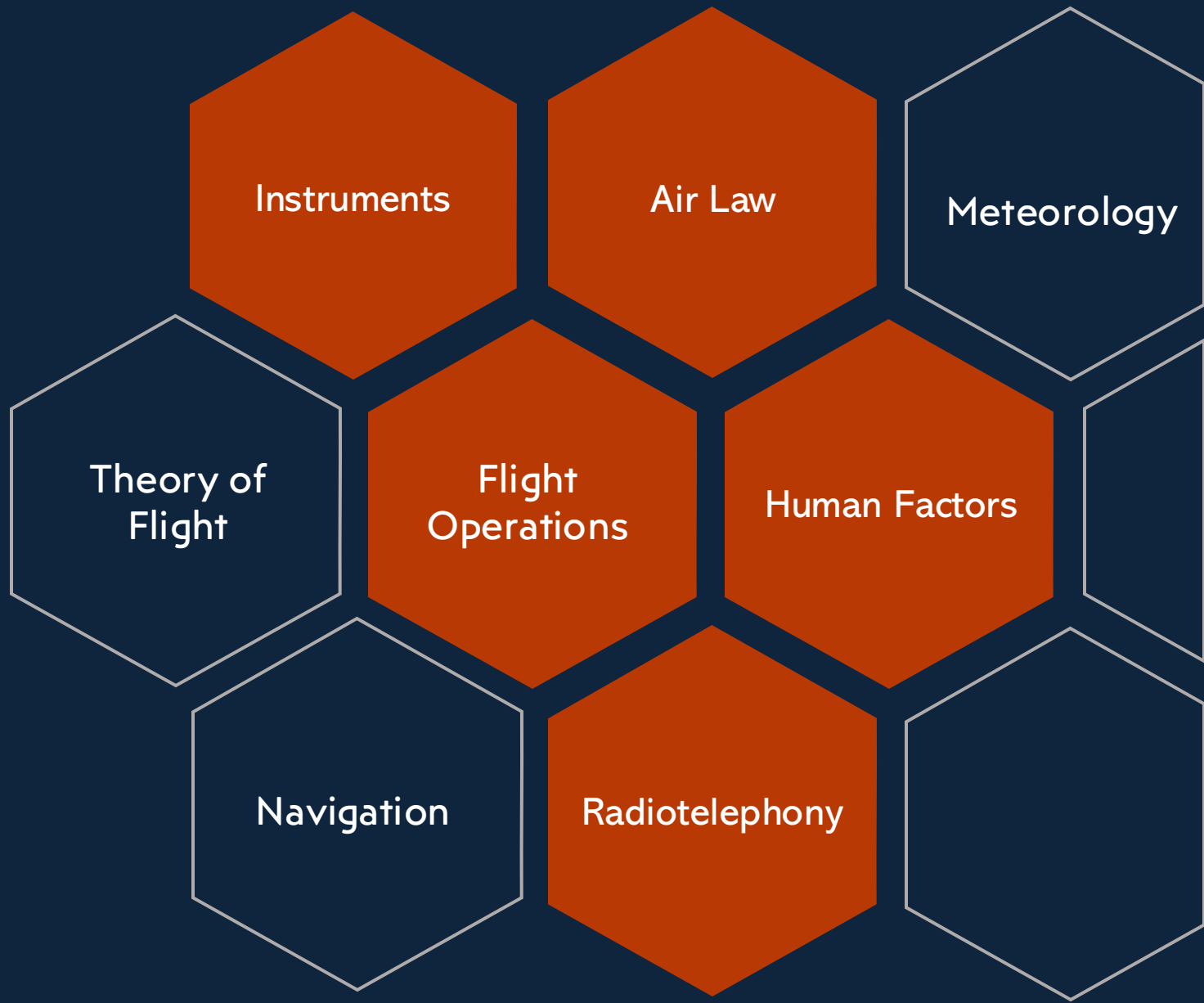
BRAMPTON FLIGHT CENTRE

Advanced RPAS Flight Operations

Brampton
Flight Centre

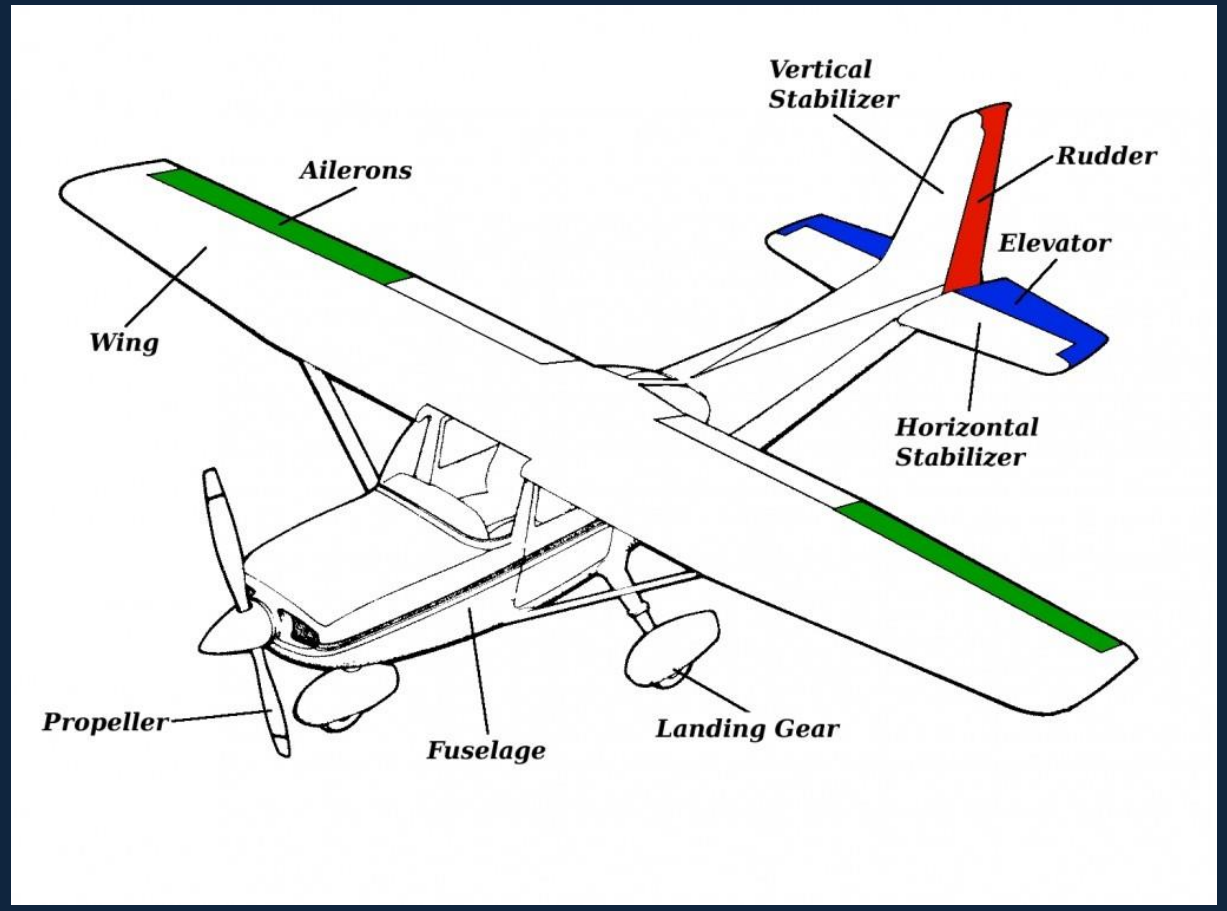
Overview


Instruments
Air Law
Meteorology
Theory of Flight
Flight Operations
Human Factors
Navigation
Radiotelephony

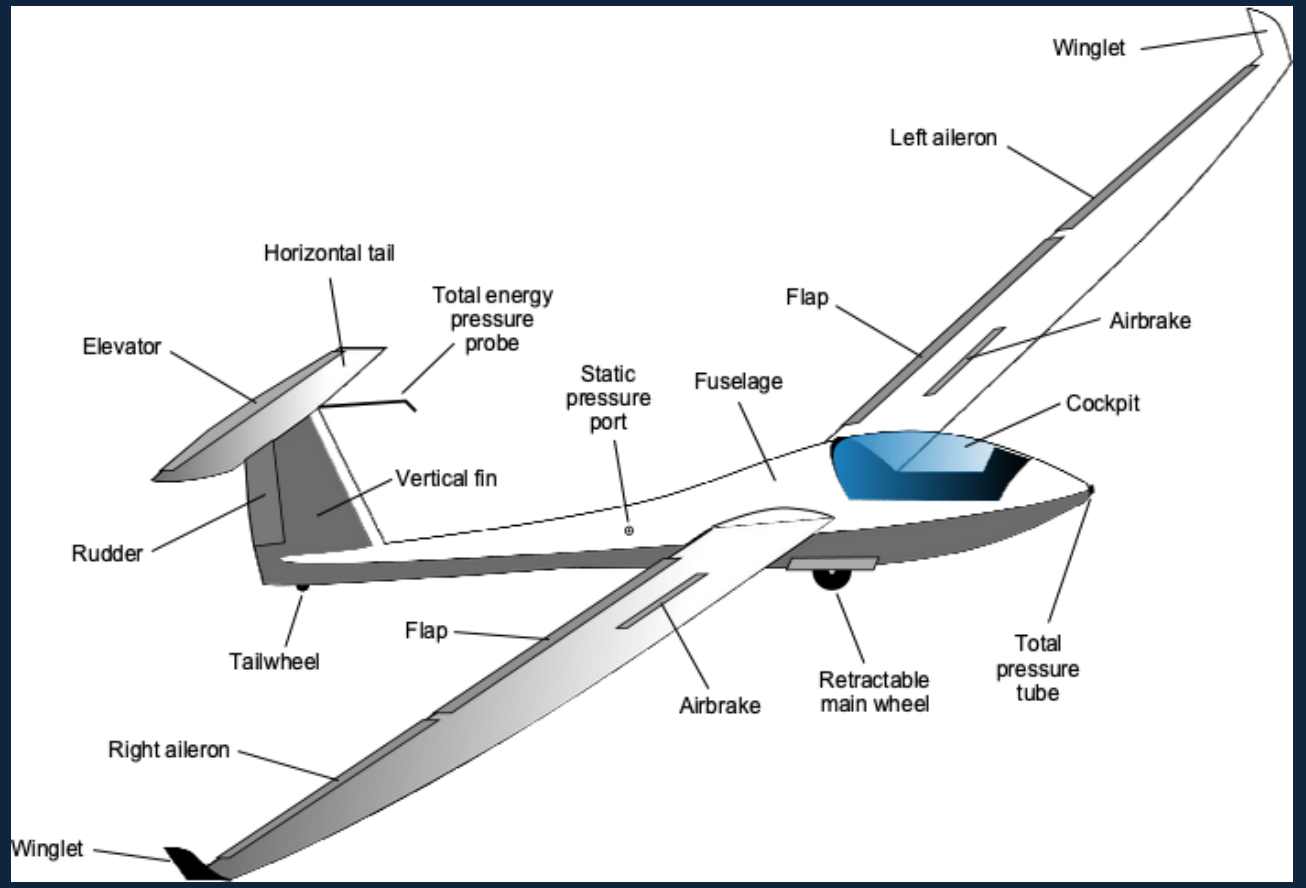
Theory of Flight

- Aircraft Components
- Forces on an Aircraft
- Stability
- Gliders
- Design of the Wing
- Aircraft Flight Controls and Dynamics
- Load Factor

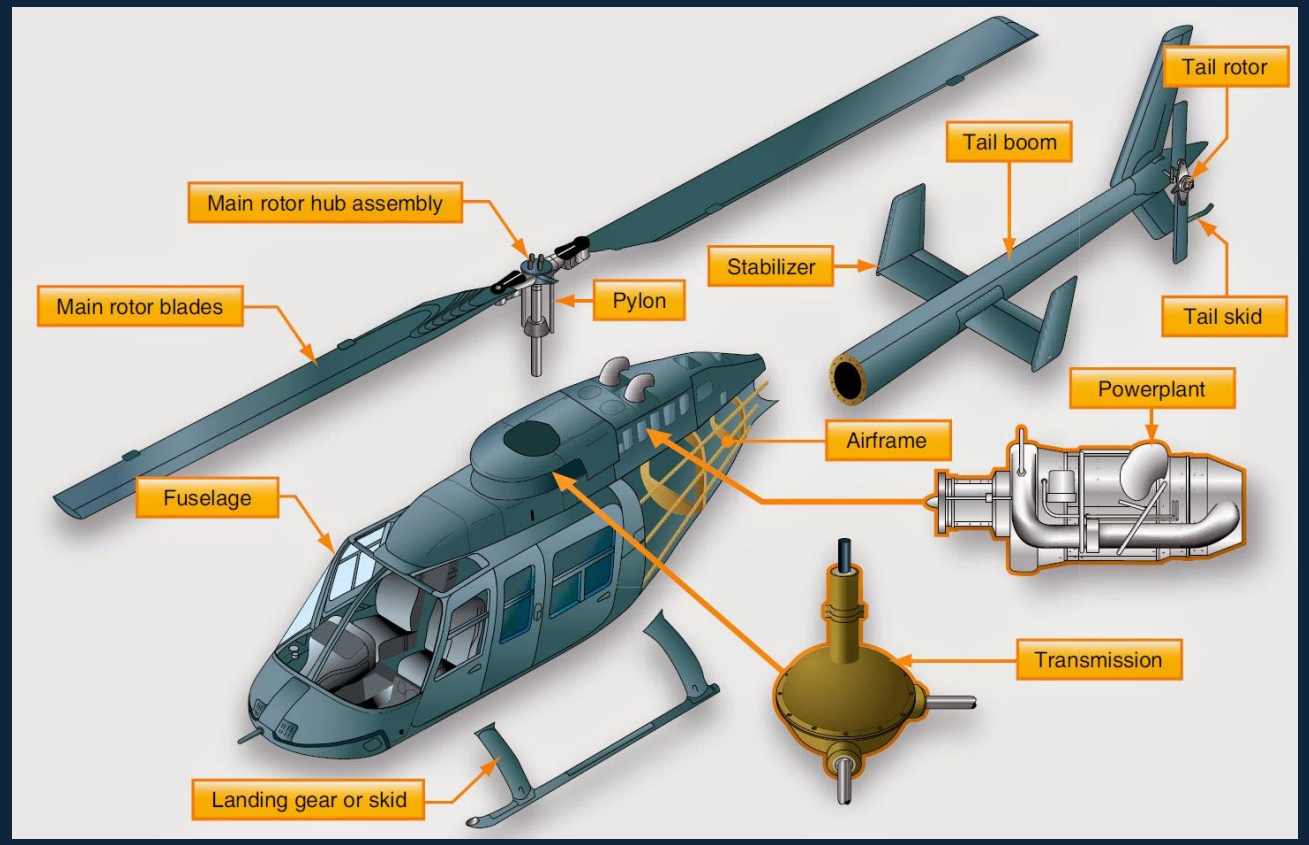
Parts of an Aircraft



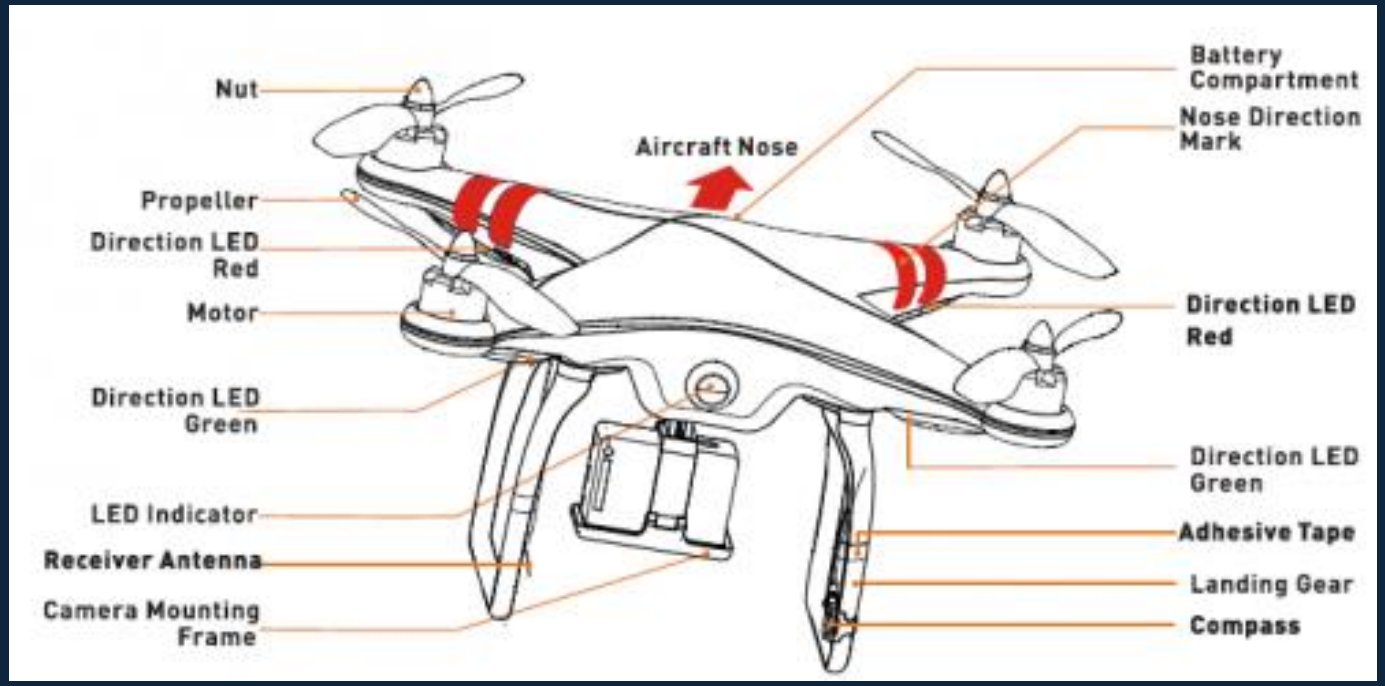
Parts of a Glider



Parts of a Helicopter

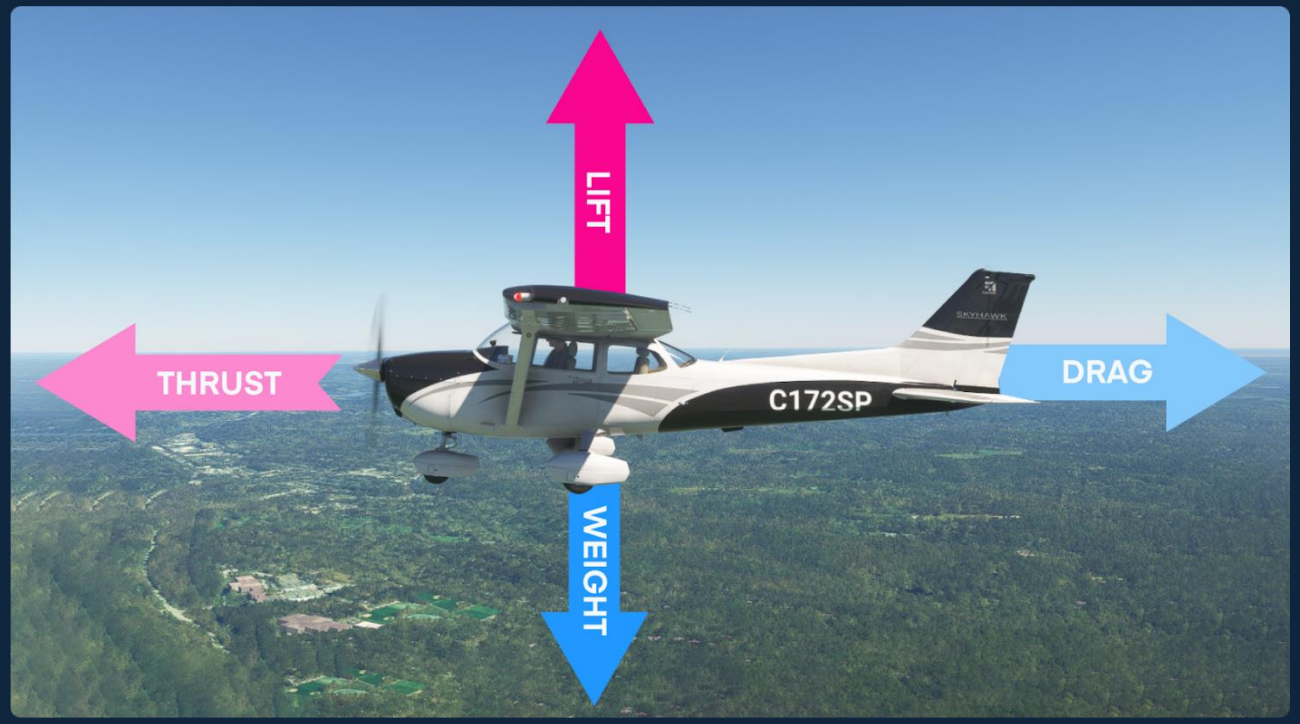


Parts of a Multirotor



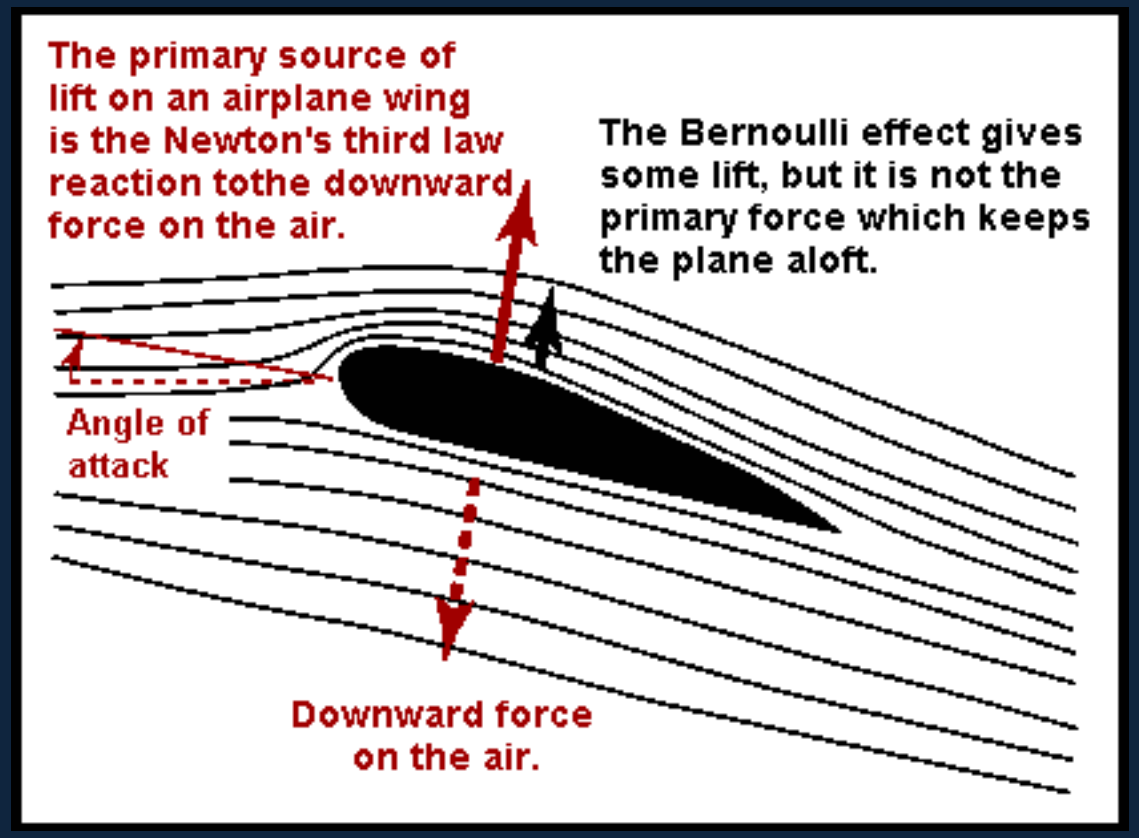
Theory of Flight

The 4 Forces on an Aircraft



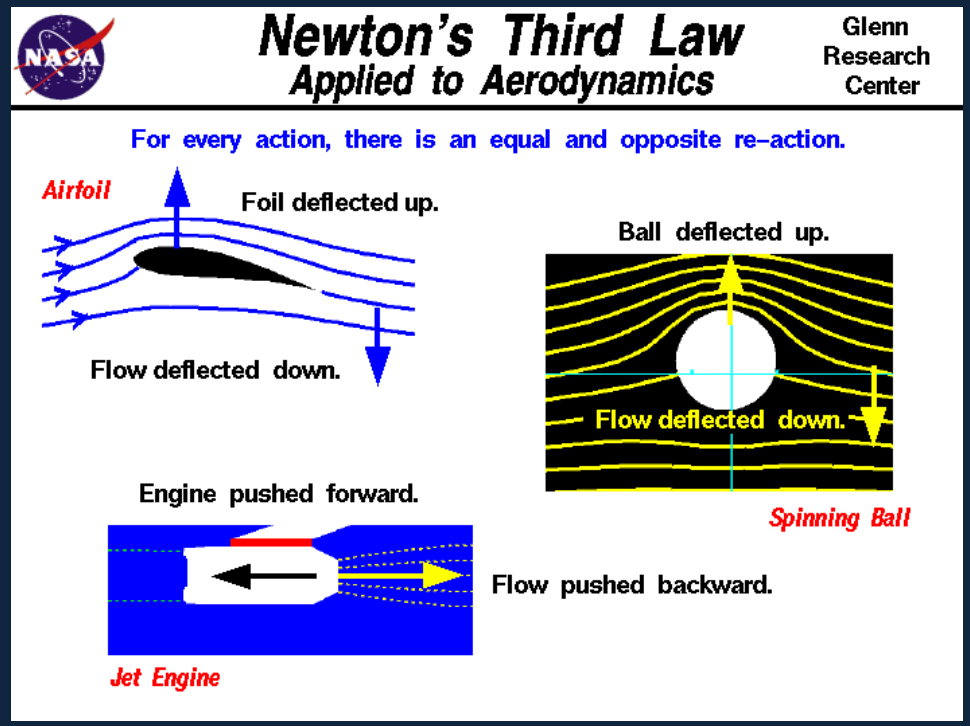
How is Lift Produced?

Bernoulli's Principle & Newton's 3rd Law



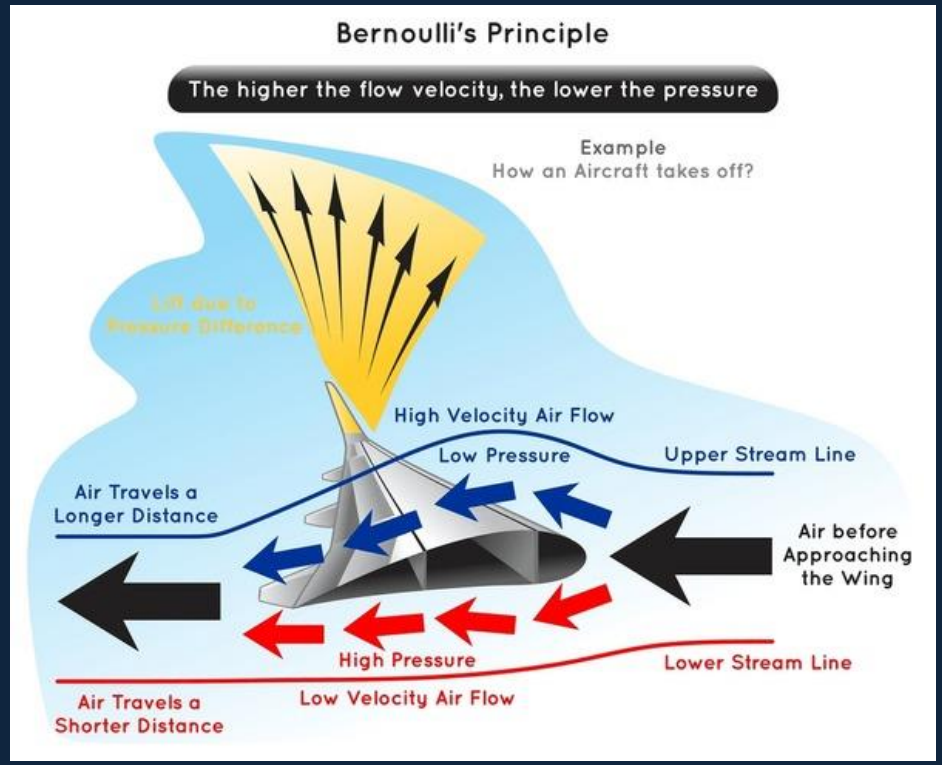
Newton’s Laws

- Every object in a state of motion will remain in motion unless an external force is applied to it
- The relationship between an objects mass and acceleration and its applied force is F=ma
- For every action there is an equal and opposite reaction



Bernoulli's Principle

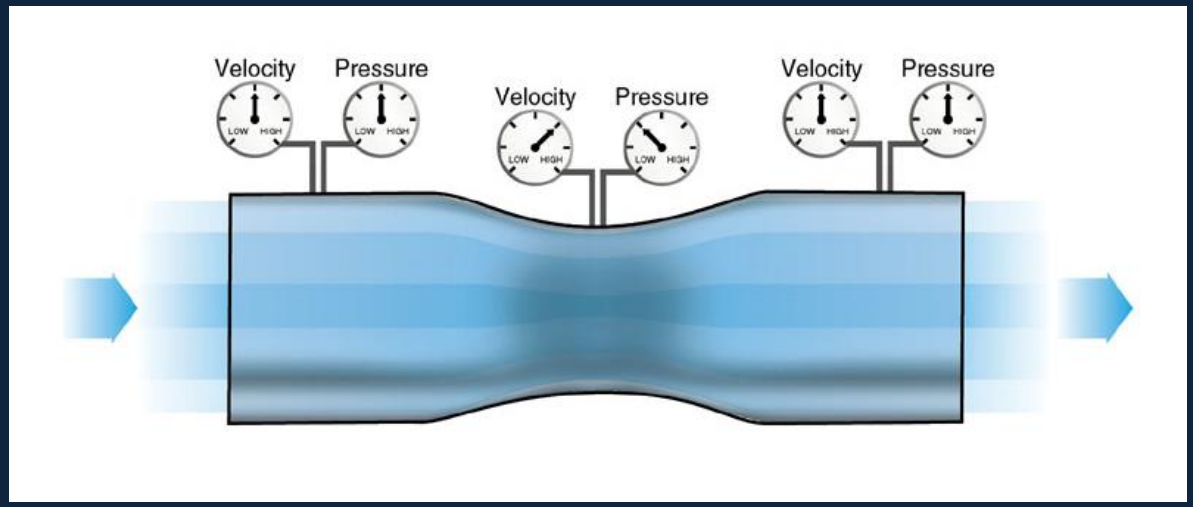
- Bernoulli's principle of conservation of energy
- The total energy in a closed system remains constant
- As the velocity of a fluid increases the pressure decreases
- P + V always remain constant



Bernoulli's Principle

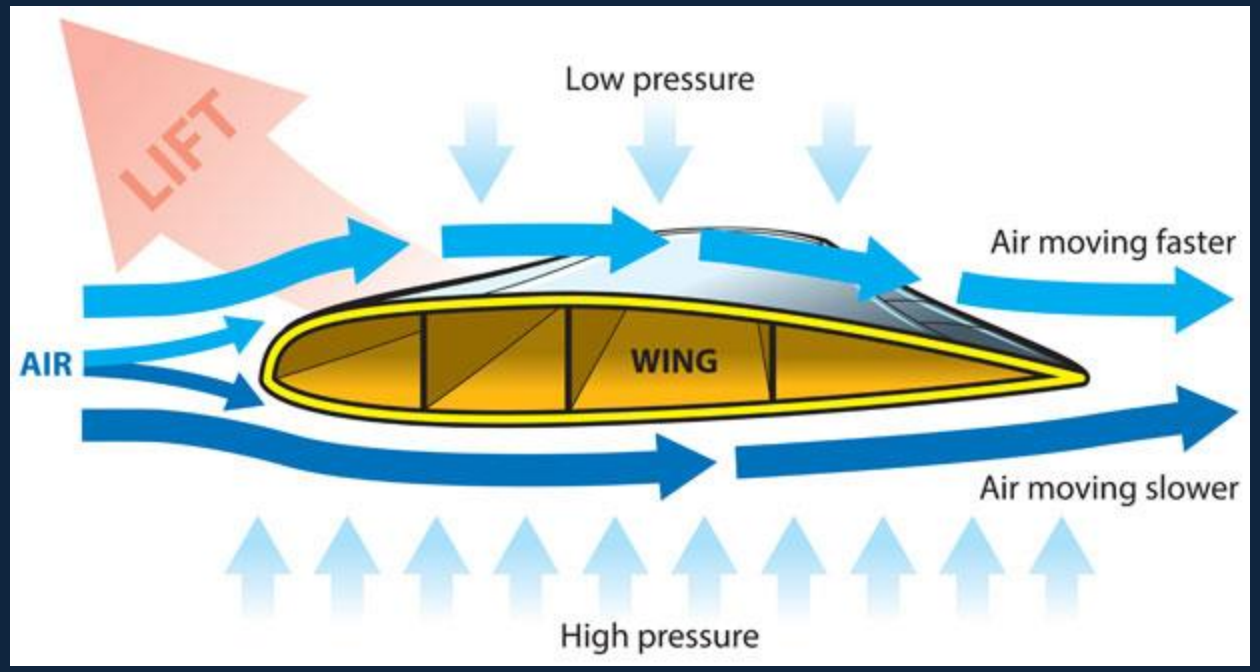
The Venturi Effect

- As Velocity Increases, Pressure Decreases
- As Velocity Decreases, Pressure Increases



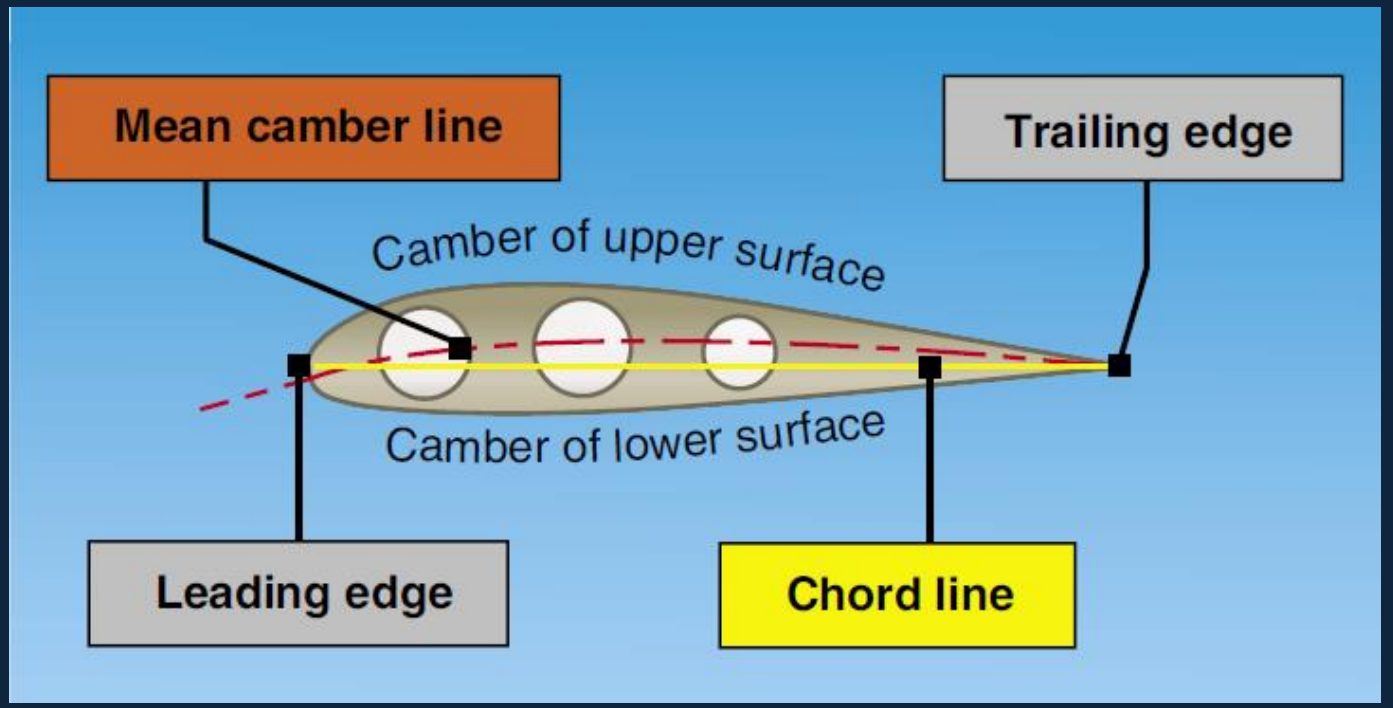
Bernoulli's Principle

How is lift generated?



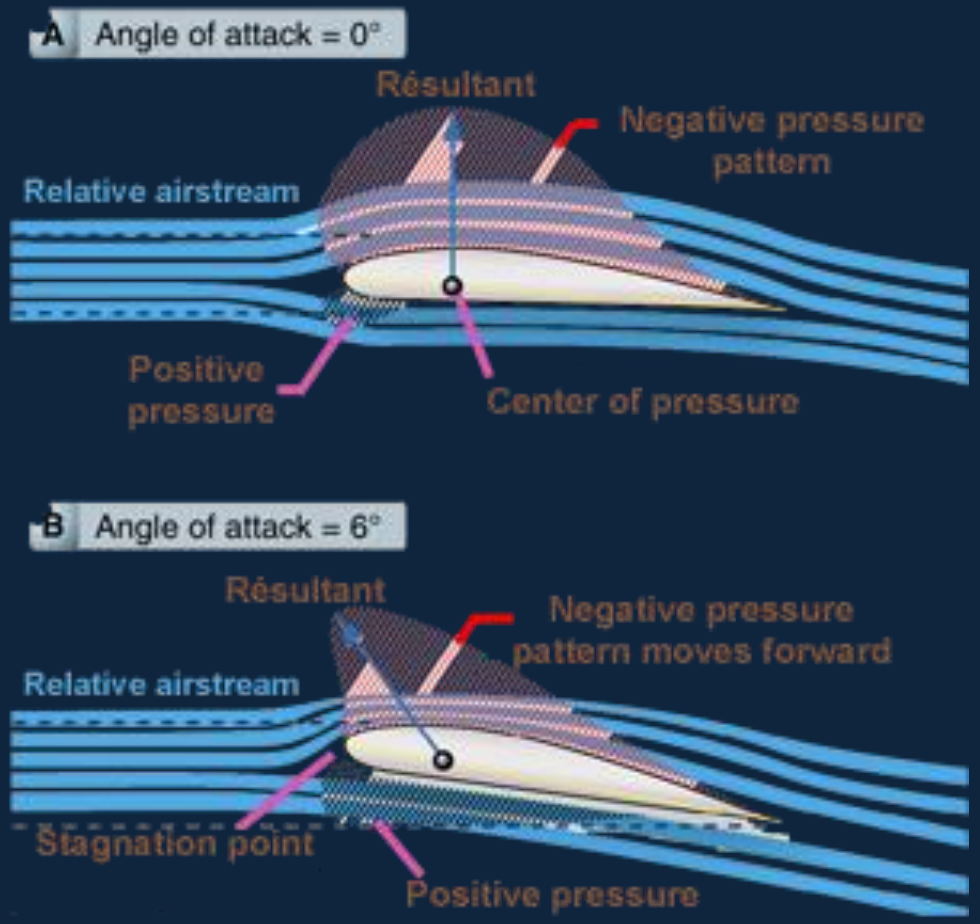
Airfoil Shape

How is lift generated?



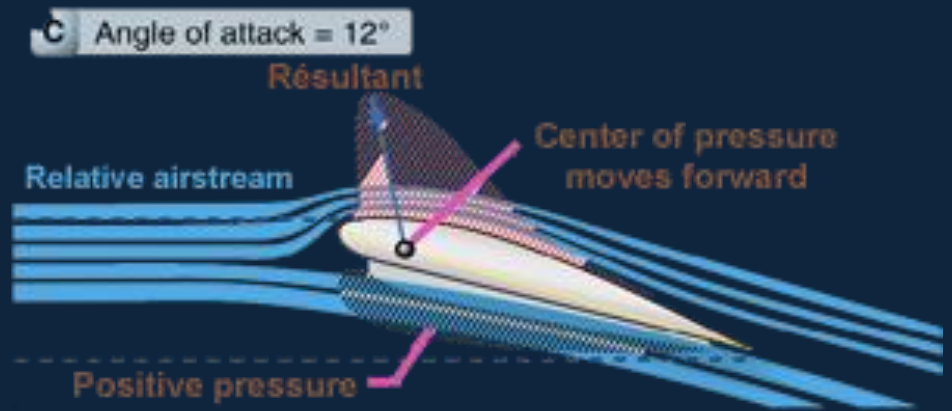
Relative Airflow

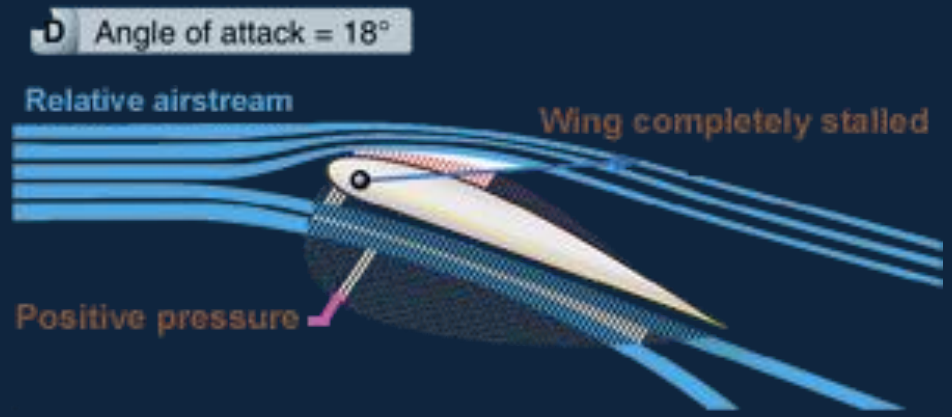
Produced by an airfoil moving through the air



Relative Airflow

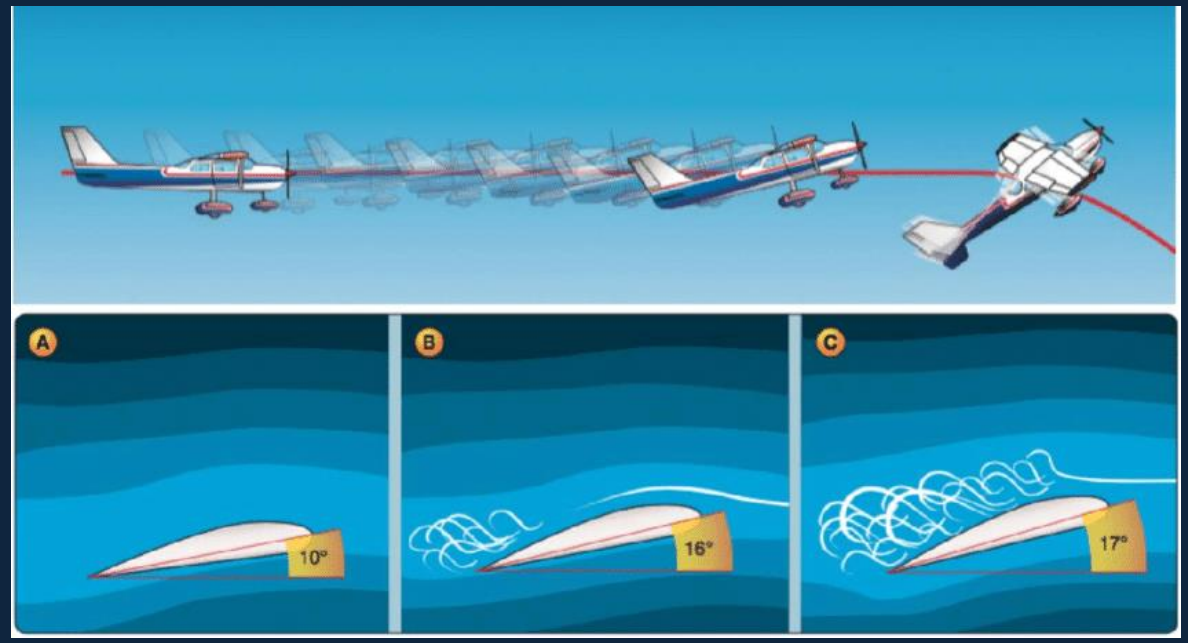
It is always opposite to the direction of flight





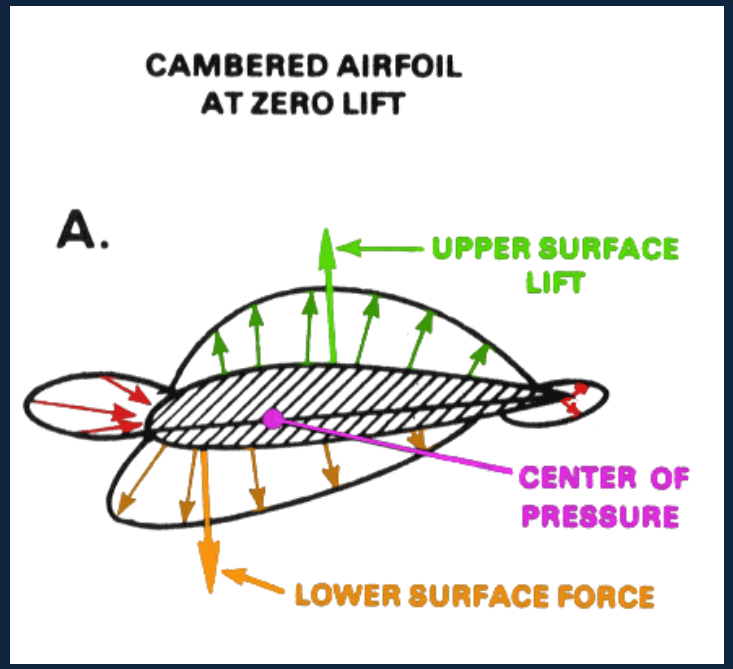
Angle of Attack

The angle the relative airflow makes with the chord line



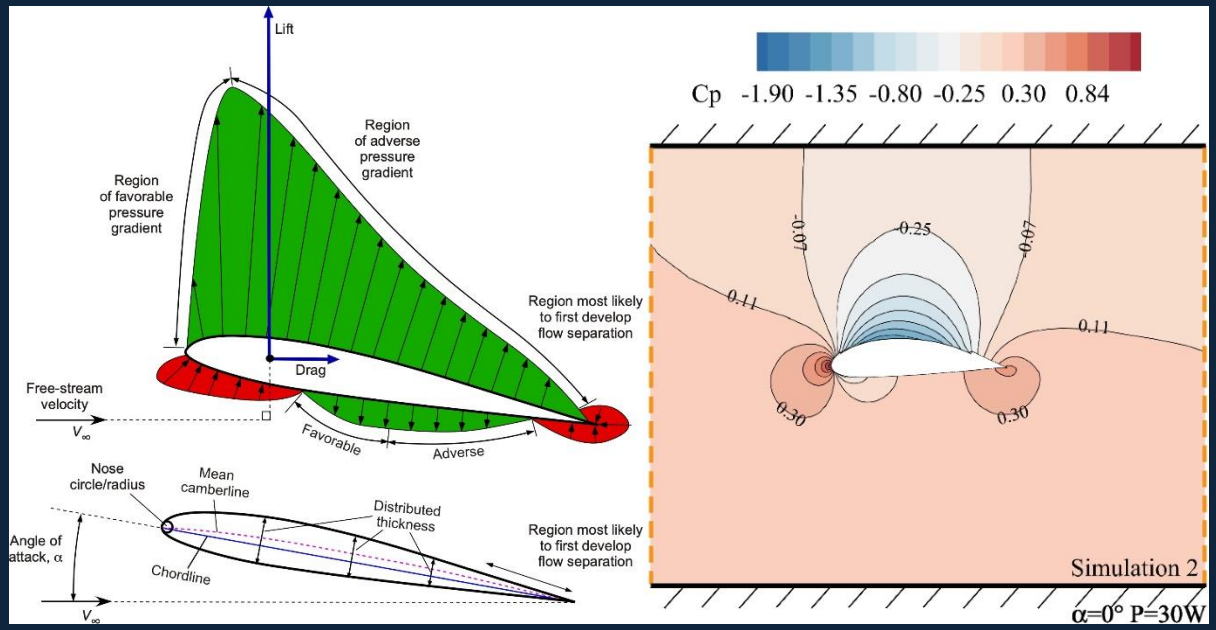
Airfoils – Pressure Distribution

- The upper surface has pressures distributed which produce the upper surface lift.
- The lower surface has pressures distributed which produce the lower surface force.
- Net lift produced by the airfoil is the difference between lift on the upper surface and the force on the lower surface.
- Effectively concentrated at a point on the chord called the ***Center Of Pressure***.



