast precipitation and thunderstorms.

**Severe Weather Outlook Chart:** is a 48-hour forecast of thunderstorm activity

- Issued every morning at about 0800Z
- Left panel depicts the outlook for general and severe thunderstorm activity for the first 24-hours
- Right panel depicts a forecast for the next day beginning at 1200Z

**Forecast Winds and Temperatures Aloft Chart:**

- 12-hour forecast valid at 0000Z and 1200Z daily.

### PREFLIGHT WEATHER SOURCES



- Flight Service Station (FSS), National Weather Service (NWS), DUATS, and internet.

#### **Flight Service Stations (FSS):**

- Weather briefings; Standard, Abbreviated, Outlook, and Inflight
- 122.2; Airport Advisory/Information (Local Airport Advisory LLA) 123.6;

#### **In-Flight Weather Sources:**

- **Enroute Flight Advisory Service** (EFAS) “Flight Watch” 122.0 above 5,000 ft AGL and below 18,000 from 6 A.M to 10 P.M.
- **Transcribed Weather Broadcast** (TWEB): including winds aloft and route forecast for a cross-country flight.
- **Hazardous In-Flight Weather Advisory Service** (HIWAS): such as AIRMETs, SIGMETs, Convective SIGMETs, and urgent PIREP. When a HIWAS is updated, ARTCC and terminal facilities will broadcast an alert on all but emergency frequencies.
- **Automated Weather Observing System** (AWOS): was the first widely installed automated weather data.
  1. AWOS –A = only reports altimeter setting
  2. AWOS-1 = also measures and reports wind speed, direction and gust, temperature, and dewpoint.
  3. AWOS-2 = everything in AWOS-1 plus, visibility
  4. AWOS-3 = everything in AWOS-2 plus, cloud and ceiling data.
- **Automated Surface Observation System** (ASOS): is the primary surface weather observing system.
  5. Measures everything in AWOS-3 as well as variable cloud height, variable visibility, rapid pressure changes, precipitation type, intensity, accumulation, and beginning and ending times.

## **Weather Theory**

- **Atmosphere:** 78% nitrogen 21% oxygen 1% other
- **Circulation**—refers to the movement of air relative to the earth's surface.
- **Temperature**—every physical process of weather is accompanied by, or is the result of heat exchange

#### **Atmospheric Pressure**—Isobars reveals pressure gradient

- Isobars spread widely apart, the gradient is considered weak; results in lighter winds v/v
  1. **High** = center of high pressure surrounded on all sides by lower pressure
  2. **Low** = an area of low pressure surrounded on all sides by higher pressure
  3. **Ridge** = elongated area of high pressure
  4. **Trough** = elongated area of low pressure
  5. **Col** = can designate either a neutral area between two highs or two lows.
- **Airflow Rotational patterns:** High pressure areas flow downward clockwise and outward; low pressure areas flow inward, upward and counterclockwise, roughly parallel to the isobars
- Unequal heating of the Earth's surface causes variations in altimeter settings between weather reporting points.
- **Coriolis force:** High always wants to go to low pressure; however, as soon as the air begins to move, it is deflected by a phenomenon known as **Coriolis** force deviates the air to the right.
- **Frictional Force:** Below 2000 ft AGL friction caused by the earth's surface slows the moving air and reduces Coriolis force; pressure gradient force is now greater than Coriolis force and wind is diverted from its path along the isobars toward the lower pressure.

#### **Local Wind Patterns:**



- **Sea Breeze**—since land surfaces warm or cool more rapidly than water surface, land is usually warmer than water during the day; wind blows from cool water to warmer land.
- **Land Breeze**—at night, land cools faster than water and wind blows from the cooler land to the warmer water
- **Valley Breeze**—as mountain slopes are warmed by the sun during the day, the adjacent air also is heated, since heated air is less dense than the air at the same altitude over the valley an upslope flow is created.
- **Mountain Breeze**—at night, the high terrain cools off and eventually becomes cooler than air over the valley.

**Atmospheric Stability:** is the atmosphere's resistance to vertical motion

- Air that moves upward expands and cools due to lower atmospheric pressure. When air moves downward, it is compressed and heated by the increased pressure at lower altitudes.
- Stability of the air can be measured by its actual lapse rate
- A characteristic of stable air is the presence of stratiform clouds.
- Characteristics of unstable air include turbulence and good surface visibility.
- **The average lapse rate is 2 C (3.5 F) per 1,000 ft.**
- **Temperature Inversions:** When temperature increases with altitude. (Temperature usually decreases with an increase in altitude.)
  1. The most frequent type of ground or surface-based temperature inversion is that which is produced by terrestrial radiation on a clear, relatively still night.
  2. The weather conditions that can be expected beneath a low-level temperature inversion layer when the relative humidity is high are smooth air, poor visibility, fog, haze or low clouds.
  3. A temperature inversion is associated with a stable layer of air.

