PILOT ESSENTIALS

# Private Pilot Study Guide

## Aircraft Required Equipment - 91.205

### Day time - ATOMATOFLAMES

**A**irspeed Indicator
**T**achometer
**O**il Pressure Gauge
**M**anifold Pressure Gauge (if equipped)
**A**ltimeter
**T**emperature Gauge (if equipped)
**O**il Temperature Gauge
**F**uel Quantity Indicator (for each fuel tank)
**L**anding Gear Position Indicator (if equipped)
**A**nti-Collision Lights
**M**agnetic Compass
**E**LT
**S**afety Belts

### Night time - **FLAPS** (+ all day time equipment!)

**F**uses or Circuit Brakers
**L**anding Light (if for hire)
**A**nti-Collision Lights (the FAR's say it under both regulations for some reason)
**P**osition Lights (also called Navigation Lights)
**S**ource of Electricity (Alternator or Generator)

## Inoperative Equipment - 91.213

If any of the following equipment is broken, you may NOT fly:
1. ATOMATOFLAMES
2. FLAPS (when flying at night only)
3. Kinds of Equipment List (KOEL)
4. Type Certificate Data Sheet (TCDS)
5. Airworthiness Directives (AD's)

Example 1: If the altimeter is not working, you may NOT fly. That is on the ATOMATOFLAMES list from 91.205.

Example 2: If the stall horn is not working on a Cessna 172, you may NOT fly. That is on the Type Certificate Data Sheet.

Example 3: If the Outside Air Temperature Gauge is not working, you MAY fly. BUT! You must do the following for it to be legal:

1. Remove or disable the inoperative equipment
2. Label the equipment inoperative inside the cockpit
3. Record it in the maintenance logbook

****Finally you must determine that it is safe to fly as the PIC****

Once you have completed these steps, you could fly with the Outside Air Temperature Gauge inoperative.

**Required Aircraft Inspections - AVIATE**

**A**nnual - 12 months (Must be signed by an IA mechanic)
**V**OR - 30 days (IFR)
**1**00-hr - 100 hrs of tachometer time (for hire operations only)(may be signed by A&P)
**A**ltimeter/Static - 24 months (IFR)
**T**ransponder - 24 months
**E**LT - 12 months or after reaching half battery life or after 1-hr of cumulative use

**How do you know you are ready to fly?**

**Safe to fly - IMSAFE**

**I**llness
**M**edication (list of medications not to use on FAA website)
**S**tress (Acute vs Chronic)
**A**lcohol (8 hrs and .04 MINIMUM, must not be under the influence of alcohol)
**F**atigue (Acute vs Chronic)
**E**motion/Eating

**Documents to fly**

- Student Pilot Certificate (Private after checkride)
- Medical Certificate
- Government Issued Photo ID
- Logbook with Endorsements (Student pilots only)

**Recency to fly**

- To act as PIC: Flight Review within 24 calendar months
- To act as PIC w/ Passengers: 3 Take-off & Landings within previous 90 days (to a full stop if at night or tailwheel)

## Private Pilot Privileges & Limitations

May not act as PIC for compensation or hire EXCEPT:

1. In connection with any business or employment IF it is incidental to that business or employment AND no passengers or property are being carried for compensation or hire.
2. May share the PRO RATA share of the costs of a flight (limited to fuel, oil, airport expenditures, and airplane rental costs)
3. Charitable, Non-Profit, or Community Event
4. Search and Rescue (reimburse only, limited to costs included in PRO RATA)
5. Aircraft Salesman demonstrating to prospective buyer (must have 200 hrs of flight time)
6. Towing a glider or unpowered ultralight vehicle (must comply with 61.69)
7. Flight test in light sport aircraft intended for certification
8. May act as PIC or required flightcrew member without a medical if you have a valid drivers license

## Medical Certificate

| Medical Certificate | Age | Operation | Valid Period |
|---|---|---|---|
| 1st Class | Under 40 | ATP | 12 monts |
| | 40 or older | | 6 months |
| | Under 40 | Commercial | 12 months |
| | 40 or older | | |
| | Under 40 | Private | 60 months |
| | 40 or older | | 24 months |
| 2nd Class | Under 40 | ATP for Second-in-command or Commercial | 12 months |
| | 40 or older | | |
| | Under 40 | Private | 60 months |
| | Over 40 | | 24 months |
| 3rd Class | Under 40 | Private | 60 months |
| | 40 or older | | 24 months |

**BasicMed**

BasicMed is an alternate way for pilots to fly without holding an FAA Medical Certificate provided they meet the following requirements:

1. The aircraft is authorized to carry NO MORE than 6 occupants
2. The aircraft has a maximum takeoff weight of 6,000 lbs or less
3. The aircraft is operated with no more than 5 passengers on board
4. Must stay below 18,000' MSL
5. Must stay in the US (unless authorized by the other country)
6. Must not exceed 250 KIAS
7. Flight is not operated for compensation or hire
8. Logbook with completed medical examination checklist and certificate of course completion per 61.23(c)(3)

**Aerodynamics**

Chord Line - A line drawn between the leading edge and trailing edge of an airfoil. The chord line can change with flap deployment.

Angle of Attack - The angle between the chord line and relative wind.

Critical Angle of Attack - The angle of attack beyond which lift begins to diminish rapidly, or in other words, stalls.