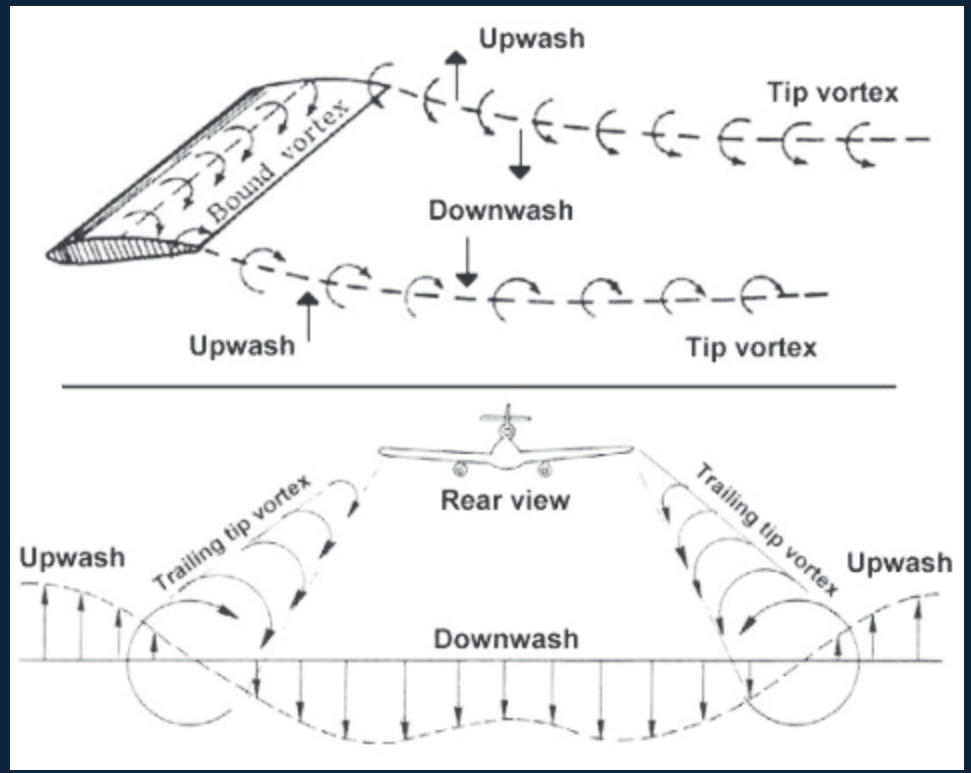
Airfoils – Pressure Distribution

- Upper surface lift increases relative to the lower surface force.
- Since the two vectors are not located at the same point along the chord line, a twisting force is exerted about the center of pressure.
- Center of pressure also moves along the chord line when angle of attack changes, because the two vectors are separated.
- This characteristic of nonsymmetrical airfoils results in undesirable control forces that must be compensated for if the airfoil is used in rotary wing applications.

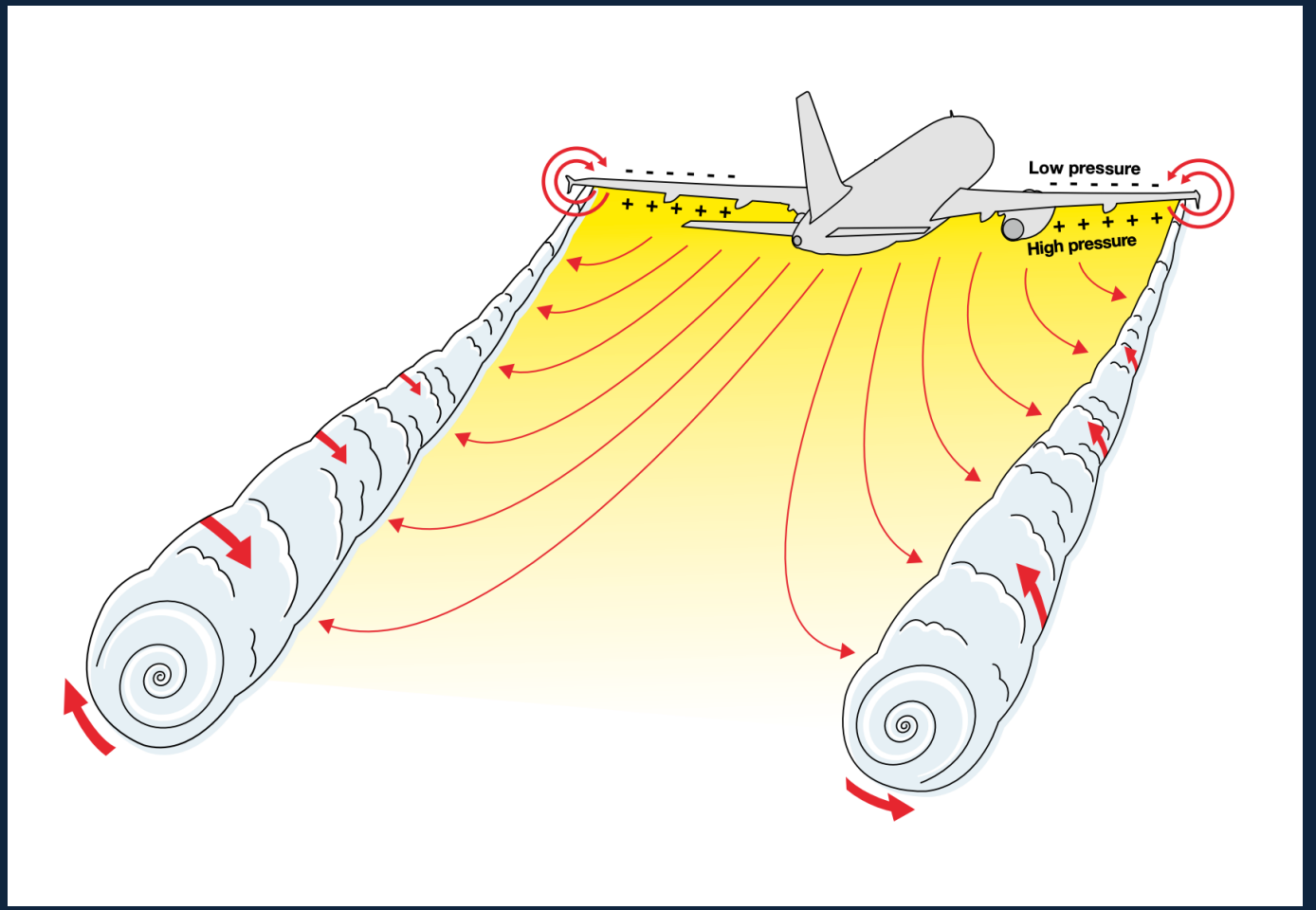


Airfoils – Downwash

- Downwash refers to the flow of air behind the airfoil
- As the air flows back over the airfoil, the air flows not only rearward but downward as well
- The airflow under the airfoil also gets deflected downward by the bottom of the wing surface



Airfoils – Downwash



Airfoils – Types

CONVENTIONAL AIRFOILS

Low camber — low drag — high speed — thin wing section
Suitable for race planes, fighters, interceptors, etc.

Deep camber — high lift — low speed — thick wing section
Suitable for transports, freighters, bombers, etc.

Deep camber — high lift — low speed — thin wing section
Suitable as above.

Low lift — high drag — reflex trailing edge wing section.
Very little movement of centre of pressure. Good stability.

Symmetrical (cambered top and bottom) wing sections.
Similar to above.

GA(W)-1 airfoil — thicker for better structure and lower weight — good stall characteristics — camber is maintained farther rearward which increases lifting capability over more of the airfoil and decreases drag.

Lift vs. Angle of Attack

- As angle of attack (α) increases the amount of lift produced increases
- THIS IS TRUE FOR ANGLES UP TO THE CRITICAL ANGLE OF ATTACK
- Beyond that AoA, lift will decrease with increasing angle of attack.

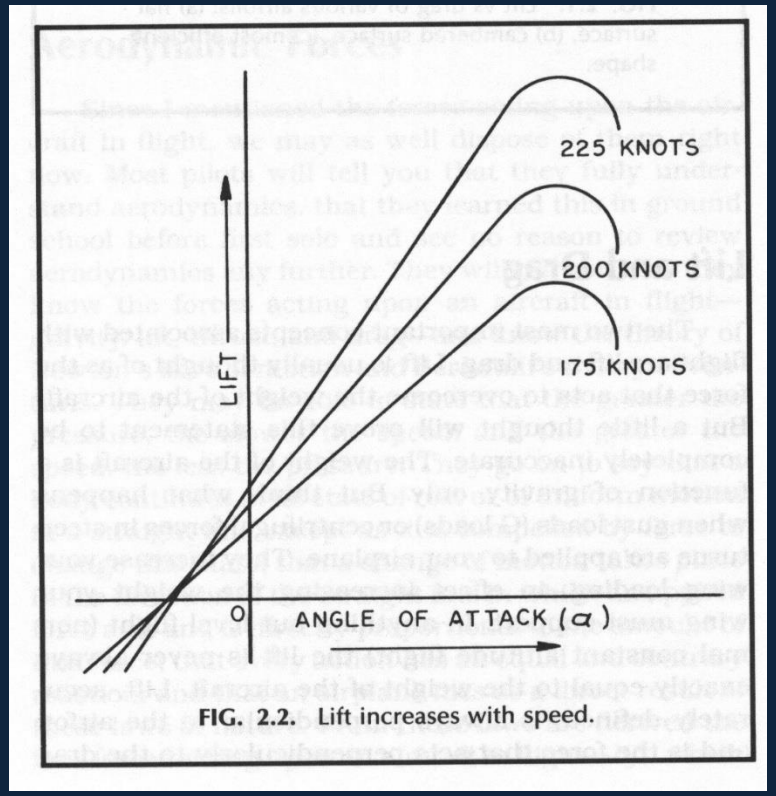
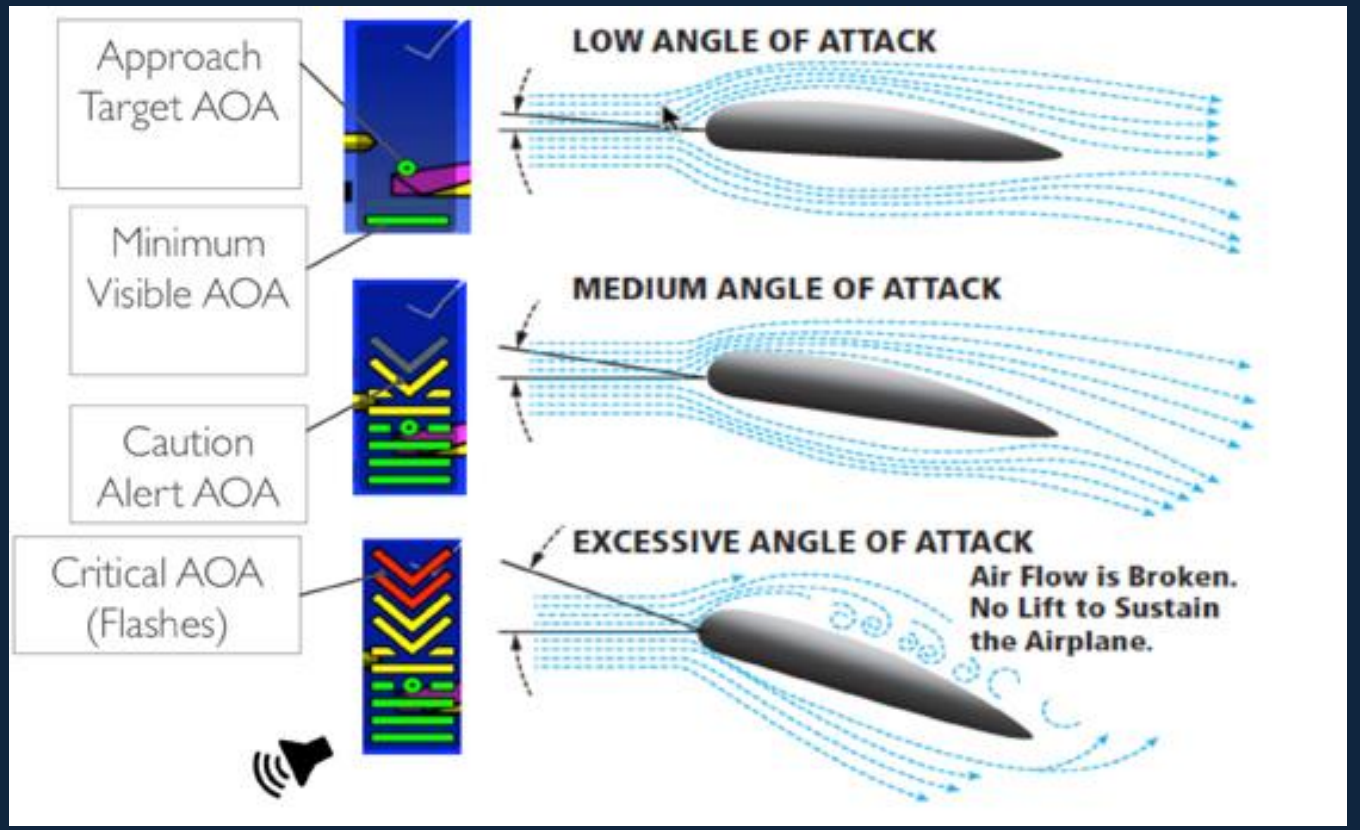
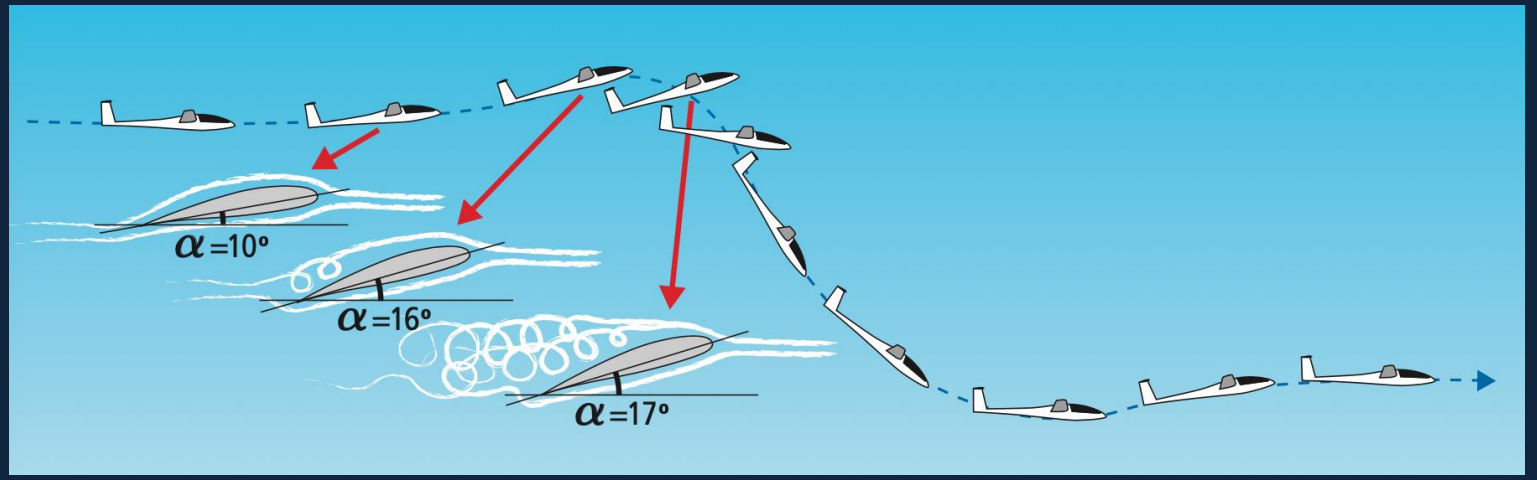


FIG. 2.2. Lift increases with speed.

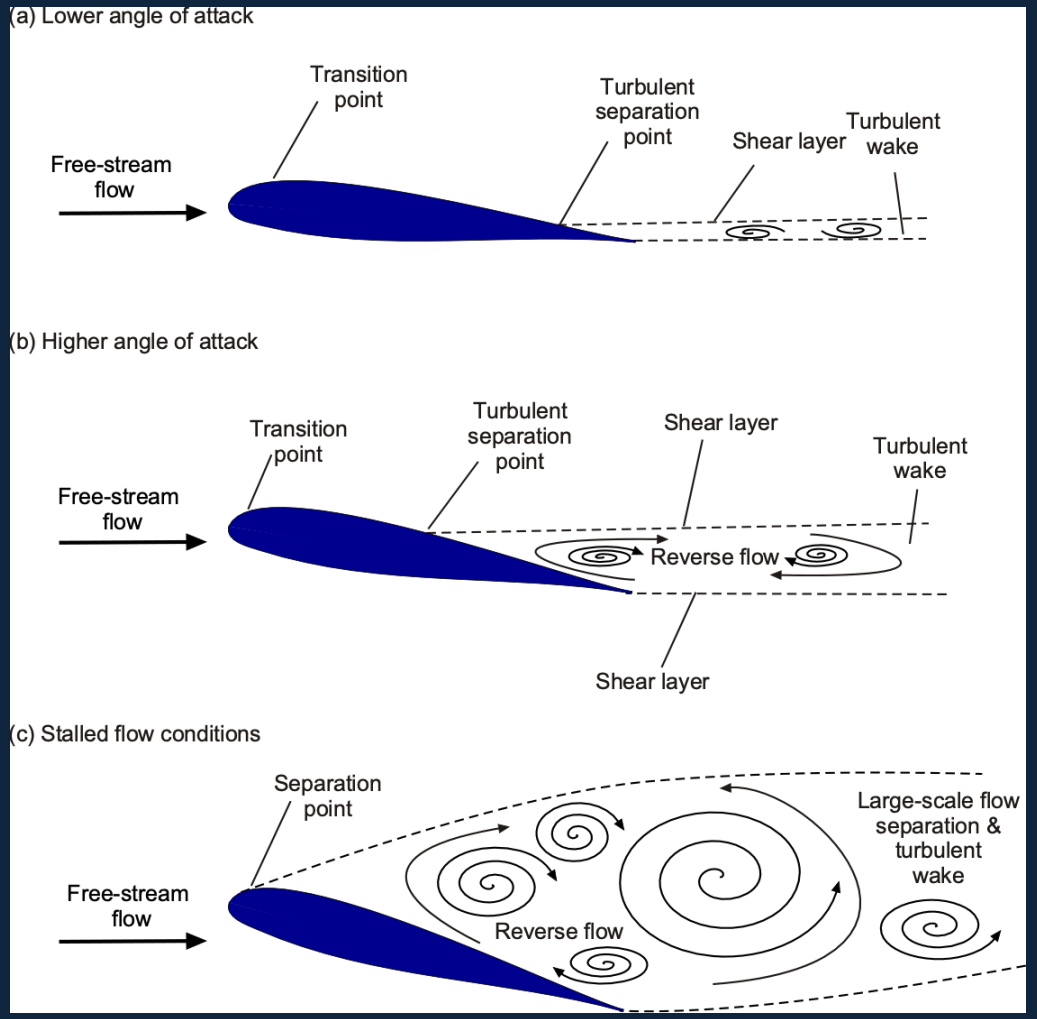
Lift vs. Angle of Attack



Lift vs. Angle of Attack

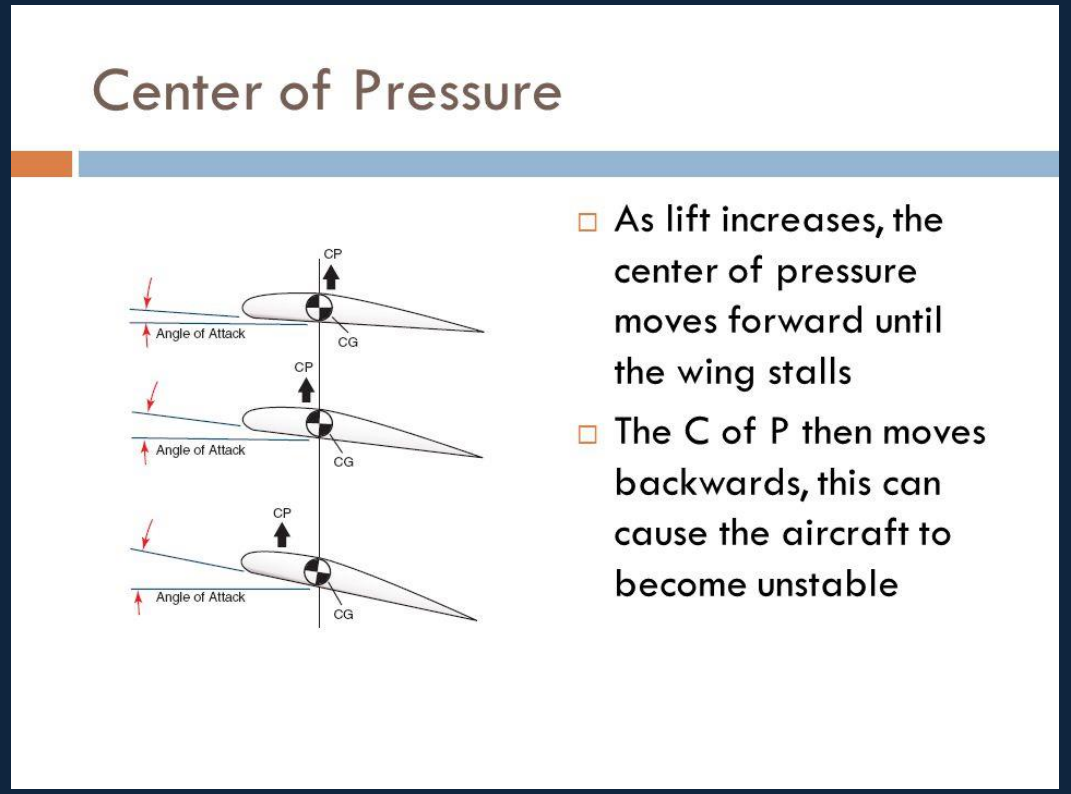


Angle of Attack

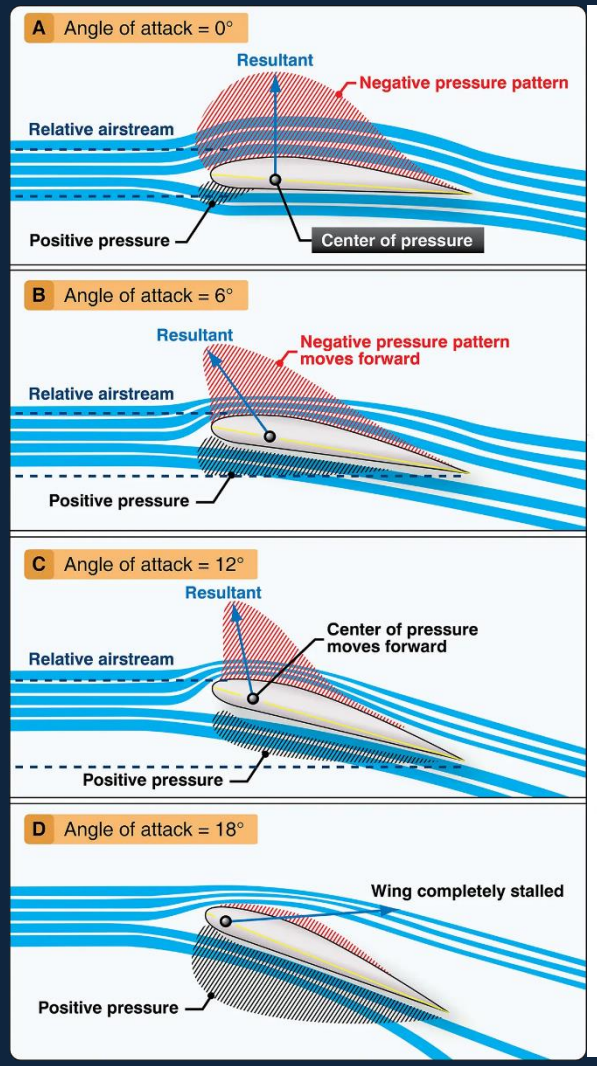


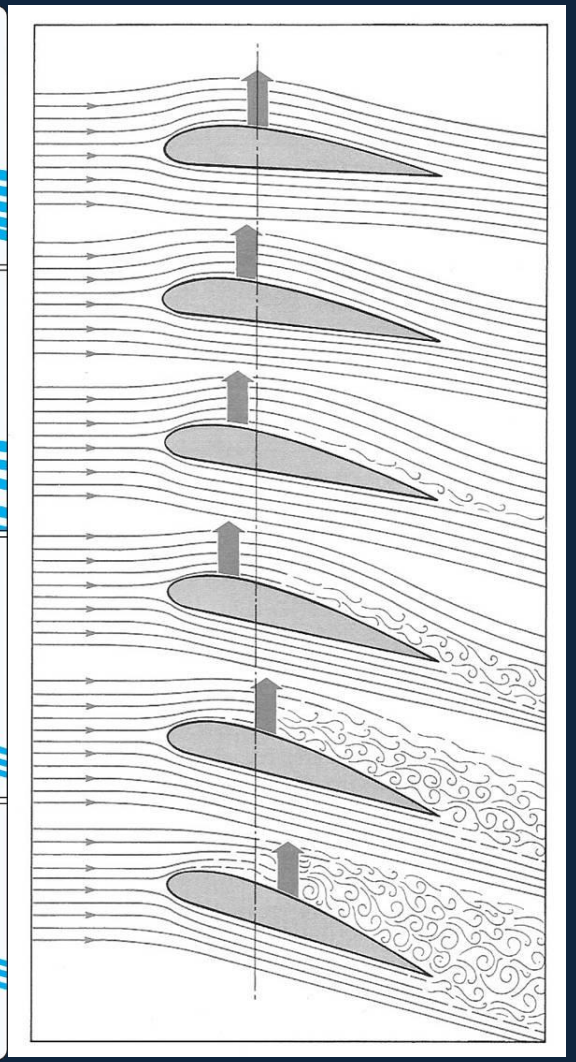
Center of Pressure

- The point where all lift can be said to be acting.
- Moves forward as Angle Of Attack increases
- Then moves back once we exceed the critical angle of attack and this is where the stall occurs



Center of Pressure

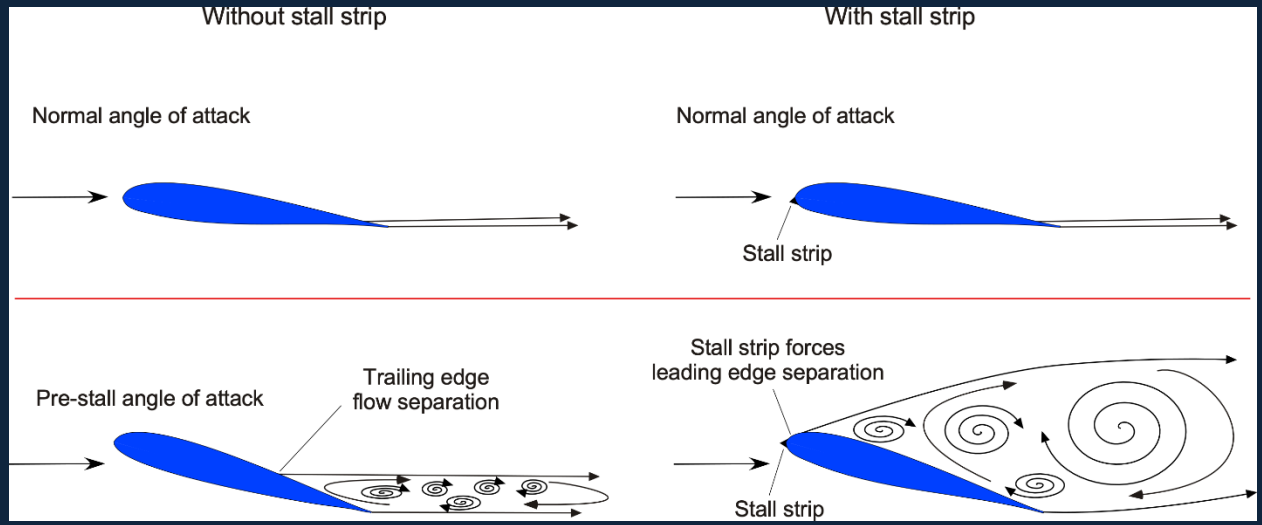




Aerodynamic Stalls

What is a Stall?

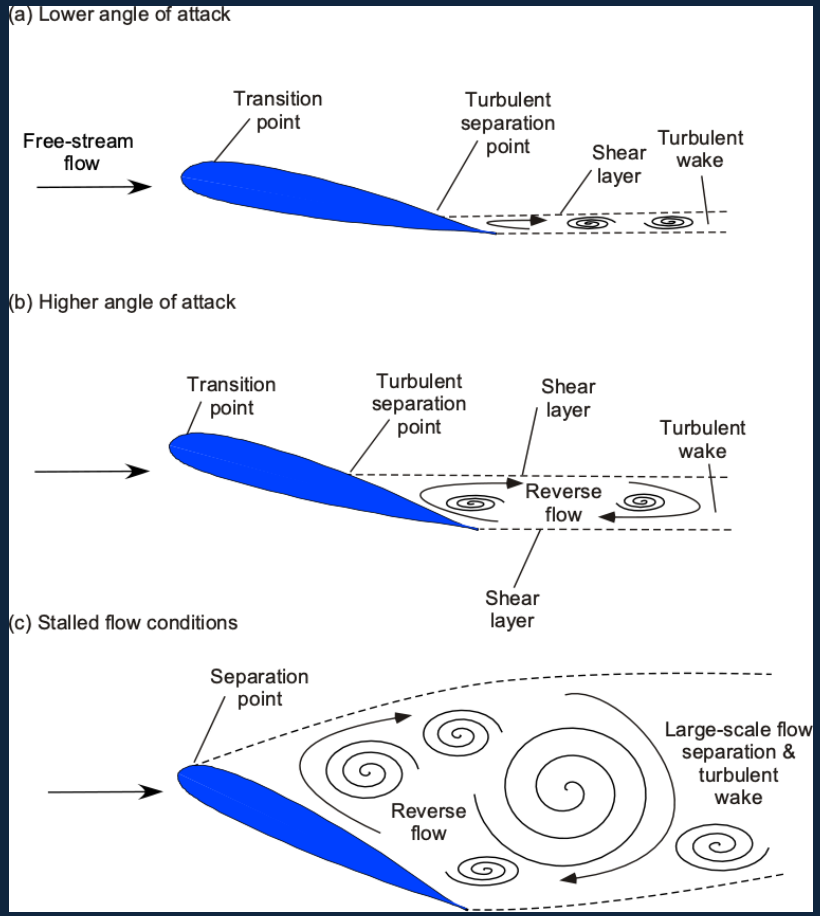
- A Stall is essentially a loss of lift
- A Stall occurs when an aircraft is flown at an AoA greater than the angle for maximum lift.
  - *This is known as the Critical Angle of Attack.*
- A Stall can occur at any attitude or airspeed as long as that AoA is exceeded BUT IS DEPENDANT ON ANGLE OF ATTACK ONL



Aerodynamic Stalls

How does stall occur?

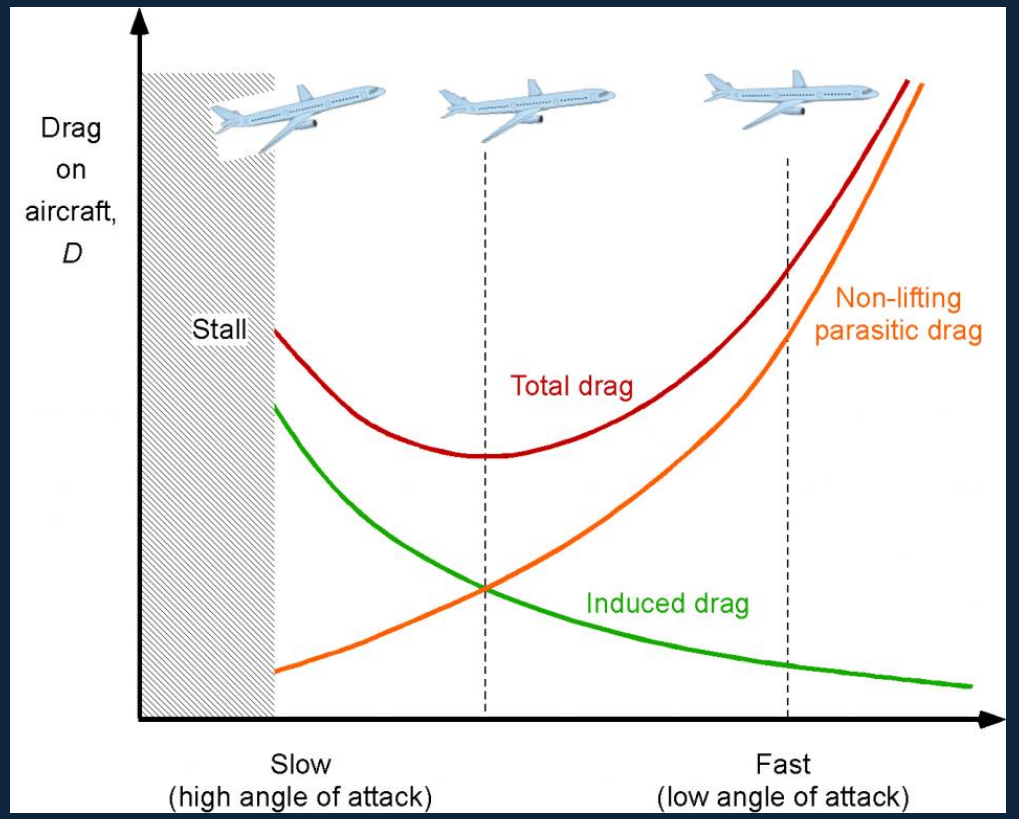
- A Stall occurs when the flow of air over the top of the wing separates away from the upper surface.
- The airflow separates because the Angle of Attack is too great to maintain smooth flow along the upper surface.
- This separation results in the lift created by the wing decreasing rapidly.



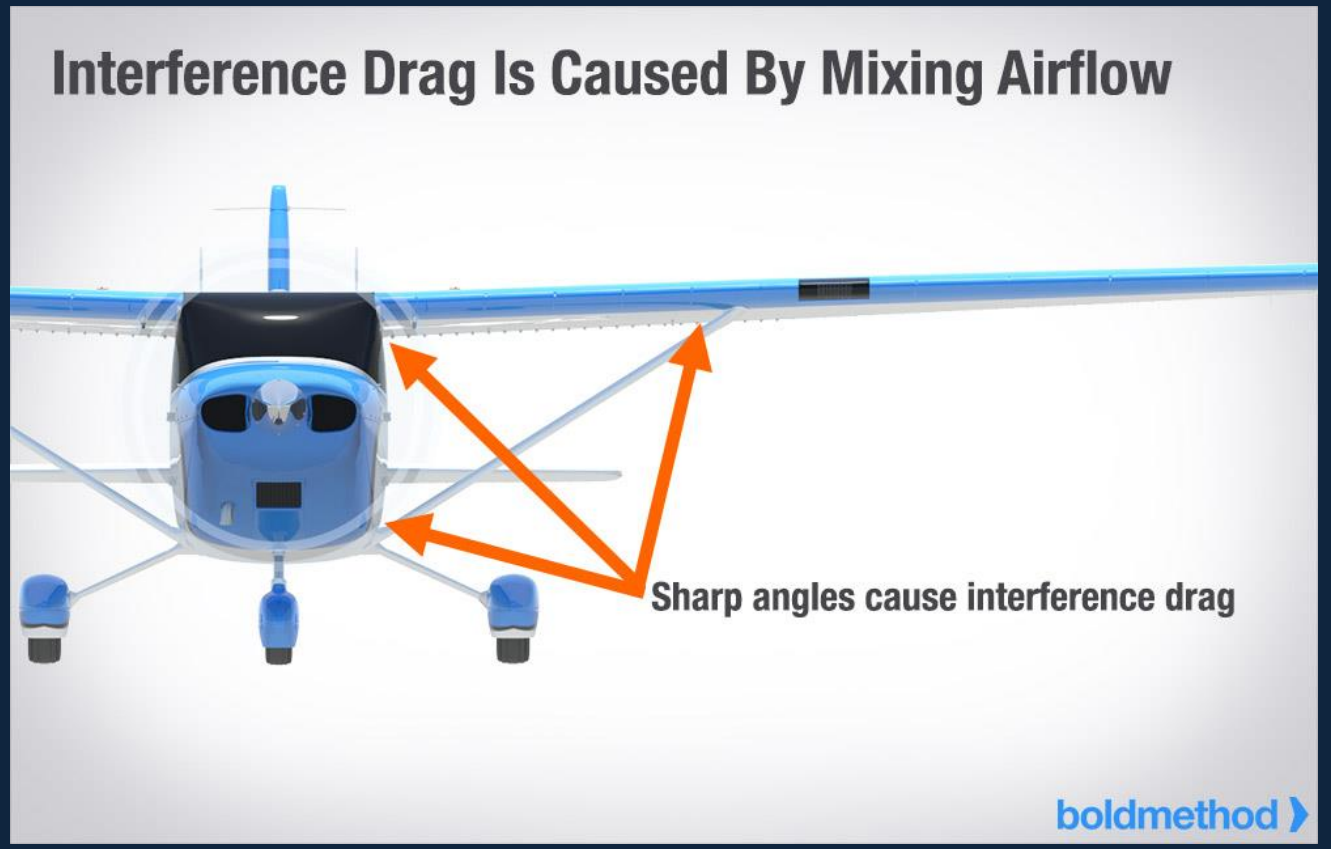
Types of Drag

There are two main types of drag:

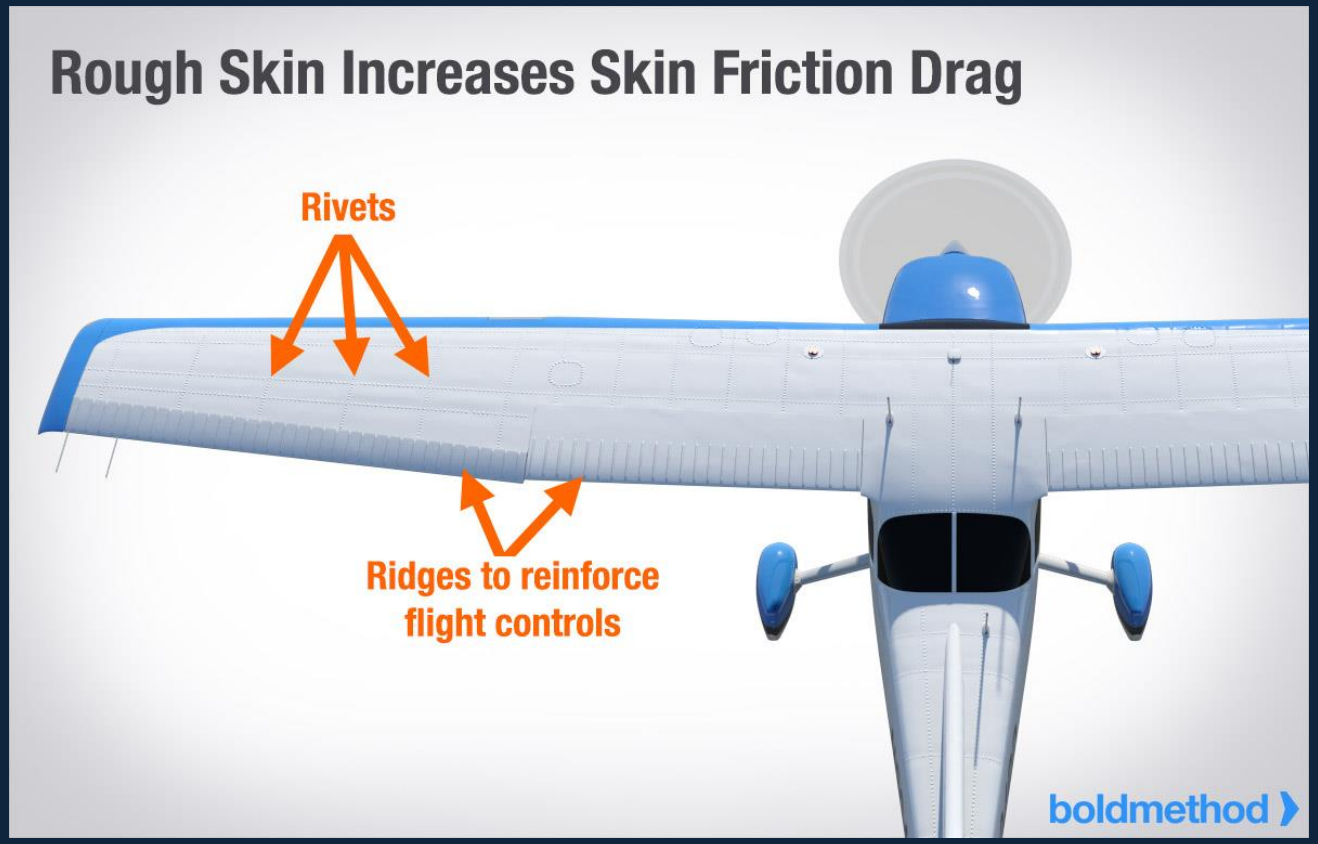
- Parasitic Vs Induced



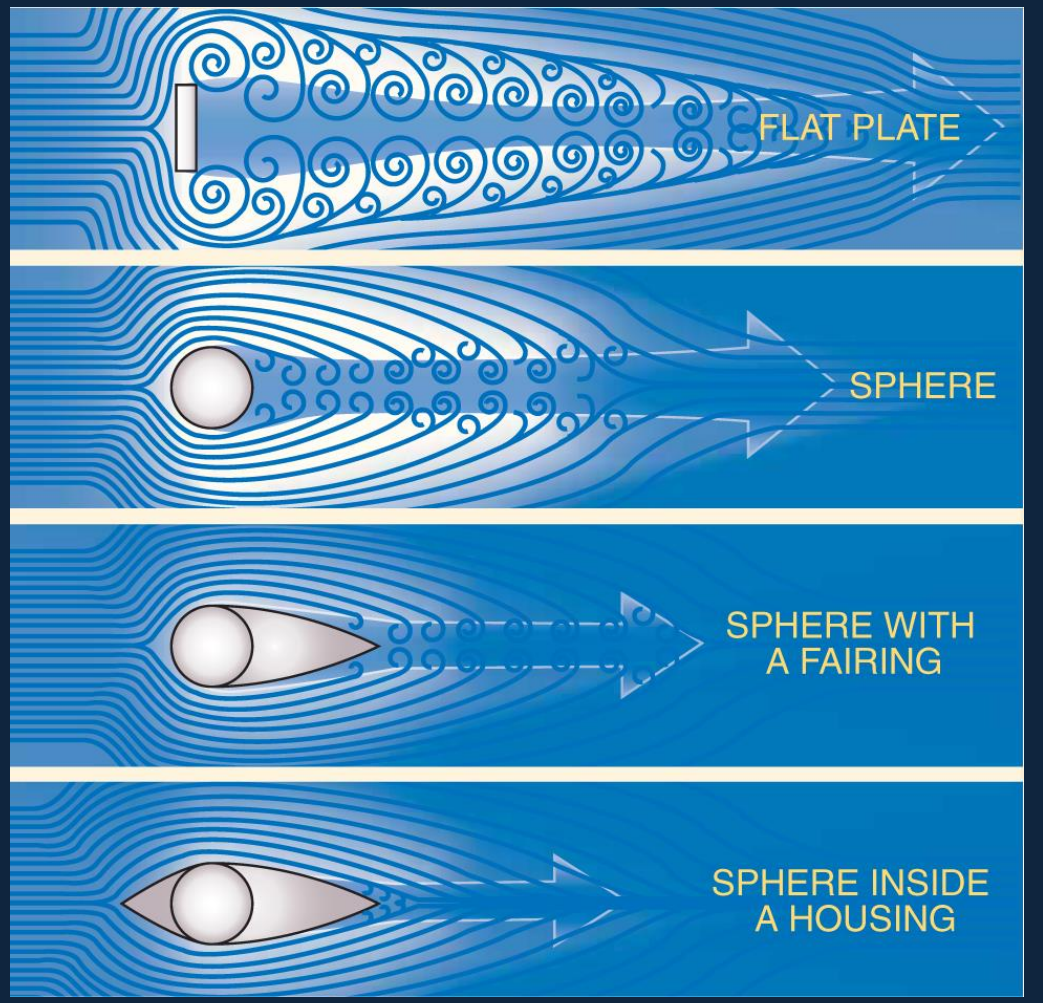
Parasitic Drag (Interference)