**Processes by which moisture is added to unsaturated air.**

- **Change of State:** Water is present in the atmosphere in three states: Solid, Liquid, and Gas.
  1. **Evaporation** = changing of liquid water to invisible water vapor (latent heat of evaporation)
  2. **Condensation** = water vapor changes to a liquid (latent heat of condensation, important in cloud development.
  3. **Sublimation** = changing of ice directly to water vapor
  4. **Deposition** = water vapor to ice
  5. **Melting + Freezing**

**Humidity:** refers to moisture in the air.

If the air is very moist, poor, or even severe weather can occur; if the air is dry, the weather usually will be good.

- **Relative Humidity**, is the actual amount of moisture in the air compared to the total amount that could potentially be present.; the amount of potential moisture depends on air temperature.
- **Dewpoint:** is the temperature to which the air must be cooled in order to become saturated.
- **Frost:**
  1. If the temperature of the collecting surface is at or below the dewpoint of the adjacent air, and the dewpoint is below freezing, frost will form.
  2. Frost on the wings affects takeoff performance by disrupting the smooth flow of air over the airfoil, adversely affecting its lifting capacity. Frost may prevent the airplane from becoming airborne at normal takeoff speed. Frost is considered a hazard to flight for this reason.

**Clouds**

- Clouds often form at altitudes where temp. and dewpoint converge. (4.5 f/ 2.5 C per 1,000 ft)
- Clouds, fog or dew will always form when water vapor condenses.
- **Condensation Nuclei**—can be dust, salt from evaporating sea spray or products of combustion.
- **Cloud Types:** clouds are divided into four families according to their height range.
  - **Low** = surface to 6,500 AGL.      **Middle** = 6,500 to 20,000 (alto)





- **High** = above 20,000 AGL (cirrus)
  - **Clouds w/Vertical Development** (cumulus, towering cumulus, cumulonimbus); associated turbulence can be expected when an unstable air-mass is forced upward.
  - **Nimbus** = denotes a rain cloud
  - **Stratus** = form when moist, stable air flows upslope.
- Fog:** if the temp./dewpoint spread is small and decreasing, and the temperature is above freezing, fog or low clouds are likely to develop.
- **Radiation fog**—forms as warm, moist air lies over flatland areas on clear, calm nights.
  - **Advection fog**—forms when a warm air mass moves inland from the coast in winter.
  - **upslope fog**—when moist stable air is forced up a sloping land mass.
  - **Steam fog**—occurs as cold dry air moves over warmer water.
  - **Precipitation Induces fog**—when warm rain or drizzle falls through cooler air near the surface.
  - **Precipitation:** defined as any form of particles, whether liquid or solid, that fall from the atmosphere.
    1. Snowflakes, raindrops, drizzle, ice pellets, hail, or virga.
    2. The presence of ice pellets at the surface is evidence that there is a temperature inversion with freezing rain at a higher altitude.
  - **Airmasses:** is a large body of air with fairly uniform temperature and moisture content. classified according to the regions where they originate. (stable or unstable)
  - **Fronts:** the boundary between two different Air-masses **Cold front; warm front; stationary front; occluded front.**
    1. An easy way to determine the cross of a front is a change in temperature.
    2. Change in temperature is an obvious indication of frontal passage.
    3. One weather phenomenon which will always occur when flying across a front is a change in the wind direction.

**Thunderstorms:** cumulonimbus clouds have the greatest turbulence.

1. **3 conditions must be present: 1. lifting action 2. unstable 3. moist air**
2. **squall line** A non-frontal, narrow band of active thunderstorms that often develops ahead of a cold front.
3. **Life Cycle: 1. cumulus 2. mature 3. dissipating**
4. If there is thunderstorm activity in the vicinity of an airport at which you plan to land, you can expect to encounter **wind-shear turbulence** during the landing approach. ;
5. lightning is always associated with thunderstorm

**Turbulence:** upon encountering severe turbulence, the pilot should attempt to maintain a level flight attitude.

**Wake Turbulence:** wingtip vortices are created only when an aircraft is developing lift.

- Greatest vortex strength occurs from aircraft heavy, clean and slow.
- Taking off or landing
- The wind condition that requires maximum caution on landings is a light, quartering tailwind.