4 Phases of a Spin

1. Entry (Aggravated or uncoordinated stall)
2. Developing (2-3 rotations)
3. Fully Developed (Once rate of rotation, descent, airspeed, have stabilized)
4. Recovery

Spin Recovery Procedure - PARE

**P**ower Idle (To help reduce the angle of attack)
**A**ilerons Neutral (Wings are stalled, use the tail AKA rudder and elevator)
**R**udder Opposite (To reduce rotation)
**E**levator Forward (To reduce the angle of attack)

Drag - A rearward force caused by disruption of airflow
Types of Drag -
1. Induced drag - drag that is a byproduct of lift
2. Parasitic drag - drag that is not a byproduct of lift
    a) Form drag - Caused by the aircraft shape and airflow around it

b) Interference drag - Caused by the intersection of airstreams that creates turbulent airflow
c) Skin-friction drag - Caused by the friction between air and the aircraft surfaces

Lift - A force produced by the dynamic effect of air on the wing, acting perpendicular to the flight path.

Bernoulli's Principle - The faster a fluid(air) moves, the lower pressure it has. Air flows faster over the top of the wing than the bottom due to the shape of the wing. Therefore there is higher pressure below the wing and lower pressure above it. High pressure always seeks the path of least resistance and moves towards the lower pressure, raising the wing.

Newton's Third Law - For every action there is an equal and opposite reaction. When flying with a positive angle of attack, air is impacting the wing and deflected downward. The aircraft experiences an equal and opposite reaction in the opposite direction; up.

Adverse Yaw - The initial tendency of the aircraft to yaw in the opposite direction of a turn. This is caused by INDUCED DRAG on the outside wing in the turn. The outside or raised wing is producing more lift than the inside or lower wing, and therefore more induced drag.

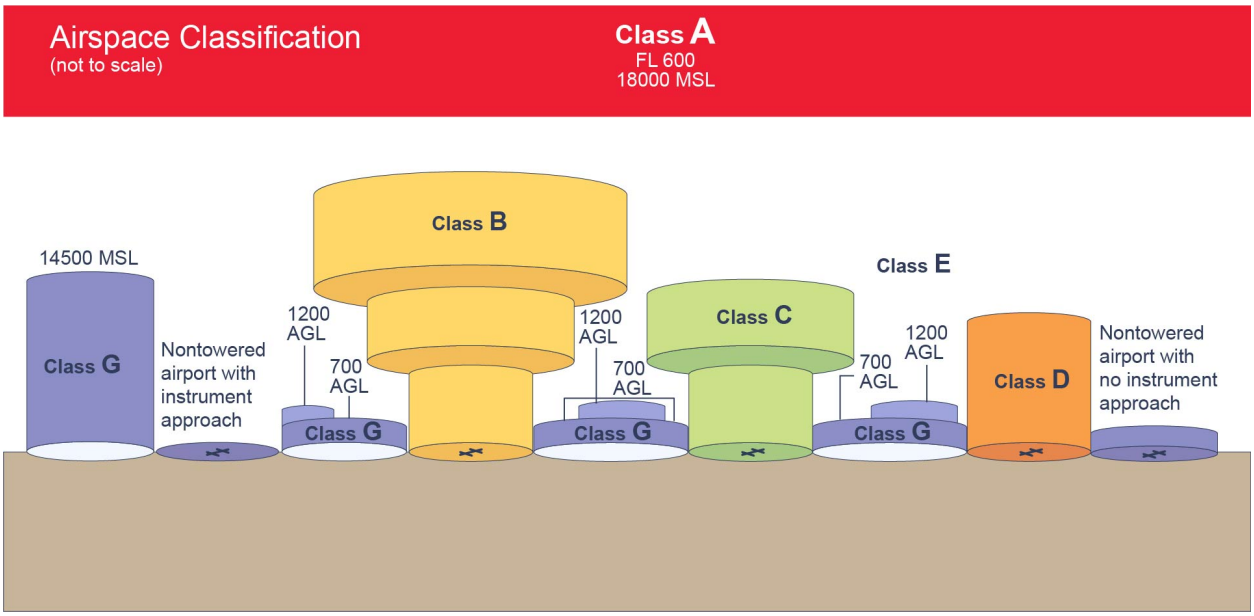
Rudder is used to counteract Adverse Yaw. There are also 2 design characteristics built into a typical training aircraft to counteract Adverse Yaw:

1. Differential Ailerons - the aileron travels a greater distance when it is raised versus when it is lowered. This causes more parasitic drag on the lower or inside wing in a turn.
2. Frise-type Ailerons - the leading edge on the underside of the lower or inside wing sticks out slightly into the air flowing under the wing. This also causes more parasitic drag on the lower or inside wing in a turn.

Left Turning Tendencies

1. **Torque** - for every action there is an equal and opposite reaction, the propellor spins right from the pilots view, so the plane rolls left.
2. **P-Factor** - at a positive AOA, the descending blade produces more thrust than the ascending blade, causing yaw to the left.
3. **Spiraling Slipstream** - Airflow from the propellor spirals around the fuselage and impacts the rudder, causing yaw to the left.
4. **Gyroscopic Precession** - The propellor acts like a gyro because it is spinning at a high speed. When a gyro is impacted by a force, the resultant impact is experienced 90 degrees later as the gyro spins. When a tailwheel raises its tail on takeoff, the resultant force on the propellor causes yaw to the left.