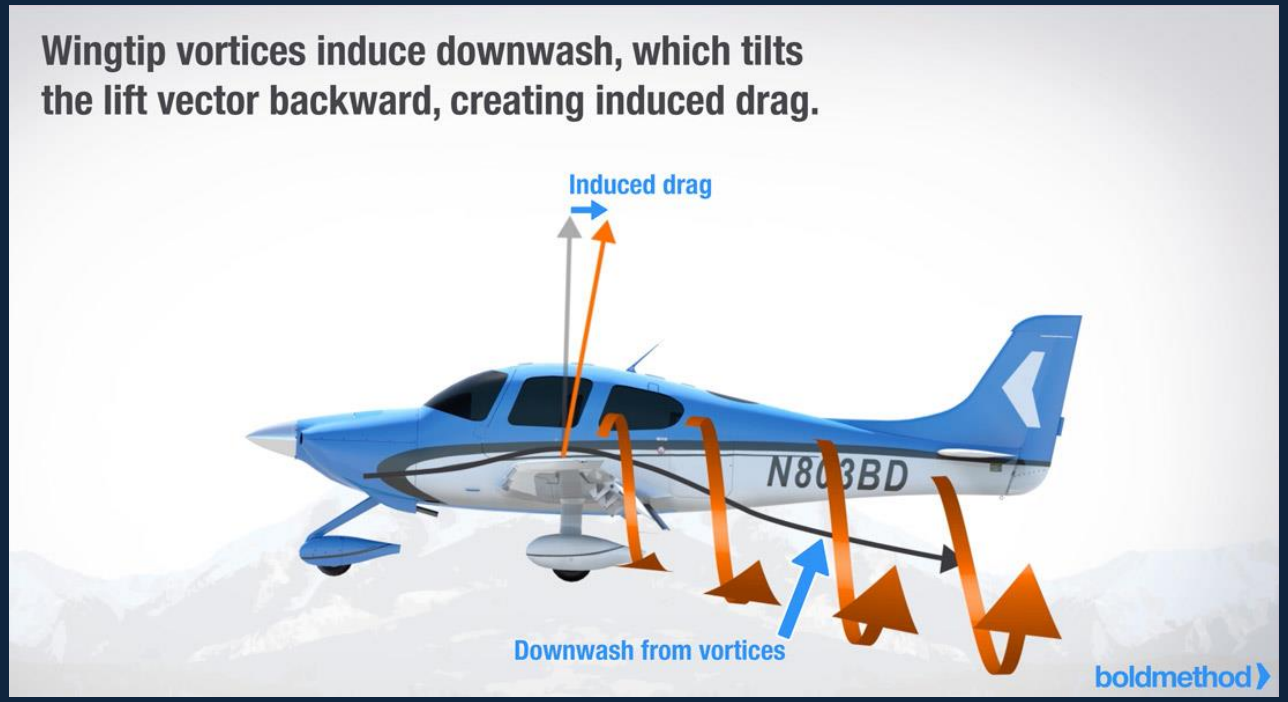
Parasitic Drag (Friction)



Parasitic Drag (Form)

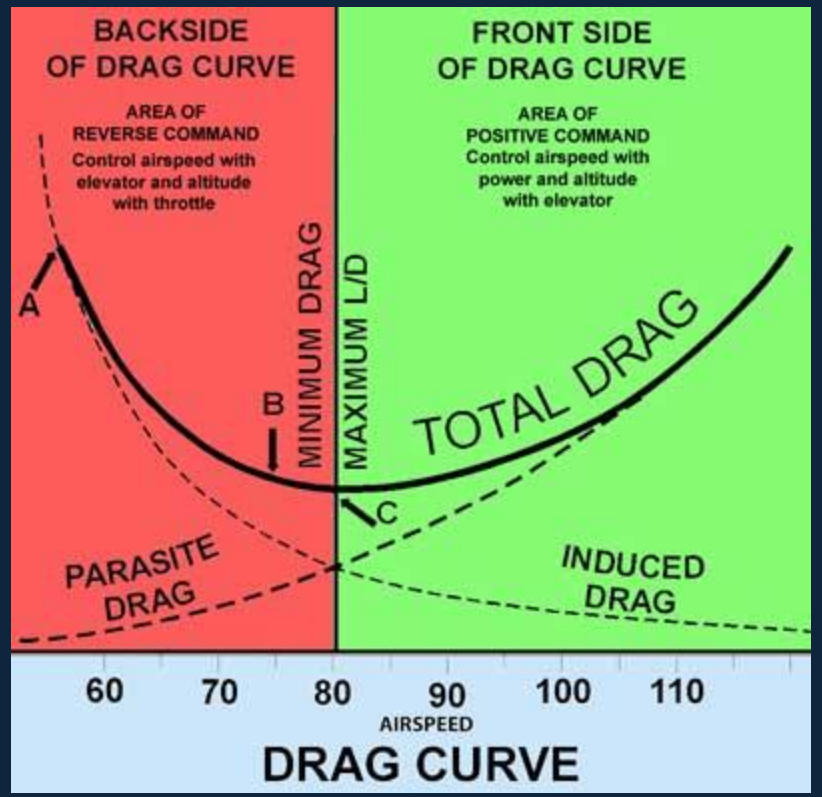


Induced Drag



Lift/Drag Ratio

- Best Lift to Drag Ratio is the speed at which an aircraft will get the most amount of lift with the least amount of drag
- Aka. Best glide speed or Glide Ratio



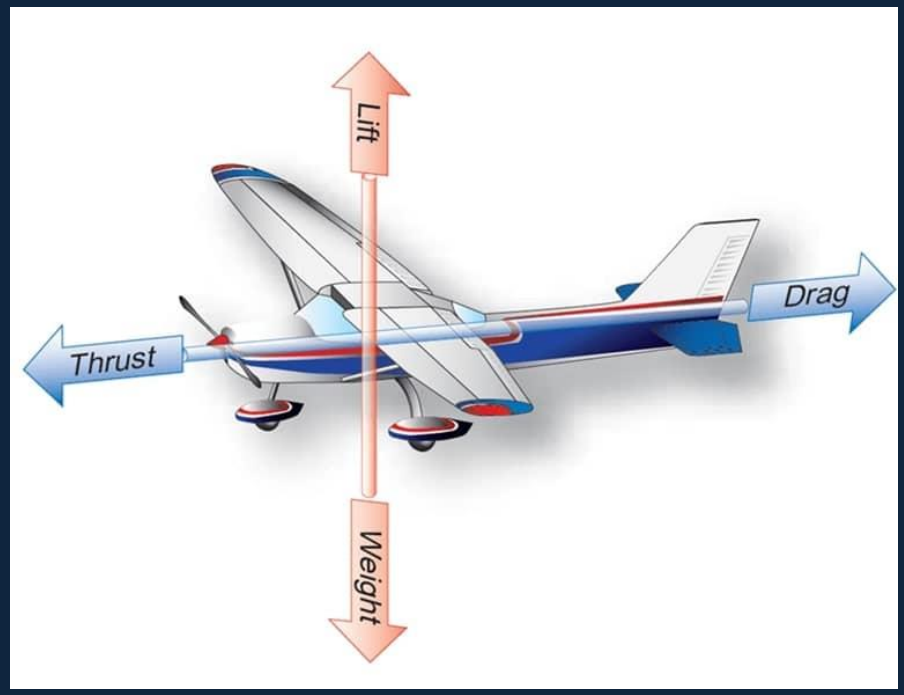
Glide ratio = number of feet travelled horizontally for every foot of altitude lost

Ex: Glide ratio of 50:1 means a travel of 50 feet for every foot of altitude lost

$$\text{Glide ratio} = \frac{\text{Lift}}{\text{Drag}} : 1$$

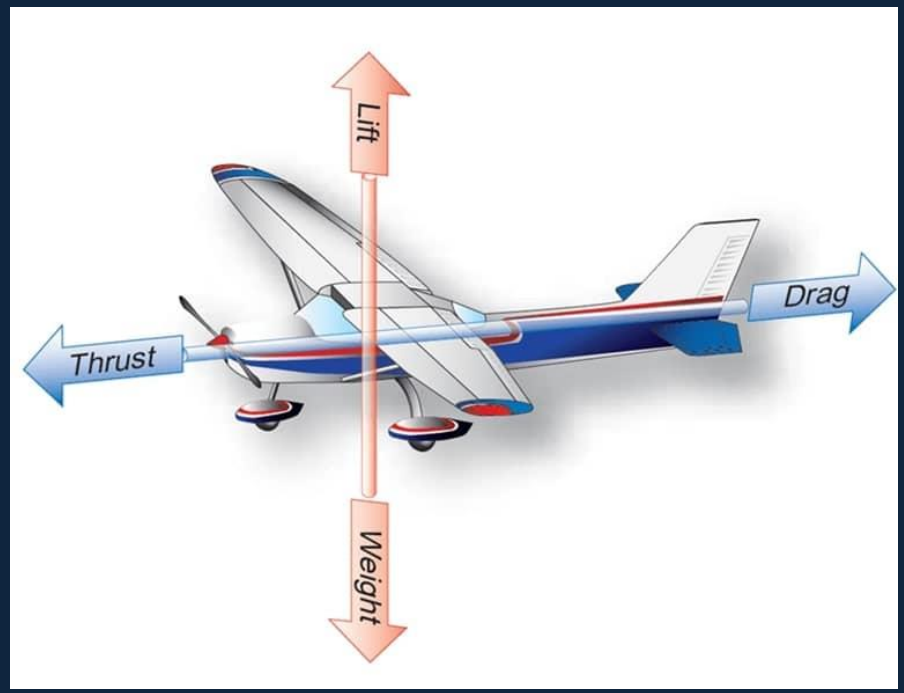
Thrust

- This is your forward momentum and is generated by the propeller
- When the propeller rotates it pulls in air from in front of the blade and pushes it back, propelling you in that direction



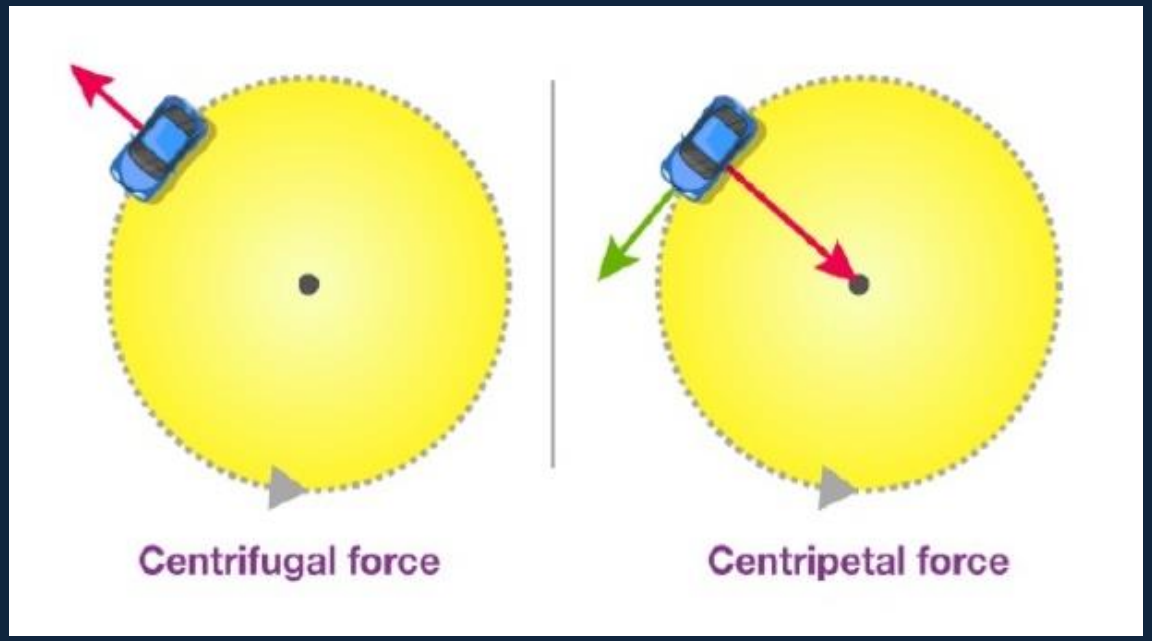
Weight

- The force of gravity pulling you towards the earth
- Weight is the opposing force to lift



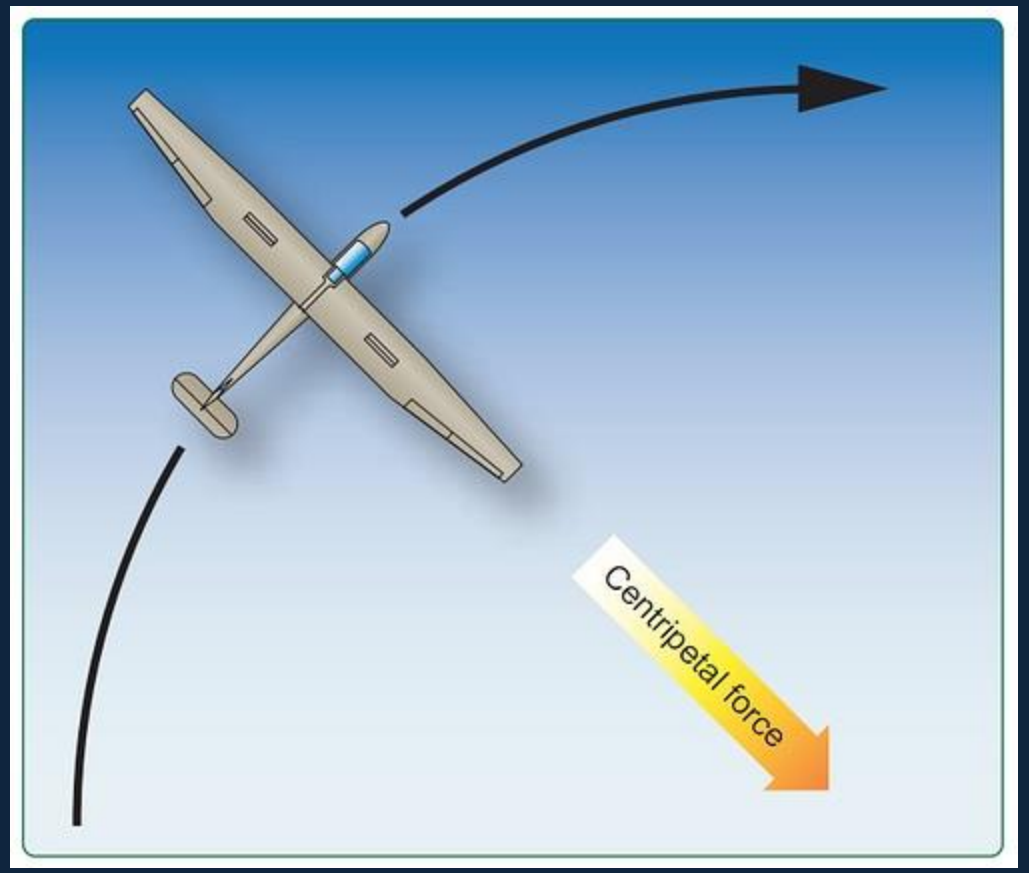
Centripetal vs Centrifugal Force

- Centripetal force pulls objects toward the center of a circle, while centrifugal force is the imaginary outward push felt when spinning, caused by inertia in a rotating system.



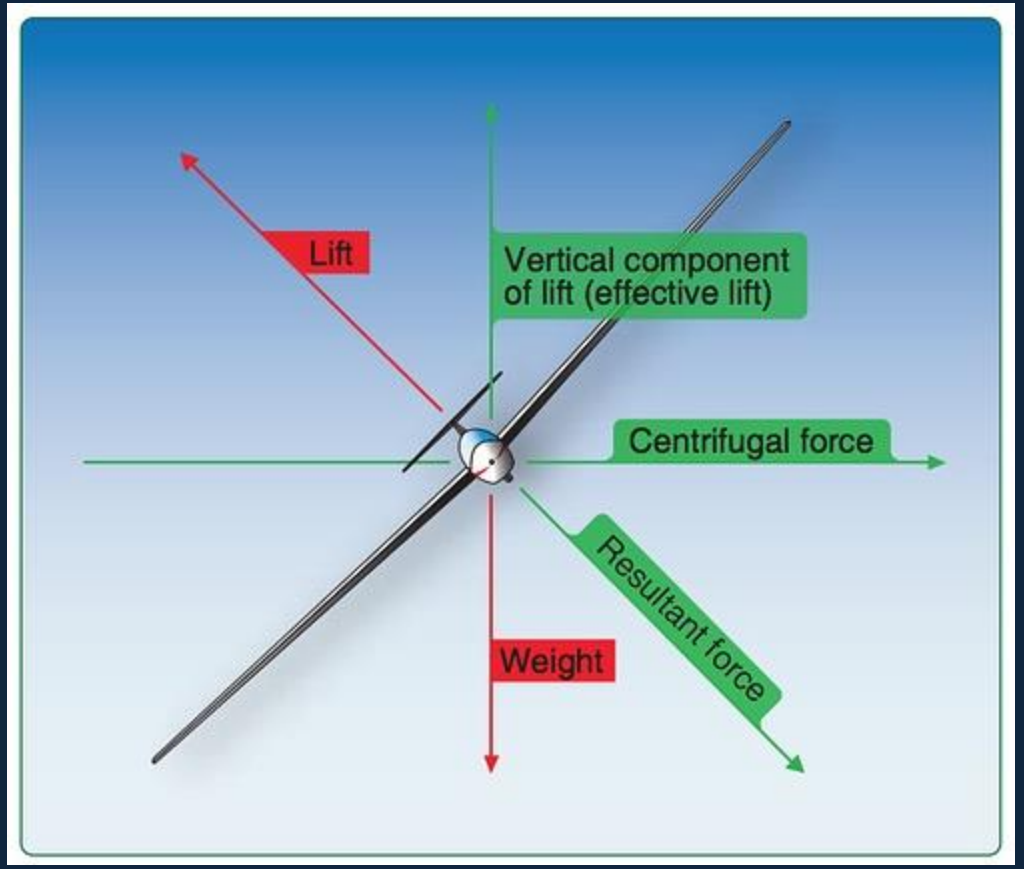
Centripetal Force

- The force by which bodies are impelled towards a point in the center
- Making a moving object follow a curved path



Centrifugal Force

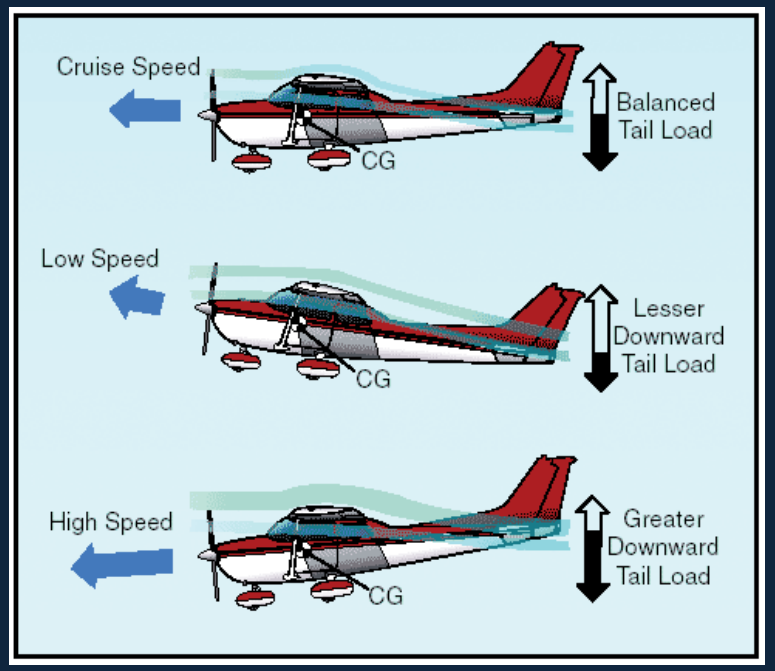
- An inertial force that is a reaction to the centripetal force exerted



Equilibrium – Level, Club, Descent

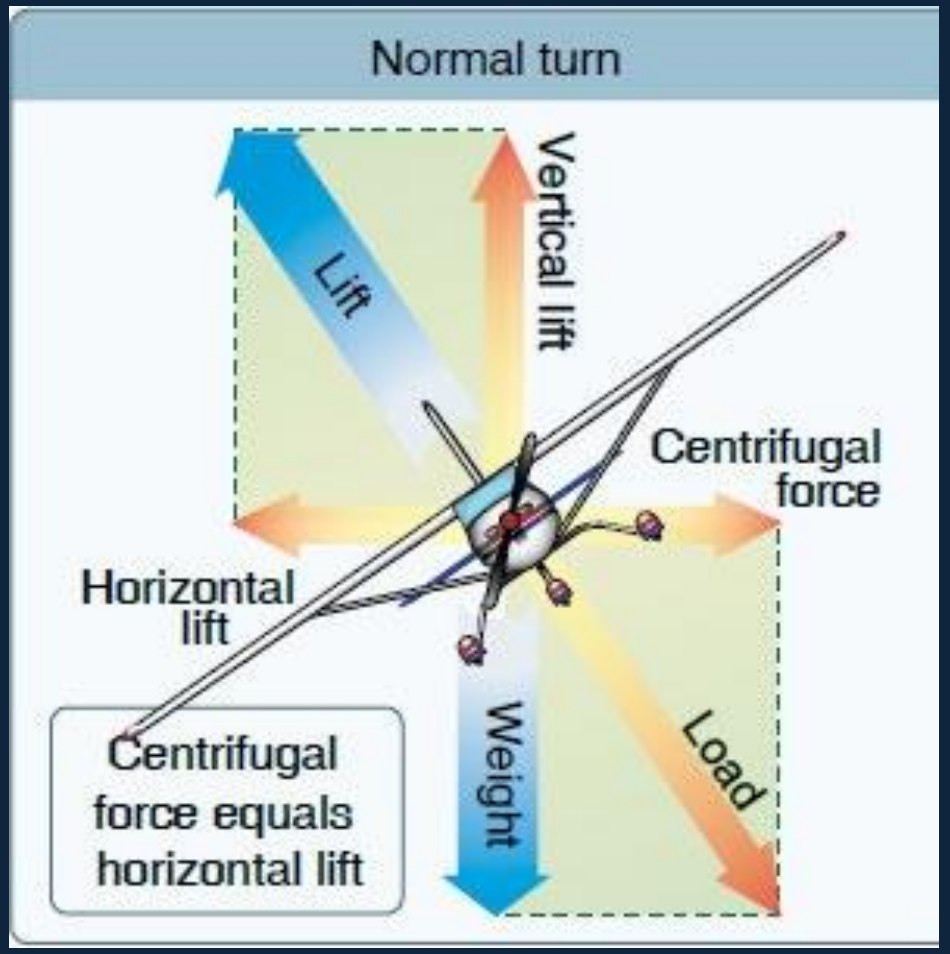
There are 3 cases when an aircraft is in equilibrium:

1. Straight & level flight at a constant forward airspeed
2. Straight and steady climb at a constant forward airspeed
3. Straight and steady descent at a constant forward airspeed

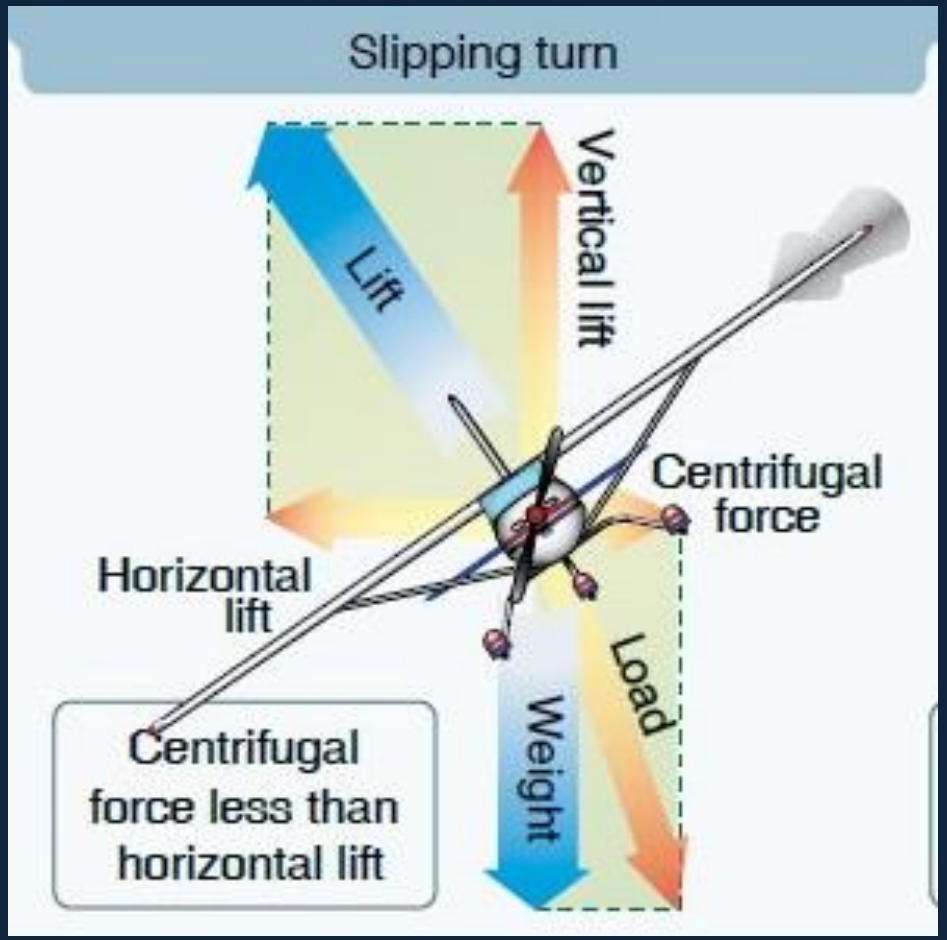


No acceleration during equilibrium

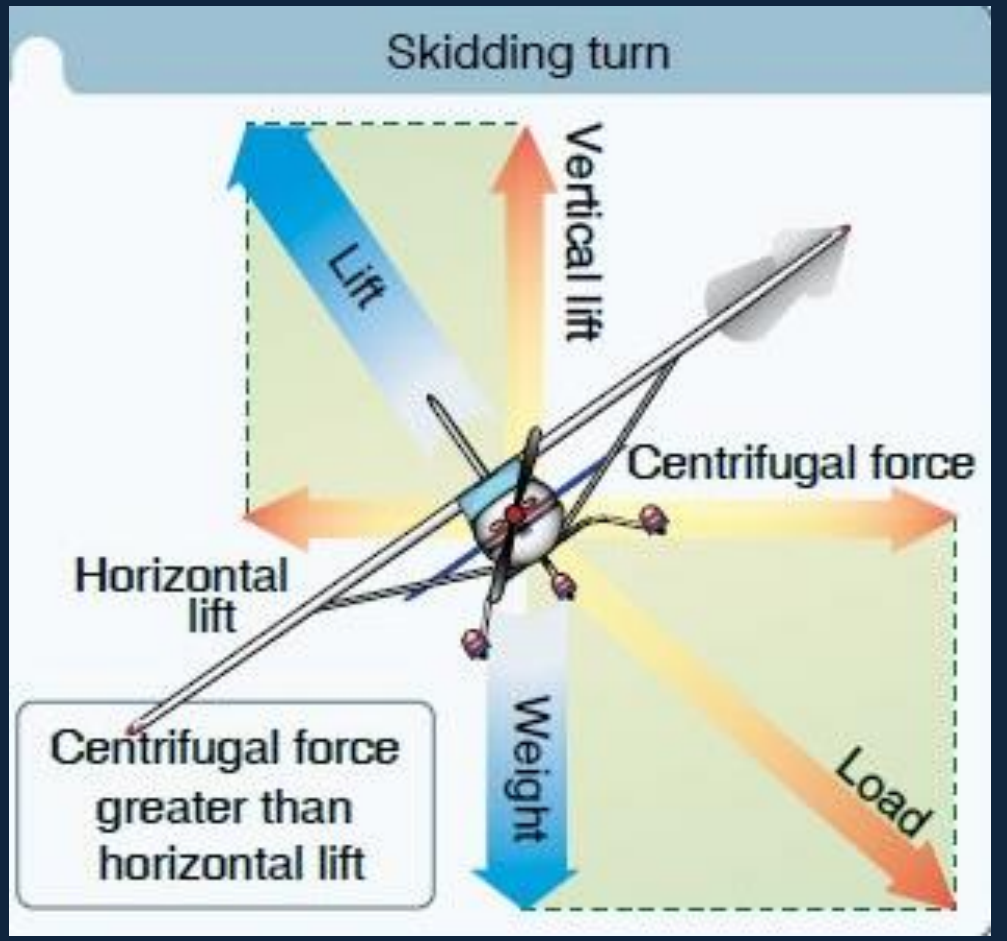
The Forces in a Turn



The Forces in a Turn

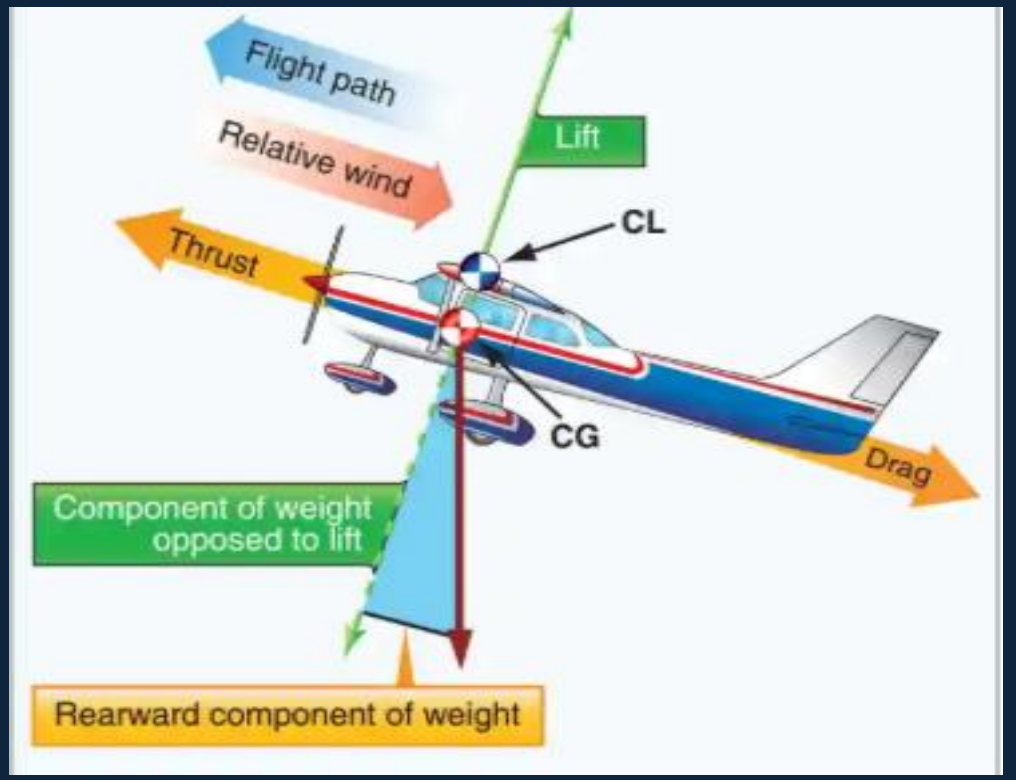


The Forces in a Turn



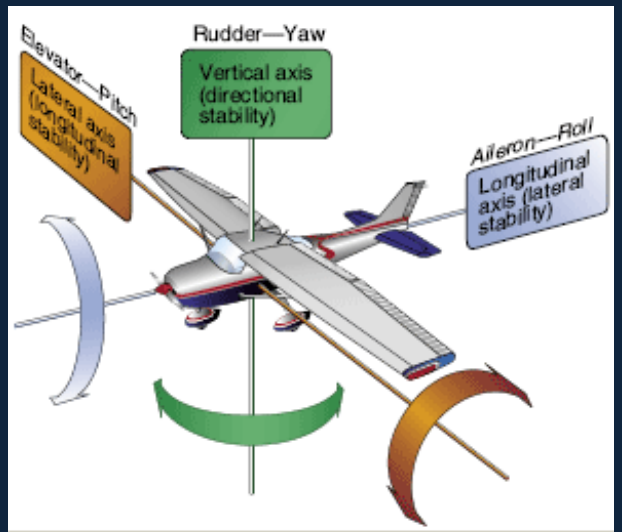
The Forces in a Climb

- As weight is no longer acting perpendicular to the flight path it must be broken down into components
- Now we have a component of weight that is acting rearward the same direction as drag.



Stability

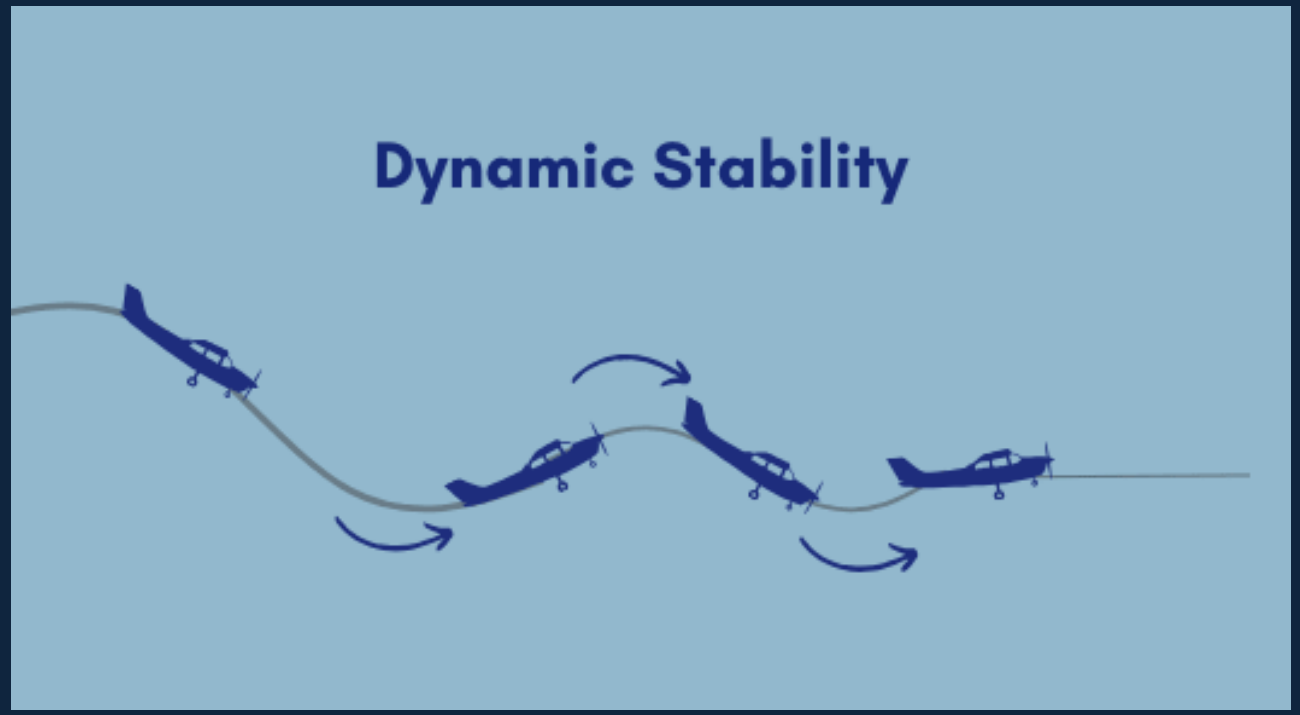
- The tendency of an aircraft to return to straight and level flight after a disturbance without corrective action by the pilot
- Different stability about each axis
  - We will focus on longitudinal stability



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

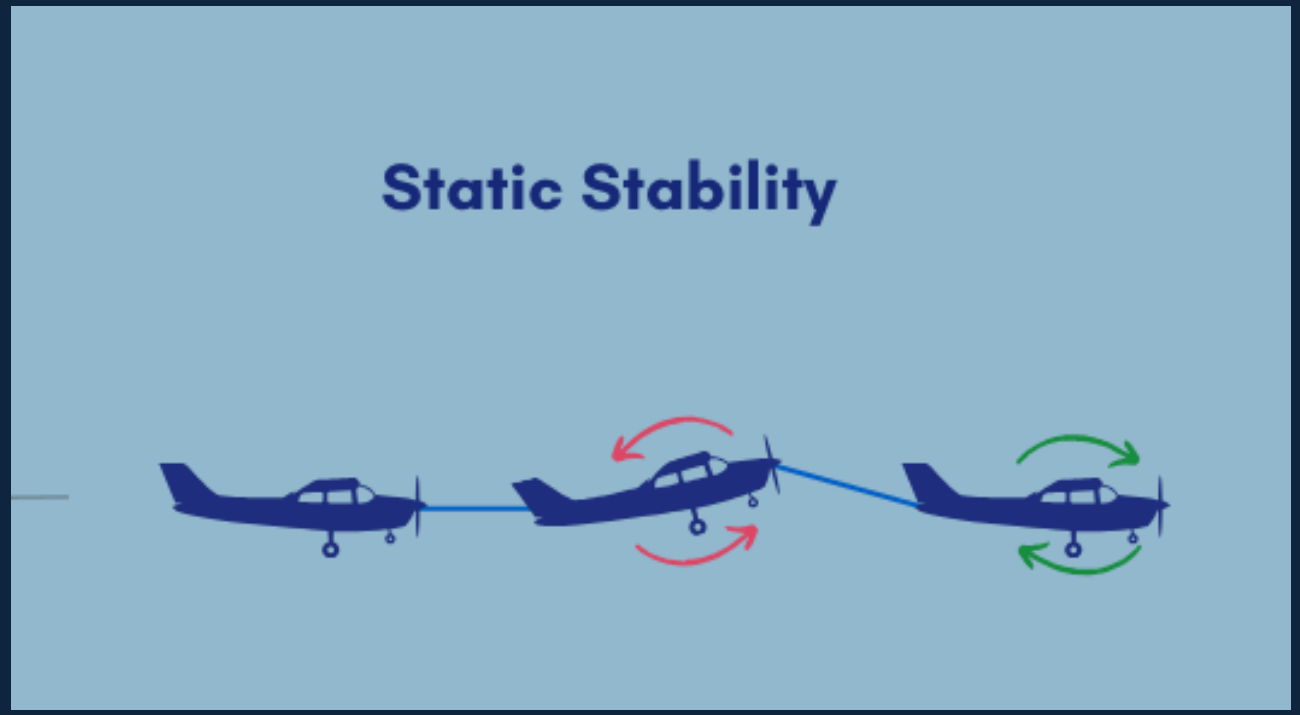
Dynamic Stability

How it responds over time to a disturbance

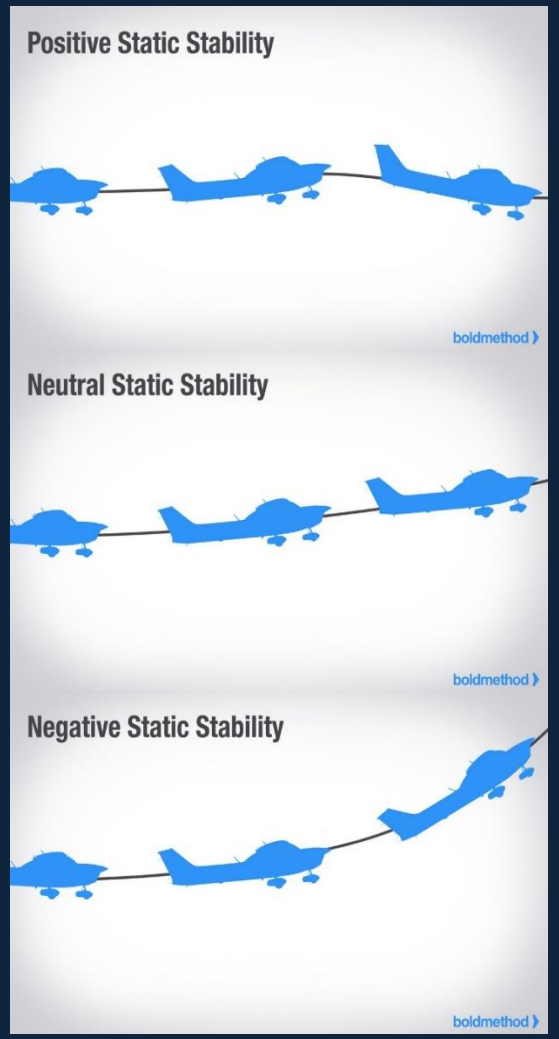


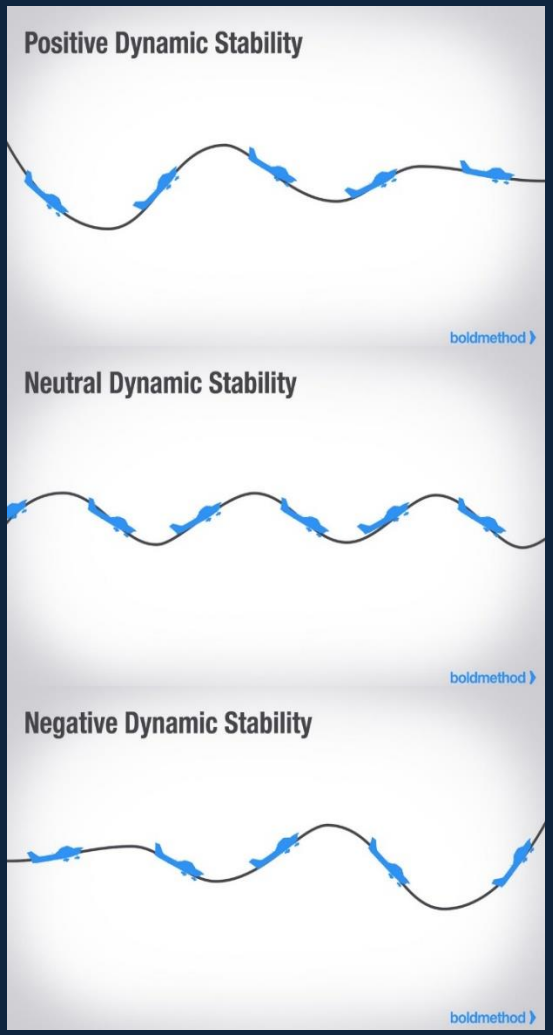
Static Stability

Initial tendency to return to original position when disturbed



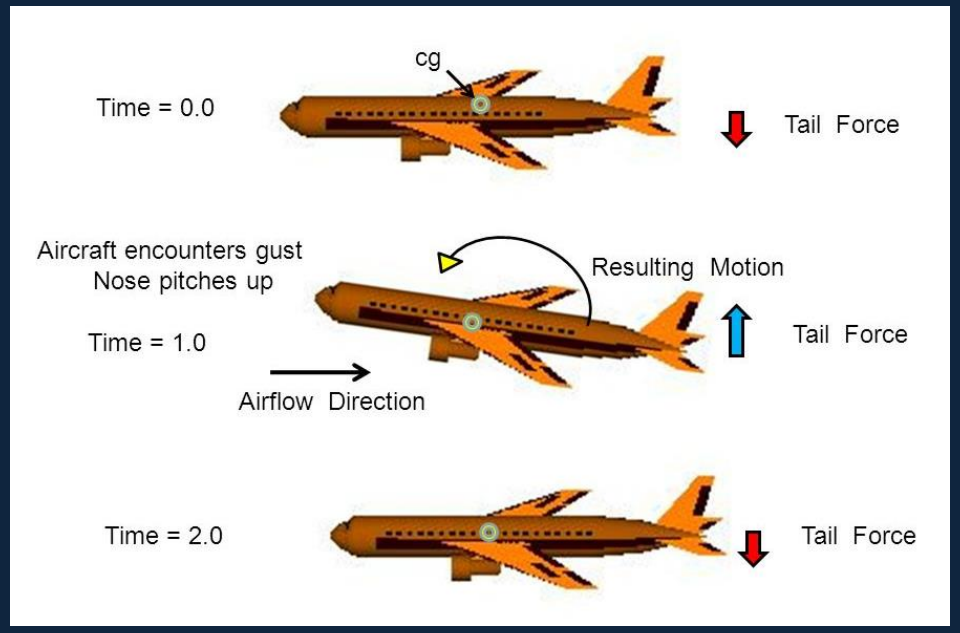
Dynamic vs Static Stability





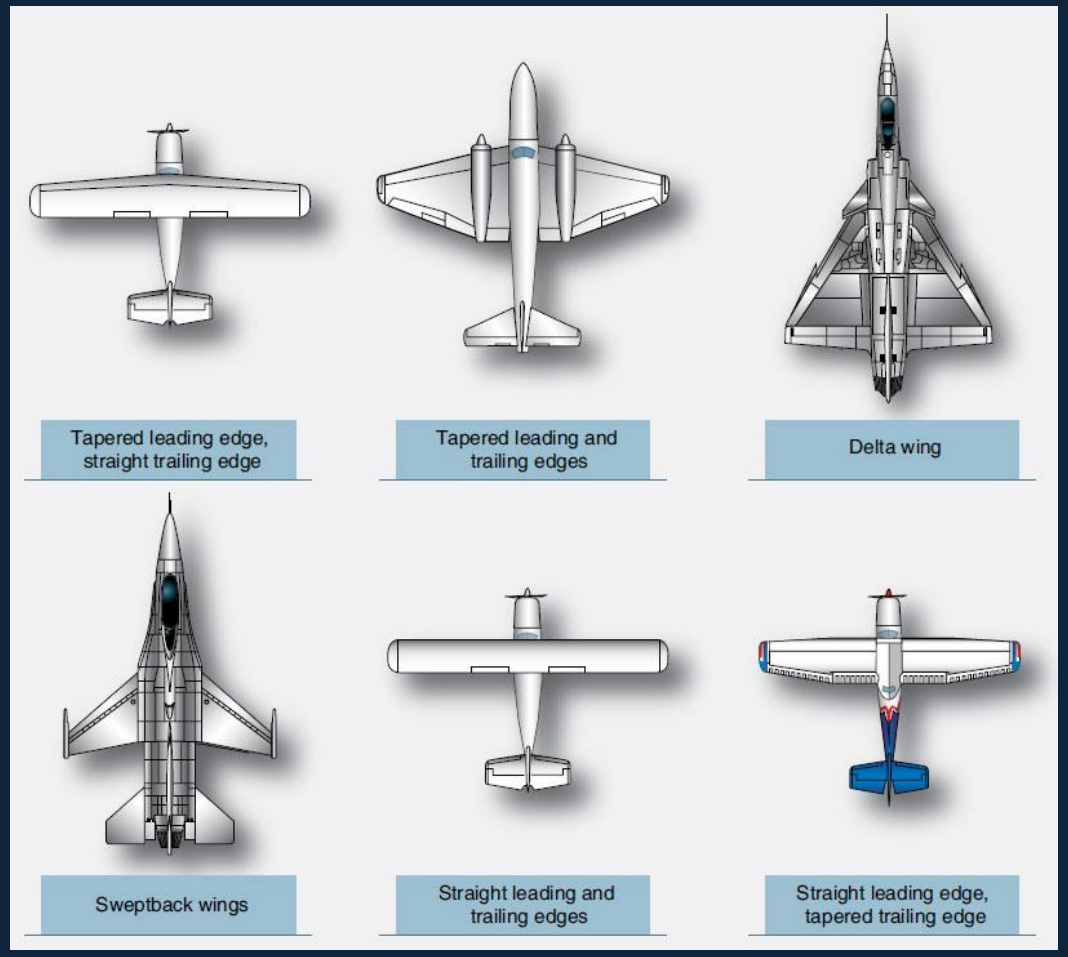
Longitudinal Stability

- Stability around the lateral axis (Pitch stability)
- Obtained by designing aircraft to be nose heavy
- There are two influencing factors
    1. Size and position of horizontal stabilizer
    2. Position of center of gravity