**Mechanical Turbulence:** when buildings or rough terrain interfere with normal wind flow.

**Convective Turbulence:** which is also referred to as thermal turbulence. (indicated by towering cumulus)

**Mountain Wave Turbulence:** Standing lenticular cloud, rotor cloud.

**Wind Shear:** is a sudden, drastic shift in wind speed and/or direction that may occur at any altitude in a vertical or horizontal plane.

- May be expected in areas of low-level temperature inversion,
- frontal zones and clear air turbulence, and
- whenever the wind speed at 2000 to 4000 ft above the surface is at least 25 knots.

**Icing:** must have visible moisture and freezing temp. two types; Structural and Induction Icing

- **Rime**      **Clear Ice**      **Mixture of the two.**



## Flight Procedures & Technique

- **Taxiing in Wind: PHAK**
  - **quartering tailwind, Dive away.** ( the windy side aileron should be down. Elevator down.
  - **headwind quartering, Steer into** ( the windy side aileron should be up. Elevator neutral
  - A quartering tailwind is the most critical wind condition to a tricycle-gear, high-wing airplane.

## AIRSPACE

### Weather Minimums surface areas. 91.155

- 1,000 ft ceiling. and ground visibility at least 3 statute miles.
- **VFR Cloud Clearance/ vis requirements §91.155**
  - \* 3 miles vis 2,000 ft horizontal, 1,000 ft above, 500 ft below, (3 /2<sup>1</sup>/<sub>5</sub>)
  - 5 exceptions:**
    - \* **Class B-** 3miles vis, Clear Of Clouds;
    - \* **Class G day < 1,200 agl** 1 mile Clear of Clouds
    - \* **Class G day >1200 agl <10,000 msl-** 1mile vis 2000 horz 1000 abv /500 blw
    - \* **Anywhere (E&G) >10,000 ft msl-** 5miles vis 1 mile horizontal 1000 ft above and below.
    - \* **Class G Night within ½ mile of airport (traffic pattern)** 1mile vis Clear of clouds
  - \* **Special VFR Weather Minimums 91.157;** operations may only be conducted—
    - \* In surface areas B,C,D,E
    - \* With an ATC Clearance; 1sm/ Clear or clouds
    - \* Day only unless; pilot and aircraft is IFR

### Special Use Airspace 3-4-1,2,3,4,5,6,7:

- \* Prohibited Areas; Restricted Areas; Warning Areas; Military Operations Areas; Alert Areas; Controlled Firing Areas

### Other Airspace Areas 3-5-1,2,3,4,5,6,7;

- \* Airport Advisory/Information; Military Training Routes; Temporary Flight Restrictions; Parachute Jump Aircraft Operations; Published VFR Routes; Terminal Radar Service Area; National Security Areas.
- \* Military Training Routes; when route is a three digit number, the route contains one or more sections above 1500 ft AGL
- \* IR training routes aircraft may fly at speeds in excess of 250 knots.

## AIRPORTS

- \* **Runway Markings 2-3-6:**
  - \* Runway numbers correspond to the magnetic direction and are rounded to the nearest 10 degrees, with the last zero dropped out.
  - \* Displaced threshold may be used for taxi and takeoff.
  - \* A closed runway is marked with **X's** painted on its surface at each end.
  - \* Taxiway hold lines.
- \* **Segmented Circles:** traffic pattern indicators on the segmented circle show the base to final to various runways on the airport.



- The wind cone or sock in the center gives current wind direction
- Tetrahedron, wind “T”
- \* **Beacon**
  - \* White and Green identifies a lighted land airport
  - \* Yellow and White identifies a sea base airport
  - \* Green, Yellow, and White identifies a heliport
  - \* Green and dual-peaked white identifies a military airfield.
  - \* When an airports beacon is on during the daytime, it usually means that the weather is below basic VFR minimums (ceiling less than 1000 ft and/or visibility is less than 3 miles.
- \* **Pilot-Controlled Lighting2- 1-7**
  - \* 7 clicks of the microphone in 5 seconds will set the lights on high intensity
  - \* 5 is medium, 3 is low; lights will stay on for 15 minutes.
- \* **Taxiway lights2-1-9**
  - \* Are blue with green centerline lights.
- \* **Visual Glide-slope indicators2-1-2**
  - **VASI** provides safe obstruction clearance within plus or minus 10 degrees of the extended runway centerline and to 4 NM from the runway threshold.
  - **PAPI** Precision Approach Path Indicator (); Tri-color; Pulsating
  - Pilot should fly at or above the glide path when approaching an airport with a VASI.