# Airspace




| Class Airspace | Entry Requirements | Equipment | Minimum Pilot Certificate |
|---|---|---|---|
| Class A | ATC clearance | IFR equipped | Instrument rating |
| Class B | ATC clearance | Two-way radio, transponder with altitude reporting capability | Private - (However, a student or recreational pilot may operate at other than the primary airport if seeking private pilot certification and if regulatory requirements are met.) |
| Class C | Two-way radio communications prior to entry | Two-way radio, transponder with altitude reporting capability | No specific requirement |
| Class D | Two-way radio communications prior to entry | Two-way radio | No specific requirement |
| Class E | None for VFR | No specific requirement | No specific requirement |
| Class G | None | No specific requirement | No specific requirement |

*Beginning January I, 2020, ADS-B Out equipment may be required in accordance with 14 CFR part 91, section 91.225.

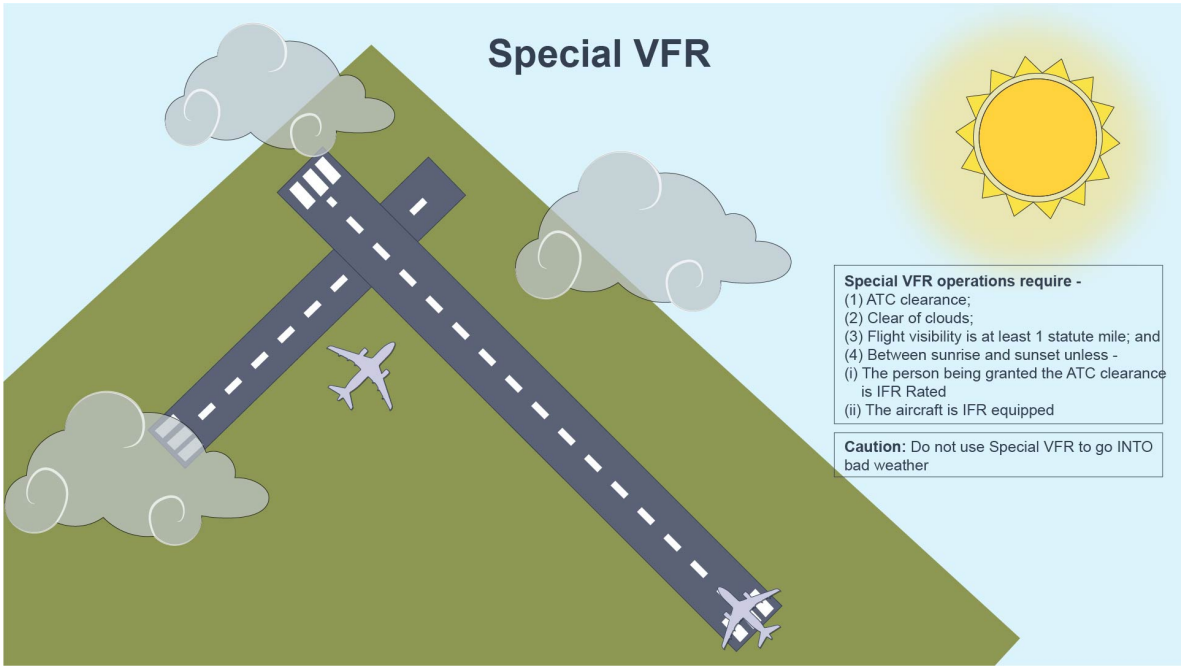
**Special Use Airspace** - MCPRAWN

**M**OA - Military Operating Area
**C**FA - Controlled Firing Area
**P**rohibited
**R**estricted
**A**lert
**W**arning
**N**SA - National Security Area

**Other Airspace**

MTR - Military Training Route - Watch out for fast moving aircraft > 250 knots
TFR - Temporary Flight Restrictions - Check your NOTAMS before you fly!
TRSA - Terminal Radar Service Area - Radar services for a Class D airport
SFRA - Special Flight Rules Area - Think Washington DC, do you research before flying in one of these

**Basic VFR Weather Minimums**

## Systems

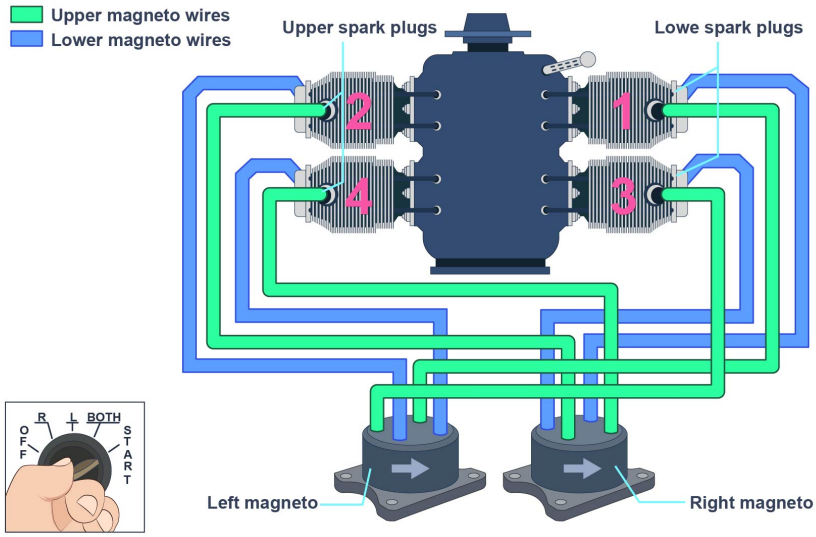
**Engine (C172)** - LHAND

The engine is a Lycoming O-320-E2D, carbureted engine rated at 150 horsepower at 2700 RPM.