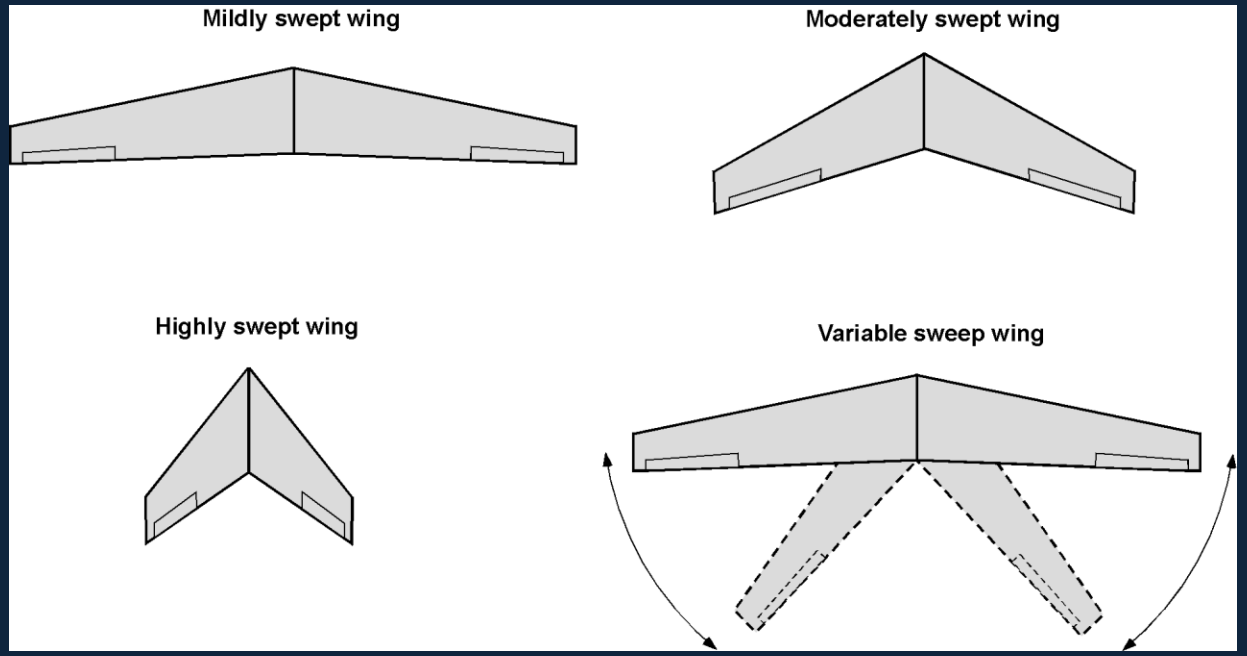
Wing Design

Wing Planform – the shape as viewed from directly above



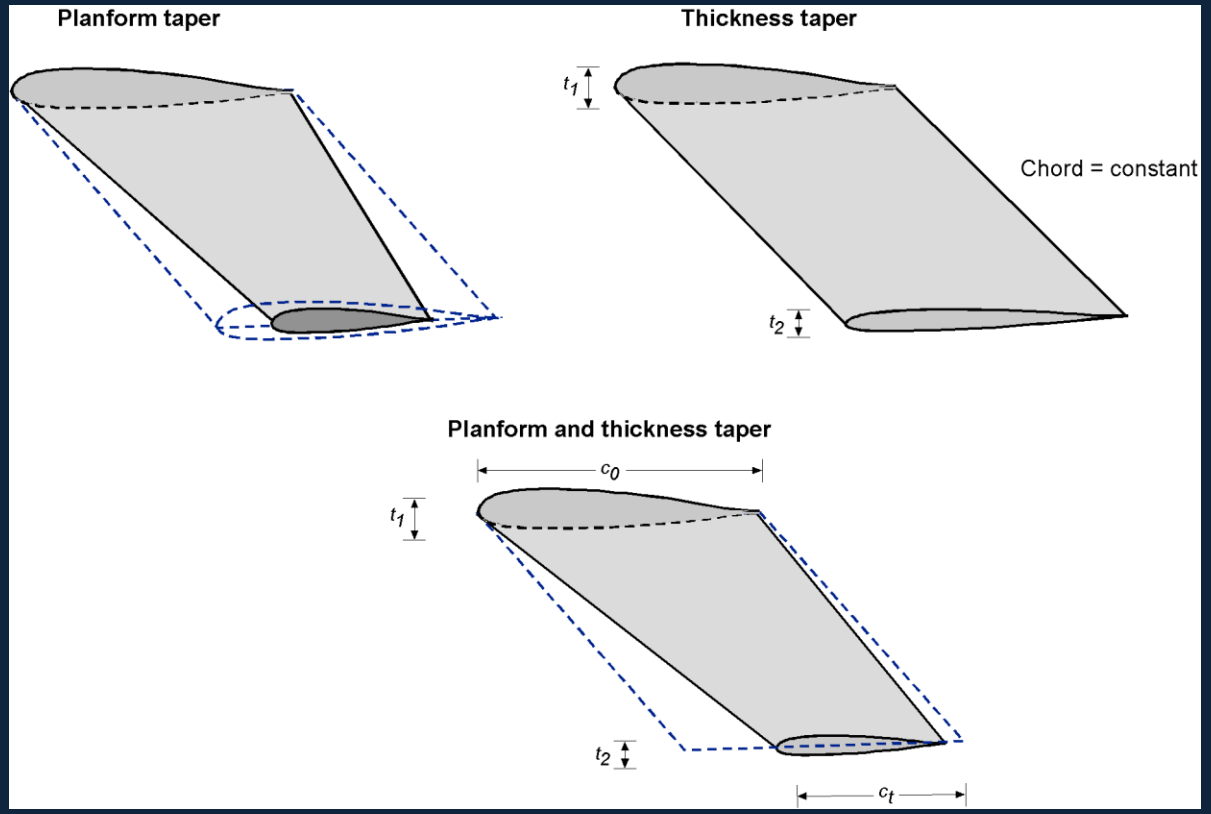
Wing Design

Sweep – rearward slant of a wing, tail, or other airfoil surface



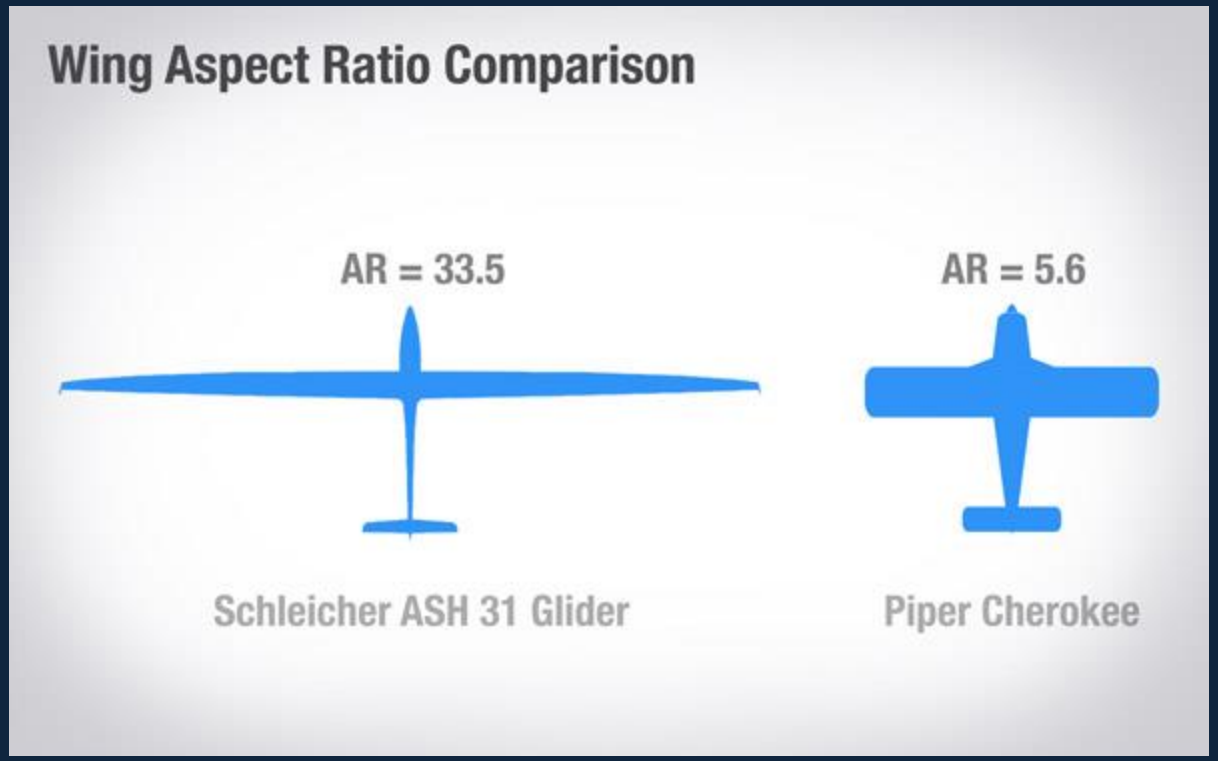
Wing Design

Taper – decrease of either width or thickness from wing root to wingtip



Wing Design

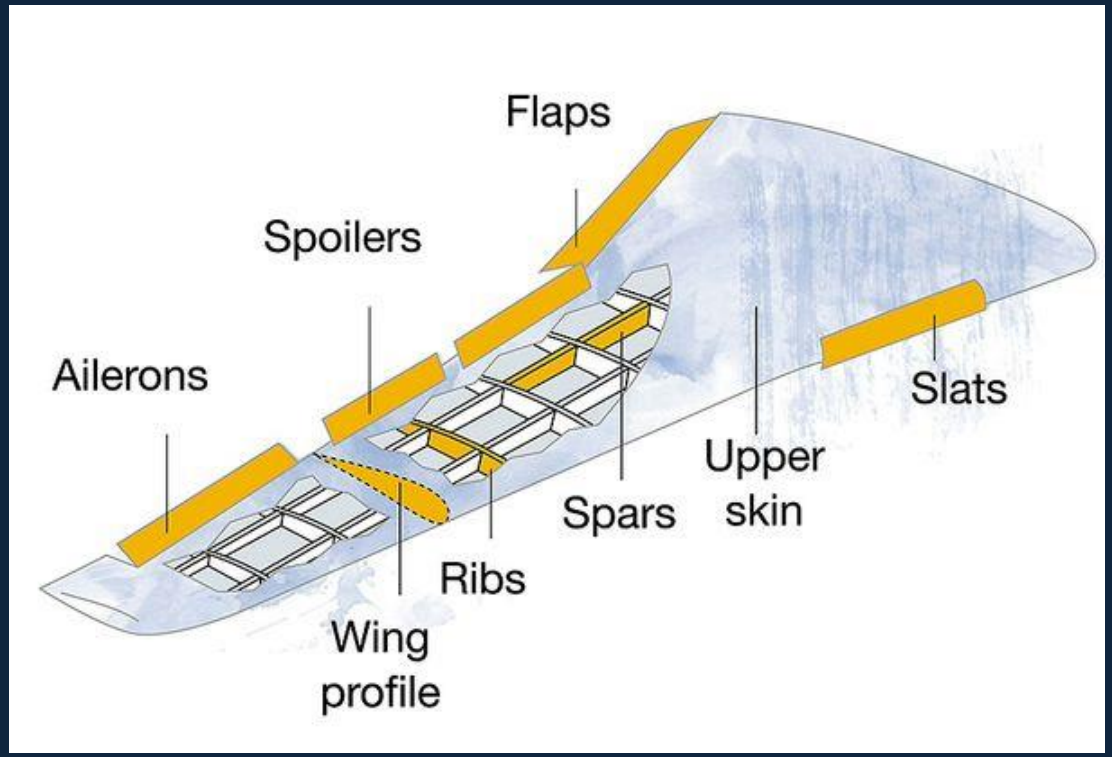
Aspect Ratio – relationship between length (span) and width (chord) of the wing. A higher aspect ratio will generate more lift/less induced drag



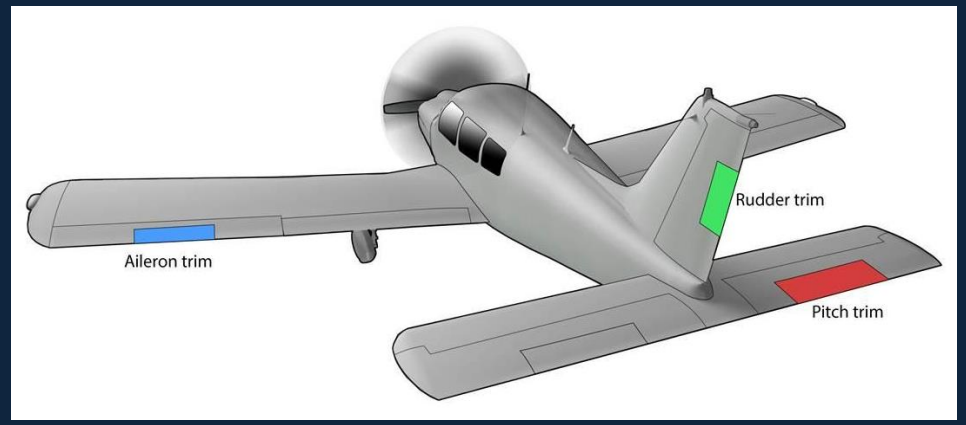
Wing Design

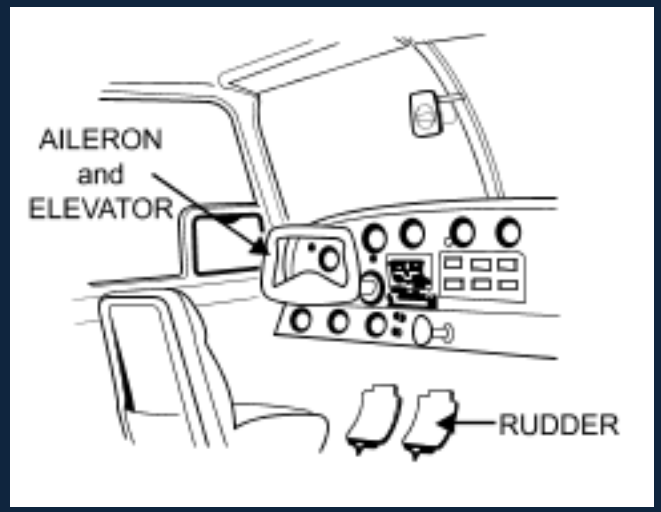
Spoilers - Small hinged plates on the top portion of wings used to slow down an aircraft and makes an aircraft descend when both are deployed

Flaps - High lift devices that increase the camber, and sometimes the area, of a wing gives better take-off and climb performance, increase rate of descent

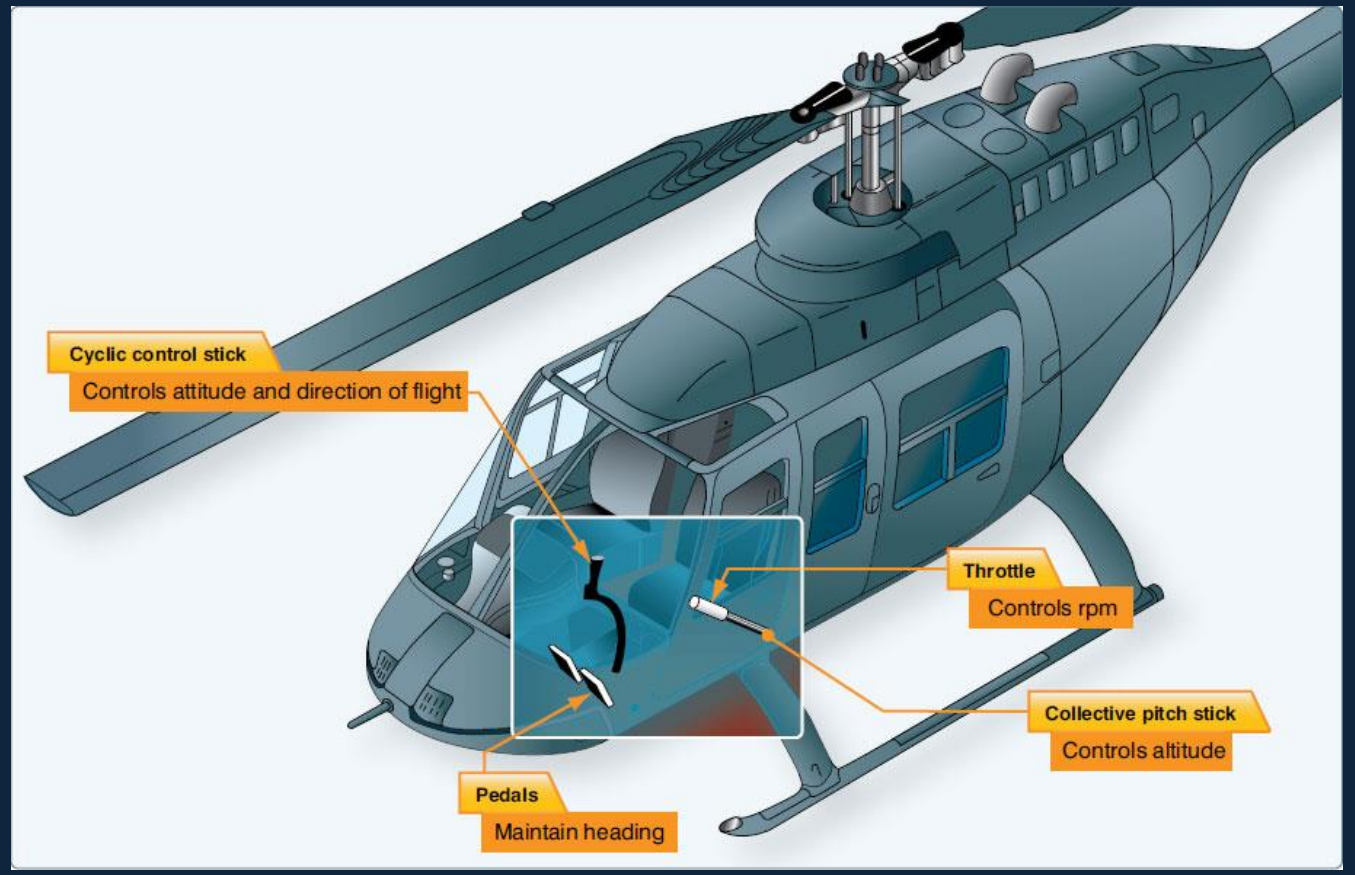


Airplane Flight Controls





Helicopter Flight Controls

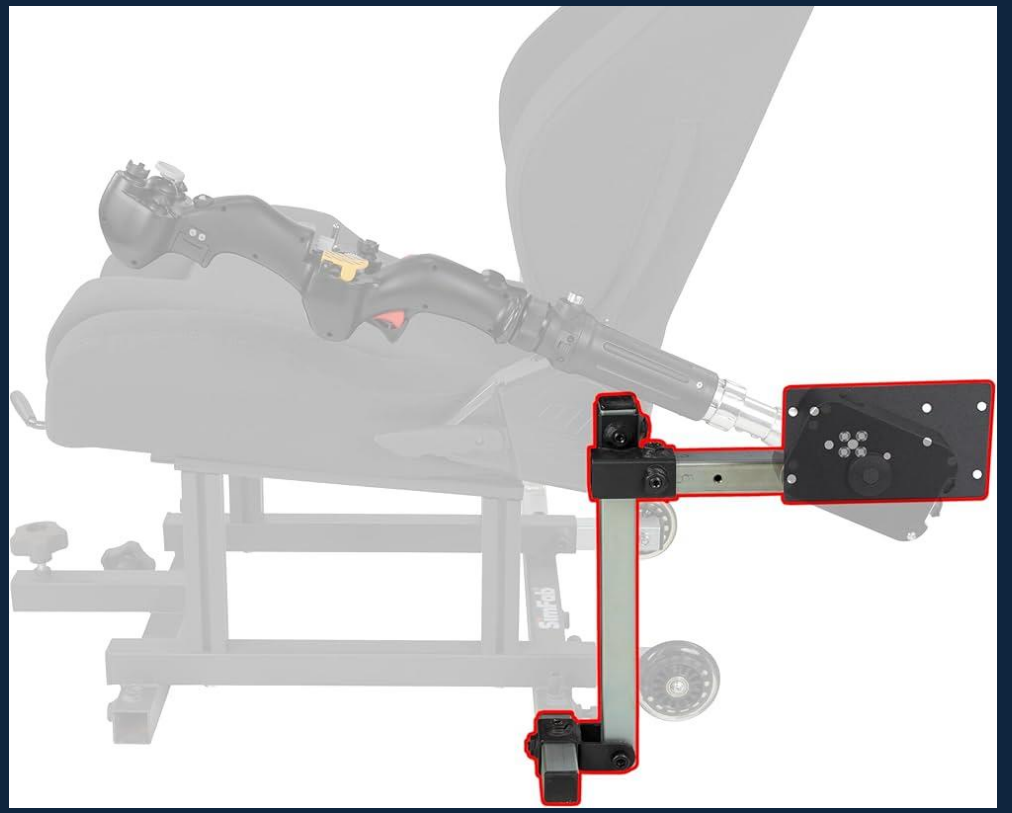


Helicopter Flight Controls

Cyclic - Controls main rotor, changes rotor blade pitch independently to create thrust in a given direction and is used to control attitude, direction of flight and airspeed

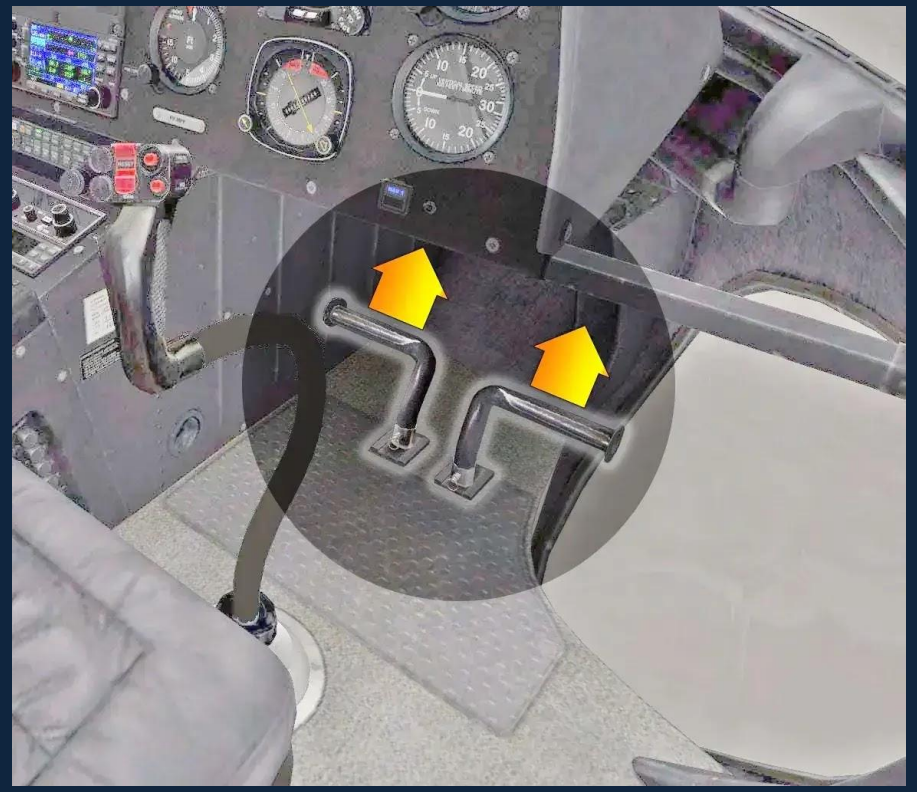
Helicopter Flight Controls

Collective - Changes the pitch of all rotor blades at the same time and is used to control altitude



Helicopter Flight Controls

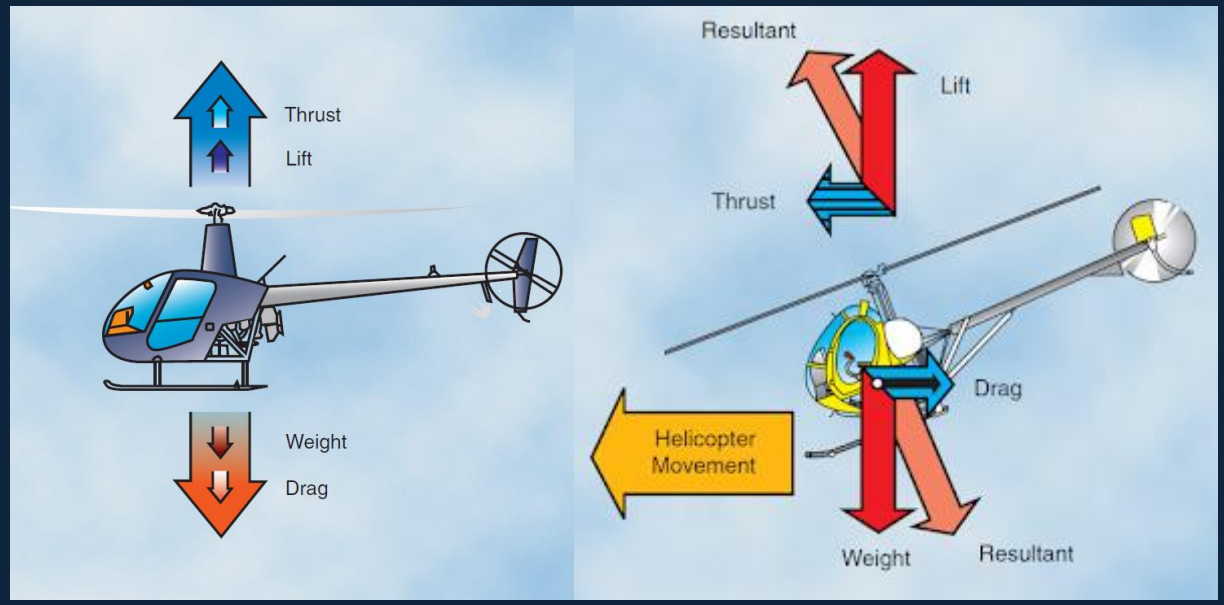
Pedals - Controls pitch of the tail rotor to offset torque induced by main rotor



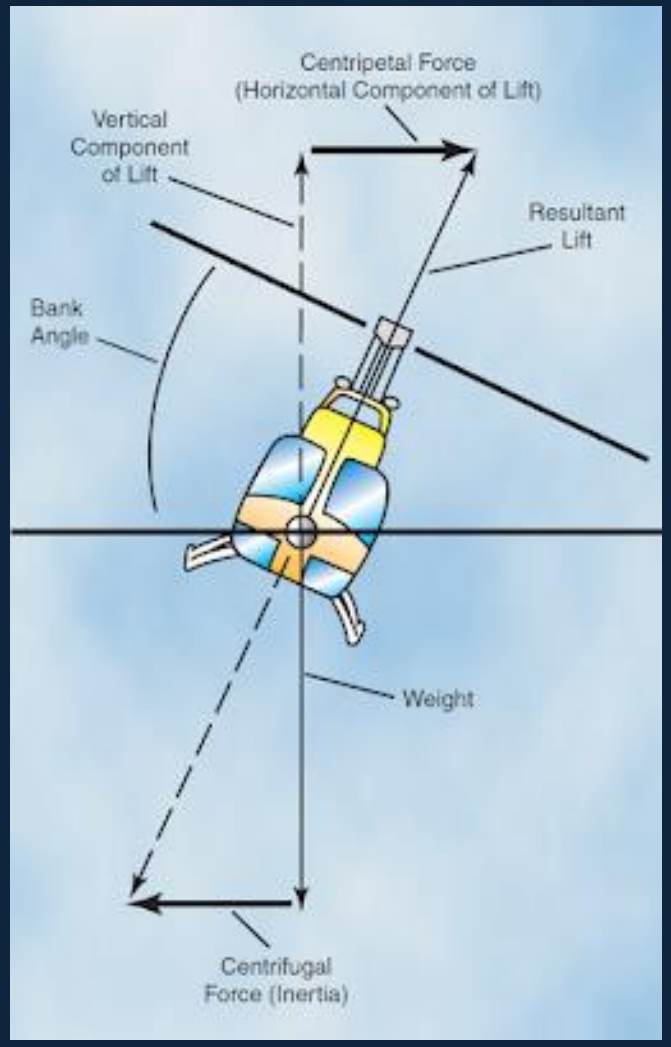
Helicopter Lift

Normal Powered Flight

- Consist of hovering, vertical, forward, sideward, and rearward flight
- Air is drawn into the main rotor system from above and exhausted downward
- Forces acting on the helicopter are similar to airplanes
- To generate lift, rotor blades must be rotating



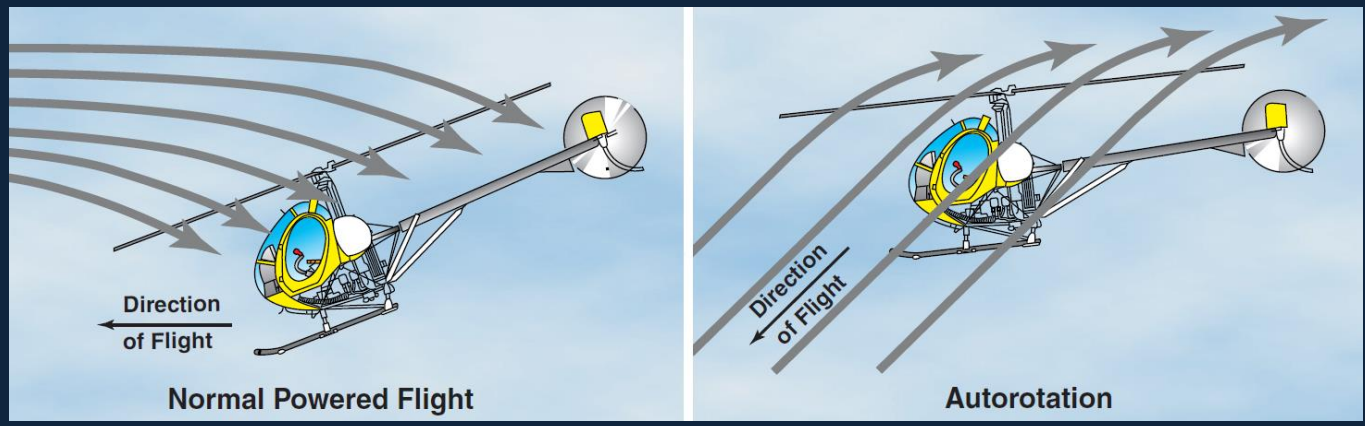
Helicopter Lift



Helicopter Lift

Autorotation

- The state of flight where the main rotor system is being turned by the action of relative wind rather than engine power.
- How to landed safely in the event of an engine failure
- Uses a freewheeling unit, which allows the main rotor to continue turning even if the engine is not running
- Airflow enters the rotor disc from below as the helicopter descends

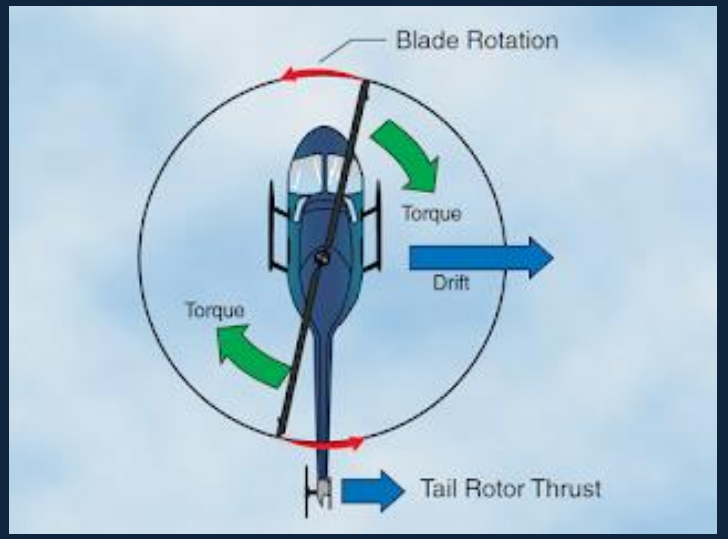


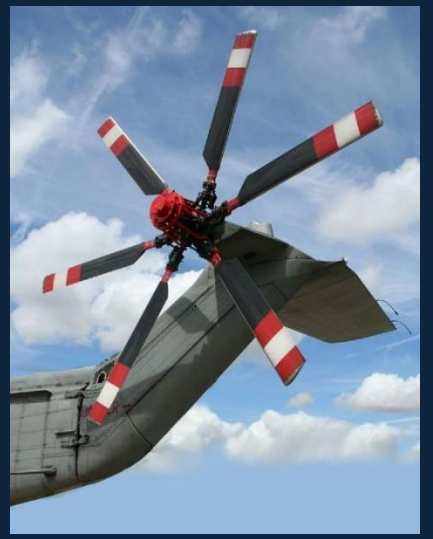
Helicopter Tail Rotor

Two main purposes:

1. Prevents fuselage from turning in circles continuously
2. Used to control direction

- A small rotor designed to produce thrust in the direction opposite of the torque
- Air is forced down between the blades and pushes the fuselage straight





Multi-Rotor Aircraft Dynamics

How are Movements Achieved in RPAS?

- Do not have control surfaces like other aircraft do, instead they vary the speed of their motors to produce different movements and create lift

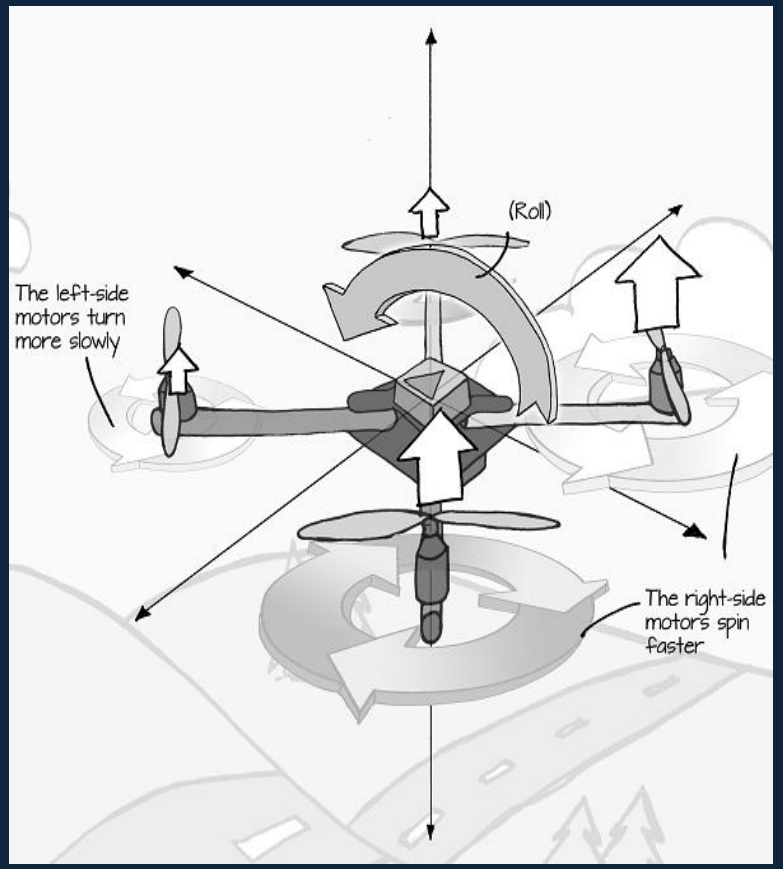
Altitude Control

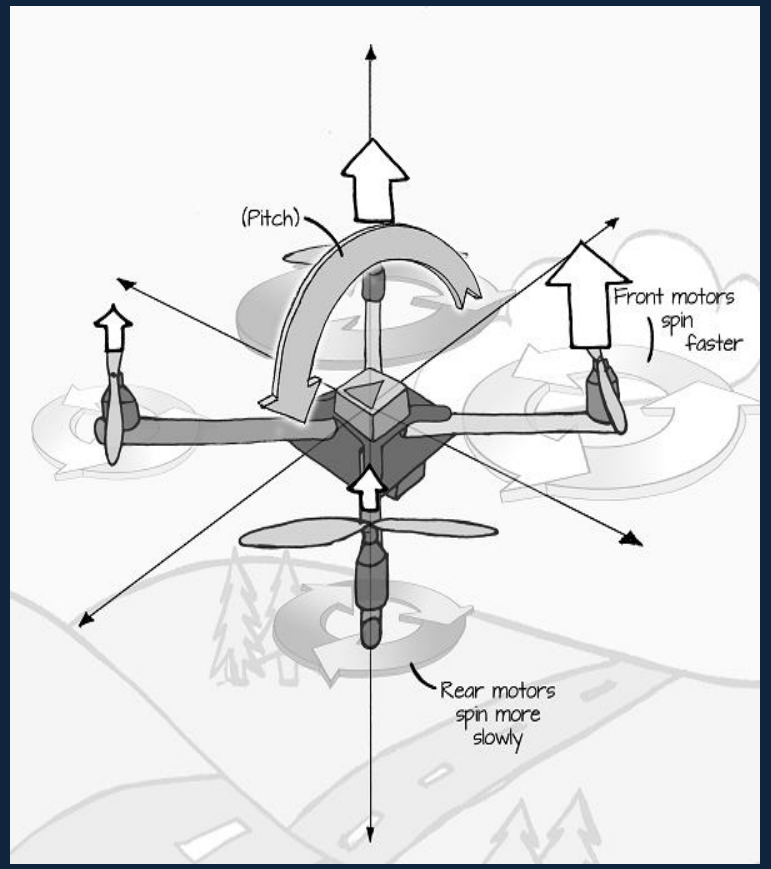
- **Hovering**
- Stay at a constant altitude without rotating in any direction
- Requires a balance of forces will need to counteract the force of gravity with the lift produced by the rotors

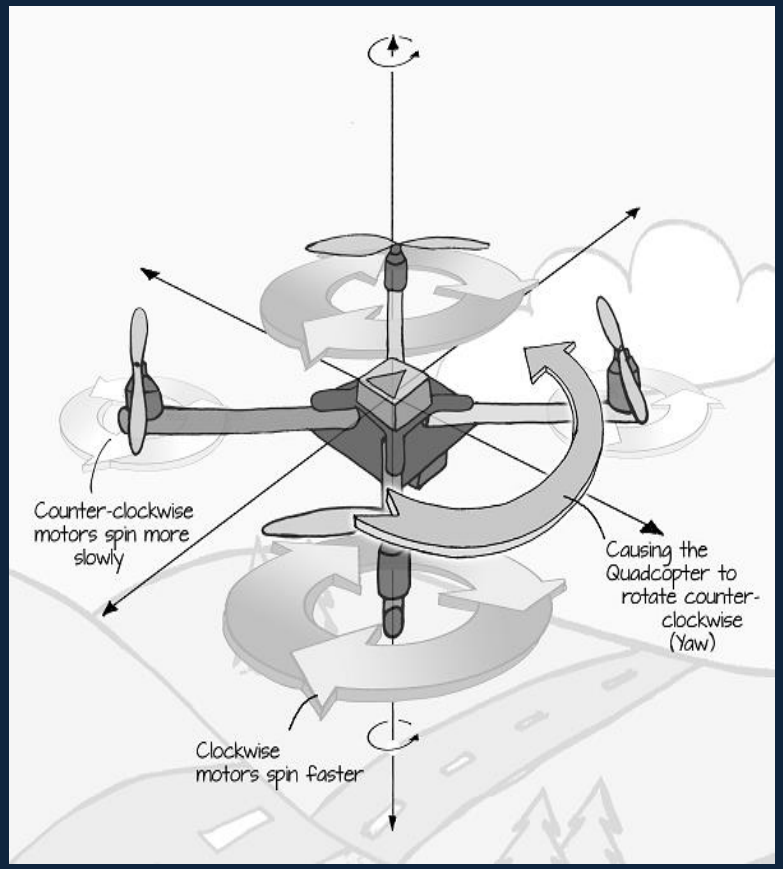
Climb and Descent

- Will need to disrupt that balance
- If the lift produced is greater than the force of gravity, the multirotor will gain altitude
- If the lift produced is less than the force of gravity acting on the multirotor, then the multirotor will fall

Multi-Rotor Aircraft Dynamics







Multi-Rotor Aircraft Dynamics

Settling with Power

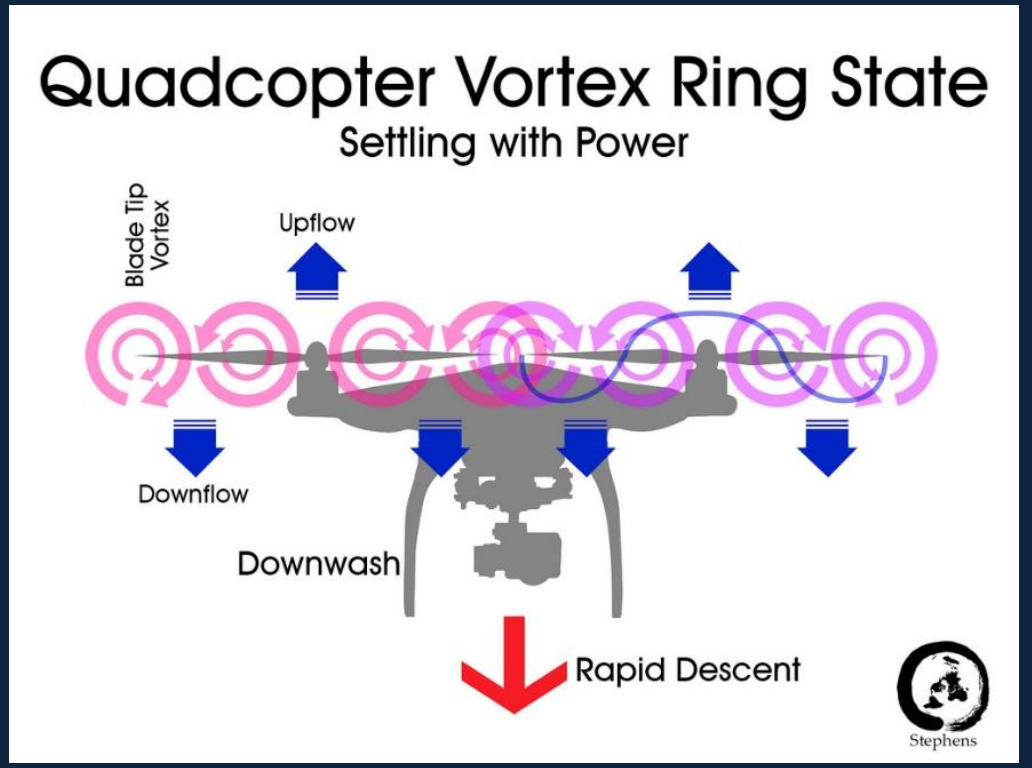
- Using power to descent vertically
- Turbulent downwash from your propeller blades can be recirculated back into the propeller
- The turbulent air flowing over the blades will cause a loss of lift and the RPAS will fall down
- If the air recirculates asymmetrically, one side will loose lift first and flip over

Dynamic Rollover

- Aka. Vortex warble of death or Vortex Ring State

Multi-Rotor Aircraft Dynamics

- RPAS are capable of stalls just like an airplane.
- The following video demonstrates how this can happen with a RPAS and how to correct for it.