## Equipment

- **Transponder Operations: 91.215 4-1-19 5-6-1**
  - Tested and inspected within at least the preceding 24 calendar months. **91.413**
  - \* Transponder codes;
    - \* VFR-1200,
    - \* Emer- 7700, Lost
    - \* Com-7600
    - \* Hijack-7500
  - \* **Mode C** Required when operating;
    - \* Class B
    - \* 30 nm from class B
    - \* class C
    - \* above and below class B,C and, above 10,000 ft MSL
    - \* ADIZ

## Emergency Locator Transmitter (ELT)

- \* 121.5 / testing only the first 5 minutes after the hour and for no longer than 3 audible sweeps
- \* Airborne tests are not allowed
- \* Must be tested and maintained every 12 months
- \* Replaced, or recharged if the battery is rechargeable after one-half of the battery’s useful life, or when has been in use for more than one cumulative hour.

## Aircraft Lights

sunset to sunrise or parking in a movement are



- lighted position lights;
- anticollision lights. Must be on unless operating conditions dictate it would be in the interest of safety to turn the lights off.

## COMMUNICATION

- \* **VFR Radar Services:** traffic information is given with respect to ground track.
  - \* To use VHF/DH facilities for assistance in locating an aircraft's position, the aircraft must have a VHF transmitter and receiver. (DF Steer) 1-1-17
- Terminal VFR Radar Services 4-1-17:**
  - \* Basic radar service for VFR aircraft provides traffic advisories and limited vectoring on a workload permitting basis.
- \* **Automatic Terminal Information Service (ATIS) 4-1-13**
  - \* A continuous broadcast of recorded information concerning data in selected high-activity terminal areas.
- \* **Flight Service Stations (FSS) 4-1-3:** on call up, refer to them as "Jonesboro radio"
  - \* weather briefings,
  - \* enroute communication,
  - \* VFR search & rescue services, flight plans.
  - \* VHF direction finder (VHF/DF) (DF Steer) 1-1-17; FSS may be able to locate your aircraft, the only equipment required in the aircraft is an operable VHF transmitter and receiver. (as you key your mic the direction finding equipment homes in on your radio signal). Towers and FSS with DF services are listed in the A/FD.
- \* **Radio Procedures:**
  - \* Using numbers
  - \* Phonetic Alphabet **4-2-7**
  - \* The range of VHF transmissions is limited to line of sight.
  - \* Common Traffic Advisory **4-1-9(b)** Frequency (CTAF)
  - \* Unicom **4-1-9(h)**
  - \* Airport Advisory Areas **4-1-9(d)**
  - \* Make your initial call when you are 10 miles from the airport.
  - \* Clearance Delivery—when the ATIS message so indicates, you should contact clearance delivery prior to taxiing.
  - \* Ground—progressive taxi
  - \* Control Tower—clearance and when to leave the frequency.
- \* **Coordinated Universal Time (UTC):** to convert the local departure or arrival time to UTC, add the hours of difference from the number on the time conversion table.
  - \* Eastern Standard Time to UTC = adding 5 hours
  - \* Central Standard Time to UTC = adding 6 hours
  - \* Mountain Standard Time to UTC = adding 7 hours
  - \* Pacific Standard Time to UTC = adding 8 hours
- \* **Lost Communication Procedures**
  - Remain outside or above the airspace until you have determined the direction & flow of traffic, then join the pattern and look for light signals. Rock your wings or blink your landing light for acknowledgement.

ATC light signals [91.125](#)



	<u>Surface</u>	<u>Flight</u>
<b>Steady Green</b>	Cleared for takeoff.	Cleared to land.
<b>Flashing Green</b>	Cleared to taxi	Position for landing
<b>Steady Red</b>	Stop	Give way and circle.
<b>Flashing Red</b>	Taxi clear of runway	Airport unsafe—do not land.
<b>Flashing White</b>	Return to start	N/A.
<b>Red and Green</b>	Extreme caution	Extreme caution

### Emergency Procedures:

- \* Frequency 121.5; Transponder Codes 7700; 7600; 7500
- \* 5 C's : Climb; Communicate; Confess; Comply and Conserve

### Advisory Circulars (AC's)

- \* FAA has developed a systematic means of providing pilots with non-regulatory guidance and information in a variety of subject areas.

## Navigation

**Pilotage:** navigating by visual landmarks.

**Dead Reckoning:** involves calculating distance, speed, time, and direction as a means of navigation from your departure to your destination.

- \* Always use charts that are current.

**Course:**  $TC + VAR = MC + WCA = MH + Dev = CH$

1. To find your magnetic course, you must first find the true course, using a plotter. Then, find the nearest isogonic line to the course. Next, add or subtract the variation. West is Best and East is Least.
  2. To find the magnetic heading, you must first determine the true heading by correcting the true course for winds.
- \* Selecting Checkpoints, the best checkpoints are those that cannot be confused with anything else.
  - \* The number of checkpoints needed for a particular flight is up to you. The first check point should be close enough to be easy to locate after takeoff, but far enough that you are clear of the airport traffic pattern.
  - \* Fold the chart so that only one or two panels are showing and align it with the direction of flight.