**L**ycoming - Manufacturer
**H**orizontally Opposed - Position of the cylinders
**A**ir-Cooled - Air cools as it flows in the front of the cowling and over the engine
**N**ormally Aspirated - Does NOT compress the air before using it for combustion
**D**irect Drive - The propellor and the crankshaft rotate at the same speed

**Propellor (C172)**

The aircraft is equipped with a 2-bladed, fixed-pitch, one-piece forged aluminum alloy propellor which is anodized to retard corrosion. It is 75 inches in diameter.




**Ignition System**

Magnetos are self-contained ignition systems that do not require a battery. When the aircraft is started with the electrical starter, the starter turns the engine until the magnetos provide ignition through the spark plugs. The electrical starter is then disengaged. The electrical system could fail and the magnetos would continue to provide spark through the spark plugs.

If one of the magnetos failed or was turned off, the RPM would decrease by approximately 50-125 RPM. This is due to the positioning of the spark plugs in the

cylinder. Each cylinder has 2 spark plugs positioned across from each other at the top of the cylinder, but neither one is directly in the middle of the top of the cylinder.

When one magneto fails, each cylinder is only getting spark from one spark plug, which is not positioned directly in the center of the top of the cylinder. This results in an uneven and incomplete burn of the fuel/air mixture during combustion.

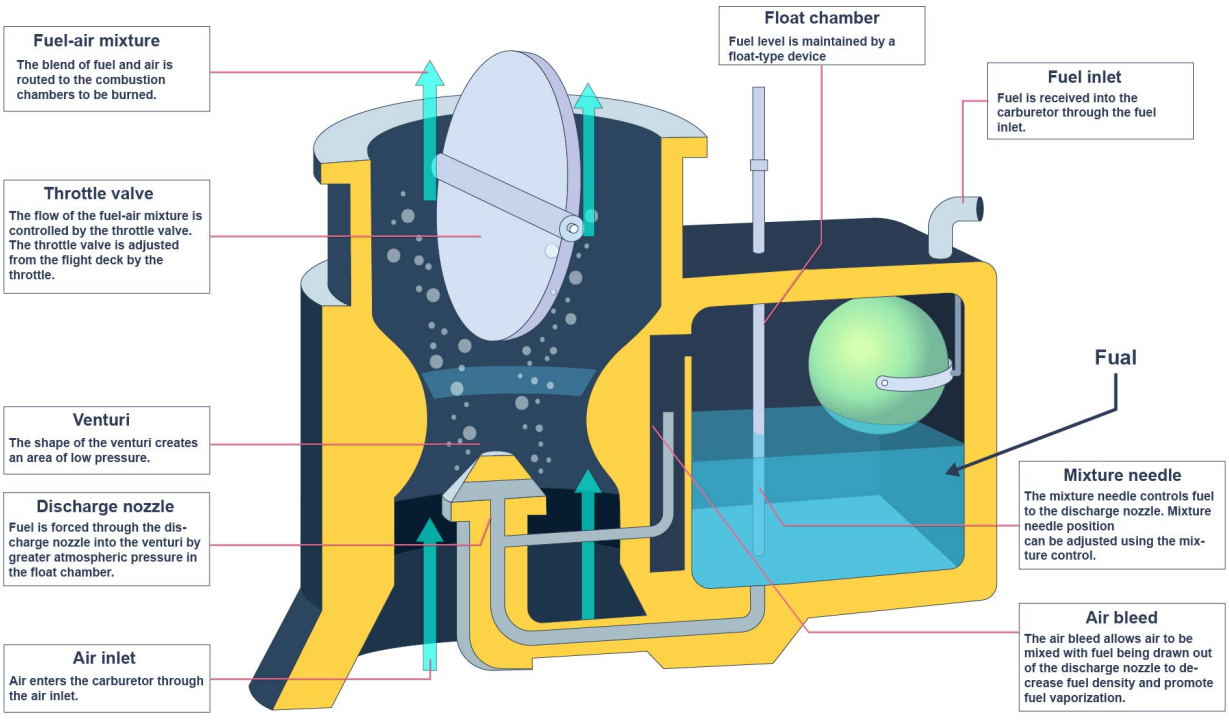
**Carburetor**

The carburetor mixes fuel and air before sending it into the cylinders for combustion. It does this with a float chamber, venturi, and butterfly valve.

Float Chamber - this is where the fuel is held prior to mixing with the air. Fuel level in the chamber is maintained via the float device.

Venturi - this is where the fuel and air are mixed together. This happens because of the shape of the venturi, it causes air to speed up as it passes through the narrow throat which reduces the pressure. This low pressure area sucks the fuel into the venturi, giving us our fuel/air mixture that is now ready for combustion.

Butterfly Valve - this valve is controlled by the throttle. As you advance the throttle forward, the butterfly valve begins to open and the fuel/air mixture can pass through more easily into the cylinders.