ROCKET
ROCK SHOX

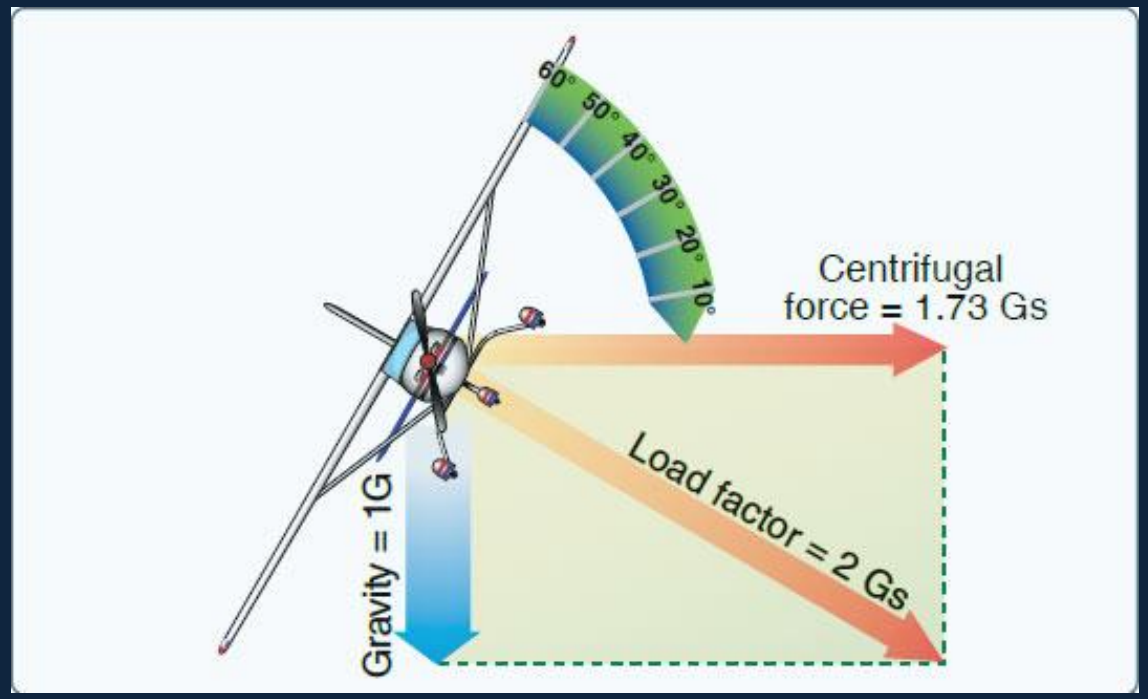
Multi-Rotor Aircraft Dynamics

Dynamic Rollover

- Vortex warble of death or Vortex Ring State
- **Recovery**
  - First you need to get your RPAS back into clean, non-turbulent air
  - Pitch forward or move sideways to get out of propeller downwash
  - DO NOT ADD THROTTLE
  - However, once you're descending though air so turbulent that you lose control, it will almost always result in a crash
- **How to avoid**
  - Descend slowly, less power means less turbulent air
  - Descend in any direction other than straight down
  - Land into a headwind

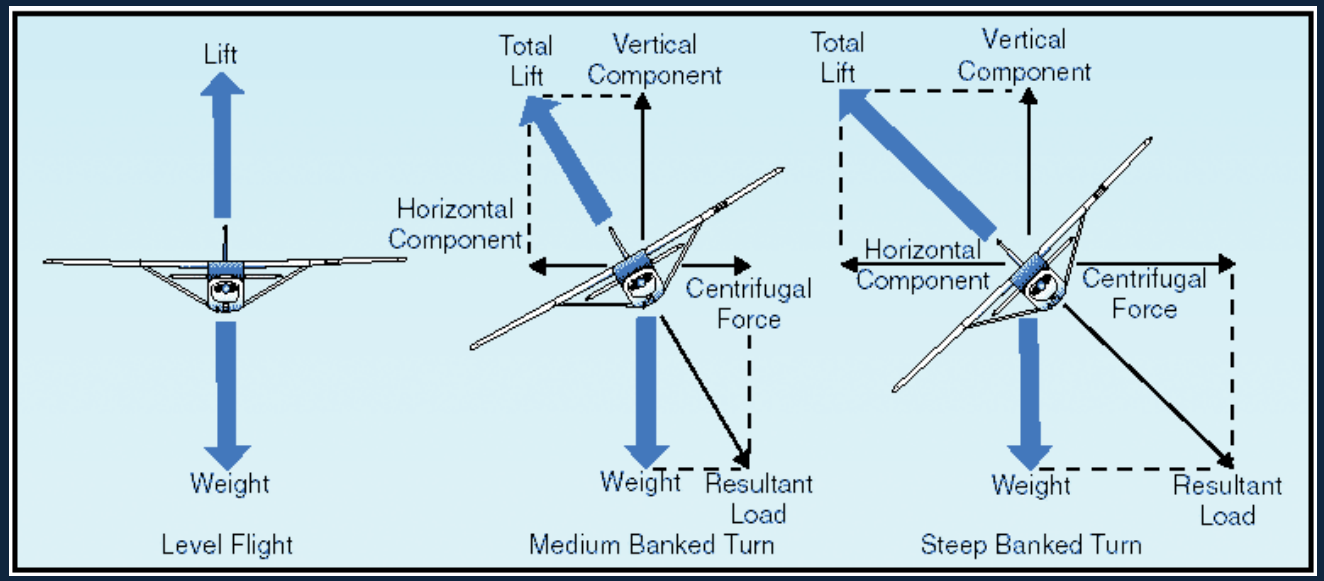
Load Factor

- Load factor is the ratio of the lift of an aircraft to its weight
- Represents the amount of stress the aircraft is under
- Typically referred to as “Gs”



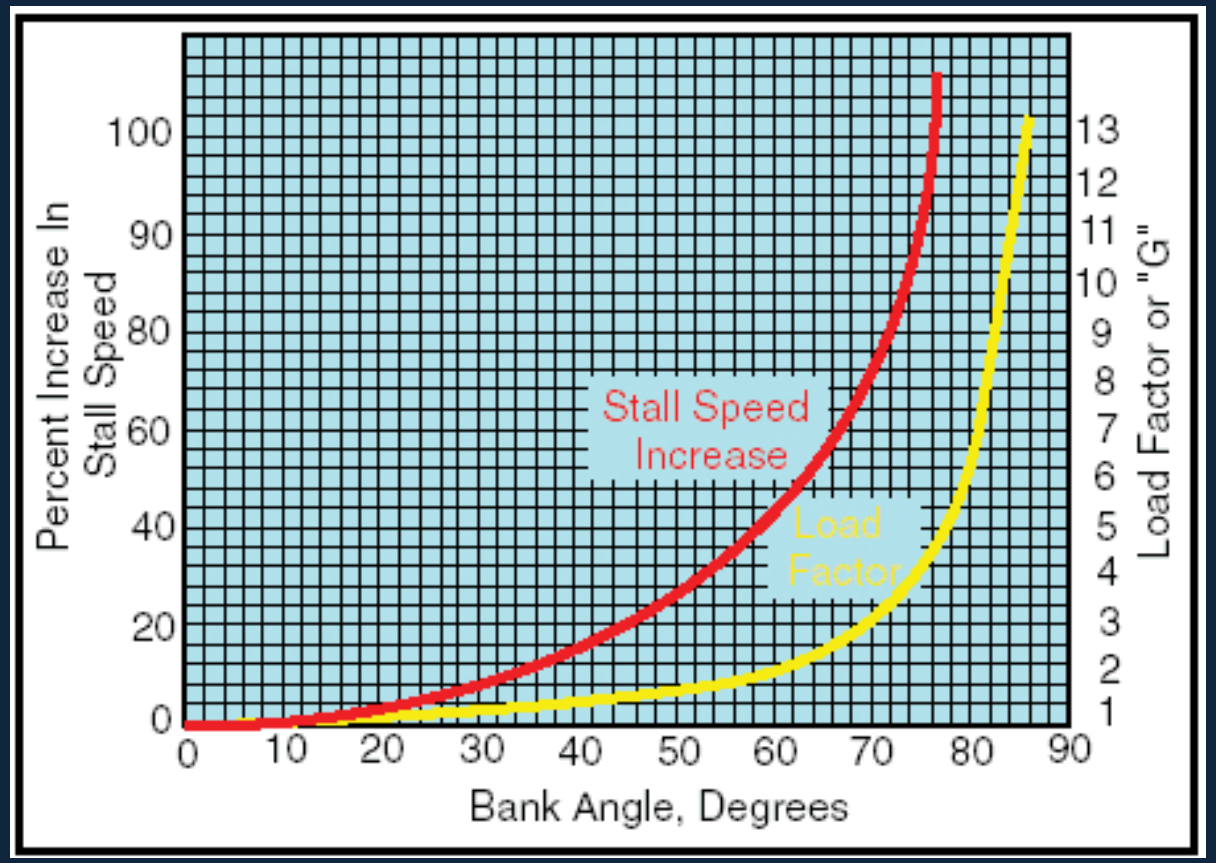
Load Factor

- Increasing the angle of bank increases the load factor
- This will require more lift so apply backpressure on the elevators
- More lift means more drag so the aircraft will want to slow down
- Therefore, power must be increased to increase thrust and maintain speed

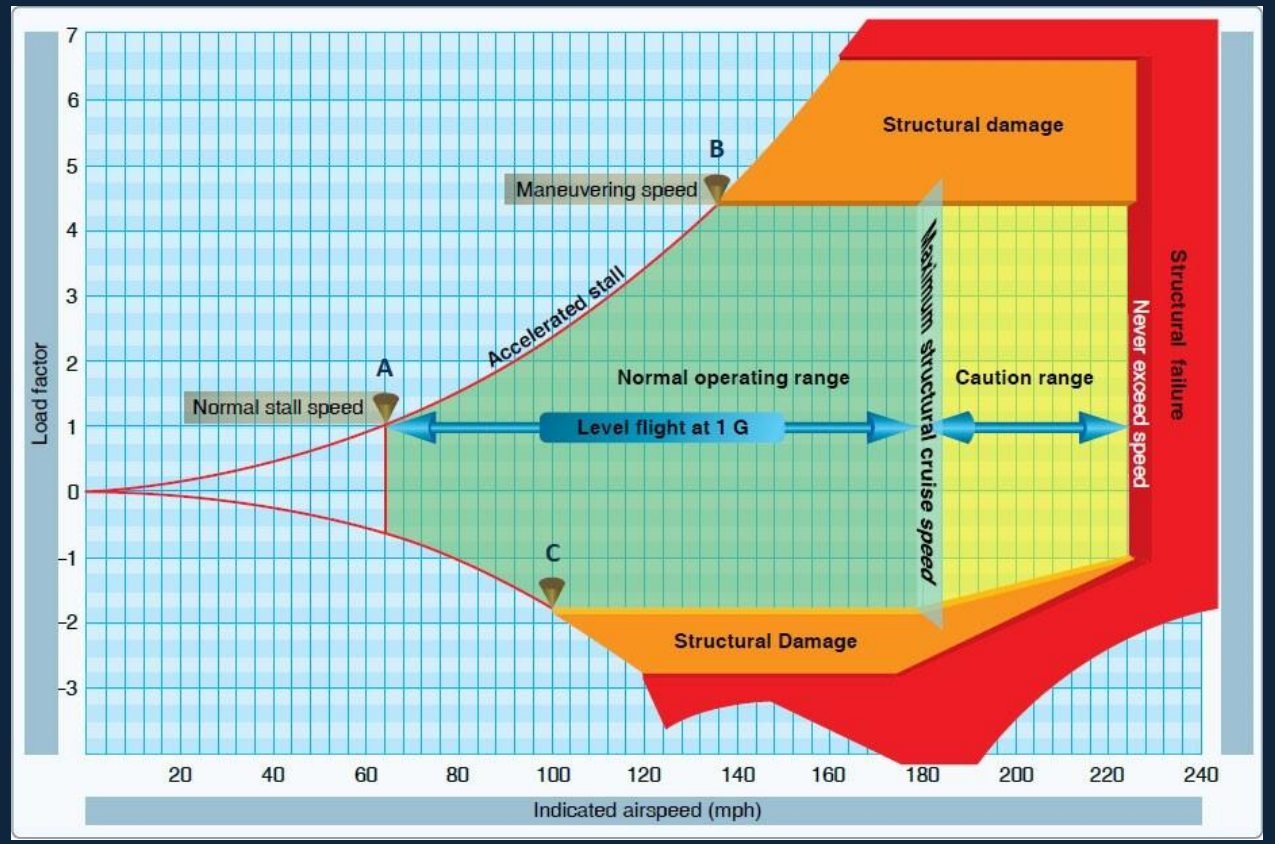


Load Factor & Stall Speed

Load factor created due to acceleration force while changing direction



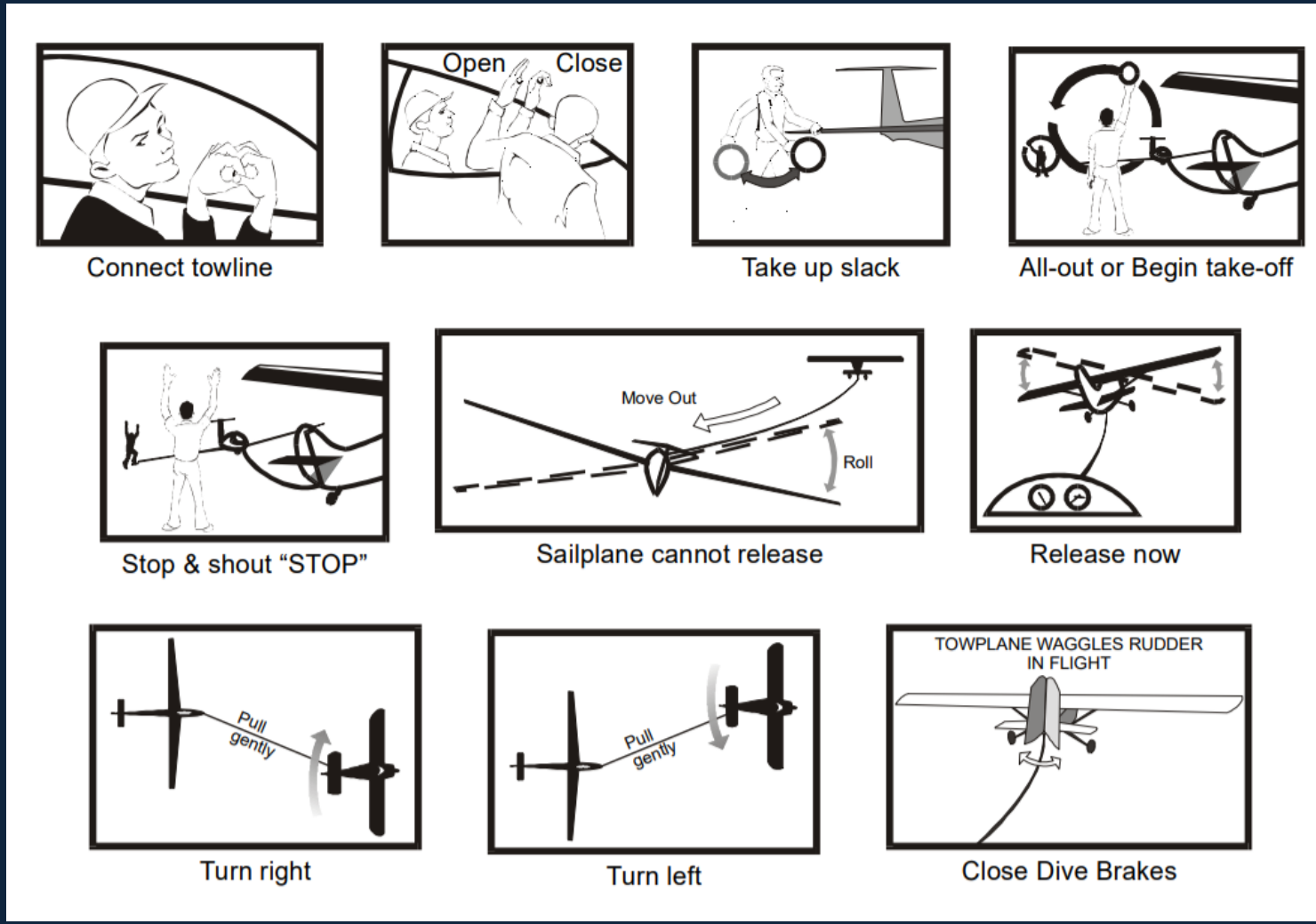
Structural/Power Limitations



Gliders

- **Can't Release:** Glider moves out to the left of the tow plane and waggles his wings. Tow pilot responds with waggle of wings.
- **Turn left:** Glider moves out and stays to the right of the tug, effectively pulling the tail right, forcing a left turn.
- **Turn right:** Opposite of above.
- **Increase Speed:** Glider rocks wings.
- **Decrease Speed:** Glider yaws.

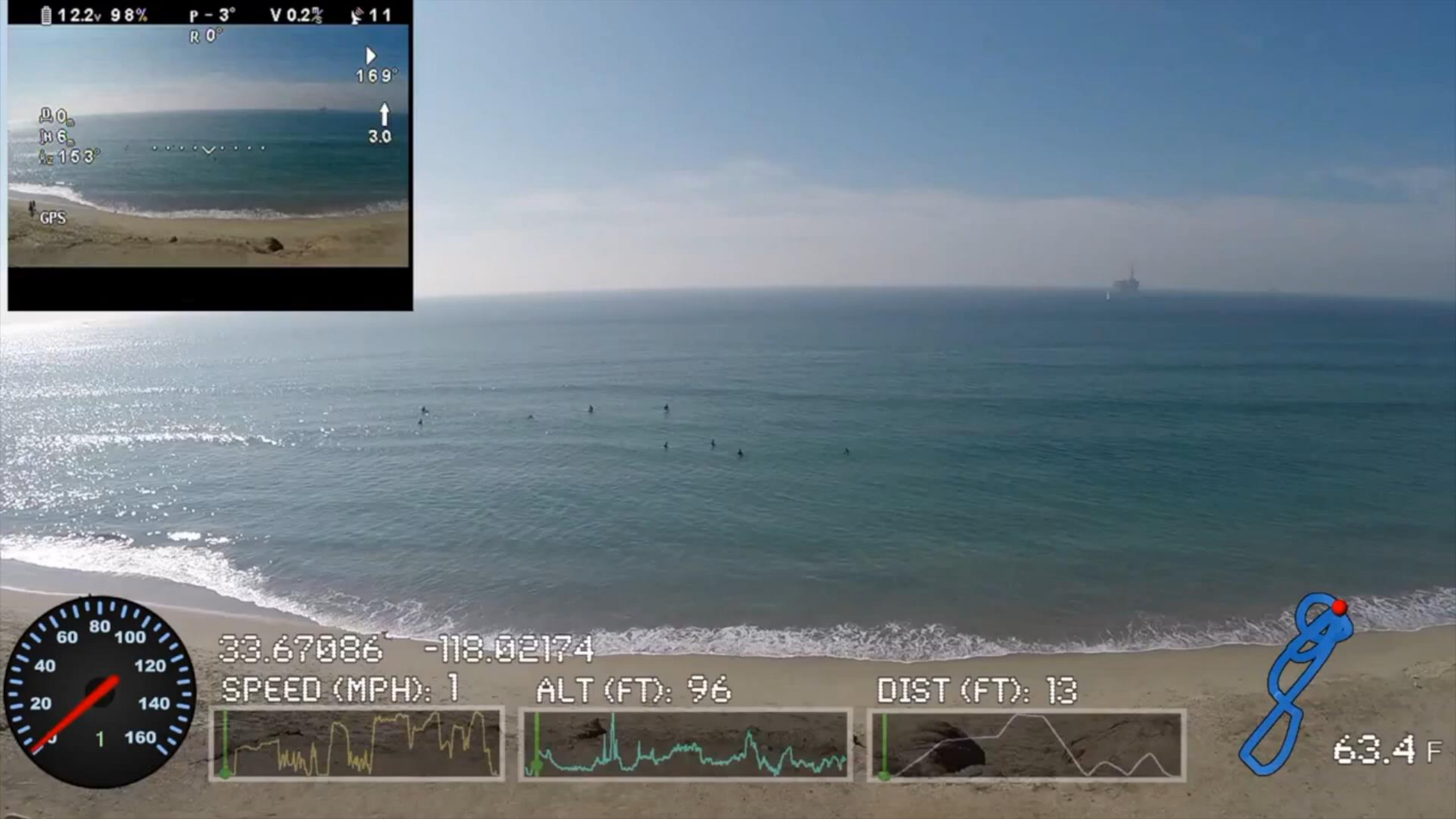
Gliders Ground/Air Signals



Gliders – Weak Link

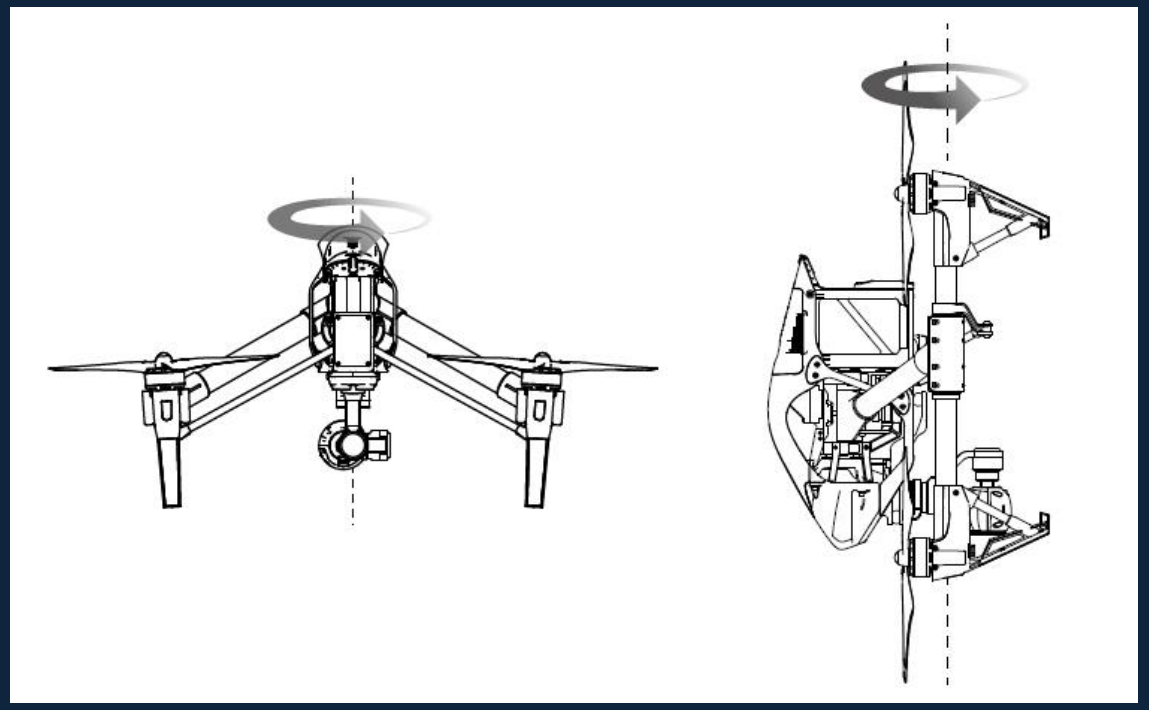
- A safety device in the winch cable or towline. They come in various strengths (indicated by their color) and the correct one must be used with a given glider.
- To prevent the tow force from increasing to a point that the glider can be stressed close to or beyond its structural limits.

Instruments


12.2v 98%
P -3°
V 0.2
11
R 0°
169°
3.0
GPS
33.67086 -118.02174
SPEED (MPH): 1
ALT (FT): 96
DIST (FT): 13
63.4 F

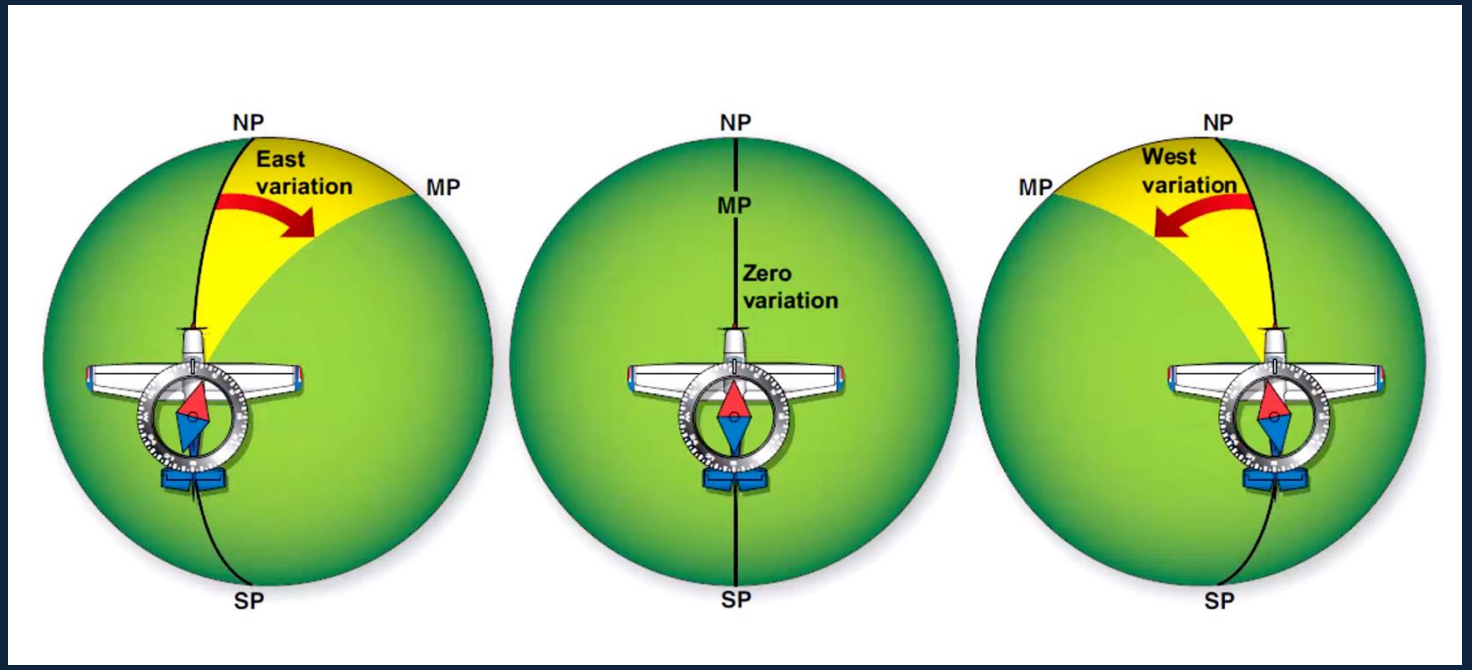
Magnetic Compass

- Simple and reliable self-contained instrument that operates using a needle that is influenced by Earth's magnetic field
- **Importance of calibration**
  - Since the magnetic north pole is not stationary and instead moves in an erratic circle, the variation changes slowly from year to year



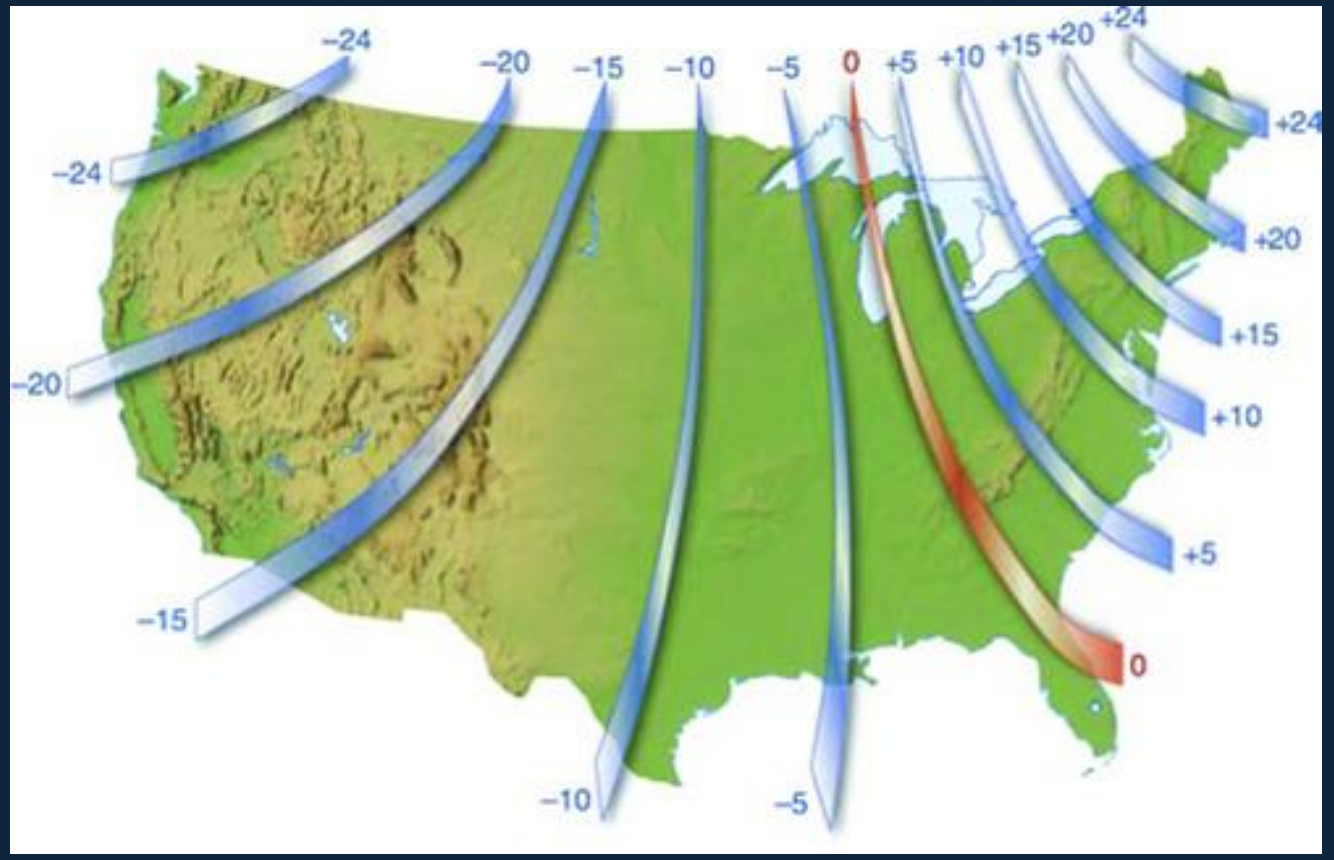
Magnetic Variation/Declination

- Magnetic Variation/Declination: The angle between true north and magnetic north
- True North: The axis in which the earth rotates about
- Magnetic North: The earth's magnetic north pole



Agonic & Isogonal Lines

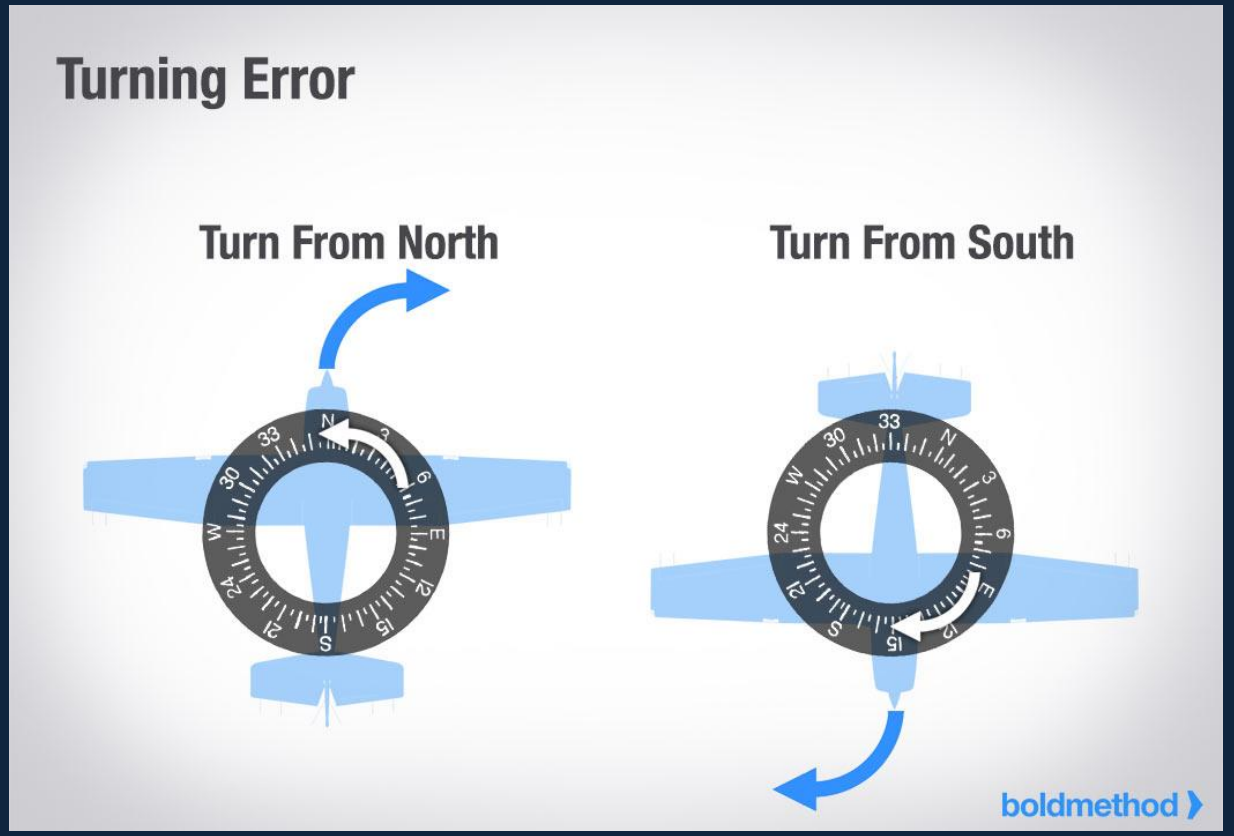
- Agonic Line: Lines along which variation is zero (Red)
- Isogonal Line: Lines of equal variation (Blue)



Factors Affecting Compass Operation

Turning Error
Occurs during turns and rapid speed changes

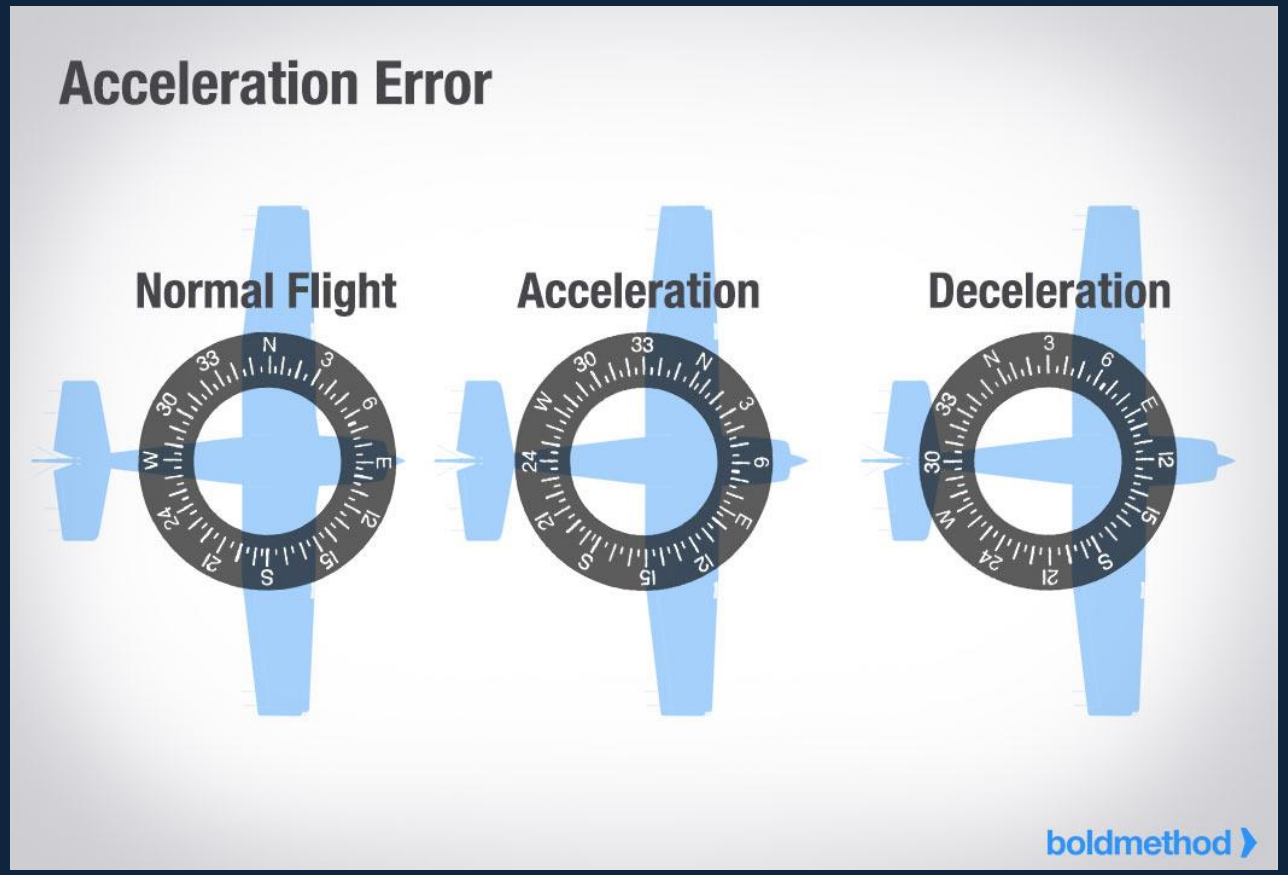
Northerly Turning Error
Turn from the North → Lag
Turn from the South → Lead



Factors Affecting Compass Operation

Acceleration and Deceleration Error

ANDS (Accelerate North, Decelerate South)



Pitot-Static System

- Consists of instruments operated by changes in air pressure
- Operates the Airspeed Indicator, Altimeter and Vertical Speed Indicator
- Uses two sources – static pressure source and pitot pressure source

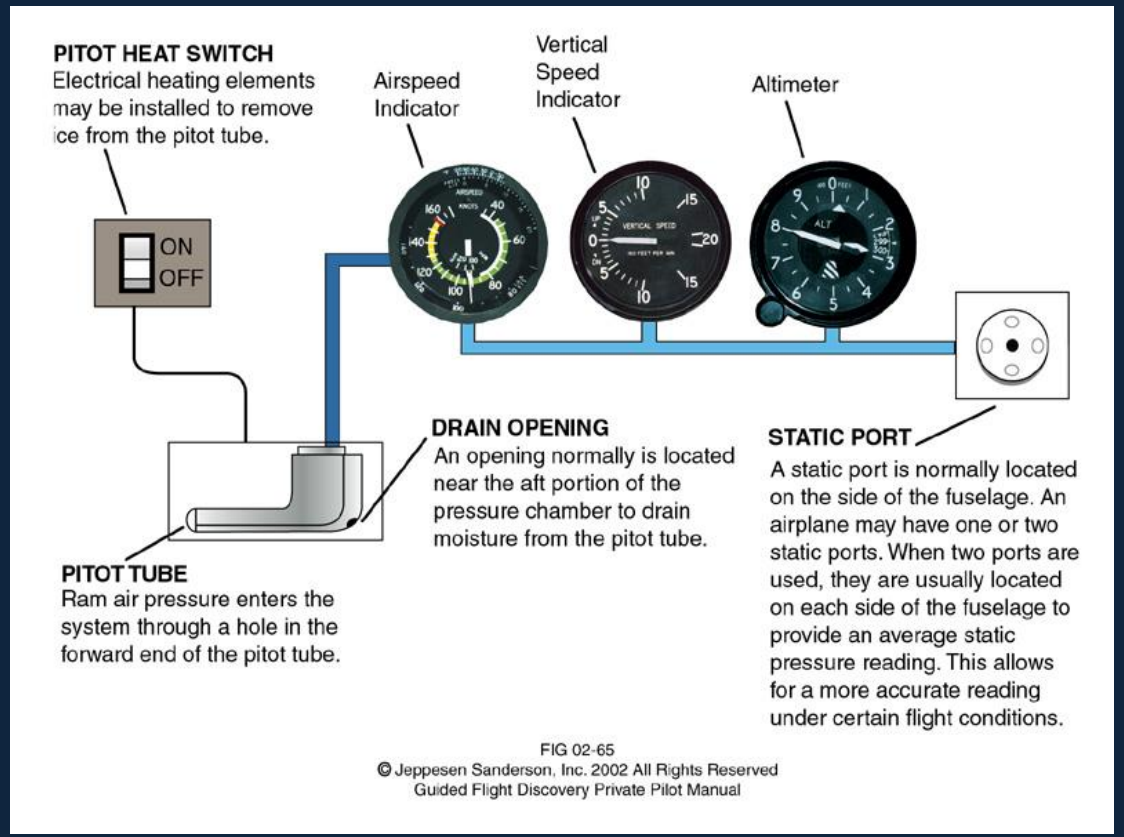


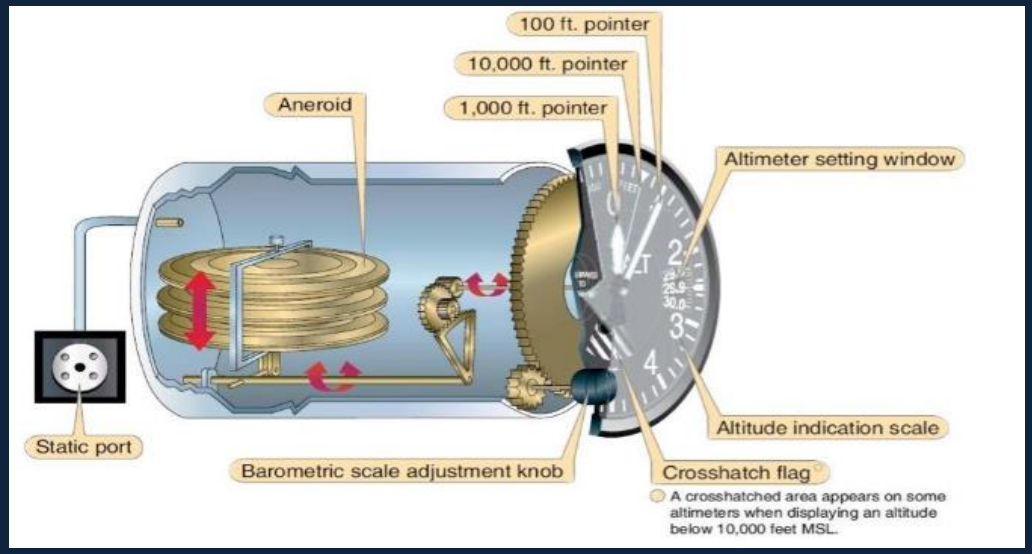
FIG 02-65

Guided Flight Discovery Private Pilot Manual

Altimeter

Principles of Operation

- This type of altimeter is known as an Aneroid Barometer
- The instrument is connected to the Static Port which is located in the slipstream of air on the fuselage of the aircraft
- Inside the instrument are a number of aneroid capsules which are filled with air at a pressure of 29.92 in Hg
- As the aircraft climbs or descends pressure outside the aircraft changes which passes through the static port and into the Altimeter
- Pressure increase causes the aneroid capsule to contract, indicating a descent
- Pressure decrease causes the aneroid capsule to expand, indicating a climb



Altimeter

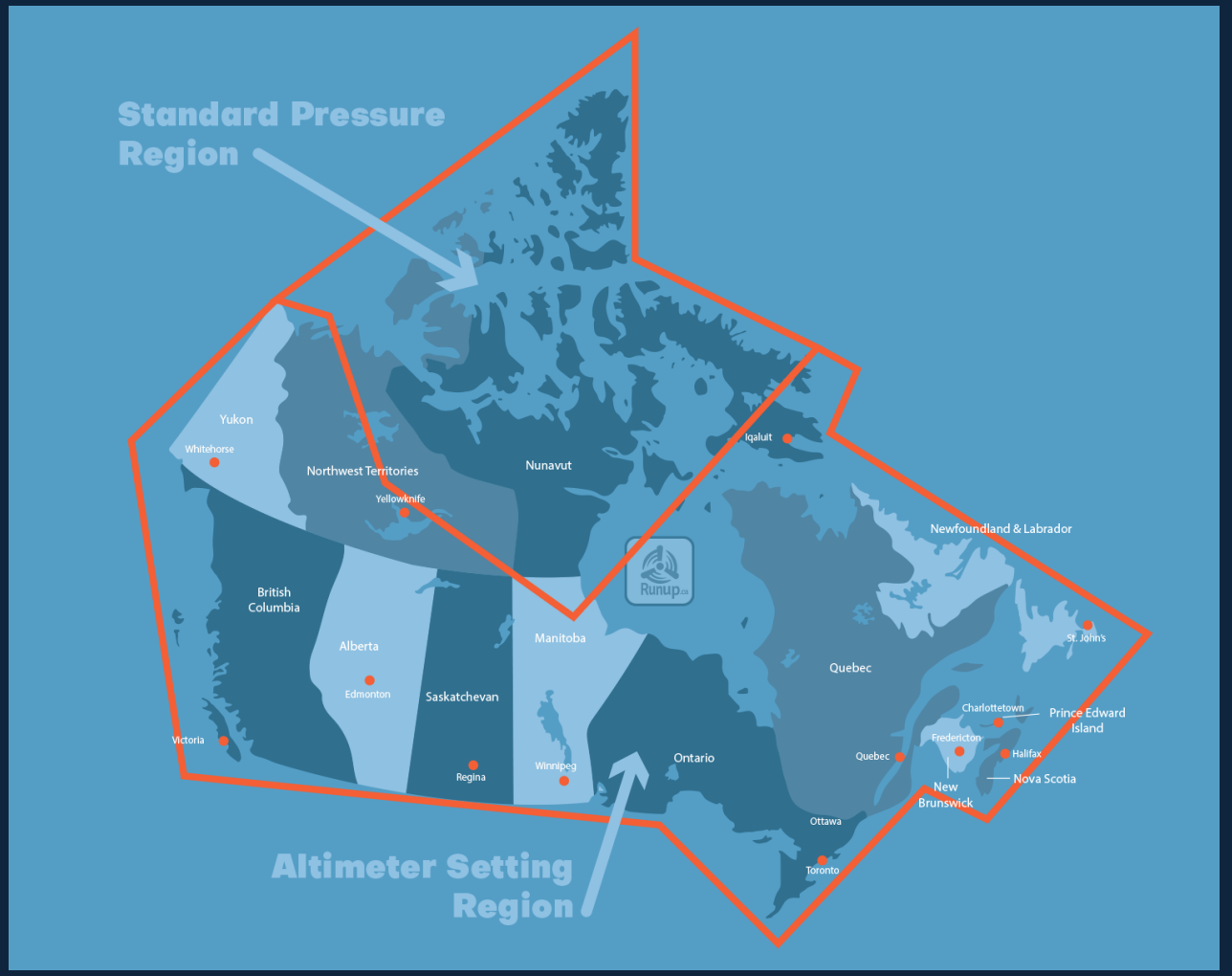
Principles of Operation

- The importance of a Barometric Altimeter Setting lies in the fact that pressure is not equal everywhere on any given day.
- We use the altimeter setting from either a METAR, AWOS, LWIS, or ATIS to properly set the altimeter to our field elevation.
- If we are somewhere without a weather observation station, we would use the dial on the altimeter to set the elevation of the field which would give us the "Altimeter Setting" in the Kollsman Window.

Altimeter – Blockages in Static System

	 Indicated Airspeed	 Indicated Altitude	 Indicated Vertical Speed
Pitot Ram Air Source and Drain Hole Blocked	Increases with altitude gain; decreases with altitude loss	Unaffected	Unaffected
Pitot Ram Air Source Blocked and Drain Hole Open	Displays zero knots	Unaffected	Unaffected
Static Source Blocked	Decreases with altitude gain; increases with altitude loss	Does not change with altitude gain or loss	Does not change with vertical speed changes
Both Static and Pitot Sources Blocked	All indications remain constant, regardless of changes in airspeed, altitude, and vertical speed.		

Standard and Altimeter Regions



Airspeed Indicator

Calibrated Airspeed (CAS)

- Calibrated airspeed is indicated airspeed corrected for the instrument and installation error (position errors) in the pitot static system
- This speed can be found by consulting a chart which appears in your aircrafts POH

Indicated Airspeed (IAS)

- Indicated airspeed is uncorrected speed which is read directly off the indicator

True Airspeed (TAS)

- True Airspeed is calibrated airspeed which is corrected for air density
- This is known as the actual speed of the plane through air
- This can be calculated using a flight computer, or a true airspeed indicator
    - As a note: True airspeed is always higher at the stall, at high altitudes or high temperatures – however, indicated airspeed will always remain the same

Airspeed Indicator

AIRSPEED CALIBRATION

NORMAL STATIC SOURCE

FLAPS UP												
KIAS	40	50	60	70	80	90	100	110	120	130	140
KCAS	49	55	62	70	80	89	99	108	118	128	138
FLAPS 10°												
KIAS	40	50	60	70	80	85	---	---	---	---	---
KCAS	49	55	62	71	80	85	---	---	---	---	---
FLAPS 40°												
KIAS	40	50	60	70	80	85	---	---	---	---	---
KCAS	47	54	62	71	81	86	---	---	---	---	---

Altimeter – Blockages in Pitot System

	 Indicated Airspeed	 Indicated Altitude	 Indicated Vertical Speed
Pitot Ram Air Source and Drain Hole Blocked	Increases with altitude gain; decreases with altitude loss	Unaffected	Unaffected
Pitot Ram Air Source Blocked and Drain Hole Open	Displays zero knots	Unaffected	Unaffected
Static Source Blocked	Decreases with altitude gain; increases with altitude loss	Does not change with altitude gain or loss	Does not change with vertical speed changes
Both Static and Pitot Sources Blocked	All indications remain constant, regardless of changes in airspeed, altitude, and vertical speed.		

Air Law

- General Provisions
- Airspace
- Miscellaneous
- Aerodromes and Airports
- Part 9 – RPAS Operations
- Transportation Safety Board

Definitions (101.01)

- **Aerodrome**
  - is any area of land or water (including the frozen surface) or other supporting surface used or designed, prepared, equipped or set apart for the arrival and departure, movement or servicing of aircraft. It includes any buildings, installations, and equipment in connection therewith.
- **Airport**
  - means an aerodrome in respect of which an airport certificate issued under subpart 2 of part III is in force
- **Pilot-in-command**
  - the pilot responsible for the operation and safety of an aircraft during flight time.
- **Day or daylight**
  - means the time between the beginning of morning civil twilight and the end of evening civil twilight.
- **Night**
  - means the time between the end of evening civil twilight and the beginning of morning civil twilight.

Definitions (101.01)

- **Remotely piloted aircraft**
  - means a navigable aircraft, other than a balloon, rocket or kite, that is operated by a pilot who is not on board.
- **Small remotely piloted aircraft**
  - means a remotely piloted aircraft that has a maximum take-off weight of at least 250 g (0.55 pounds) but not more than 25 kg (55 pounds).
- **Remotely piloted aircraft system**
  - or RPAS means a set of configurable elements consisting of a remotely piloted aircraft, its control station, the command & control links and any other system elements required during flight operation.

Application (102)

Application 02.01

- These regulations do not apply in respect of:
  - (B) Military aircraft of a country other than Canada, to the extent that the minister of national defense has exempted them from the application of these regulations pursuant to subsection 5.9(2) of the act.
  - It does not apply to remotely piloted aircraft that are operated indoors or underground or; (c) rockets, hovercraft or wing-in-ground-effect machines, unless otherwise indicated in these regulations.