**VFR Flight Plan:** is simply a request that the FSS initiate a search for you if they have not heard from you by a certain time

- \* FAA does not require pilots of VFR aircraft to file flight plans
- \* You must close within 30 minutes after your stated ETA
- \* FSS will keep you flight plan on file for up to 1 hour after your departure time

### Lost Procedures

- \* 5 C's; Climb; Communicate; Confess; Comply; Conserve
- \* DF "steer"

### Radio & GPS Navigation

- \* **VOR Navigation** (Very High Frequency Omnidirectional Range)
- \* **1000-14,500 40 nm**



- \* **14,500-18,000 100 nm**
- \* **18,000-45,000 130 nm**
- \* **45,000-60,000 100 nm**
  - \* Reception is strictly line of sight
  - \* Basic **VOR's** provide course guidance; **VOR/DME** and **VORTAC** also provide distance information to aircraft equipped with distance measuring equipment (DME)
  - \* VOR stations transmit radio beams, or **Radials**, outward in every direction. Compass Rose.
  - \* **Victor Airways** are class E starting at 1200 ft AGL, 8 miles wide.
  - \* **3 classes of VOR** according to their normal reception and altitude range.
    1. Terminal VOR = is normally located on an airport
    2. Low Altitude
    3. High Altitude
- **Identifying A station**
  - \* VOR's Morse code identifier or voice identification
  - \* If the station is down for maintenance, it may transmit a T-E-S-T signal or no identifier.
- \* **VOR Indications**
  - \* TO and FROM (OBS and CDI)
  - \* Each dot on the scale representing a course deviation of two degrees.

### Reverse Sensing

- \* A VOR airborne system does not perceive your aircraft's heading: it only senses your direction from the station and gives the same instrument indications regardless of which way the nose of the aircraft is pointing.
- \* For correct sensing, you must set the VOR indicator so it generally agrees with your intended course.

### Off Indications

- \* The area over the station at which the TO-FROM indicator changes is called the **Cone of Confusion**, or no signal area.
- \* **Area of ambiguity** -When the aircraft is abeam the station on the selected course.

### Tracking

- \* You maintain the selected course by keeping the CDI centered

### Intercepting a Course

- \* Flying a radial inbound or outbound

### Cross checking your Position

- \* By using more than one VOR

### Checking VOR Accuracy

- \* The FAA requires VOR equipment to meet certain criteria if the system is being used for IFR navigation.
- \* VOR Checkpoints
- \* VOR Test Facilities (VOTs)
- \* **NDB** (non-directional radio beacons)
  - \* **ADF Navigation** (automatic direction finder)

#### Limitations:

- \* Night Effect: causes fluctuations
- \* Thunderstorm effect: causes the needle to point to lightning flashes
- \* Precipitation Static: causes the needle to wander
- \* Terrain effect: mountains reflect the radio waves and cause erroneous bearing





indications

- \* Shoreline effect: degrade the accuracy of the ADF

### GPS Navigation (Global Positioning System)

- \* 24 satellites make up the GPS system, the minimum of 5 is always observable anywhere on earth, and a minimum of 4 is required to yield a three dimensional position.

## Aero Medical Principles

### Vision In Flight:

- \* **Retina**—contains many photosensitive cells called cones and rods which are connected to the optic nerve.
- \* **Cones**—function well in bright light and are sensitive to colors
- \* **Rods**—are 10,000 times more sensitive to light than the cones, and are much of your peripheral vision.

#### Night Vision

- \* Most effective way to look for traffic during night flight is to scan slowly, to permit off-center viewing. Look to the side of an object for the clearest focus.
- \* A steady red light and a flashing red light ahead and at the same altitude. The other aircraft is crossing to the left.
- \* To adapt the eyes for night flying, avoid bright white lights for at least 30 minutes before the flight
- \* Position light from SS to SR

### Visual Illusions

- \* **Autokinesis**—if you stare at a single point more than a few seconds the light may appear to move.
- \* **False Horizon**—occurs when the natural horizon is obscured or not readily apparent.
- \* **Flicker Vertigo**—can occur when looking through a slow-moving propeller toward the sun or when the sun is behind you, reflecting off the propeller.

### Landing Illusions

- \* **Haze**—can cause you to fly a low approach
- \* **Featureless Terrain**—can cause you to fly a lower-than-normal approach
- \* **Fog**—creates the illusion of pitching up which can cause you to steepen your approach.