**Stages of Combustion**

1. Intake - the piston is lowered and the fuel/air mixture delivered to the cylinder's combustion chamber
2. Compression - the piston is raised to compress the fuel/air mixture
3. Combustion - the spark plugs fire when the fuel/air mixture is compressed
4. Exhaust - the combustion of the fuel/air mixture drives the piston downward and the exhaust is discarded

**Primary Flight Controls**

| Control Surface | Airplane Movement | Axes of Rotation | Type of Stability |
|---|---|---|---|
| Aileron | Roll | Longitudinal | Lateral |
| Elevator | Pitch | Lateral | Longitudinal |
| Rudder | Yaw | Vertical | Directional |

**Secondary Flight Controls (C172)**

- Flaps - Plain, Slotted Flaps
- Trim - Trim tab on the elevator

What do flaps do?
Flaps enable the pilot to increase the rate of descent without increasing the airspeed, and also to reduce the ground roll on landing.

What does trim do?
Trim adjusts the airspeed that the aircraft will fly without intervention from the pilot. This helps to relieve the manual input required to maintain a desired flight position.

**Landing Gear (C172)**

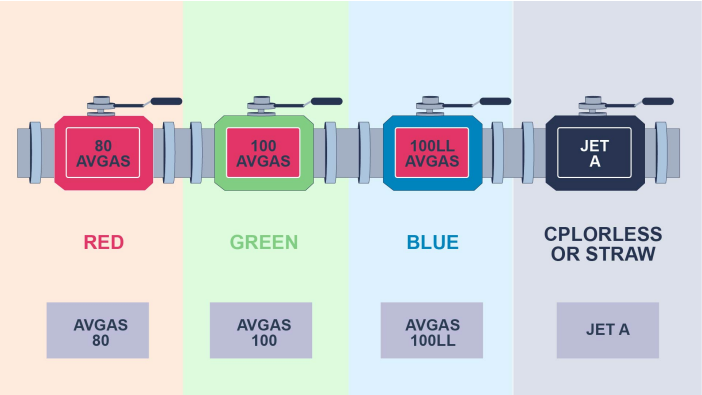
Tricycle type landing gear with a steerable nose wheel and two main wheels. Shock absorption is provided by the tubular spring-steel main landing gear struts and the air/oil nose gear shock strut.

Each main gear wheel is equipped with a hydraulically actuated disc brake on the inboard side of each wheel.

**Fuel (C172)**

The aircraft has 2 vented fuel tanks, a four-position selector valve, fuel strainer, manual primer, and carburetor.

We use 100LL AVGAS which is blue in color.




**Electrical (C172)**

Electrical energy is supplied by a 14-volt, direct-current system powered by an engine-driven, 60-amp alternator. The 12-volt battery is located on the left side of the firewall. Power is supplied to all electrical circuits through a split bus bar.

**Compass Deviations - VDMONA**

**V**ariation
**D**eviation
**M**agnetic Dip
**O**scillation
**N**ortherly Turning Errors (UNOS)
**A**cceleration Errors (ANDS)

**Pressure Altitude** - Altitude corrected for non-standard pressure. Standard pressure and temperature is 29.92” Mercury and 15°C at Sea Level.

**Density Altitude** - Pressure altitude corrected for non-standard temperature.

Higher density air reduces performance in each of the following:
1. Propellor
2. Engine
3. Wings

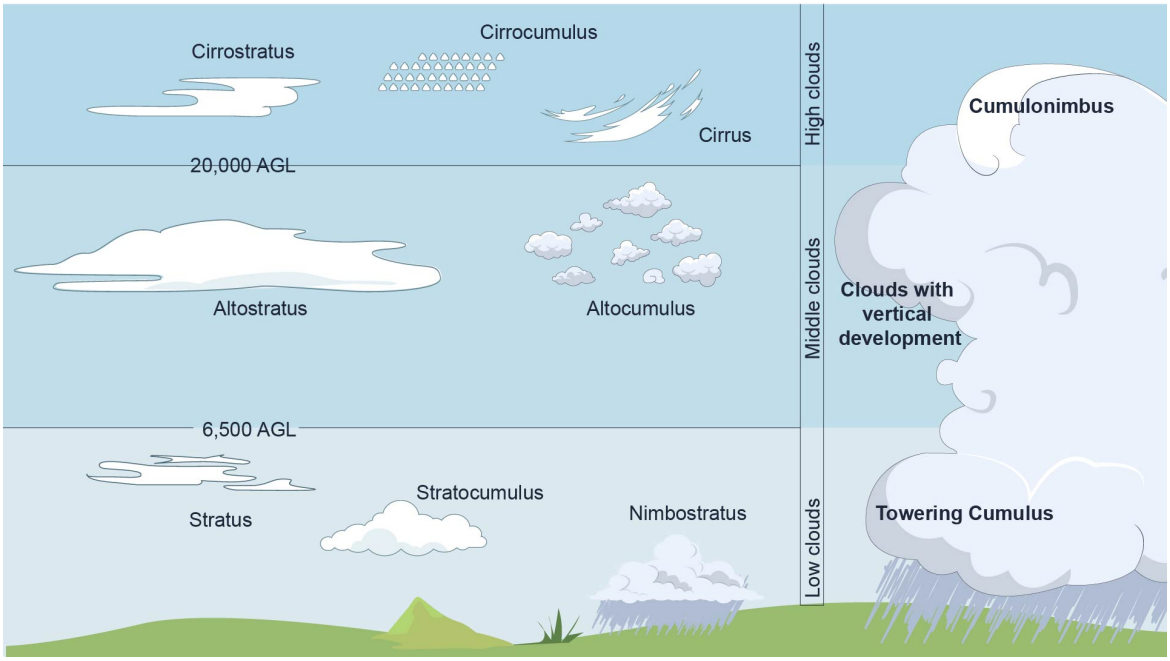
Because of reduced performance with higher density altitude, it is important to account for longer take-off and landing roll, as well as reduced climb performance over an obstacle.