Administration & Compliance (103)

- **Inspection of Aircraft, Requests for Production of Documents and Prohibitions**
  - 103.02(2) : [You] shall produce the Canadian aviation document, technical record or other document for inspection in accordance with the terms of a demand made by a peace officer, an immigration officer or the Minister.
- **Return of Canadian Aviation Documents**
  - 103.03: Where a Canadian aviation document has been suspended or cancelled, the person to whom it was issued shall return it to the Minister immediately after the effective date of the suspension or cancellation
- **Inspection of Aircraft, Requests for Production of Documents and Prohibitions**
  - 103.02(2) : [You] shall produce the Canadian aviation document, technical record or other document for inspection in accordance with the terms of a demand made by a peace officer, an immigration officer or the Minister.
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Administration & Compliance (103)

- **Inspection of Aircraft, Requests for Production of Documents and Prohibitions**
  - 103.02(2) : [You] shall produce the Canadian aviation document, technical record or other document for inspection in accordance with the terms of a demand made by a peace officer, an immigration officer or the Minister.
- **Return of Canadian Aviation Documents**
  - 103.03: Where a Canadian aviation document has been suspended or cancelled, the person to whom it was issued shall return it to the Minister immediately after the effective date of the suspension or cancellation
- **Record Keeping**
  - 103.04 Recording systems, including computer records and microfiche, that do not comprise entries on paper may be used to comply with the record-keeping requirements of these Regulations if
    - measures are taken to ensure that the records contained in the recording systems are protected, by electronic or other means, against inadvertent loss or destruction and against tampering; and
    - a copy of the records contained in the recording systems can be printed on paper and provided to the Minister on reasonable notice given by the Minister.

Aircraft Operating Restrictions and Hazards to Aviation Safety

601.14

- **Directed bright light source**
  - means any directed light source (coherent or non-coherent), including lasers, that may create a hazard to aviation safety or cause damage to an aircraft or injury to persons on board the aircraft;
- **Fire control authority**
  - means an official of a government forestry service or other fire control agency that is responsible for the protection of persons and property against fire;
- **Forest fire area**
  - means an area on the surface of the earth on which standing timber, grass or any other vegetation or buildings are burning

Forest Fire Aircraft Operating Restrictions

- **601.15 No person shall operate an aircraft**
  - Over a forest fire area, or over any area that is located within five nautical miles of a forest fire area, at an altitude of less than 3,000 feet AGL; or
  - In any airspace that is described in a NOTAM issued pursuant to section 601.16
- **601.17 Section 601.15 DOES NOT apply to**
  - Persons who are operating an aircraft at the request of an appropriate fire control authority; and
  - Department of Transport personnel who are operating an aircraft in the performance of duties related to surveillance and the enforcement of aviation legislation.
- 601.16 The Minister may issue a NOTAM
  - that relates to restrictions on the operation of aircraft in the case of a forest fire and that describes the location and dimensions of the forest fire area; and
  - the airspace in which forest fire control operations are being conducted.

Projection of Directed Bright Light Source at an Aircraft

- **601.20: Subject to section 601.21,**
  - no person shall project or cause to be projected a directed bright light source into navigable airspace in such a manner as to create a hazard to aviation safety or cause damage to an aircraft or injury to persons on board the aircraft.

Projection of Directed Bright Light Source at an Aircraft - Requirement for Notification

601.21

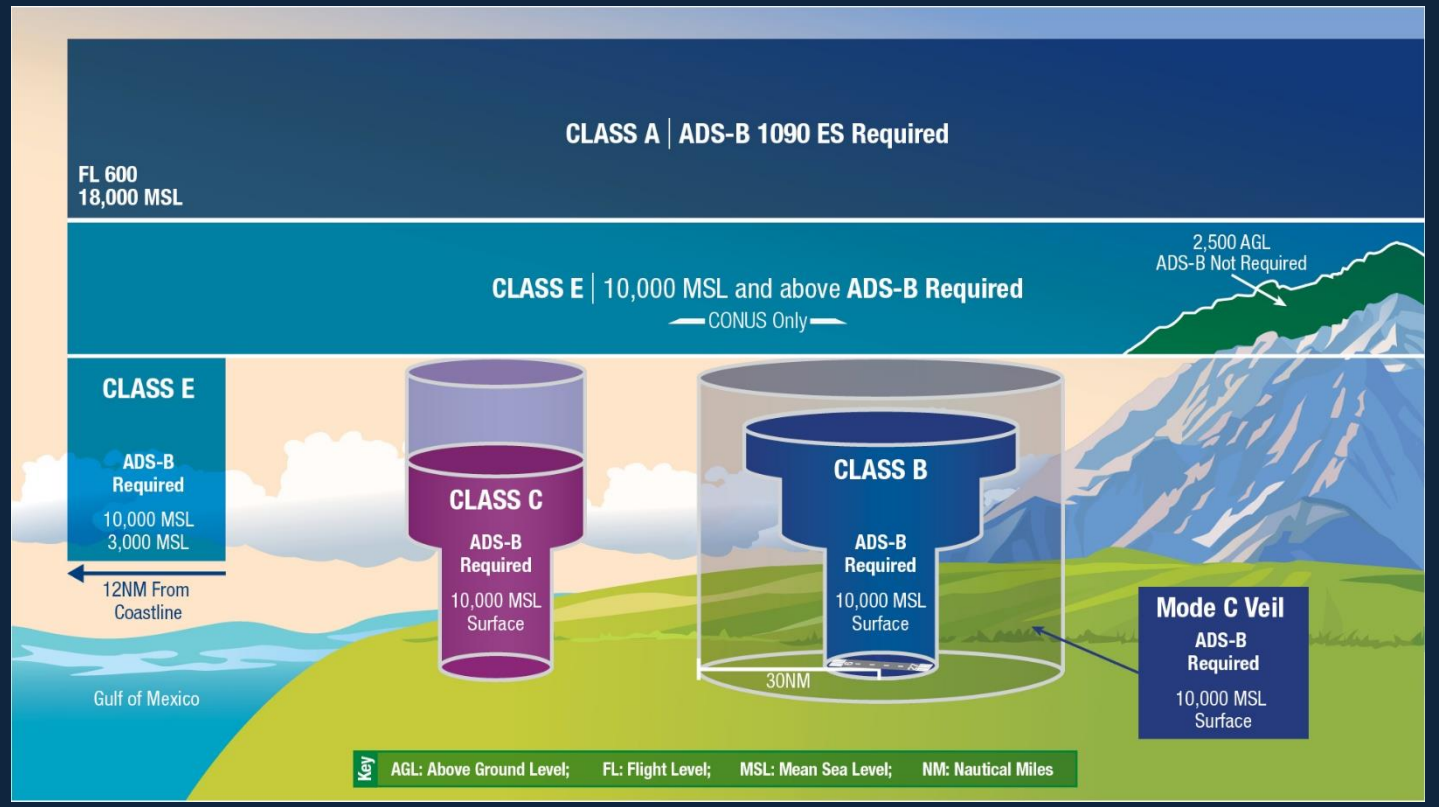
- (1) Any person planning to project or cause to be projected a directed bright light source into navigable airspace shall, before the projection,
  - submit a written request to the Minister for an authorization to project the directed bright light source into navigable airspace; and
  - obtain a written authorization from the Minister to do so.
- (2) On receipt of the request for authorization, the Minister shall issue a written authorization if the projection is not likely to create a hazard to aviation safety or to cause damage to an aircraft or injury to persons on board the aircraft.
- (3) The Minister may specify in the authorization any conditions necessary to ensure that the projection is not likely to create a hazard to aviation safety or to cause damage to an aircraft or injury to persons on board the aircraft.
  - This includes the use of LIDAR on an RPA since it uses a pulsed laser to measure ranges (variable distances) to the Earth

Projection of Directed Bright Light Source at an Aircraft – Pilot in Command

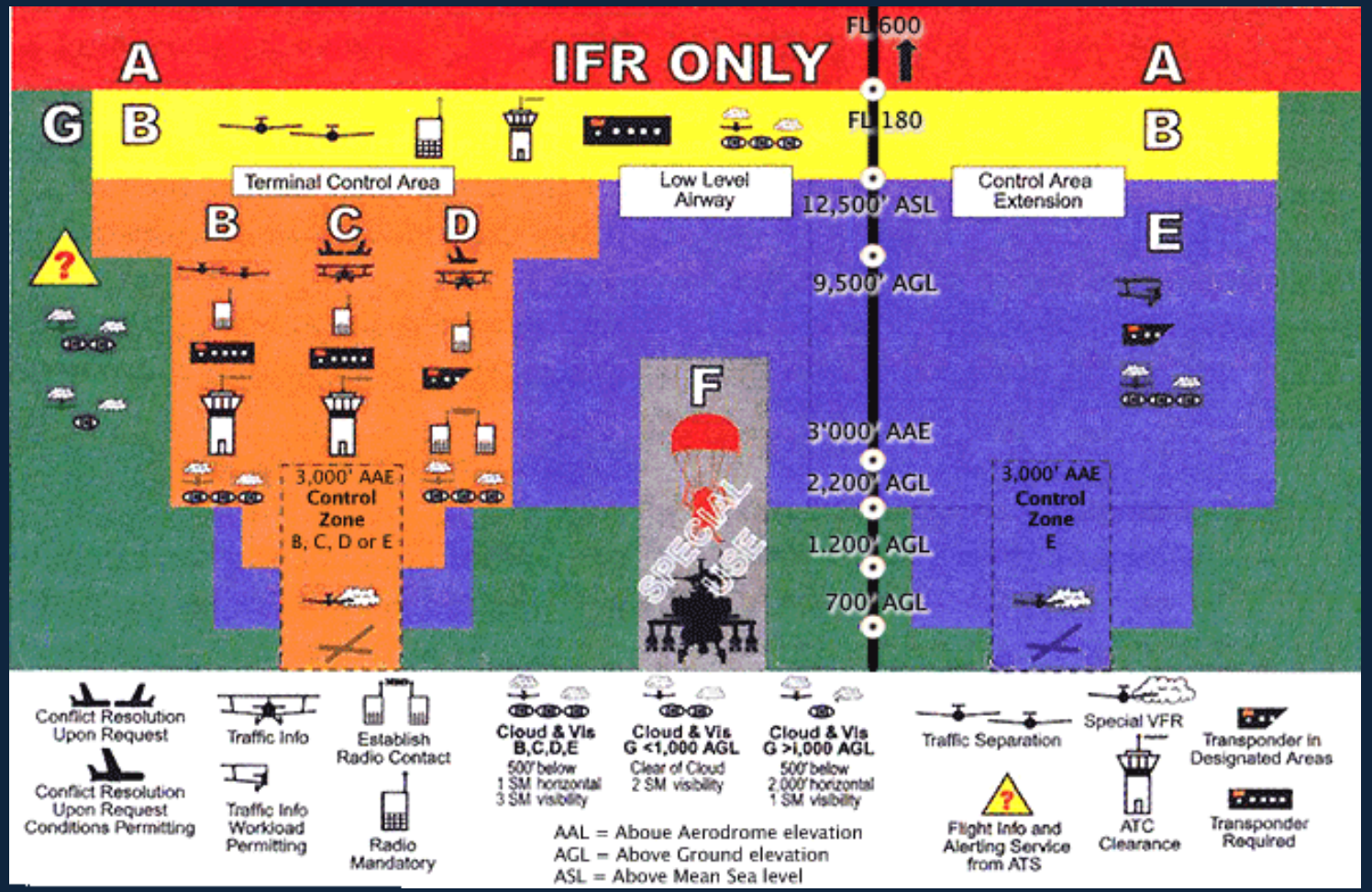
601.22

- (1) No pilot-in-command shall intentionally operate an aircraft into a beam from a directed bright light source or into an area where a directed bright light source is projected, unless the aircraft is operated in accordance with an authorization issued by the Minister.
- (2) The Minister may issue the authorization if the operation of the aircraft is not likely to create a hazard to aviation safety.

Air Law & Airspace

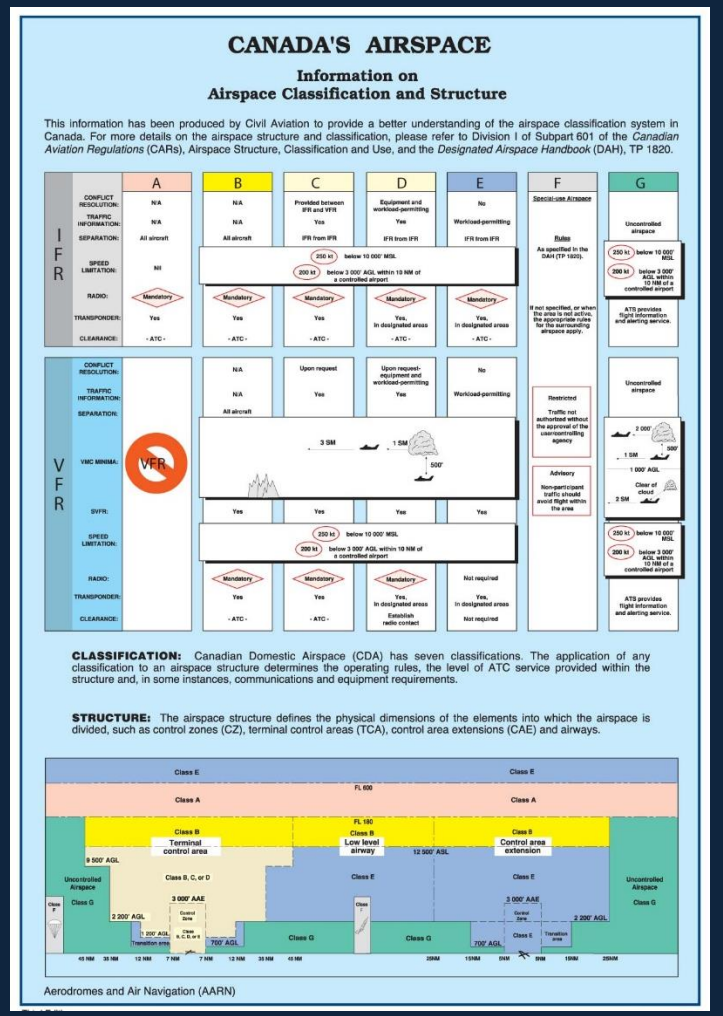


Air Law & Airspace



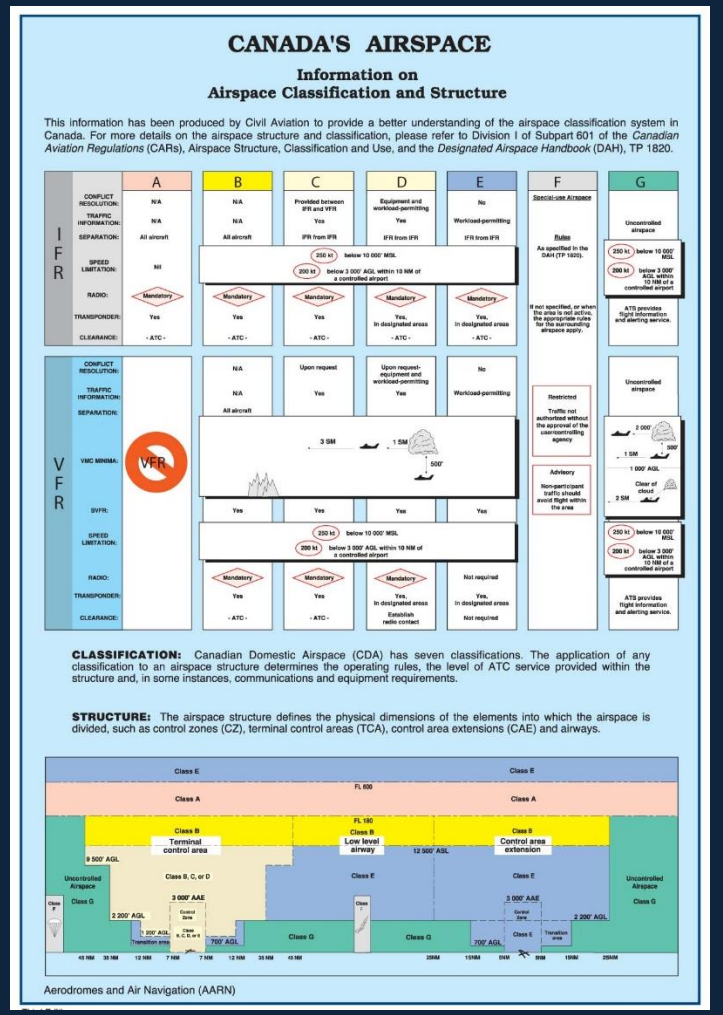
Air Law & Airspace

- 601.02: (1) The class of any controlled airspace of a type referred to in subsection 601.01(1) is one of the following, as specified in the Designated Airspace Handbook:
  - Class A;
  - Class B;
  - Class C;
  - Class D;
  - Class E;
  - Class F Special Use Restricted; or
  - Class F Special Use Advisory



Air Law & Airspace

- 601.02 cont.:(2) The class of any uncontrolled airspace of a type referred to in subsection 601.01(2) is one of the following, as specified in the Designated Airspace Handbook:
  - Class G;
  - Class F
  - Special Use Restricted (CYR); or
  - Special Use Advisory (CYA)



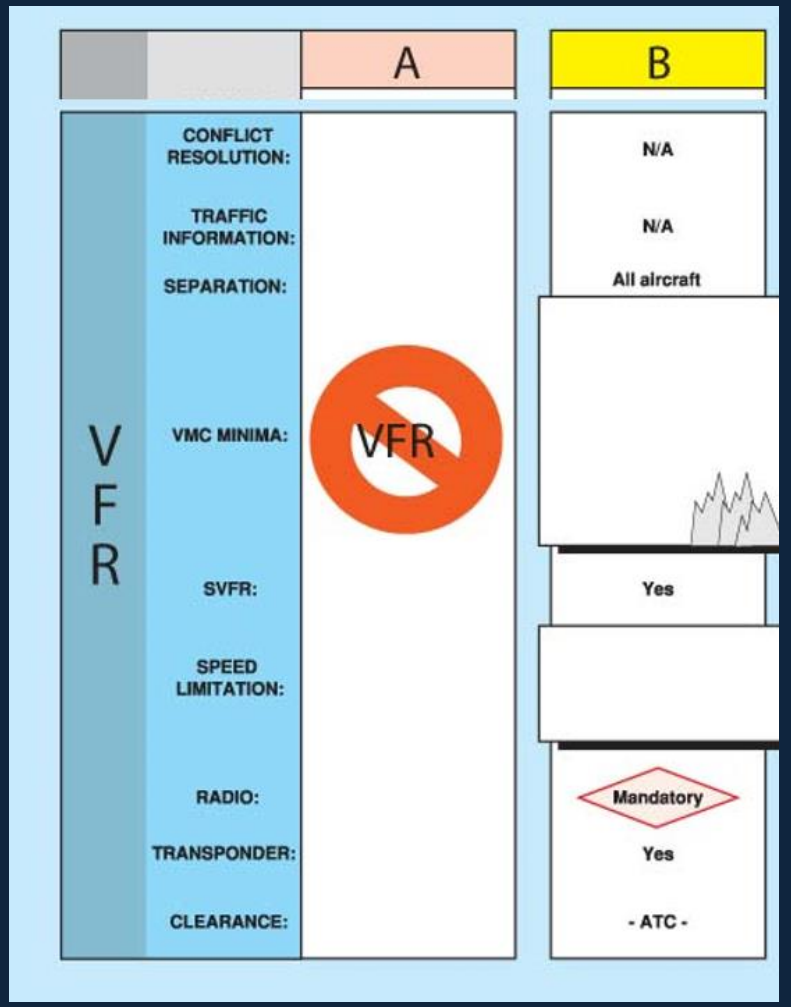
Air Law & Airspace

Class A

- Controlled High Level airspace (18,000 ft up to 60,000ft)
- IFR traffic only

Class B

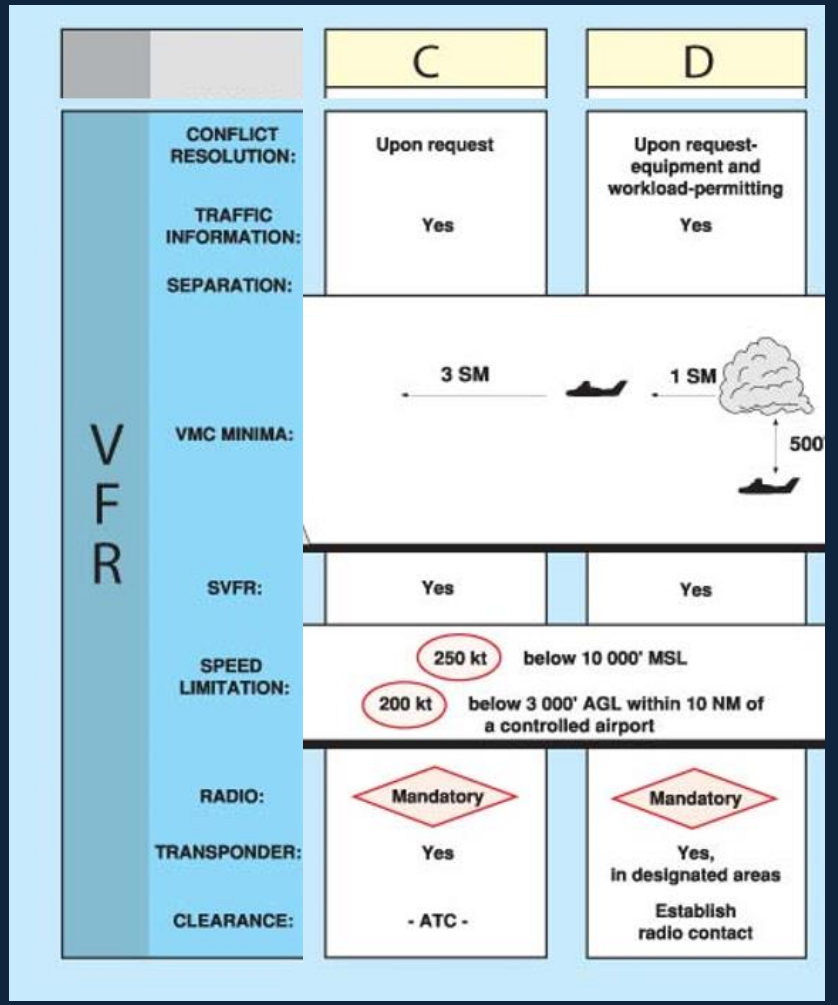
- Controlled Low-Level airspace (above 12,500 ft to 17,999 ft)
- Can also go lower if specified in the Designated Airspace Handbook, typically around an airport



Air Law & Airspace

Class C

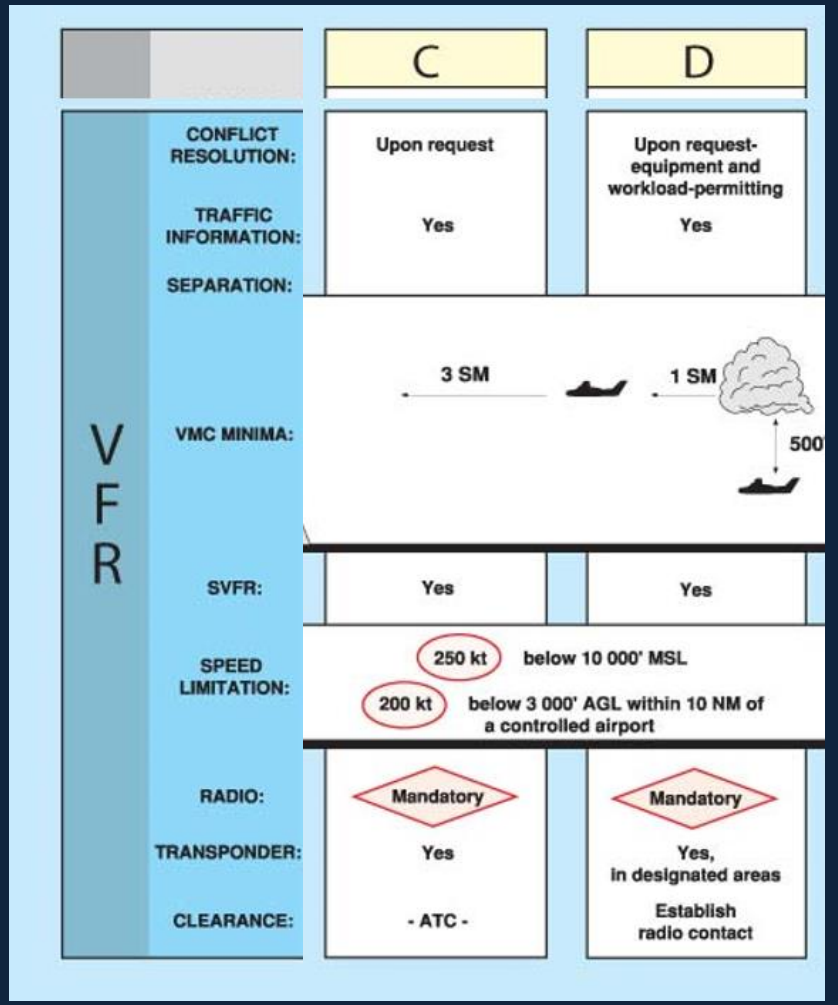
- Controlled Airspace – normally a control zone around an airport
- Altitude – Starting from ground level up to 3,000ft above ground,
- May vary based on the airport
- Requirements to Enter:
  - A mode C transponder
  - Two way radio
  - Must have clearance to enter
  - Class C airspace becomes Class E airspace if ATC unit is closed



Air Law & Airspace

Class D

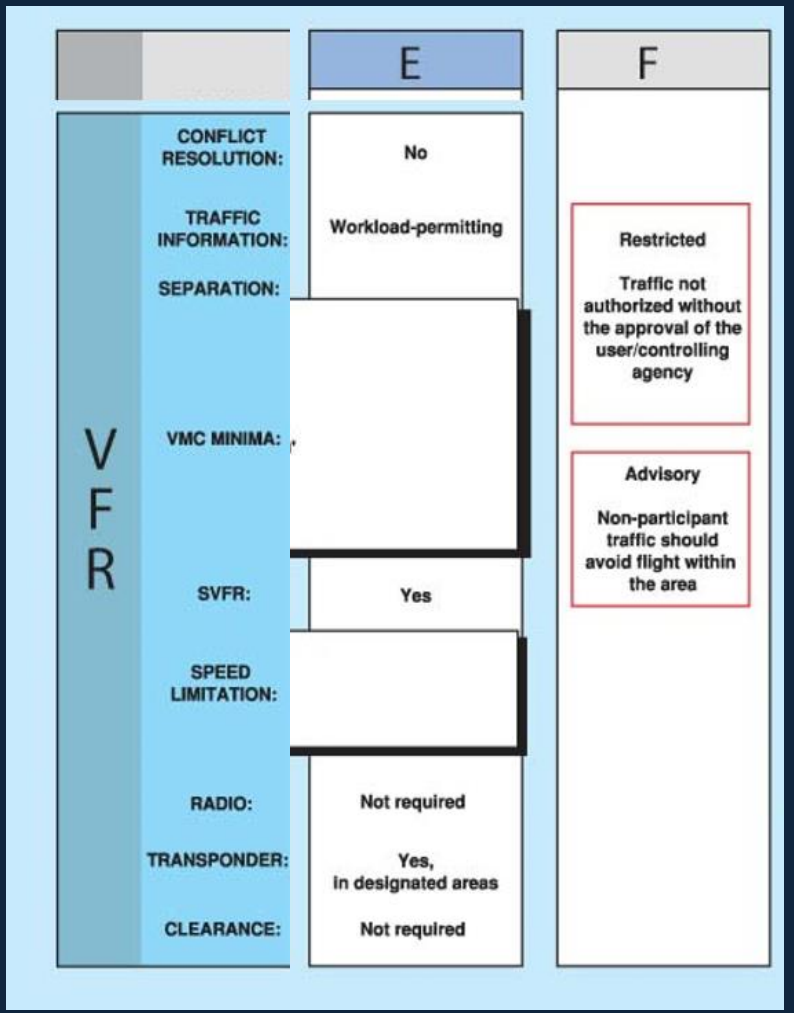
- Controlled Airspace – normally a control zone around an airport
- Altitude – Starting from ground level up to 3,000ft above ground,
- May vary based on the airport
- Requirements to Enter:
  - Transponder only required when specified
  - Two way radio
  - Must establish two way radio contact prior to entering
  - Clearance not required
  - Class D airspace becomes Class E airspace if ATC unit is closed



Air Law & Airspace

Class E

- Controlled Airspace
- Can be around an airport, control zone or control area extension
- Can also be an Airway
- The most common controlled airspace
- Extends up to 12,500ft
- Radios are not required
- Transponder may be required in designated areas
- No clearance required to enter



Air Law & Airspace

Class F

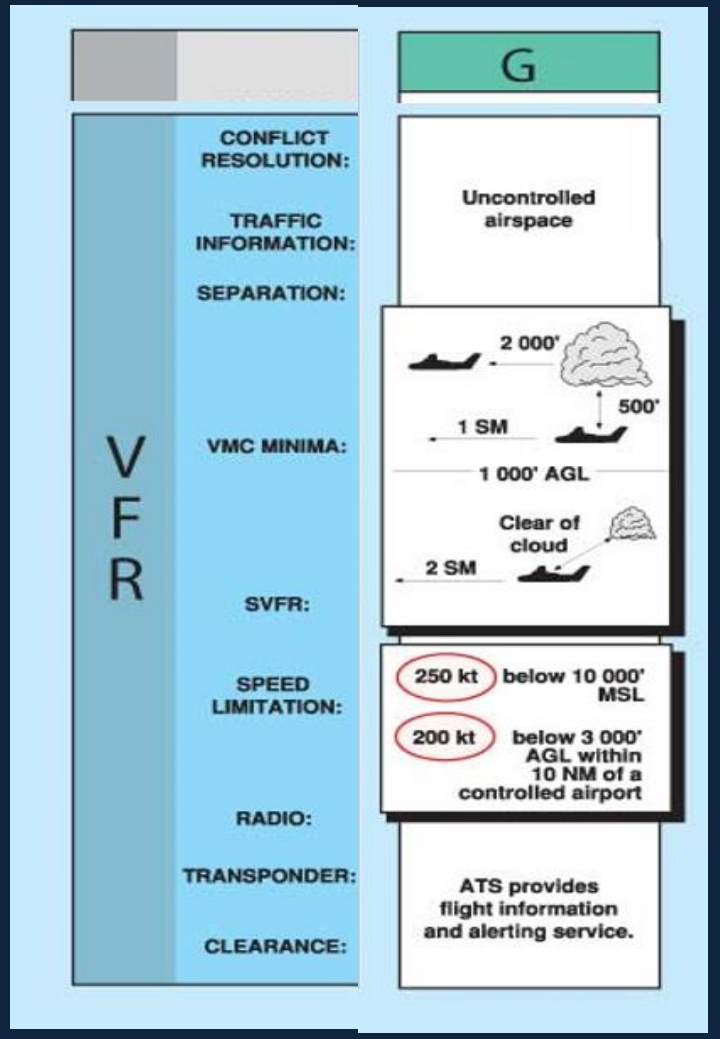
- Special use airspace
- Details can be found in the Designated Airspace Handbook
- Can be controlled or uncontrolled
- Two types of Class F airspace:
- Restricted – no entry permitted unless authorized
- Will need to contact the controlling agency to request permission to enter
- Advisory – entry authorized, only serves as a caution
- You can enter but it is not recommended unless you are participating in that activity

		E	F
VFR	CONFLICT RESOLUTION:	No	Restricted Traffic not authorized without the approval of the user/controlling agency
	TRAFFIC INFORMATION:	Workload-permitting	
	SEPARATION:		
	VMC MINIMA:		Advisory Non-participant traffic should avoid flight within the area
	SVFR:	Yes	
	SPEED LIMITATION:		
	RADIO:	Not required	
	TRANSPONDER:	Yes, in designated areas	
	CLEARANCE:	Not required	

Air Law & Airspace

Class G

- Uncontrolled Airspace
- Includes:
  - Low level air routes,
  - High level air routes,
  - Aerodrome traffic zones, and
  - All other airspace that is not classified as controlled
- **This is where RPAS pilots can freely fly**



Weather Minima

Figure 2.7 – VFR Weather Minima*

AIRSPACE		FLIGHT VISIBILITY	DISTANCE FROM CLOUD	DISTANCE AGL
Control Zones		not less than 3 miles**	horizontally: 1 mile vertically: 500 feet	vertically: 500 feet
Other Controlled Airspace		not less than 3 miles	horizontally: 1 mile vertically: 500 feet	–
Uncontrolled Airspace	1 000 feet AGL or above	not less than 1 mile (day) 3 miles (night)	horizontally: 2 000 feet vertically: 500 feet	–
	below 1 000 feet AGL – fixed-wing	not less than 2 miles (day) 3 miles (night) (see Note 1)	clear of cloud	–
	below 1 000 feet AGL – helicopter	not less than 1 mile (day) 3 miles (night) (see Note 2)	clear of cloud	–

Air Law & Airspace

Default Airspaces

- **Airway**
  - The routes that air traffic follows, by default this airspace starts at 2,200 ft above the ground up to 18,000 ft, this is controlled airspace
- **Air-route**
  - Similar to an airway, this time uncontrolled, starting at the surface and going up to 18,000 ft
- **Forest Fires**
  - 5 nautical mile restricted airspace zone (can be authorized to enter under an SFOC)
- **Control Zones**
  - Normally 5 nautical miles in radius, 3000’ AGL (can be up to 7nm)
- **Nuclear Power Plants**
  - Not restricted airspace, but it should be avoided

Wildlife Conservation

Fur and Poultry Farms

- Avoid overflying these farms below 2,000 ft AGL
- Fur farms may be marked with chrome yellow and black stripes painted on pylons or roofs

Protection of Wildlife

- In the interest of conserving wildlife, pilots must not fly at an altitude of less than 2,000 ft AGL when in the vicinity of herds of wildlife animals or above wildlife refuges/bird sanctuaries, depicted on affected aeronautical charts
- The landing or takeoff of aircraft in areas designated as bird sanctuaries may require a permit

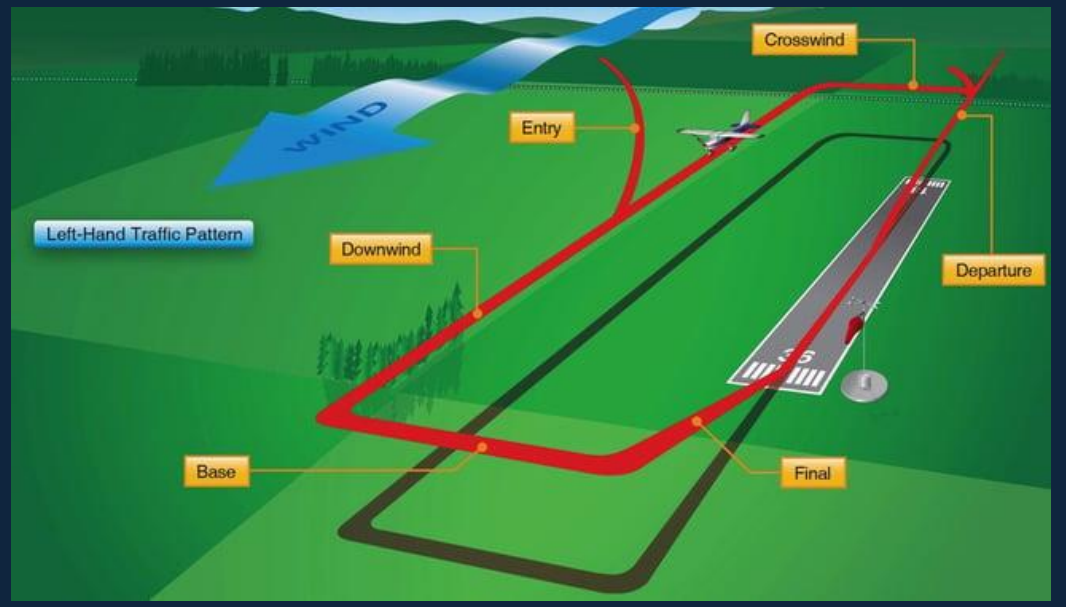
National, Provincial and Municipal Parks, Reserves and Refuges

- To preserve the natural environment of parks, reserves and refuges, and to minimize the disturbance to the natural habitat, overflights should not be conducted below 2,000 ft AGL
- Their boundaries are depicted on the affected aeronautical charts
- The landing or takeoff of aircraft in national parks and national park reserves may only take place at prescribed locations
- *Flying in any of these parks would require permission and/or and SFOC

Air Law – Aerodromes & Airports

Air Law – Aerodromes & Airports

- **301.08/ 302.10 : No person shall**
  - (a) walk, stand, drive a vehicle, park a vehicle or aircraft or cause an obstruction on the movement area of an Aerodrome or and Airport except in accordance with permission given by the operator of the aerodrome, and
  - (ii) where applicable, by the appropriate air traffic control unit or flight service station;



*Know that pilots of RPASs shall avoid flying the RPA in the traffic pattern at an aerodrome

Air Law – Aerodromes & Airports

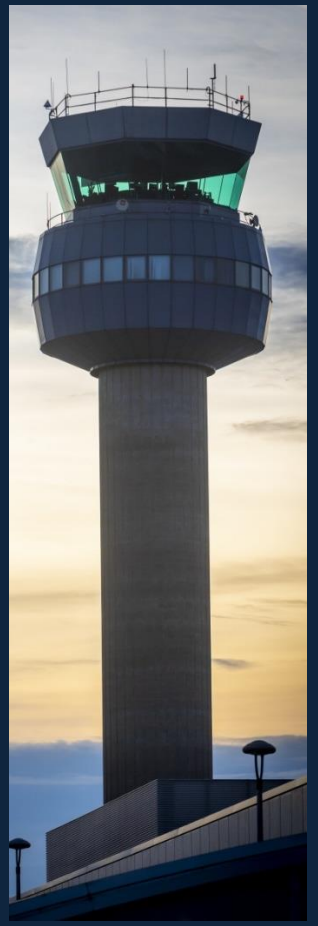
- **301.09/ 302.11: No person shall, while at an aerodrome, smoke [or use electronic cigarettes] or display an open flame**
  - (a) on an apron;
  - (b) on an aircraft loading bridge or on a gallery or balcony that is contiguous to or that overhangs an apron; or
  - (c) in an area where smoking [or use of electronic cigarettes] or the presence of an open flame is likely to create a fire hazard that could endanger persons or property

Air Law – Aerodromes & Airports

- Certified airports in Canada are required to have a plan to identify and control the hazards wildlife (birds and other animals) present to flight operations
- The risk of wildlife strikes may increase during spring and autumn migrations; however, airports can be subject to hazardous wildlife year-round.
- Pilots should monitor ATIS for information concerning this hazard.

Air Traffic Services and Procedures

- **1.1.1 Air Traffic Control (ATC) and Information Services**
  - The ATC service has been established primarily for the prevention of collisions and the expediting of traffic. The provision of such service will take precedence over the provision of flight information service, but every effort will be made to provide flight information and assistance.
  - The following air traffic control and information services are provided by ACCs and TWRs.
    - (a) Airport control service is provided by airport TWRs to aircraft and vehicles on the maneuvering area of an airport and to aircraft operating in the vicinity of an airport.
    - (b) Area control service is provided by ACCs to IFR and CVFR flights operating within specified control areas.
    - (c) Terminal control service is provided by ACCs to IFR and CVFR flights operating within specified control areas.
    - (d) Terminal radar service is an additional service provided by IFR units to VFR aircraft operating within Class C airspace.



Air Traffic Services and Procedures

Area Control Center (ACC)

- The ACC is responsible for the provision of control services via radar, multi-lateration (MLAT), and satellite for IFR operations, largely during the enroute phase of flight and for positive control of high density aviation traffic areas, such as in the vicinity of major airports served by commercial carriers

Flight Information Centers (FICs)

- The FIC is the central point of contact for VFR operations in the planning phase, delivering such services as the issuance of NOTAMS, initial consultation for coordination, and weather briefings.

Flight Service Stations (FSS)

- FSS are responsible for all aircraft operations within 5NM of the associated facility, from the ground up.
- Uses standard set of radio frequencies emergency channel 121.5, advisory channel 122.2, and at most stations 122.1
- Provides pilots with the ability to obtain or pass information, or to report emergencies
- Also provide advisory services to arriving and departing aircraft at their airport

Air Traffic Services and Procedures

Control Towers (TWR)

- Responsible for all aircraft operations within their respective Control Zones (CZ) which are defined in the Canada Flight Supplement (CFS) or in the Designated Airspace Handbook (DAH)
- May have limited operation hours

UNICOM – Universal Communications

- An air-to-ground communications facility operated by a private agency that provides private advisory station service to aircraft at uncontrolled aerodromes

Air Traffic Services and Procedures

Air Traffic Control (ATC) Clearances, Instructions and Information

- Whenever pilots receive and accept an ATC clearance, they shall comply with the clearance.
- If unable to comply with the clearance, immediately inform ATC otherwise the controller will understand the acknowledgement of the clearance as indicating acceptance.
- A clearance will be identified by the use of some form of the word “clear” in its contents. An instruction will always be worded in such a manner as to be readily identified, although the word “instruct” will seldom be included. Pilots shall comply with and acknowledge receipt of all ATC instructions directed to and received by them, provided the safety of the aircraft is not jeopardized
- NOTE: A clearance or instruction is only valid while in controlled airspace. Pilots crossing between controlled and uncontrolled airspace should pay close attention to the terrain and obstacle clearance requirements.

Inability to Issue Clearance

- ATC is not authorized to issue ATC clearances when traffic conditions are unknown, when any part of the aerodrome is partially or fully closed, or when the aerodrome or runway operating minima are not met.

Operations at or in the Vicinity of an Aerodrome

- **602.96: (1) This section applies to persons operating VFR or IFR aircraft at or in the vicinity of an uncontrolled or controlled aerodrome.**
  - (2) Before taking off from, landing at or otherwise operating an aircraft at an aerodrome, the pilot-in-command of the aircraft shall be satisfied that
    - (a) there is no likelihood of collision with another aircraft or a vehicle; and
    - (b) the aerodrome is suitable for the intended operation.

Operations at or in the Vicinity of an Aerodrome

- **602.96:** (3) **The PiC of an aircraft operating at or in the vicinity of an aerodrome shall**
  - (a) observe aerodrome traffic for the purpose of avoiding a collision;
  - (b) conform to or avoid the pattern of traffic formed by other aircraft in operation;
  - (c) make all turns to the left when operating within the aerodrome traffic circuit, except where right turns are specified by the Minister in the Canada Flight Supplement or where otherwise authorized by the appropriate air traffic control unit;
  - (d) where the aerodrome is an airport, comply with any airport operating restrictions specified by the Minister in the Canada Flight Supplement;
  - (e) where practicable, land and take off into the wind unless otherwise authorized by the appropriate air traffic control unit;
  - (f) maintain a continuous listening watch on the appropriate frequency for aerodrome control communications or, if this is not possible and an air traffic control unit is in operation at the aerodrome, keep a watch for such instructions as may be issued by visual means by the air traffic control unit; and
  - (g) where the aerodrome is a controlled aerodrome, obtain from the appropriate air traffic control unit, either by radio communication or by visual signal, clearance to taxi, take off from or land at the aerodrome.

Operations at or in the Vicinity of an Aerodrome

- **602.96: (4) Unless otherwise authorized by the appropriate air traffic control unit, no pilot-in-command shall operate an aircraft at an altitude of less than 2,000 feet over an aerodrome, except for the purpose of landing or taking off or if the aircraft is operated pursuant to subsection (5)**
  - (5) Where it is necessary for the purposes of the operation in which the aircraft is engaged, a pilot-in-command may operate an aircraft at an altitude of less than 2,000 feet over an aerodrome, where it is being operated
    - (a) in the service of a police authority;
    - (b) for the purpose of saving human life;
    - (c) for fire-fighting or air ambulance operations;
    - (d) for the purpose of the administration of the Fisheries Act or the Coastal Fisheries Protection Act;
    - (e) for the purpose of the administration of the national or provincial parks;
    - (f) for the purpose of flight inspection;
    - (g) for the purpose of aerial application or aerial inspection;
    - (h) for the purpose of highway or city traffic patrol;
    - (i) for the purpose of aerial photography conducted by the holder of an air operator certificate;
    - (j) for the purpose of helicopter external load operations; or
    - (k) for the purpose of flight training conducted by the holder of a flight training unit operator certificate

VFR and IFR Aircraft Operations at Uncontrolled Aerodromes within an MF Area

- **MF (Mandatory Frequency) Area – an area in the vicinity of an uncontrolled aerodrome for which an MF has been designated.**
  - Normally, the MF area is a circle with a 5NM radius capped at 3,000 ft AAE.
  - At uncontrolled aerodromes without a published MF or ATF (air traffic frequency):
  - The common frequency for the broadcast of aircraft position and the intentions of pilots flying in the vicinity of that aerodrome is 123.2 MHz.
  - At aerodromes within an MF area:
    - Traffic information may be exchanged by communicating with an FSS, CARS, UNICOM operator, vehicle operator, or by a broadcast transmission.

RCR	Opr 12-22Z‡ Oct-Apr, 11-01Z‡ May-Sep O/T 1 hr PN (Fees) 450-531-6736 or 450-531-7288 PLR/PCN
LIGHTING	05-AD(non-std 2600') (T LO) P2, 23-(T LO) P2 ARCAL-122.15 type J
COMM	(bil)
CLNC DEL	Prior dep pilots must ctc Québec FIC for IFR clnc at 866-GOMÉTÉO or 866-WXBRIEF
MF/ATF	UNICOM (AU) 12-22Z‡ Oct-Apr,11-01Z‡ May-Sep O/T tfc 122.15 5NM 3400 ASL (CAR 602.98)
NAV	
NDB	ZBM 343 (L) N45 14 27 W72 47 47
PRO	**Circuits:** Rgt hand circuits Rwy 23 (CAR 602.96). Do not overfly airport during glider ops. **Mil Glider Ops (yellow):** Left hand circuits Rwy 23, Rgt hand circuits Rwy 05 (CAR 602.96). All glider ops and tow acft ops conducted parallel to and 300' E of rwy. Give way to

VFR and IFR Aircraft Operations at Uncontrolled Aerodromes within an MF Area

Some uncontrolled aerodromes are indirectly served by an FSS through an RCO (Remote Communications Outlet) and may provide RAAS (Runway Awareness and Advisory System).

- Flight service specialists may be located some distance from an aerodrome, so it is essential that they be kept fully informed of both aircraft and vehicle activity.
- Other aerodromes are designated as having an ATF
- At some aerodromes with a control tower or FSS, an ATF is designated for use when the air traffic facility is closed.
- If a radio-equipped vehicle is present at ATF aerodromes, pilots can contact the vehicle operator directly on the ATF to ascertain that no vehicle-aircraft conflict exists
- Operators of such radio-equipped vehicles will also provide pilots with any other available information on runway status and presence of other aircraft or vehicles on the runway.

LIGHTING	05-(TE LO), 23-(TE LO) ARCAL-121.7 key mic 3 times in 5 sec
COMM	(bil)
ATF	UNICOM ltd hrs O/T tfc 122.8 5NM 4000 ASL
ARR	Montreal Centre 135.025 270.9
DEP	Montreal Centre 135.025 270.9
PRO	Parachute jumps over aprt fr surface to 15,000 ASL.