**Disorientation:** is an incorrect mental image of your position, attitude, or movement in relation to what is actually happening to your aircraft.

- \* Input from three primary sources: **Vision**, **Vestibular**, and **Kinesthetic Sense**.

**Spatial Disorientation:** is a conflict between the information relayed by your central vision scanning the instruments, and your peripheral vision.

- \* Pilots are more subject to spatial disorientation if body signals are used to interpret flight attitude.
- \* The best way to overcome the effect is to rely on the aircraft instrument indications.

**Hypoxia:** occurs when the tissues in the body do not receive enough oxygen.

- \* **Hypoxic Hypoxia**—inadequate supply or pressure of oxygen (going to high altitudes)
- \* **Hypemic Hypoxia**—inability of the blood to carry oxygen (Carbon Monoxide)
- \* **Stagnant Hypoxia**—inadequate circulation of oxygen (excessive G forces)
- \* **Histotoxic Hypoxia**—inability of the cells to effectively use oxygen (by alcohol or drugs)

**Oxygen Supplemental Oxygen un pressurized aircraft:** FAR requirements

- \* **12,500—14,000 ft MSL** = Flight crew must use O<sub>2</sub> after 30 minutes



- \* **14,000—15,000 ft MSL** = Flight crew must use O<sub>2</sub>
- \* **15,000—Above** = Flight crew must use O<sub>2</sub> and all occupants must be provided with O<sub>2</sub>

**Pressurized aircraft**

- >FL250 10 min supply for each oxygen for each occupant in the event of depressurization and emergency descent
- >FL350
  - one pilot is wearing and using a mask that is providing oxygen at all times or
  - automatically provides oxygen when cabin descends to 14K
  - or two pilots @ the controls with quick donning masks and below FL410

**Hyperventilation:** occurs with excessive loss of carbon dioxide.

- \* You need to slow the breathing rate, breathing into a bag or talking aloud.

## Aeronautical Decision Making

**Decision-Making Process:** involves an evaluation of each risk elements.

- \* **Pilot**—your fitness, currency, and flight experience.
- \* **Aircraft**—performance, limitations, equipment, and airworthiness
- \* **Environment**—Weather, airport conditions, services
- \* **Operation**—the purpose of the flight
- \* **Situation**—maintain awareness
- \* One of the most important decisions that you will make as pilot in command is the **go/no-go decision**. Evaluating each of these risk elements can help you decide whether a flight should be conducted or continued.

**DECIDE:** is used by the FAA to describe the basic steps in the decision-making process

- \* **D**etect the fact that a change has occurred
- \* **E**stimate the need to counter or react to the change
- \* **C**hoose a desirable outcome for the success of the flight
- \* **I**dentify actions which could successfully control the change
- \* **D**o the necessary action to adapt to the change
- \* **E**valuate the effect of the action

**Self Assessment:** (I'm Safe, Checklist)

- \* **I**llness
- \* **M**edication
- \* **S**tress
- \* **A**lcohol
- \* **F**atigue
- \* **E**ating

**Hazardous Attitudes**

**Antidote**

Macho .....	Taking Chances is foolish
Anti-Authority .....	Follow the rules, they are usually right
Invulnerability .....	It could happen to me
Impulsivity .....	Not so fast. Think first
Resignation.....	I'm not helpless. I can make a difference

## FLIGHT ENVIRONMENT and Rules of the Road



- **VFR Cruising Altitudes**
  - \* On an easterly course (0 to 179) above 3,000 ft AGL, VFR cruising altitudes are odd thousands plus 500 ft.
  - \* On a westerly course (180 to 359), VFR cruising altitudes are even thousand plus 500 ft.
- \* **VFR Fuel Requirements [91.151](#)**
  - At night, plan for enough fuel, considering wind and forecast weather conditions, to fly to the first point of intended landing, and, assuming normal cruising speed, 45 min. beyond that point.
  - At day, plan for enough fuel, considering wind and forecast weather conditions, to fly to the first point of intended landing, and, assuming normal cruising speed, 30 min. beyond that point.
- \* **Visual Scanning AIM 8-1-6c.** : the most effective method of scanning for other aircraft for collision avoidance during daylight hours is to use a series of short, regularly spaced eye movements to search each 10-degree section.
  - \* An aircraft on a collision course with your aircraft will show little relative movement.
  - \* Haze reduces visibility, making objects appear to be farther away than they really are.
  - \* When climbing or descending VFR along an airway, execute gentle banks left and right for continuous scanning of the airspace.
  - \* Prior to beginning each maneuver, make clearing turns.
- \* **Right-Of-Way: FAR [91.113](#)** an aircraft in distress has right-of-way over all other aircraft.
  - \* When two aircraft are converging, the aircraft on the right has right-of-way.
  - \* The least maneuverable aircraft has the right-of-way; a glider has right-of-way over an airship, airplane or rotorcraft.
  - \* An aircraft that is towing or refueling another has the right-of-way over other engine-driven aircraft.
  - \* When aircraft are approaching head-on, each shall give way to the right.
  - \* When two or more aircraft are approaching the airport with the intention of landing, the one at the lower altitude has the right-of-way.
- \* **Minimum Safe Altitudes §91.119**
  - \* **Anywhere:**, altitude to allow for an emergency landing in the event of an engine failure, without hazard to people or property on the surface. except for takeoff or landing
  - \* **Over congested areas;** 1,000 ft above the highest obstacle within 2,000 ft horizontal of the aircraft.
  - \* **Over other than congested areas;** 500 ft above the surface, except over open water or sparsely populated areas. In those cases, the aircraft may not be operated closer than 500 feet to any person, vessel, vehicle, or structure.