**What is standard temperature at 6,000’ MSL?**

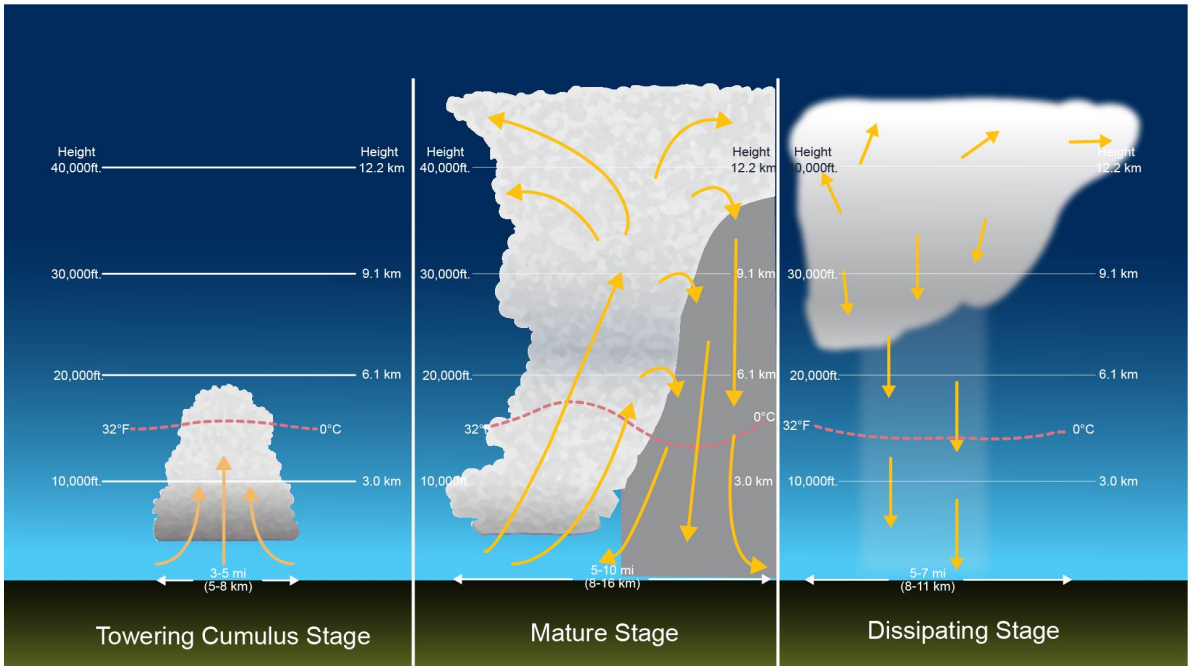
3°C - This is because the temperature of air decreases 2°C per 1,000’ in standard conditions, also called the “standard lapse rate”.

# Weather

## Types of Clouds




## 3 Stages of a Thunderstorm



**Types of Icing** (DO NOT fly into known icing conditions unless your aircraft is approved)
1. Structural - Clear, ryhme, mixed
2. Carburetor/Intake - Use carburetor heat
3. Pitot - Use pitot heat

**Weather Reports**

| Types of Current Weather | Types of Forecast Weather |
|---|---|
| PIREP | Winds/Temps Aloft |
| METAR | Prog Charts |
| Radar | TAF |
| Satellite | AIRMET, SIGMET, Convective SIGMET |

**METAR** - Meteorological Report issued every hour for a specific airport.

*Sample:* **METAR KRBD 280753Z AUTO 19011KT 10SM**
**CLR 28/22 A2982 RMK AO2 SLP088 T02830222**

METAR - Type of report
KRBD - Airport
280753Z - Date and Time (28th of the month, 0753 Zulu Time)
AUTO - ATC is closed and the computer generated this report
19011KT - Wind is 190° at 11 Knots
10SM - 10 Statute Miles Visibility
CLR - Sky Clear (no clouds)
28/22 - Temperature is 28°C/Dewpoint is 22°C
A2982 - Altimeter setting for non-standard pressure is 29.82
RMK - Remarks section
AO2 - Precipitation identifying equipment (can tell between rain or hail or snow)
SLP088 - Sea Level Pressure (not used in normal flight training in America)
T02830222 - Temperature 28.3°C/Dewpoint 22.2°C (more detailed than before)

**TAF** - Terminal Aerodrome Forecast issued every 6 hrs (4 per day) and lasts 24 hrs.

*Sample:* **KDAL 280520Z 2806/2906 17013KT P6SM FEW250**

KDAL - Airspace
280520Z - Date and Time (28th of the month, 0520 Zulu Time)
2806/2906 - Valid Time Frame (From the 28th at 0600 Zulu until the 29th at 0600 Zulu)
17013KT - Wind is 170° at 13 Knots