VFR and IFR Aircraft Operations at Uncontrolled Aerodromes within an MF Area

VFR and IFR Aircraft Operations at Uncontrolled Aerodromes within an MF Area

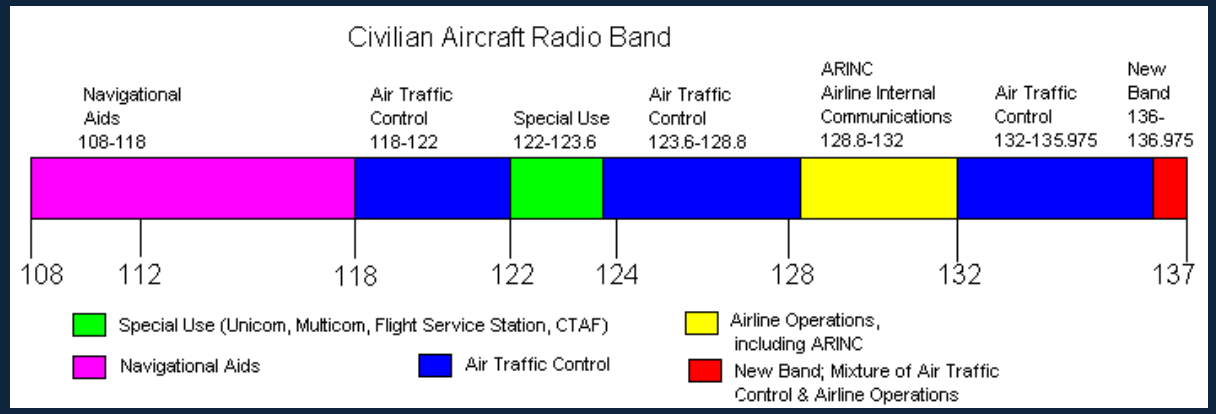
602.97: (1) Subject to subsection (3), no pilot-in-command shall operate a VFR or IFR aircraft within an MF area unless the aircraft is equipped with radio communication equipment pursuant to Subpart 5.

- (2) The pilot-in-command of a VFR or IFR aircraft operating within an MF area shall maintain a listening watch on the mandatory frequency specified for use in the MF area.
- (3) The pilot-in-command of a VFR aircraft that is not equipped with the radio communication equipment referred to in subsection (1) may operate the aircraft to or from an uncontrolled aerodrome that lies within an MF area if:
  - (a) a ground station is in operation at the aerodrome;
  - (b) prior notice of the pilot-in-command's intention to operate the aircraft at the aerodrome has been given to the ground station;
  - (c) when conducting a take-off, the pilot-in-command ascertains by visual observation that there is no likelihood of collision with another aircraft or a vehicle during take-off; and
  - (d) when approaching for a landing, the aircraft enters the aerodrome traffic circuit from a position that will require it to complete two sides of a rectangular circuit before turning onto the final approach path.

General MF Reporting Requirements

602.98: (1) Every report made pursuant to this Division shall be made on the mandatory frequency that has been specified for use in the applicable MF area.

- (2) Every report referred to in subsection (1) shall be
  - (a) directed to the ground station associated with the MF area, if a ground station exists and is in operation; or
  - (b) broadcast, if a ground station does not exist or is not in operation.



General MF Reporting Requirements

Before Entering Maneuvering Area

- Report the pilot-in-command's intentions before entering the maneuvering area of the aerodrome

Departure

- (a) before moving onto the take-off surface, report the pilot-in-command's departure procedure intentions;
- (b) before take-off, ascertain by radio communication and by visual observation that there is no likelihood of collision with another aircraft or a vehicle during takeoff; and
- (c) after take-off, report departing from the aerodrome traffic circuit.

General MF Reporting Requirements

Arrival

- (a) before entering the MF area and at least five minutes before entering the area, report the aircraft's position, altitude and estimated time of landing and the pilot-in-command's arrival procedure intentions;
- (b) when joining the aerodrome traffic circuit, giving the aircraft's position in the circuit;
- (c) when on the downwind leg, if applicable;
- (d) when on final approach; and
- (e) when clear of the surface on which the aircraft has landed.

General MF Reporting Requirements

When Flying Continuous Circuits

- **602.102: The pilot-in-command of a VFR aircraft carrying out continuous circuits at an uncontrolled aerodrome that lies within an MF area shall report**
  - (a) when joining the downwind leg of the circuit;
  - (b) when on final approach, stating the pilot-in-command's intentions; and
  - (c) when clear of the surface on which the aircraft has landed.

When Flying through an MF Area

- 602.103: The pilot-in-command of an aircraft flying through an MF area shall report
  - (a) before entering the MF area and, where circumstances permit, shall do so at least five minutes before entering the area, giving the aircraft's position and altitude and the pilot-in-command's intentions; and
  - (b) when clear of the MF area.

Radio Communications Continuous Listening Watch

- **602.136: Subject to sections 602.137 and 602.138**, where an aircraft is equipped with radio communication equipment, the pilot-in-command shall ensure that
  - (a) a listening watch is maintained on the appropriate frequency; and
  - (b) where communications are required, communication is established with an air traffic control unit, flight service station or community aerodrome radio station, as applicable, on that appropriate frequency.

Two-way Radiocommunication Failure in VFR Flight

- **602.138 Where there is a two-way radio communication failure between the controlling air traffic control unit and a VFR aircraft while operating in Class B, Class C or Class D airspace, the pilot-in-command shall**
  - (a) leave the airspace
    - (i) where the airspace is a control zone, by landing at the aerodrome for which the control zone is established, and
    - (ii) in any other case, by the shortest route;
  - (b) where the aircraft is equipped with a transponder, set the transponder to code 7600; and
  - (c) inform an air traffic control unit as soon as possible of the actions taken

Flight Safety, ROW, Collision Avoidance

Flight Safety

- 901.16 A pilot that operates a remotely piloted aircraft system shall immediately cease operations if aviation safety or the safety of any person is endangered or likely to be endangered.

Right of Way

- 901.17 A pilot of a remotely piloted aircraft shall give way to power-driven heavier-than-air aircraft, airships, gliders and balloons at all times.

Avoidance of Collision

- 901.18 No pilot shall operate a remotely piloted aircraft in such proximity to another aircraft as to create a risk of collision.

Fitness of Crew Members

- 901.19 (1) No person shall act as a crew member of a remotely piloted aircraft system if the person
    - (a) is suffering or is likely to suffer from fatigue; or
    - (b) is otherwise unfit to perform properly the person's duties.
- (2) No person shall act as a crew member of a remotely piloted aircraft system
    - (a) within 12 hours after consuming an alcoholic beverage;
    - (b) while under the influence of alcohol; or
    - (c) while using any drug that impairs the person's faculties to the extent that aviation safety or the safety of any person is endangered or likely to be endangered.

Fitness of Crew Members

The IMSAFE Checklist

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

General Operating and Flight Rules

Visual Observers

- 901.20 (1) No pilot shall operate a remotely piloted aircraft system if visual observers are used to assist the pilot in detecting and avoiding conflicting air traffic and other hazards unless reliable and timely communication is maintained between the pilot and each visual observer during the operation.
    - (2) A visual observer shall communicate information to the pilot in a timely manner, during the operation, whenever the visual observer detects conflicting air traffic, hazards to aviation safety or hazards to persons on the surface.
    - (3) No visual observer shall perform visual observer duties for more than one remotely piloted aircraft at a time unless the aircraft are operated in accordance with subsection 901.40(1) or in accordance with a special flight operations certificate — RPAS issued under section 903.03.
    - (4) No visual observer shall perform visual observer duties while operating a moving vehicle, vessel or aircraft.

General Operating and Flight Rules

Compliance with Instructions

- 901.21 Every crew member of a remotely piloted aircraft system shall, during flight time, comply with the instructions of the pilot.

Carriage of Persons

- 901.22 No pilot shall operate a remotely piloted aircraft that carries persons on board.

General Operating and Flight Rules

901.23 (1) No pilot shall operate a remotely piloted aircraft system unless the following procedures are established:

- (a) normal operating procedures, including pre-flight, take-off, launch, approach, landing and recovery procedures; and
- (b) emergency procedures, including with respect to
- (i) a control station failure,
- (ii) an equipment failure,
- (iii) a failure of the remotely piloted aircraft,
- (iv) a loss of the command and control link,
- (v) a fly-away,
- (vi) flight termination, and
- (vii) the detection and avoidance of conflicting air traffic and other hazards.

- (2) If the manufacturer of the remotely piloted aircraft system or the person who has made a declaration referred to in section 901.194 in respect of that model of system provides instructions with respect to the topics referred to in paragraphs (1)(a) and (b), the procedures established under subsection (1) shall reflect those instructions.

General Operating and Flight Rules

Horizontal Distance

- 901.26 Unless the operation is conducted under Division V, no pilot shall operate
  - (a) a small remotely piloted aircraft to conduct a VLOS operation at a distance of less than 100 feet (30 m), measured horizontally and at any altitude, from any person not involved in the operation; or
  - (b) a medium remotely piloted aircraft to conduct a VLOS operation at a distance of less than 500 feet (152.4 m), measured horizontally and at any altitude, from any person not involved in the operation.

General Operating and Flight Rules

Site Survey

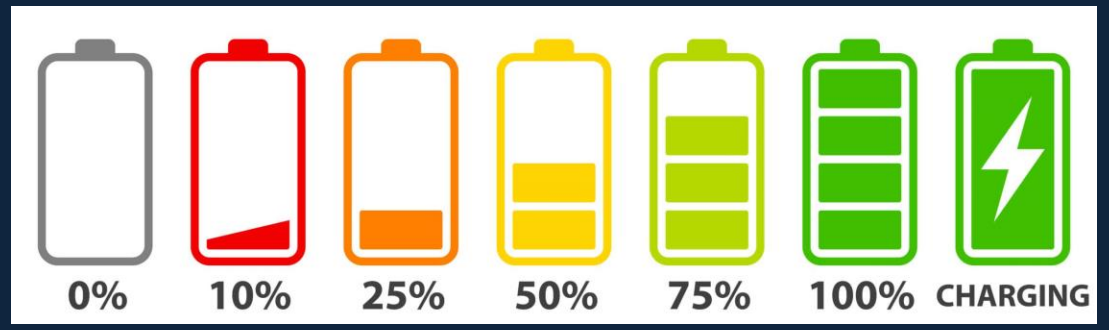
- 901.27 No pilot shall operate a remotely piloted aircraft system unless, before commencing operations, they determine that the site for take-off, launch, landing or recovery is suitable for the proposed operation by conducting a site survey that takes into account the following factors:
  - (a) the boundaries of the area of operation;
  - (b) the type of airspace and the applicable regulatory requirements;
  - (c) the altitudes and routes to be used on the approach to and departure from the area of operation;
  - (d) the proximity of manned aircraft operations;
  - (e) the proximity of aerodromes, airports and heliports;
  - (f) the location and height of obstacles, including wires, masts, buildings, cell phone towers and wind turbines;
  - (g) the predominant weather and environmental conditions for the area of operation; and
  - (h) the horizontal distances from persons not involved in the operation.

General Operating and Flight Rules

General Operating and Flight Rules

Other Pre-flight Requirements

- 901.28 A pilot of a remotely piloted aircraft shall, before commencing a flight,
  - (a) ensure that there is a sufficient amount of fuel or energy for safe completion of the flight;
  - (b) ensure that each crew member, before acting as a crew member, has been instructed
    - (i) with respect to the duties that the crew member is to perform, and
    - (ii) on the location and use of any emergency equipment associated with the operation of the remotely piloted aircraft system; and
  - (c) determine the maximum distance from the pilot the aircraft can travel without endangering aviation safety or the safety of any person.



General Operating and Flight Rules

Availability of Manuals

- 901.30 (1) No pilot shall conduct the take-off or launch of a remotely piloted aircraft unless the operating manuals applicable to the remotely piloted aircraft system of which the aircraft is an element are immediately available to crew members.
    - (2) No pilot shall conduct the take-off or launch of a remotely piloted aircraft to conduct a BVLOS operation under Division VI unless the RPAS operator's RPAS operations manual is immediately available to crew members.

Manufacturer's Instructions

- 901.31 No pilot shall operate a remotely piloted aircraft system unless it is operated in accordance with the manufacturer's instructions.

Control of Remotely Piloted Aircraft Systems

- 901.32 No pilot shall operate a remotely piloted aircraft system that is not designed to allow pilot intervention in the management of a flight.

General Operating and Flight Rules

Take-offs, Launches, Approaches, Landings and Recovery

- 901.33 A pilot of a remotely piloted aircraft shall, before take-off, launch, approach, landing or recovery,
  - (a) ensure that there is no likelihood of collision with another aircraft, person or obstacle; and
  - (b) ensure that the site set aside for take-off, launch, landing or recovery, as the case may be, is suitable for the intended operation.

General Operating and Flight Rules

Icing

- 901.35 (1) No pilot shall operate a remotely piloted aircraft system when icing conditions are observed, are reported to exist or are likely to be encountered along the route of flight unless the aircraft is equipped with de-icing or anti-icing equipment or the pilot has a means to detect icing.
    - (2) No pilot shall operate a remotely piloted aircraft system with frost, ice or snow adhering to any of the critical surfaces of the remotely piloted aircraft.
    - (3) For the purposes of subsection (2), critical surfaces means the wings, control surfaces, rotors, propellers, horizontal stabilizers, vertical stabilizers or any other stabilizing surfaces of the remotely piloted aircraft, as well as any other surfaces identified as critical surfaces in the operating manuals applicable to the system.

General Operating and Flight Rules

Icing on a drone propeller

General Operating and Flight Rules

Minimum Weather Conditions

- 901.34 (1) No pilot shall operate a remotely piloted aircraft to conduct a VLOS operation unless the weather conditions at the time-of-flight permit
    - (a) the operation to be conducted in accordance with the operating manuals applicable to the remotely piloted aircraft system of which the aircraft is an element; and
    - (b) the pilot or any visual observer to conduct the entire flight in visual-line-of-sight.
- (2) If the ground visibility is four miles or less, no pilot shall operate a medium remotely piloted aircraft to conduct a VLOS operation at a distance of more than half of the ground visibility unless the operation is conducted in accordance with a special flight operations certificate — RPAS issued under section 903.03.
- (3) Subject to subsection (4), no pilot shall operate a remotely piloted aircraft to conduct a BVLOS operation unless ground visibility is not less than three miles and the aircraft is operated clear of cloud.

General Operating and Flight Rules

Minimum Weather Conditions

- 901.34 (1) No pilot shall operate a remotely piloted aircraft to conduct a VLOS operation unless the weather conditions at the time-of-flight permit
  - (3) Subject to subsection (4), no pilot shall operate a remotely piloted aircraft to conduct a BVLOS operation unless ground visibility is not less than three miles and the aircraft is operated clear of cloud.
  - (4) A pilot may operate a remotely piloted aircraft to conduct a BVLOS operation in cloud or when the ground visibility is less than three miles if
    - (a) a declaration referred to in section 901.194 has been made in respect of the model of remotely piloted aircraft system of which the aircraft is an element and in respect of the technical requirements set out in section 922.10 of Standard 922 and the operating manuals applicable to the system allow for operation in those conditions; or
    - (b) the operation is conducted in accordance with a special flight operations certificate — RPAS issued under section 903.03.

General Operating and Flight Rules

Formation Flight

- 901.36 No pilot shall operate a remotely piloted aircraft in formation with other aircraft except by pre-arrangement between the pilots of the aircraft in respect of the intended flight.

Prohibition — Operation of Moving Vehicles, Vessels and Manned Aircraft

- 901.37 No pilot shall operate a remotely piloted aircraft while operating a moving vehicle, vessel or manned aircraft.

Transportation Safety Board of Canada (TSB)

3.1 Aviation Safety Investigation

- The purpose of an aviation safety investigation into an aircraft accident or incident is to prevent a recurrence; it is not to determine or apportion blame or liability. The TSB, is responsible for investigating all aviation occurrences in Canada involving civil aircraft registered both in Canada and abroad

Transportation Safety Board of Canada

Transportation Safety Board of Canada (TSB)

3.2 Definitions

Aviation Occurrence

- any accident or incident associated with the operation of an aircraft, and
- any situation or condition that the Board has reasonable grounds to believe could, if left unattended, induce an accident or incident

Collision

- an impact, other than an impact associated with normal operating circumstances, between aircraft or between an aircraft and another object or terrain.

Dangerous goods

- means a product, substance or organism included by its nature or by the regulations in any of the classes listed in the schedule from the Transportation of Dangerous Goods Act, 1992.
- Class 1 – Explosives; Class 2 – Gases; Class 3 – Flammable and combustible liquids; Class 4 – Flammable solids; Class 5 – Oxidizing substances; Class 6 – Poisonous (toxic) and infectious substances; Class 7 – Nuclear substances; Class 8 – Corrosives; Class 9 – Miscellaneous products, substances or organisms considered by the Governor in Council to be dangerous to life, health, property or the environment when handled, offered for transport or transported and prescribed to be included in this class

Transportation Safety Board of Canada (TSB)

3.2 Definitions

Operation

- the activities for which an aircraft is used from the time any person boards the aircraft with the intention of flight until they disembark.

Risk of collision

- a situation in which an aircraft comes so close to being involved in a collision that a threat to the safety of any person, property or the environment exists.

Serious injury

- a fracture of any bone, except simple fractures of fingers, toes or the nose;
- lacerations that cause severe hemorrhage or nerve, muscle or tendon damage;
- an injury to an internal organ;
- second or third degree burns, or any burns affecting more than 5% of the body surface;
- a verified exposure to infectious substances or injurious radiation; or
- an injury that is likely to require hospitalization

Reporting of Accidents/Incidents

Injuries to any person requiring medical attention

Reporting of Accidents/Incidents

Unintended contact between RPAS and persons, livestock, vehicles, vessels, or other structures;

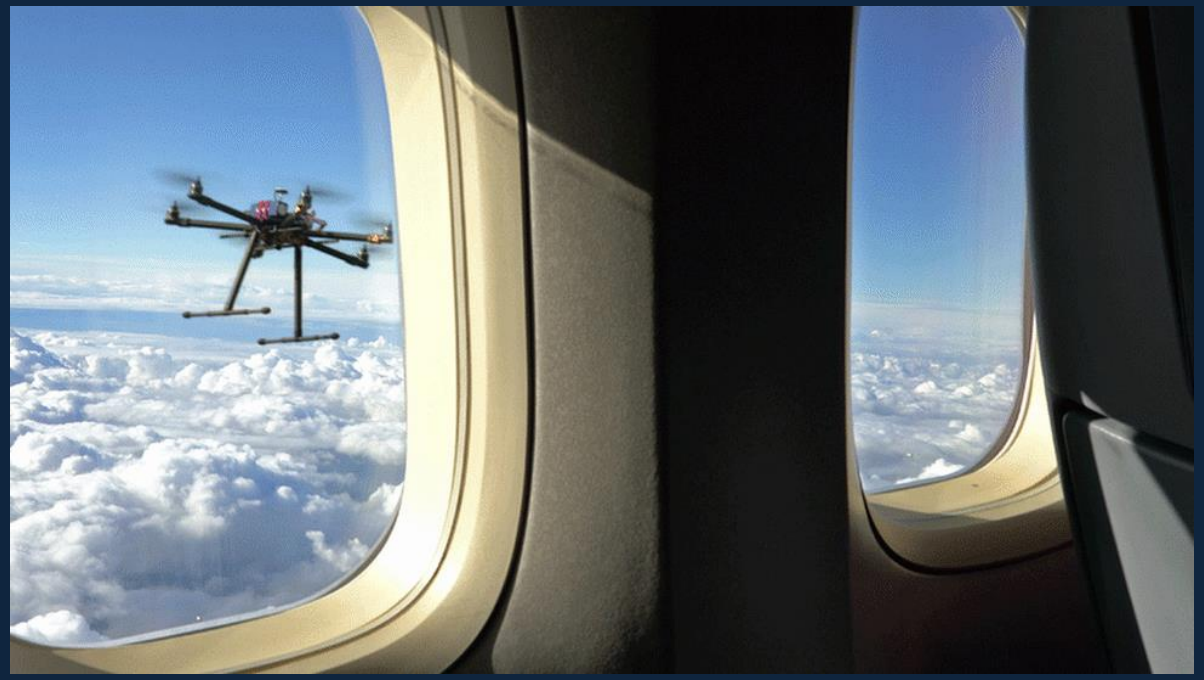
Reporting of Accidents/Incidents

Unanticipated damage incurred to the airframe, control station, payload or command and control links that adversely affect the performance or flight characteristics of the RPAS;

Reporting of Accidents/Incidents

Anytime the RPAS is not kept within geographic or altitude limits, as prescribed by the exemption or SFOC;

Reporting of Accidents/Incidents

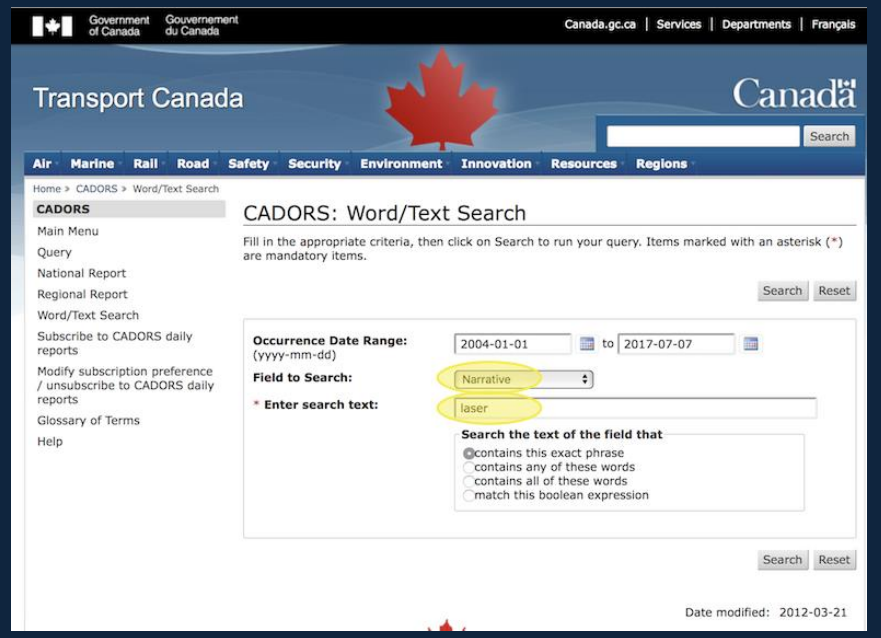


Any collision or risk of collision with another aircraft;

Reporting of Accidents/Incidents

Any other incident that results in a Canadian Aviation Daily Occurrence Report (CADORS)

- CADORS: The purpose of the system is to provide initial information on occurrences involving any Canadian-registered aircraft as well as events which occur at Canadian airports, in Canadian sovereign airspace, or international airspace for which Canada has accepted responsibility that includes events involving foreign registered aircraft.



Reporting of Accidents/Incidents

This reporting is in addition to your responsibility to report to the Transportation Safety Board of Canada if:

- (i) a person is killed or sustains a serious injury as a result of
  - being on board the aircraft,
  - coming into direct contact with any part of the aircraft, including parts that have become detached from the aircraft,
  - or being directly exposed to jet blast, rotor down wash or propeller wash,
- (ii) the aircraft sustains structural failure or damage that adversely affects the aircraft's structural strength, performance or flight characteristics and would normally require major repair or replacement of any affected component, except for
  - engine failure or damage, when the damage is limited to the engine, its cowlings or accessories, or
  - damage limited to propellers, wing tips, antennae, tires, brakes, fairings or small dents or puncture holes in the aircraft's skin, or
  - the aircraft is missing or inaccessible;

Reporting of Accidents/Incidents

3.3.3 Information to Report

- The report must contain the following information:
- the type, model, nationality and registration marks of the aircraft;
- the name of the owner, operator, pilot-in-command and, if applicable, hirer of the aircraft;
- the last point of departure and the intended destination of the aircraft, including the date and time of the departure;
- the date and time of the occurrence;
- the name of the person providing air traffic services related to the occurrence;
- the number of crew members, passengers and other persons involved in the occurrence and the number of those who were killed or sustained serious injuries as a result of the occurrence;
- the location of the occurrence by reference to an easily defined geographical point, or by latitude and longitude;

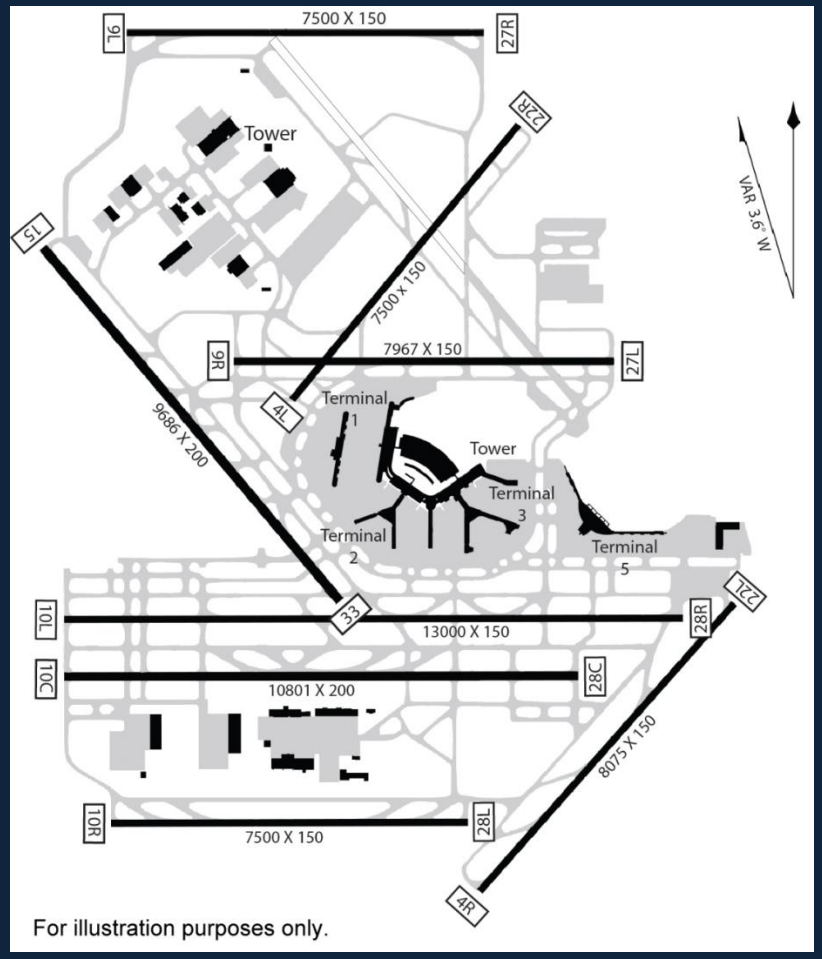
Reporting of Accidents/Incidents

3.3.3 Information to Report

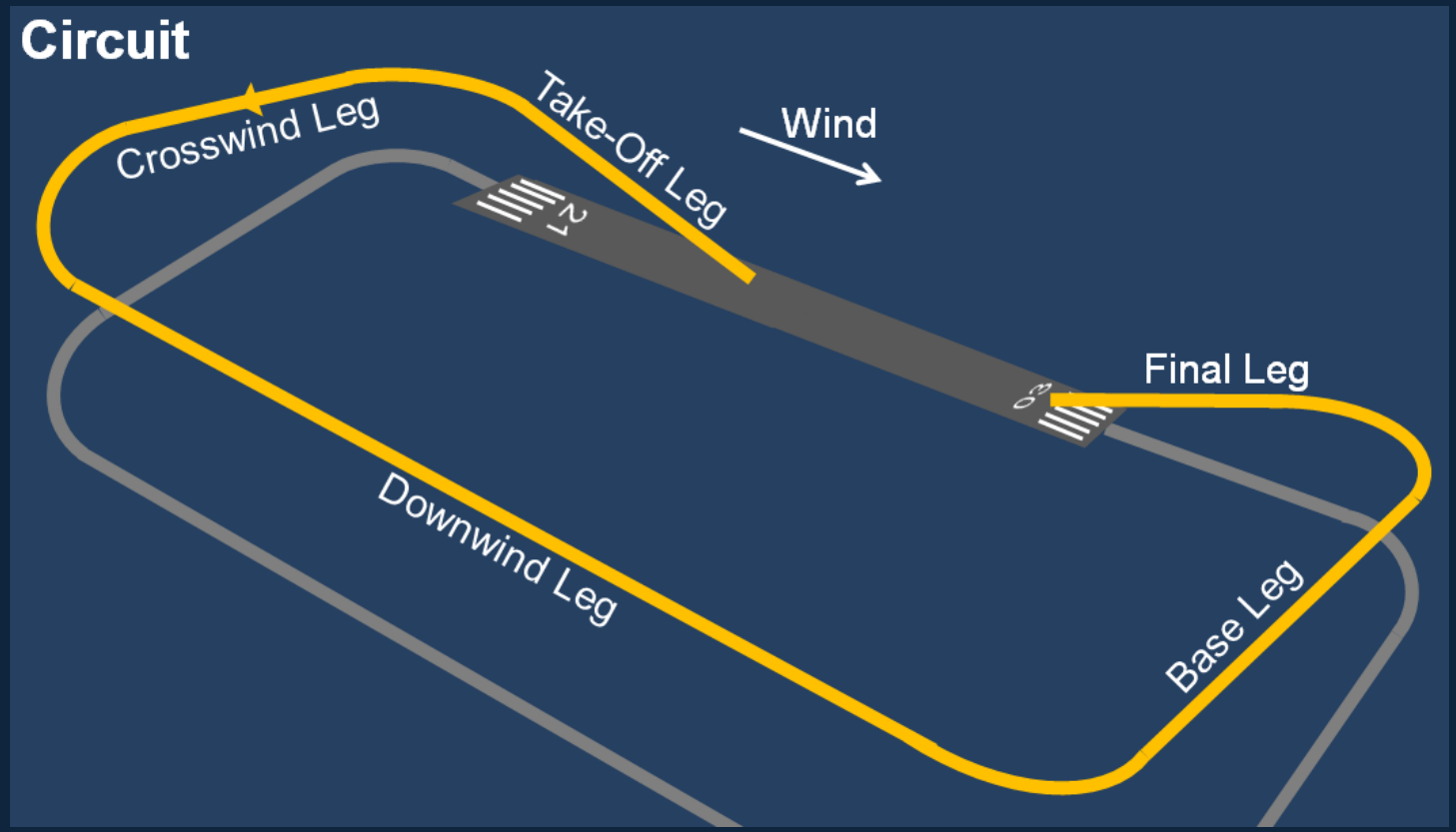
- a description of the occurrence and the extent of any resulting damage to the environment and to the aircraft and any other property;
- a list of any dangerous goods carried on board or released from the aircraft, including the shipping name or UN number and consignor and consignee information;
- if the aircraft is missing or inaccessible: (a) the last known position of the aircraft by reference to an easily defined geographical point, or by latitude and longitude, including the date and time that the aircraft was at that position, and (b) the actions taken or planned to locate or gain access to the aircraft;
- a description of any action taken or planned to protect persons, property and the environment;
- the name and title of the person making the report and the phone number and address at which they can be reached; and
- any information specific to the occurrence that the Board requires
- The person making the report must send to the Board as soon as possible and by the quickest means available, all the information required that is available at the time of the occurrence; and the remainder of that information as soon as it becomes available within 30 days after the occurrence

Runway Numbering

- Runways at airports and aerodromes are numbered
- They are numbered in regards to the direction that they face to the nearest 10°
- For example – if a runway is numbered 18 it faces 180° (or south)
- They can also be designated with Left, Right or Centre (ie. 18R)



Aerodrome Circuit Pattern



A racetrack pattern that all aircraft fly, at any aerodrome

Airport Signs

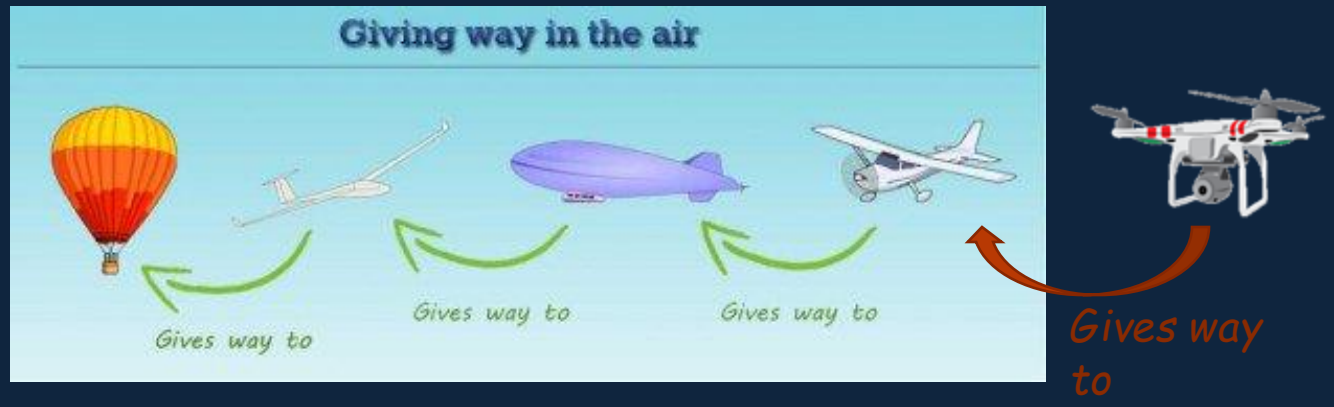
Airport Signs

Type of Sign	Action or Purpose	Type of Sign	Action or Purpose
A 4-22	**Taxiway/Runway Hold Position:** Holding position for RWY 4-22 on TWY A.		**Runway Safety Area Boundary:** Identifies exit boundary of runway safety area.
26-8	**Runway/Runway Intersection:** Identifies intersecting runways or holding position for LAHSO operations.		**ILS Critical Area Boundary:** Identifies exit boundary of ILS critical area.
B 8-APCH	**Runway Approach Hold Position:** Runway approach holding position for RWY 8 on TWY B.	↙J↗	**Taxiway Direction:** Defines direction and designation of intersecting taxiway(s).
C ILS	**ILS Critical Area Hold Position:** Holding position for the ILS critical area on TWY C.	←K	**Runway Exit:** Defines direction and designation of exit taxiway from runway.
⊖	**No Entry:** Identifies paved areas where aircraft entry is prohibited.	22↑	**Outbound Destination:** Defines directions to takeoff runway(s).
B	**Taxiway Location:** Identifies taxiway on which aircraft is located.	↖MIL	**Inbound Destination:** Defines directions to destination for arriving aircraft.
22	**Runway Location:** Identifies runway on which aircraft is located.		**Taxiway Ending Marker:** Indicates taxiway does not continue.
4	**Runway Distance Remaining:** Provides remaining runway length in 1,000-foot increments.	↙A G L→	**Direction Sign Array:** Identifies location in conjunction with multiple intersecting taxiways.

Right of Way

Giving way to other aircraft, are dependent on type of aircraft:

- Conventionally powered aircraft have to give way to everything.
- Airships have to give way to balloons and gliders, gliders have to give way to balloons.
- Balloons have very little means of maneuverability and therefore have right of way over all 3 other types of aircraft.



Collision Avoidance Lights

Strobes

- White flashing light

Nav Lights

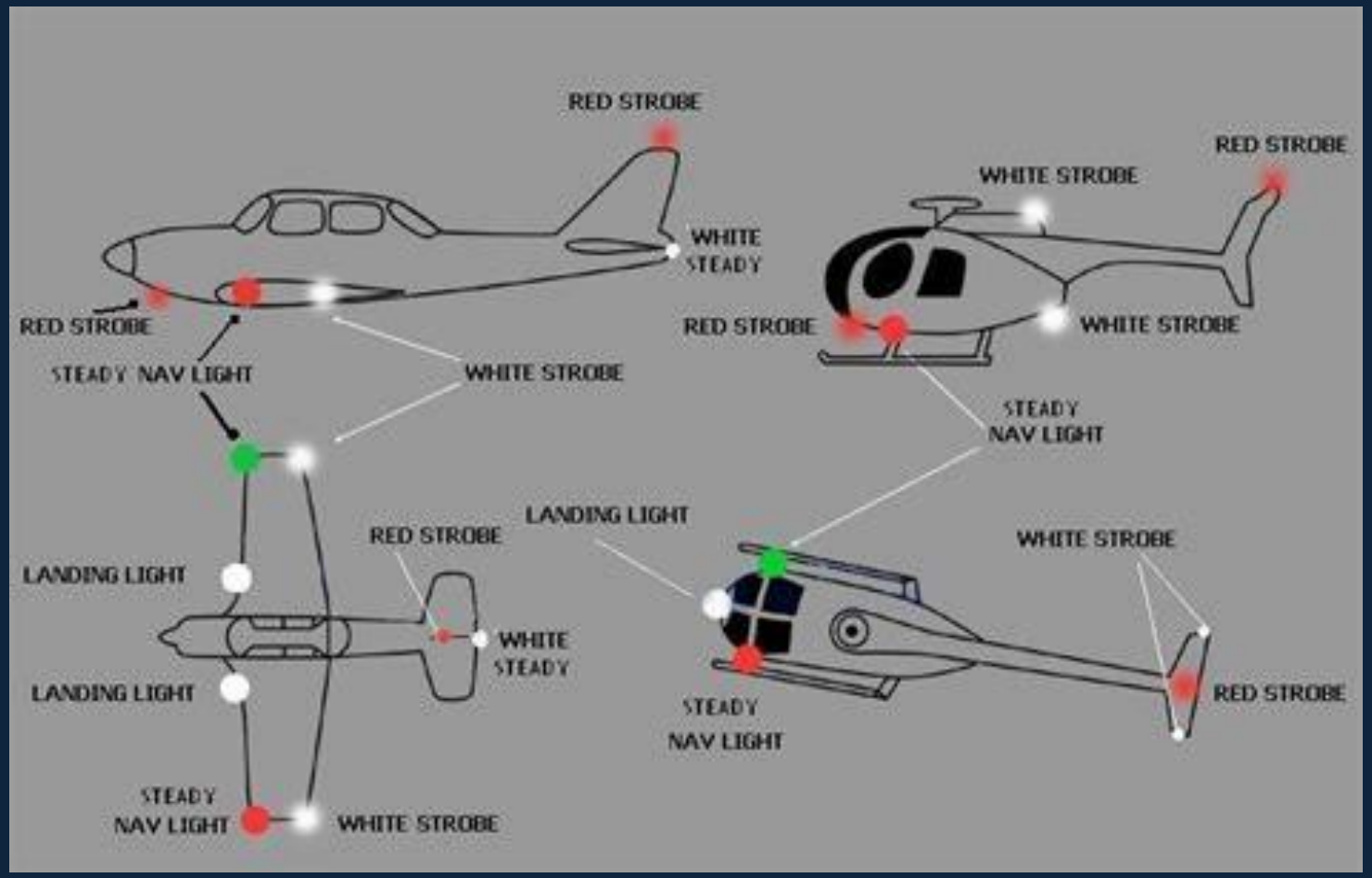
- Left side – steady red light
- Right side – steady green light
- Tail – steady white light

Beacon

- Steady red light

All RPAS requires lights for night flying, not directional (ie. Nav lights)

Collision Avoidance Lights

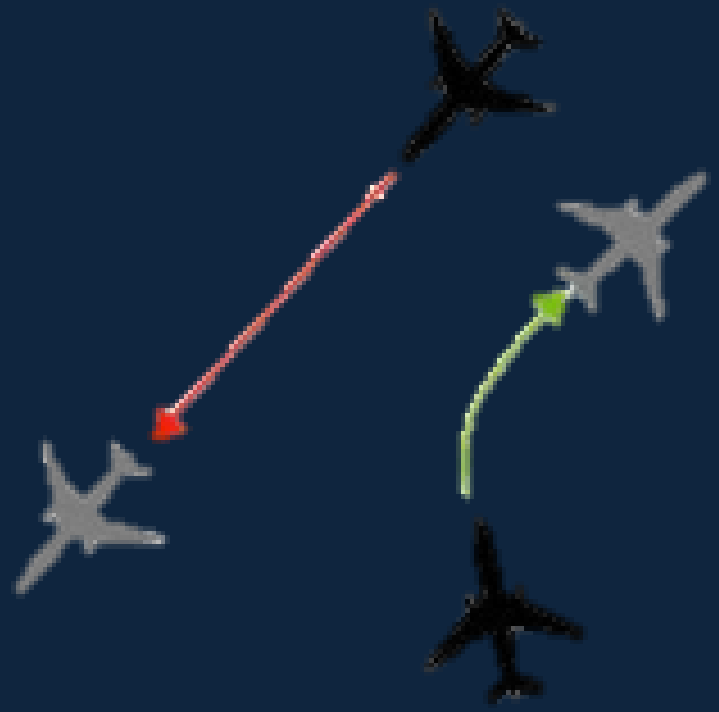


Right of Way

When two aircraft, of the same type, are flying head on, each must move to their right.

Right of Way

If two aircraft are at the same height and on converging courses, the aircraft with the other on its right-hand side (starboard side) has to give way.



Right of Way

If overtaking an aircraft, the faster-moving aircraft must overtake on the right-hand side, or starboard side, of the slower airplane.

Operating Limitations

- Can be found in the Aircraft Flight Manual (AFM)
- Sometimes referred to as the Pilot Operating Handbook (POH)
- Also found on the manufacture's website for compliant RPAS

CESSNA
MODEL 172S

SECTION 2
LIMITATIONS

SECTION 2
LIMITATIONS

TABLE OF CONTENTS Page

Weight & Balance

Definitions

Centre of gravity (C of G)

- the point through which the weights of all the various parts pass through

Basic empty weight

- weight of the aircraft with all operational equipment onboard

Payload

- load available as cameras, communication relays, forward-looking infra red-imaging (FLIR) systems, light detection and ranging (LIDAR) systems, or other extra equipment

Maximum gross weight

- maximum permissible weight of the aircraft

Typical Multirotor Autopilot Modes

- **Normal Mode (aka. Standard Mode or Manual Mode)**
  - Most common flight mode
  - Controls function as if you were sitting in the cockpit piloting the control
- **Altitude Hold Mode**
  - RPA's current altitude will be maintained
  - Roll, pitch, and yaw will operate the same, but the altitude will remain constant
- **GPS Position Hold (aka. GPS Lock Mode or Loiter Mode)**
  - RPA will automatically maintain your location, heading (where you are headed), and altitude even after your hands have been taken off the control sticks.