## Federal Aviation Regulations

### Pilot-In-Command Responsibility [91.3](#)

1. Is directly responsible for, and is the final authority as to, the operation of that aircraft.
2. In an in-flight emergency requiring immediate action, the pilot in command may deviate from any rule of this part to the extent required to meet that emergency.

### Preflight Inspection:

- \* Each pilot in command shall, before beginning a flight, become familiar with all available



information concerning that flight.

- \* Preflight action, as required for all flight away from the vicinity of an airport, shall include an alternate course of action if the flight cannot be completed as planned.
- \* In addition to the other preflight actions for a VFR flight away from the vicinity of the departure airport, regulations specifically require the pilot in command to determine runway lengths at airports of intended use and the aircraft's takeoff and landing distance data.

#### **Airworthiness**

- \* Remains valid as long as the aircraft is maintained and operated as required by FAR.
- \* The owner or operator of an aircraft is responsible for ensuring that an aircraft is maintained in an airworthy condition.

#### **Night**

- \* The definition of nighttime is the time between the end of evening civil twilight and the beginning of morning civil twilight.

#### **V-Speeds**

- \* **V<sub>A</sub>**, **V<sub>SO</sub>** (landing configuration), **V<sub>S1</sub>** (clean configuration), **V<sub>FE</sub>**, **V<sub>LE</sub>**, **V<sub>NO</sub>**, **V<sub>NE</sub>**, **V<sub>X</sub>**, **V<sub>Y</sub>**

#### **Preventive Maintenance**

- \* Includes such items as servicing landing gear wheel bearing and replenishing hydraulic fluid.

#### **Pilot Documents**

- \* While operating an aircraft as pilot in command,
- \* medical certificate
- \* pilot certificate
- \* Photo ID in your personal possession.
- \* Each person who holds a pilot certificate or a medical certificate shall present it for inspection upon the request of the Administrator, the National Transportation Safety Board, or any federal, state, or local law enforcement officer.

#### **Type Ratings**

- \* The pilot in command is required to hold a type rating for the operation of aircraft having a gross weight or more than 12,500 pounds. And all jets.

#### **High Performance Aircraft**

- \* Is an airplane with more than 200 horsepower.
- \* Required to have a one time endorsement from an instructor.

#### **Complex Aircraft**

- \* Retractable landing gear, flaps and a controllable propeller
- \* Required to have a one time endorsement from an instructor.

#### **Recency of Flight Experience**

- \* Flight review every 24 months
- \* To carry passengers, 3 takeoffs and landings in an aircraft of the same category and class, and if a type is required, of the same type, within the preceding 90 days.
- \* At night, landing to full stops and 1 hour after sunset and 1 hour before sunrise.
- \* In a tailwheel airplane, landings must be to a full stop.

#### **Special training requirements**

- MU 2

#### **FAR Part 61**

- \* **Pilots Log books 61-51**

**Private Pilot Eligibility Requirements: 61.103**



- \* Be at least 17 years of age
- \* Be able to read, speak, write, and understand the English Language.
- \* Receive the required ground and flight training and log book endorsements
- \* Pass the required knowledge test on aeronautical areas in 61.105
- \* Meet the aeronautical experience requirements in 61.109
- \* Pass a practical test on the areas of operation listed in 61.107
- \* Must hold at least a current 3rd class medical 61.23(a)(3)(i)

### **Endorsements Needed**

- \* Aeronautical knowledge areas 61.35(a)(1), 61.103(b), 61.105
- \* Flight proficiency and test preparation 61.103(f) 61.107

### **Private Pilot Limitations 61.113**

- \* No person who holds a private pilot certificate may act as pilot in command of an aircraft that is carrying passengers or property for compensation or hire.
- \* A private pilot may, for compensation or hire, act as pilot in command of an aircraft in connection with any business or employment if:
  1. The flight is only incidental to that business or employment; and
  2. The aircraft does not carry passengers or property for compensation or hire.
- \* A private pilot may not pay less than the pro rata share of the operating expenses of a flight with passengers, provided the expenses involve only fuel, oil, airport expenditures, or rental fees.