P6SM - Plus or Greater than 6 Statute Miles Visibility
FEW250 - Few clouds at 25,000' AGL

**PIREP** - Pilot Report, reported by pilots to ATC or flight service station.

*Sample:* **ABQ UA/OV ABQ115040/TM 0708/FL190/TP BE20/TA M04/IC LGT RIME/ RM OAT**

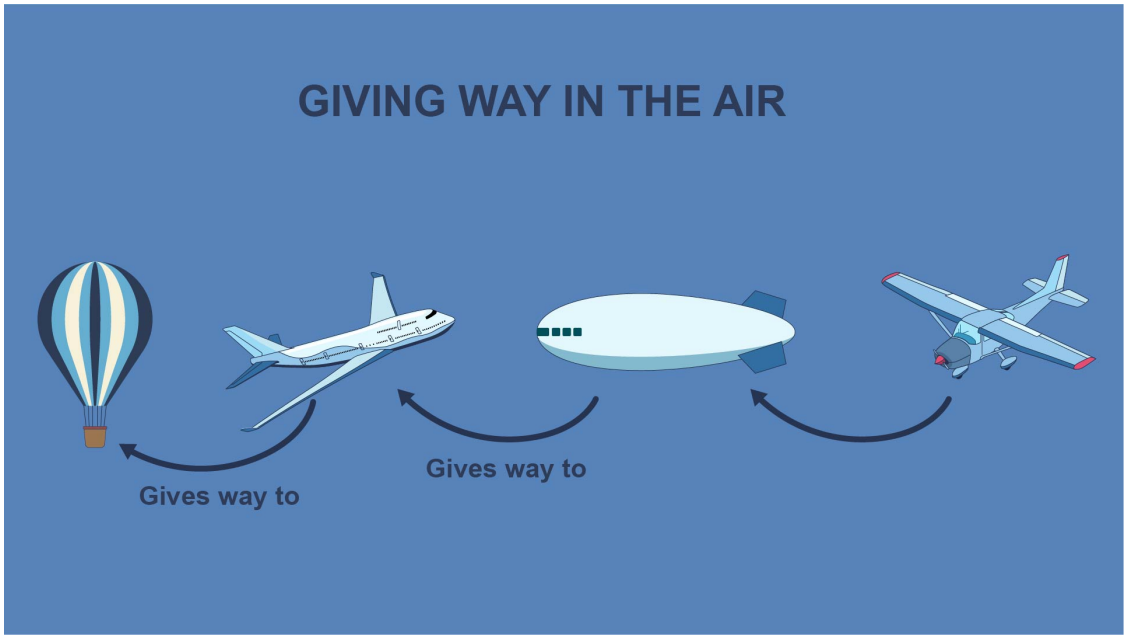
| | | | |
|---|---|---|---|
| 1 | XXX | 3-letter station identifier | Nearest weather reporting location to the reported phenomenon |
| 2 | UA | Routine PIREP, UUA-Urgent PIREP. | |
| 3 | /OV | Location | Use 3-letter NAVAID idents only.<br>a. Fix: /OV ABC, /OV ABC 090025.<br>b. Fix: /OV ABC 045020-DEF, /OV ABC-DEF-GHI |
| 4 | /TM | Time | 4 digits in UTC: /TM 0915. |
| 5 | /TL | Altitude/flight level | 3 digits for hundreds of feet. If not known, use UNKN: /FL095, /FL310, FLUNKN. |
| 6 | /TP | Type aircraft | 4 digits maximum. If not known, use UNKN: /TP L329, /TP B727, /TP UNKN. |
| 7 | /SK | Sky cover/cloud layers | Describe as follows:<br>a. Height of cloud base in hundreds of feet. If unknown, use UNKN.<br>b. Cloud cover symbol.<br>c. Height of cloud tops in hundreds of feet. |
| 8 | /WK | Weather | Flight visibility reported first:<br>Use standard weather symbols:<br>/WX FV02SM RA HZ, /WX FVOISM TSRA. |
| 9 | /TA | Air temperature in celsius (C) | If below zero, prefix with a hyphen: ITA 15, [TA M06. |
| 10 | /WV | Wind | Direction in degrees magnetic north and speed in six digits:<br>/WV270045KT, WV 2801 IOKT. |
| 11 | /TB | Turbulence | Use standard contractions for intensity and type (use CAT or CHOP when appropriate). Include altitude only if different from [FL, [TB EXTRM, [TB LGT-MOD BLO 090. |
| 12 | /IC | Icing | Describe using standard intensity and type contractions. Include altitude only if different than /FL: /IC LGT-MOD RIME, /IC SEV CLR 028-045. |
| 13 | /RM | Remarks | Use free form to clarify the report and type hazardous elements first:<br>/RM LLWS -15KT SFC-030 DURC RY22 JFK. |

**Pilot In Command Responsibility - 91.3****

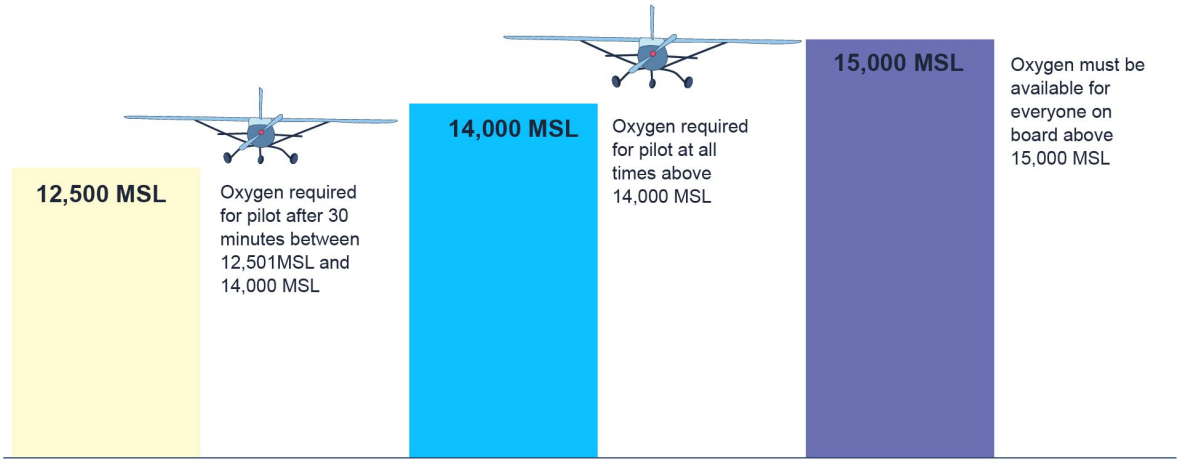
(a) The Pilot In Command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft.

(b) In an in-flight emergency requiring immediate action, the PIC may deviate from any rule of this part to the extent required to meet that emergency.

**Right of Way Rules**




**Oxygen Requirements**



**Wake Turbulence Avoidance**

Airplanes produce the most wake turbulence when they are *heavy, clean, and slow.*

To avoid wake turbulence:
- Land beyond the touch down point of the previous aircraft
- Rotate before the previous aircraft did and stay above their flight path or sidestep upwind

**Night Time**
1. Sunset and sunrise - Navlights go on
2. Morning and evening civil twilight - Log night flight time
3. 1 hr before sunrise and after sunset - Log night landings

**Logging Flight Time - 61.51**
What flight time has to be logged?
Any time required to obtain a flight review, certificate, or currency

**What is the difference between currency and proficiency?**

Current = legal
Proficient = capable

**Light Gun Signals**

| LIGHT GUN SIGNALS | | | |
|---|---|---|---|
| COLOR AND TYPE OF SIGNAL | MOVEMENT OF VEHICLES EQUIPMENT, AND PERSONNEL | AIRCRAFT ON THE GROUND | AIRCRAFT IN FLIGHT |
| STEADY GREEN | Cleared to cross, proceed, or go | Cleared for takeoff | Cleared to land |
| FLASHING GREEN | Not applicable | Cleared for taxi | Return for landing (to be followed by steady green at the proper time) |
| STEADY RED | Stop! | Stop! | Give way to other aircraft and continue circling |
| FLASHING RED | Clear the taxiway/runway | Taxi clear ofthe runway in use | Airport unsafe, do not land |
| FLASHING WHITE | Return to starting point on airport | Return to starting point on airport | Not applicable |
| ALTERNATING RED AND GREEN | Exercise extreme caution! | Exercise extreme caution! | Exercise extreme caution! |

**Engine Failure** - ABCDE

**A**irspeed to Best Glide
**B**est Place to Land
**C**hecklist
**D**eclare an Emergency
**E**xecute/Egress

**Squawk Codes**

1200 - VFR
7500 - Hijack
7600 - Lost Comms
7700 - Emergency

**Minimum Safe Altitudes - 91.119**

Except when necessary for takeoff or landing, no person may operate an aircraft below the following altitudes:

(a) Anywhere. An altitude allowing, if a power unit fails, an emergency landing without undue hazard to persons or property on the surface.

(b) Over congested areas. Over any congested area of a city, town, or settlement, or over any open air assembly of persons, an altitude of 1,000 feet above the highest obstacle within a horizontal radius of 2,000 feet of the aircraft.

(c) Over other than congested areas. An altitude of 500 feet 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.

**Hypoxia** - Lack of oxygen

Symptoms of hypoxia include blue extremities, light headedness, headache, shortness of breathe, etc.

| Types of Hypoxia | Caused by | Example |
|---|---|---|
| Hypoxic | Lack of oxygen | High altitude |
| Hypemic | Lack of oxygen to the blood | Carbon Monoxide Poisoning |
| Histotoxic | Lack of oxygen to the cells | Alcohol |
| Stagnant | Flow or delivery of oxygen being blocked | Pulling g's or sitting on your leg |

**V-Speeds**

VA - Maneuvering Speed
VFE - Maximum Flaps Extended Speed
VNO - Maximum Structural Cruising Speed
VNE - Never Exceed Speed
VS - Stall Speed in the clean configuration
VSO - Stall Speed in the landing configuration
VX - Best Angle of Climb
VY - Best Rate of Climb

**Maneuvering Speed (Va)** - The speed below which the aircraft can make one full control input, on one axis of movement without damaging the aircraft. Below the maneuvering speed, the aircraft will stall before it is damaged. Maneuvering speed changes with weight.