### **Flight Review 61.56**

- \* A flight review consists of a minimum of 1 hour of flight training and 1 hour of ground training
- \* No person may act as pilot in command of an aircraft unless, since the beginning of the 24th calendar month before the month in which that pilot acts as pilot in command has accomplished a flight review and received the proper logbook endorsements.
- \* To fly passengers, the pilot in command must have made 3 takeoffs and landing within 90 day in the same make and model aircraft. To fly passengers at night, the landings must be to full stop beginning 1 hour after sunset and ending 1 hour before sunset.

### **Medical Certificate duration 61.23 8-1-1**

- \* First Class—6 months
- \* Second Class—12 months
- Third Class— over 40 years old: 24 months under 40 years old: 60 months.
- Basic med

### **Change of Address**

- \* The pilot is entitled to exercise the privileges of the pilot certificate for a period of only 30



days after the date of the move.

### **Glider Towing**

- \* A certificated pilot may not act as pilot in command of an aircraft towing a glider unless there is entered in the pilot's logbook a minimum of 100 hours of pilot flight time in powered aircraft.
- \* To act as pilot in command of an aircraft towing a glider, a person is required to have made within the preceding 12 months at least three actual or simulated glider tows while accompanied by a qualified pilot.

### **Private Pilot Limitations**

- \* May share the pro rata share of the operating expenses of the flight with a passenger.
- \* May act as pilot in command of an aircraft used in a passenger-carrying airlift sponsored by a charitable organization, and for which the passengers make a donation to the organization.

### **ELTS**

- \* Inspected every 12 months; replace or recharged if has been in use more than 1 cumulative hour, or if 50% of the useful life of the battery expires.
- \* Can listen on 121.5 @ 5 minutes past the hour.

### **Acrobatic Flight**

- \* Acrobatic flight is prohibited over congested area of a city, town or settlement.
- \* Must be 1500 ft AGL and Visibility at least 3 miles

### **Parachutes**

- \* Must be packed by a certificated and appropriately rated parachute rigger within the preceding 120 days.
- \* With certain exceptions, each occupant must wear an approved parachute when intentionally pitching the nose up or down more than 30 degrees or exceeding 60 degrees of bank.

### **Maintenance**

- \* [91.409](#) Annual; 100 hour (may be flown beyond 100 hours if it is being transported to a place where service can be completed);
- \* Airworthiness Directives;
- \* MEL's [91.213](#)
- \* Special Flight Permits.
- \* Preventative maintenance allowed by an owner pilot stuff listed in [Part 43 appendix A \(c\)](#)

### **Transponders/ ADS B out**

- \* Inspection required every 24 months
- \* Required to have and use:
  - \* within class A,B and C
  - \* above class C and B up to 10,000 MSL(does not apply to a/c without electrical system, a balloon, or a glider)
  - \* all airspace above 10,000 ft unless your below 2500agl(mountainous areas) (does not apply to a/c without electrical system, a balloon, or a glider)
  - \* within 30 nm of airports listed in part 91appendix d (ADSB/Mode C veil)
  - \* ADIZ. (Class E airspace at and above 3,000 feet MSL over the Gulf of Mexico from the coastline of the United States out to 12 nautical miles.) (does not apply to a/c without electrical system, a balloon, or a glider)
- \* All times in all controlled airspace: IF YOU HAVE YOU MUST USE IT.





### **NTSB 830**

#### **Accidents**

- \* If an aircraft is involved in an accident which results in substantial damage to the aircraft, the nearest NTSB field office should be notified immediately
- \* Aircraft Wreckage may be moved prior to the time the NTSB takes custody, but only to protect the wreckage from further damage.
- \* The owner of an aircraft has been involved in an accident is required to file an accident report within 10 days.

#### **Incidents**

- \* A flight control system malfunction or failure, and an in flight fire are two incidents that require immediate notification to the nearest NTSB field office.
- \* An overdue aircraft that is believed to be involved in an accident must be immediately reported to the nearest NTSB field office.
- \* The operator of an aircraft that has been involved in an incident is required to submit a report to the nearest NTSB field office when requested.