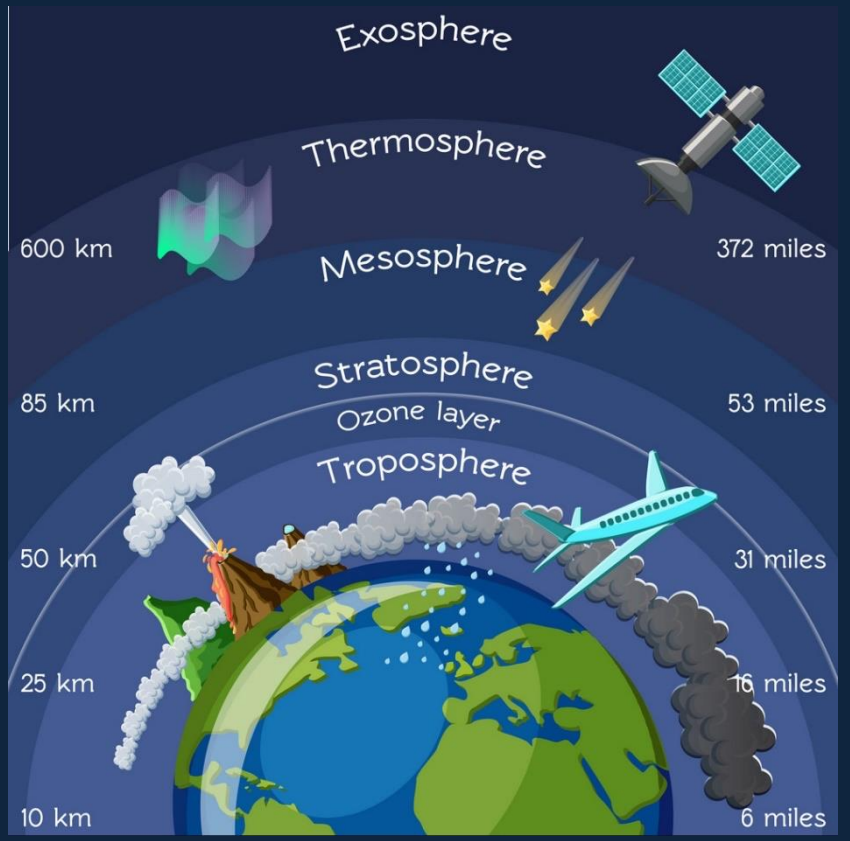
Typical Multirotor Autopilot Modes

- **Stabilize Mode**
  - In a fully manual mode, you would have to level out the pitch or roll manually. Stabilize mode does this automatically.
- **Auto Or Waypoint Programming**
  - Some refer to waypoint navigation as an “autonomous” flight mode because the operator does not give control inputs during flight
  - GPS waypoints and altitudes are programmed into the flight controller prior to the flight, can be done with the use of a laptop or tablet
  - This flight mode is used whenever a specific flight path is desired
- **Auto Return Mode (RTH)**
  - Will fly back to the place where it was armed in the event that control communication is lost.
  - Usually initialized by default if calibrated correctly, but refer to your manual to ensure that it is; otherwise, you could lose your RPAS if you get out of range or lose battery power in your controller

Meteorology

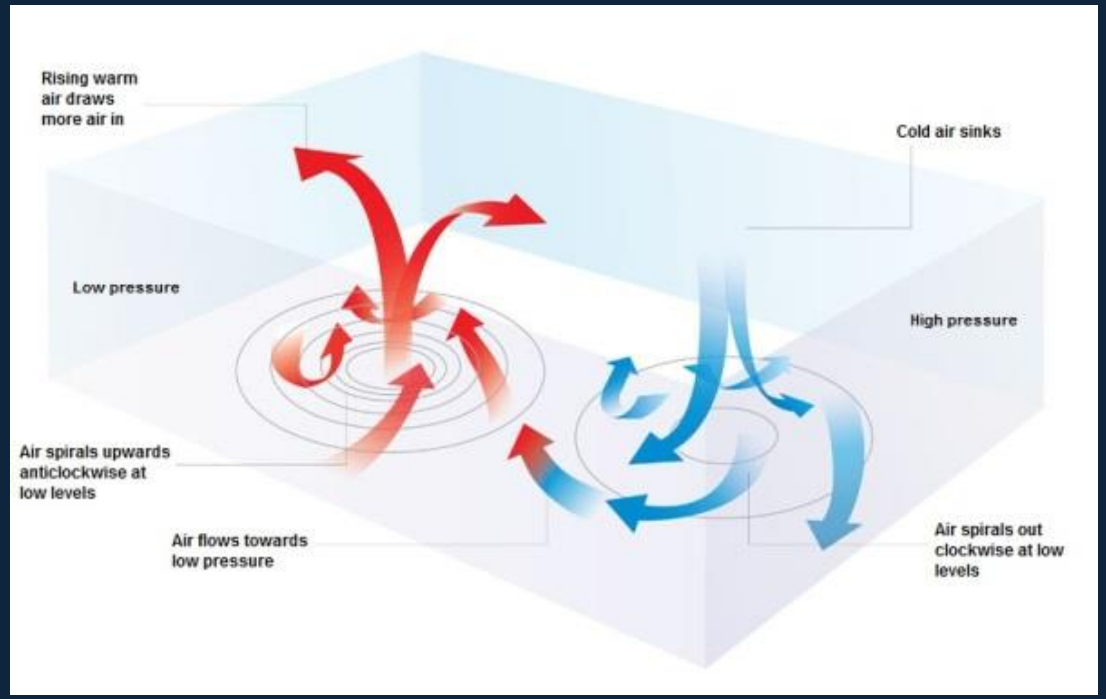
Earth's Atmosphere

- Composed of :
  - 78% nitrogen,
  - 21% oxygen, and
  - 1% other gases such argon and carbon dioxide
- Physical Properties
  1. Mobility
  2. Capacity expansion, and
  3. Capacity for compression
- The combination of these three are the cause of almost all atmospheric weather phenomena



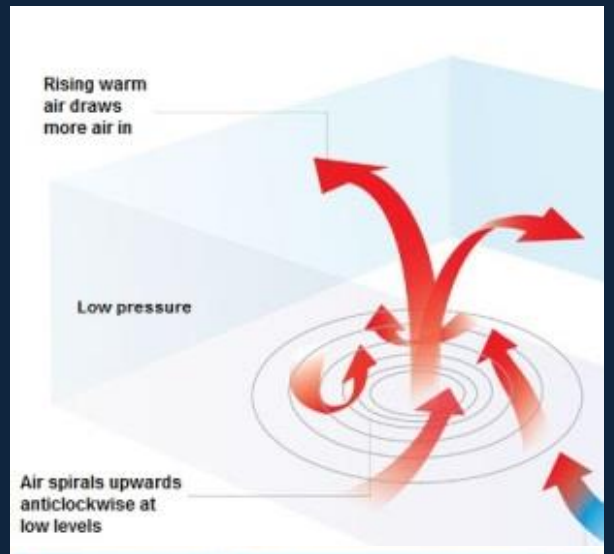
Pressure Systems

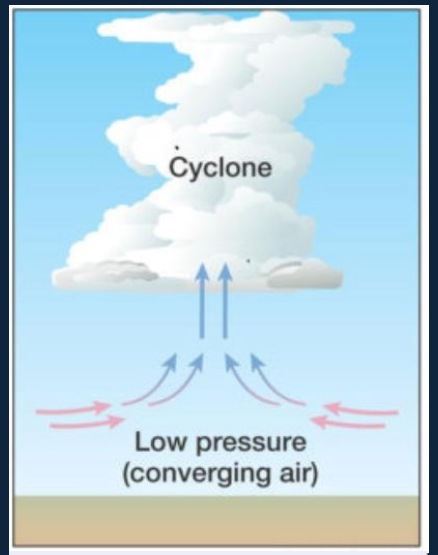
- The driving force behind most weather
- Consists of relative areas of high pressure and areas of relative low pressure due to the uneven heating of the earth
- High pressure systems tend to be associated with favorable weather conditions, while low pressure will be unfavourable

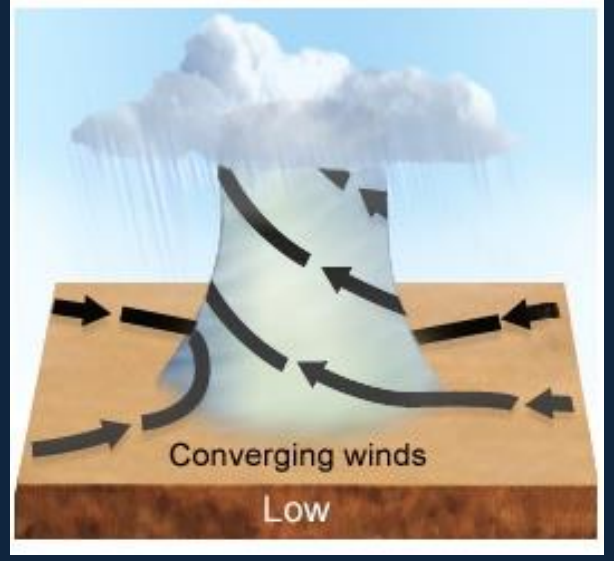


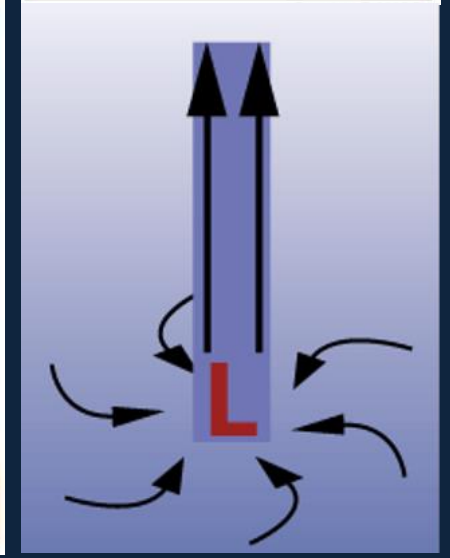
Low Pressure Systems

- Areas of low pressure are called cyclones, depressions, or “lows”
- As warm rises more air is dragged in and forced upwards (convergence) where it cools and forms clouds
- Air rotates counter-clockwise (anticlockwise) around a low
- Associated with poorer weather, precipitation, storms, and possibly stronger winds



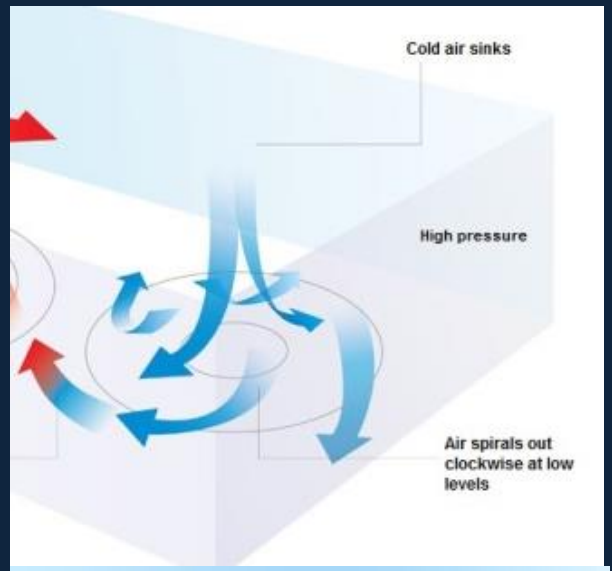


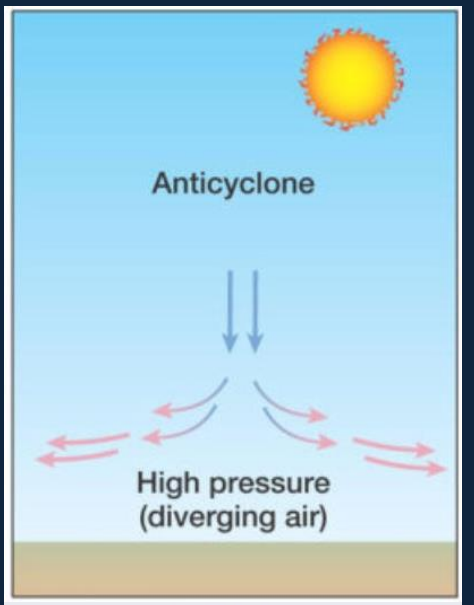


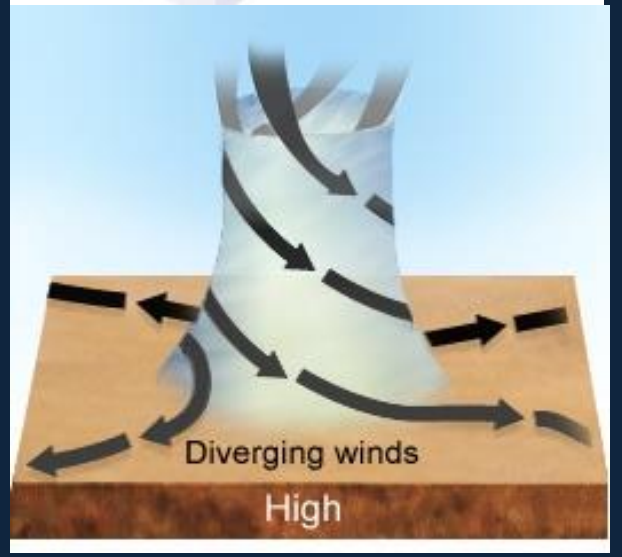


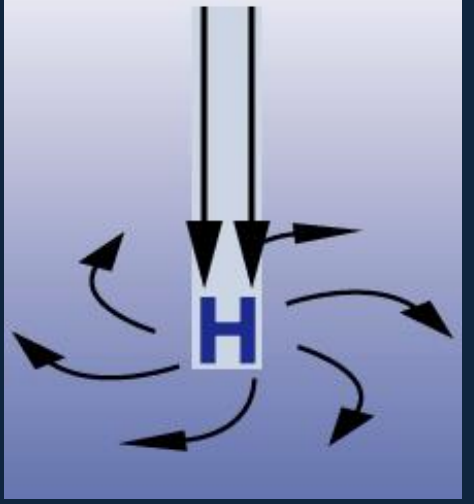
High Pressure Systems

- Called anti-cyclones or “highs”
- Colder, dense air is forced downwards and spreads out over the surface of the earth (divergence)
- Air rotates clockwise around a high
- Associated with fair weather, clear and bright sunny days, and light and variable winds



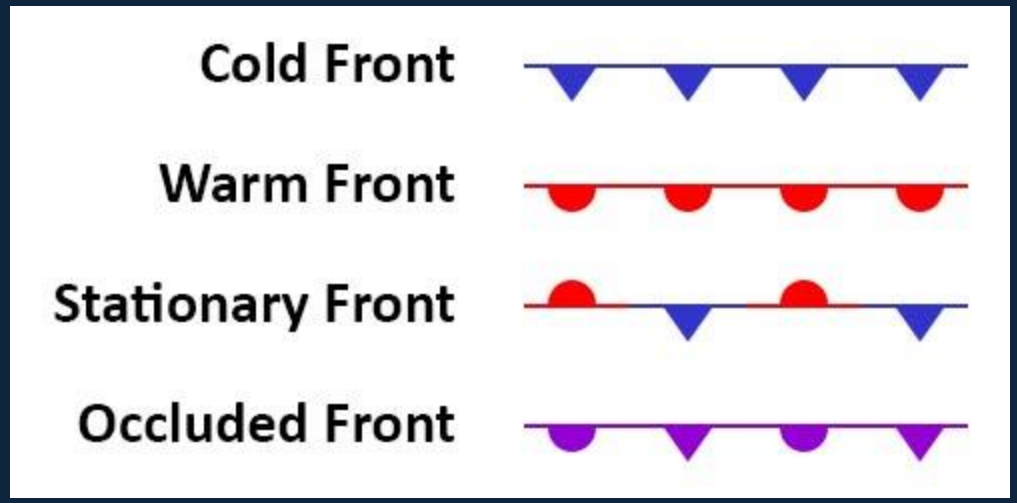




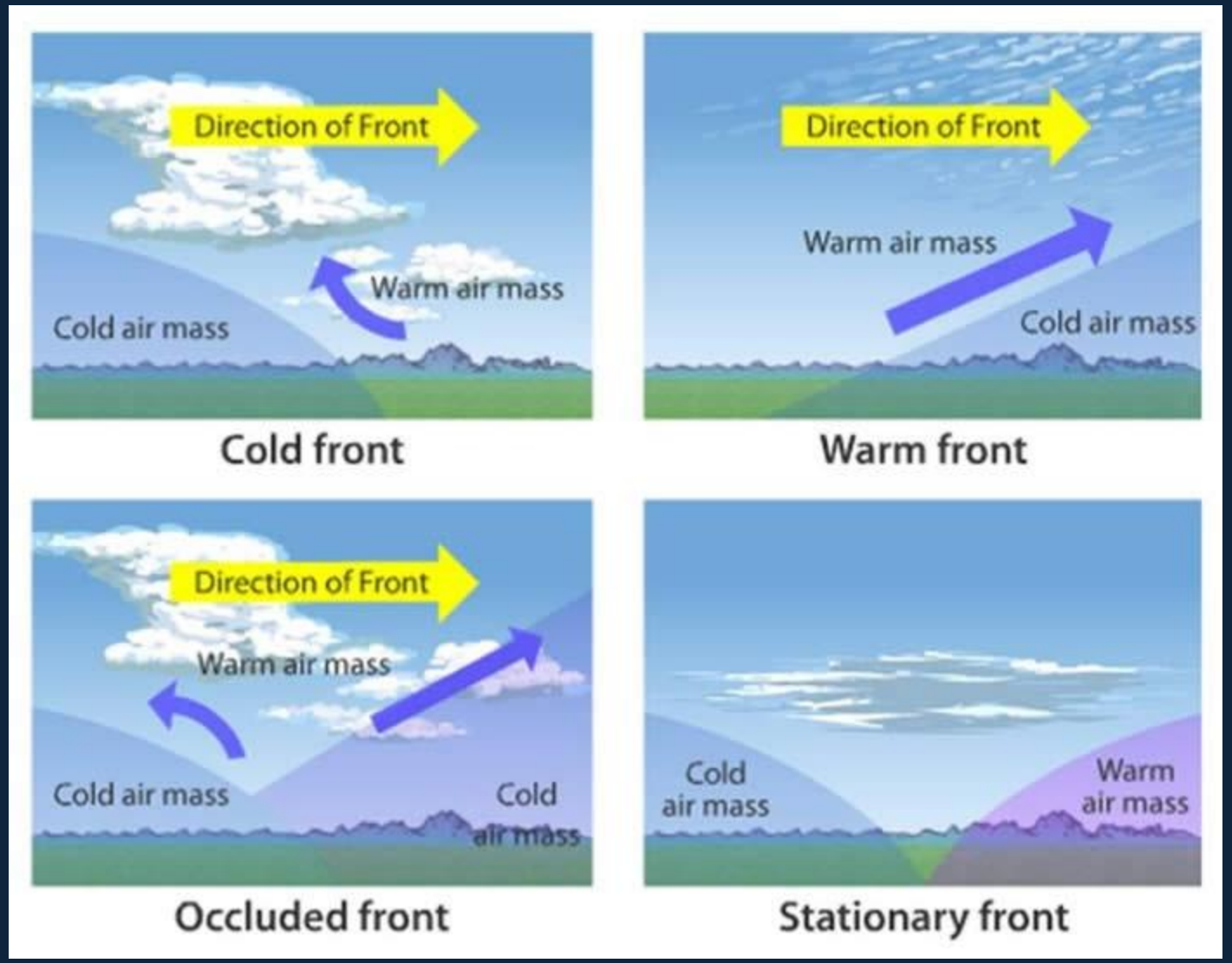


Fronts

- Fronts are the borders between different air masses
- This tends to be were most of the weather occurs
- They are often depicted on weather charts
- The main fronts we will focus on are cold fronts and warm fronts

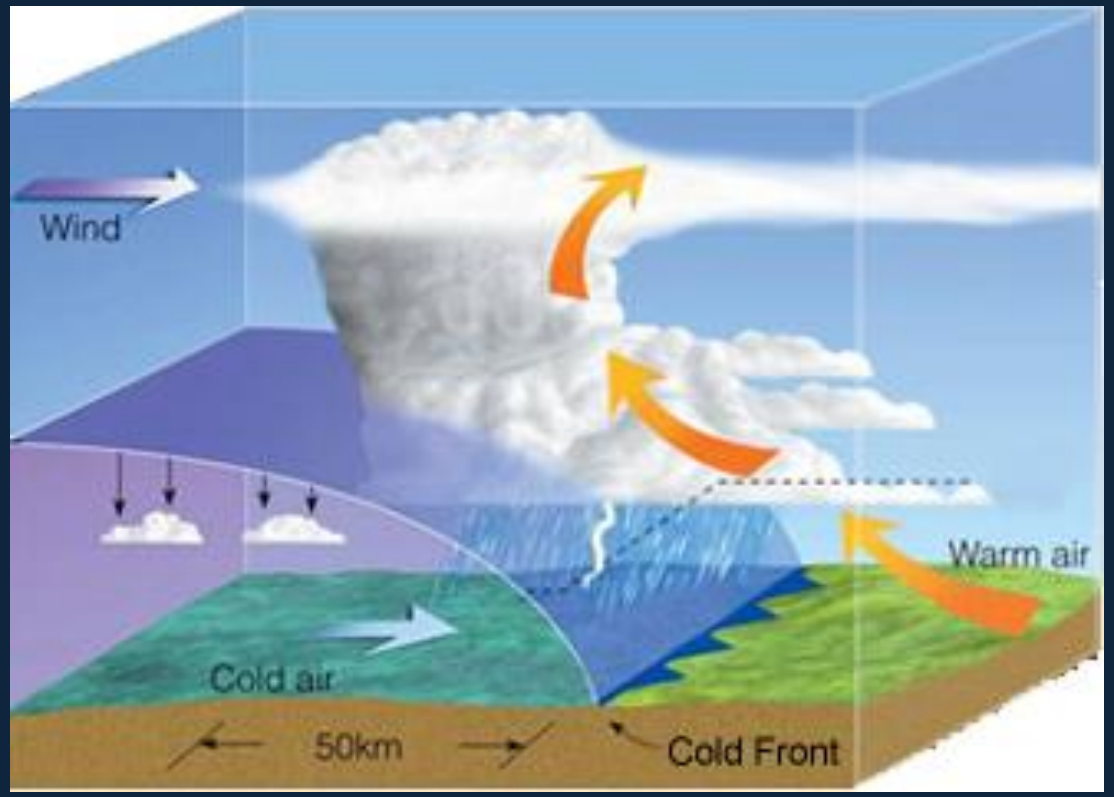


Fronts


Direction of Front
Warm air mass
Cold air mass
Cold front
Direction of Front
Warm air mass
Cold air mass
Warm front
Direction of Front
Warm air mass
Cold air mass
Cold air mass
Occluded front
Cold air mass
Warm air mass
Stationary front

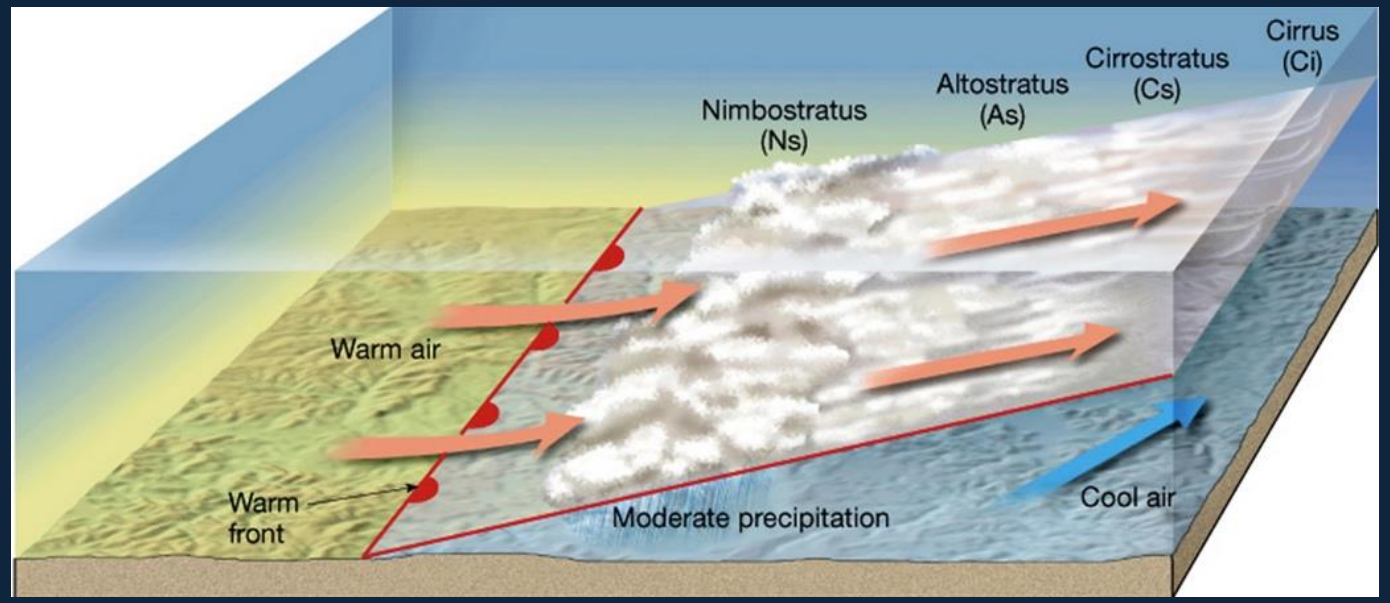
Cold Fronts

- Cold fronts are the steeper of the two fronts and also tend to be associated with the strongest weather
- Unstable, fast moving cold fronts can be associated with lines of thunderstorms over the summer



Warm Fronts

- Warm fronts are shallower than cold fronts, they stretch for larger distances and can be easier to see visually
- Warm fronts are associated with continuous precipitation, lower visibility and are more progressive in nature



Moisture and Temperature

- Limit to the amount of water that can exist as vapour in the air at any given temperature
- When limit is reached, saturation occurs and any cooling will cause condensation and clouds will form
- Condensation will not occur even when the air is cooled below the saturation temperature unless condensation nuclei are present in the atmosphere
- Whether or not precipitation will fall from the clouds depends on other factors, but essentially occurs when the droplets become too heavy and fall from the cloud
- Warmer air can hold more moisture since it is less dense than cold air

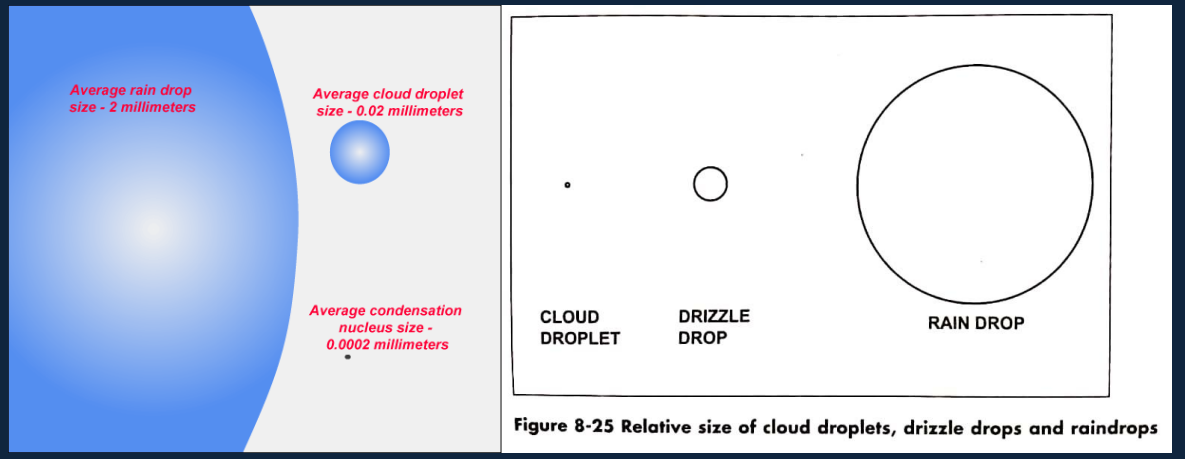


Figure 8-25 Relative size of cloud droplets, drizzle drops and raindrops

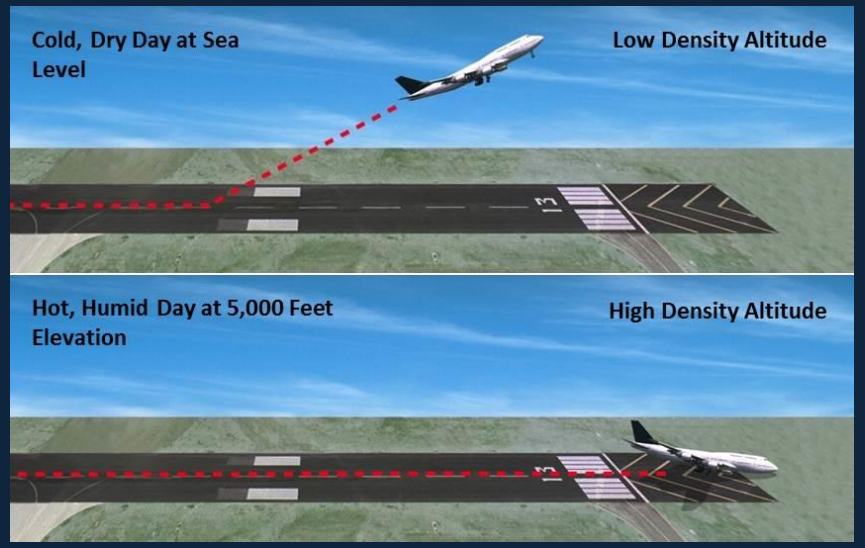
Meteorological Aspects of Altimetry

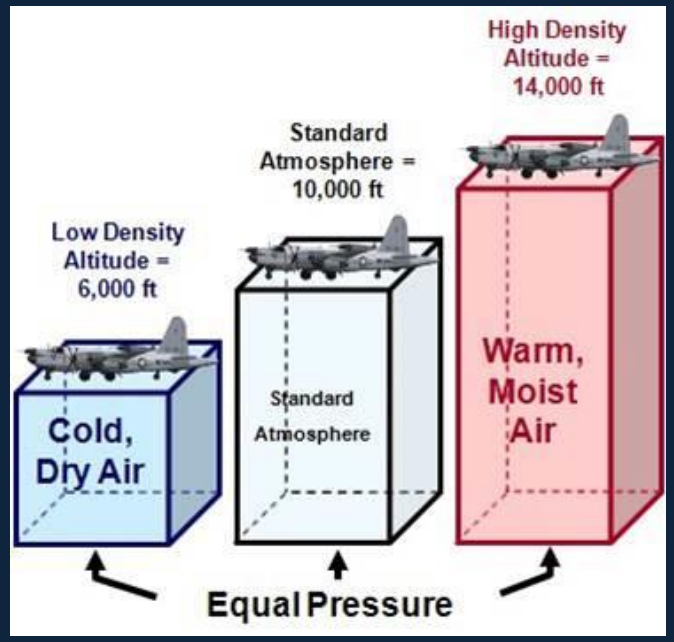
Pressure Altitude

- Height corrected for pressure

Density Altitude

- Pressure altitude corrected for temperature
- Affected by temperature and humidity





Density Altitude and Humidity

Pressure Altitude

- Height corrected for pressure

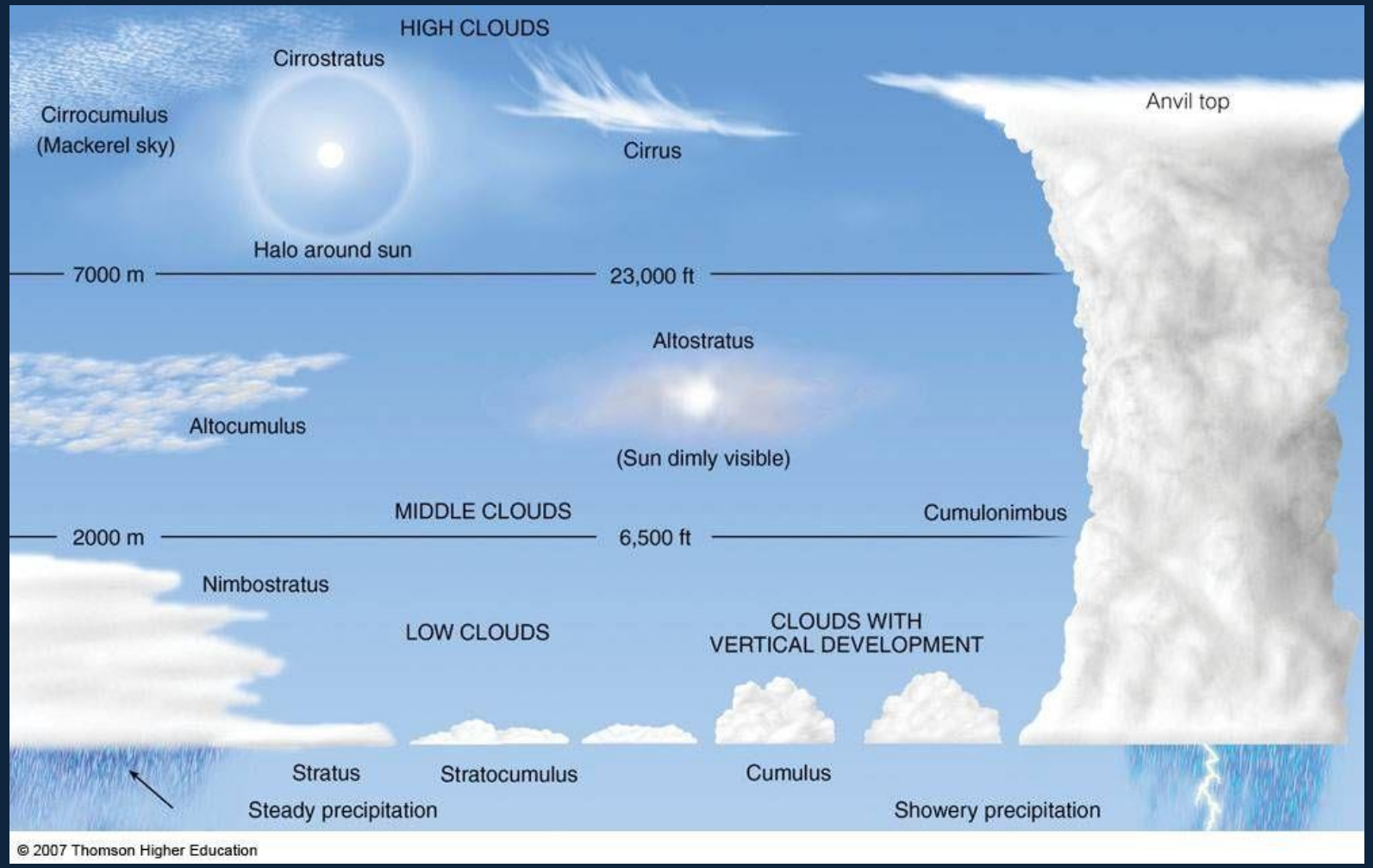
Density Altitude

- Pressure altitude corrected for temperature
- Affected by temperature and humidity
- Essentially the altitude the aircraft thinks it is at
- Directly affects lift, drag, engine performance and propeller thrust

Humidity

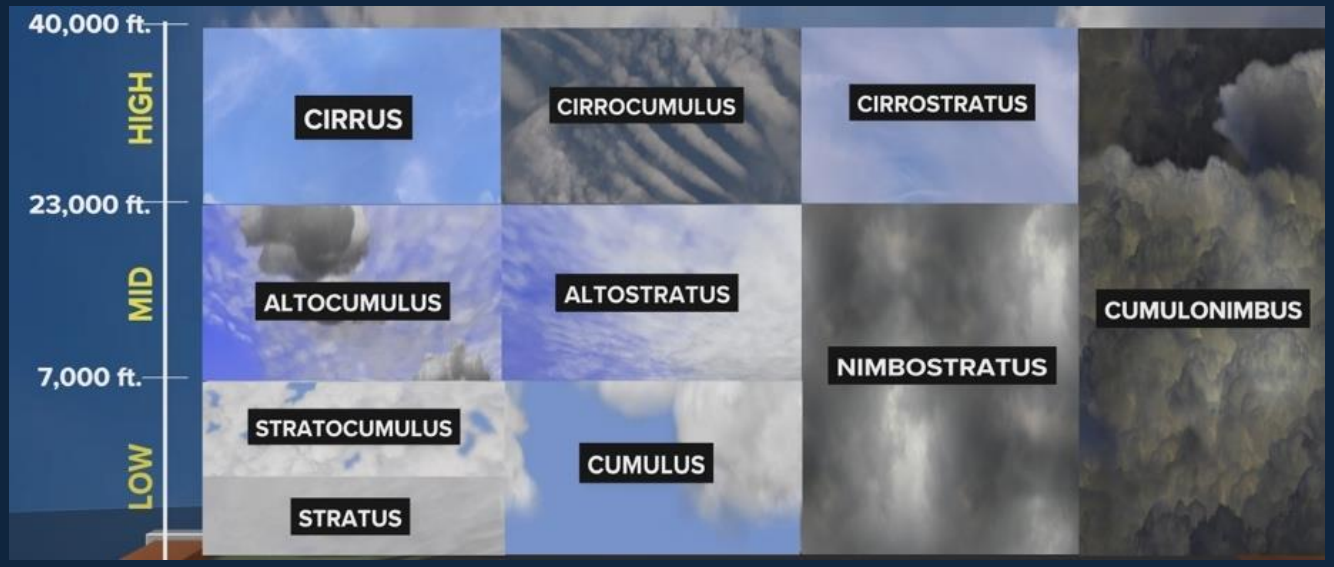
- As humidity goes up, the air pressure for a given volume goes down
- Few air molecules to flowing over wings which decrease lift

Clouds


HIGH CLOUDS
Cirrostratus
Cirrocumulus
(Mackerel sky)
Cirrus
Anvil top
Halo around sun
7000 m
23,000 ft
Altostratus
Altocumulus
(Sun dimly visible)
MIDDLE CLOUDS
Cumulonimbus
2000 m
6,500 ft
Nimbostratus
LOW CLOUDS
CLOUDS WITH
VERTICAL DEVELOPMENT
Stratus
Stratocumulus
Cumulus
Steady precipitation
Showery precipitation
© 2007 Thomson Higher Education

Clouds

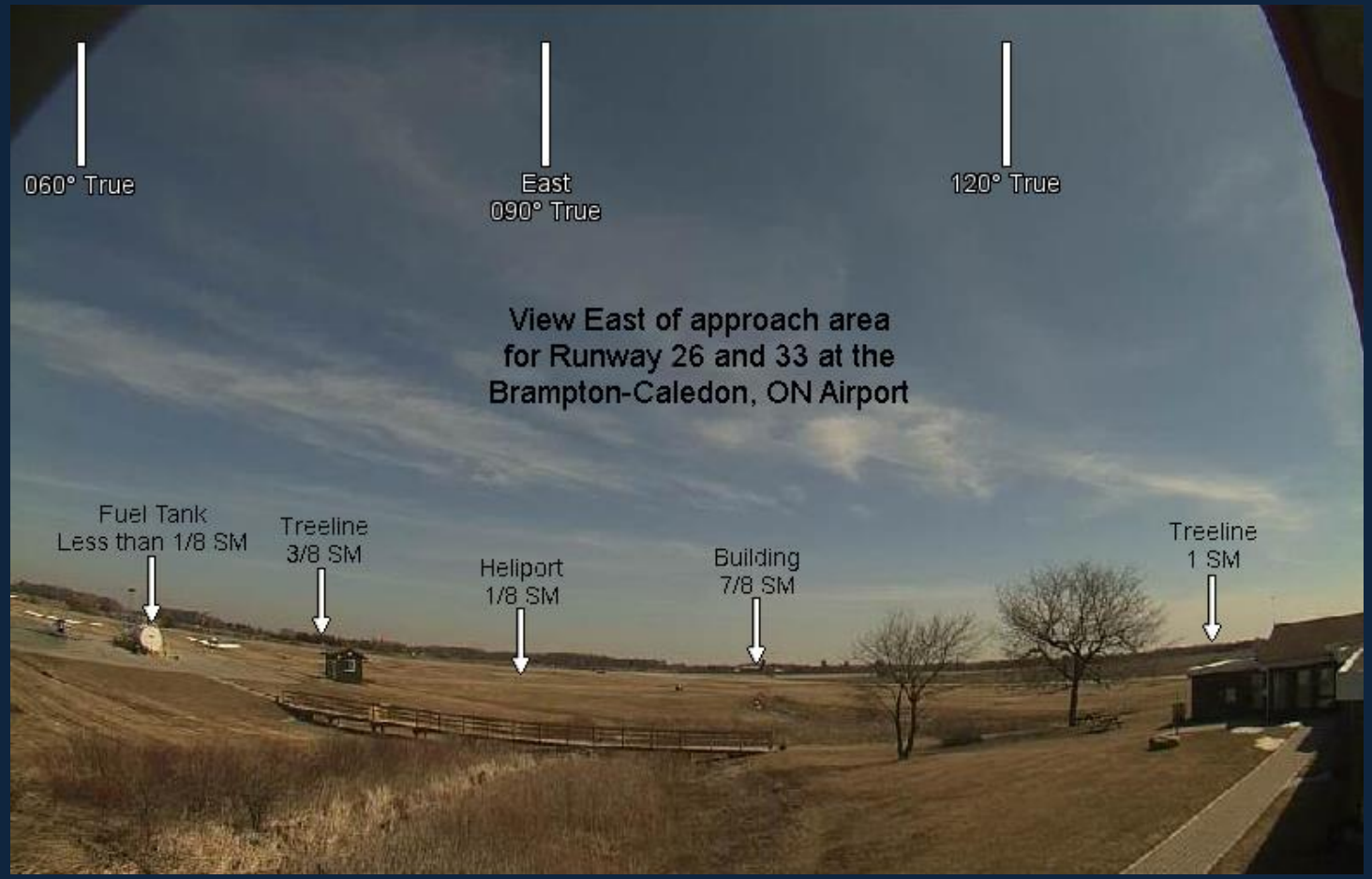
- When a RPAS enters cloud, it is no longer visible
- All outside references to the ground are lost, along with the relationship to any obstacles, other aircraft or the ground observer
- Aircraft operating within the cloud would also be unable to avoid the RPAS which is why certain limitations apply to operation near and around cloud
- Other hazards of clouds are; icing, precipitation, electrostatic discharge, turbulence and convective activity



Visibility

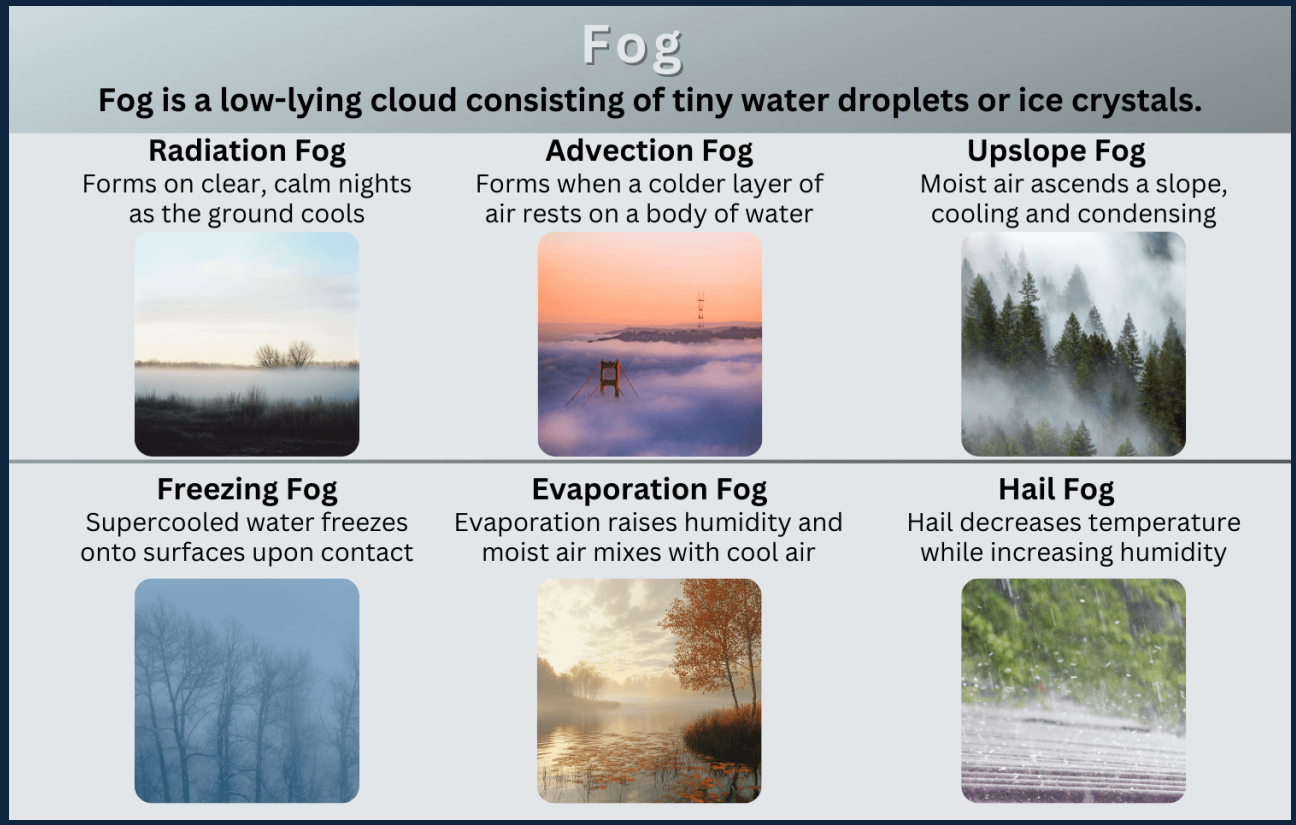
- You will need to maintain a specific visibility requirements
- Visibility will affect whether you are able to keep the RPAS within VLOS
- Outside of this VLOS, your risk for a collision will increase
- Normally visibility is generally poorer in stable air, due to the stagnant nature which leads to particles being trapped in the lower levels
- If the air is unstable, vertical current scatter the particles that reduce visibility but they can cause blowing snow or dust which can also reduce visibility
- Restrictions to visibility include: cloud, precipitation, fog, haze, smoke, blowing dust or snow
- You can use known objects with their distances to determine localized visibility

Visibility


060° True
East
090° True
120° True
View East of approach area
for Runway 26 and 33 at the
Brampton-Caledon, ON Airport
Fuel Tank
Less than 1/8 SM
Treeline
3/8 SM
Heliport
1/8 SM
Building
7/8 SM
Treeline
1 SM

Fog

- Fog will normally form when the humidity is high (ie. The difference between temperature and dew point is close) with light winds
- Often occurs in costal areas
- Dissipating of fog will often occur with:
  - Sunlight, which results in heating and dissipation, or
  - Stronger winds



Radiation Fog

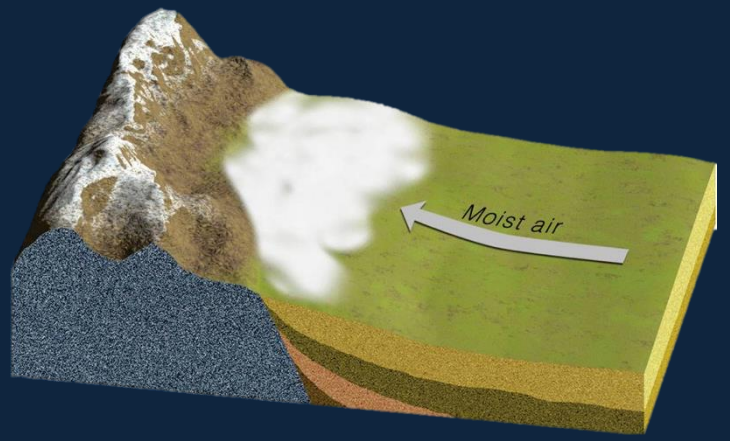
- Formed on clear nights with light wind
- Ground cools through radiation, the moist air above the surface cools and condenses into fog

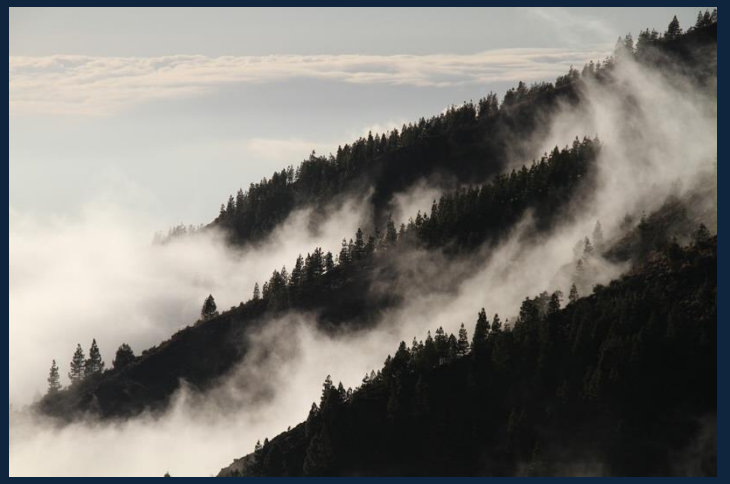
Advection Fog

- Caused by the drifting of warm, damp air over a colder land or sea surface
- Widespread and can last for days, as it is not affected by daytime heating

Upslope Fog

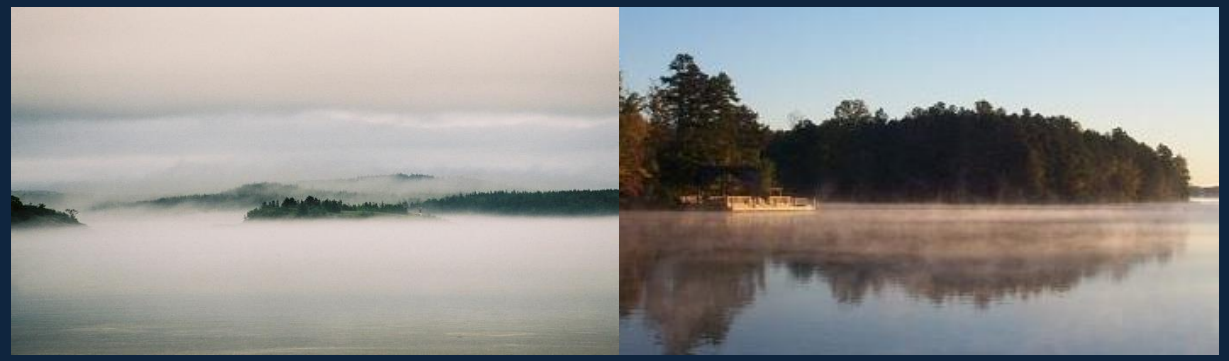
- Caused by the cooling of the air due to expansion as it moves upslope
- A light upslope wind is necessary for formation

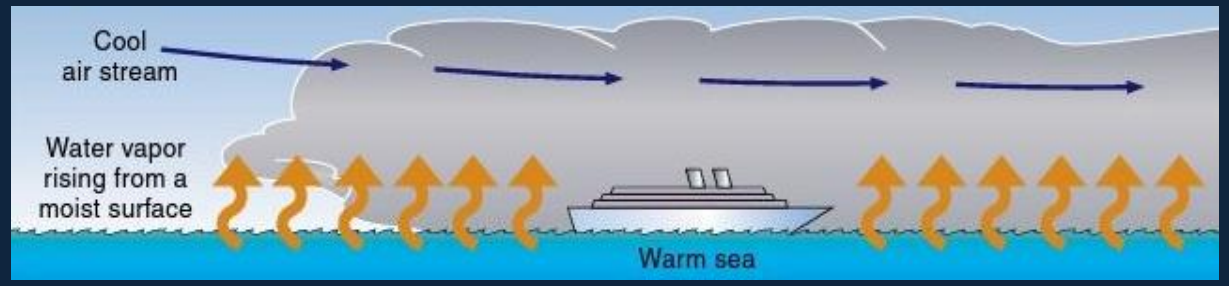




Steam Fog

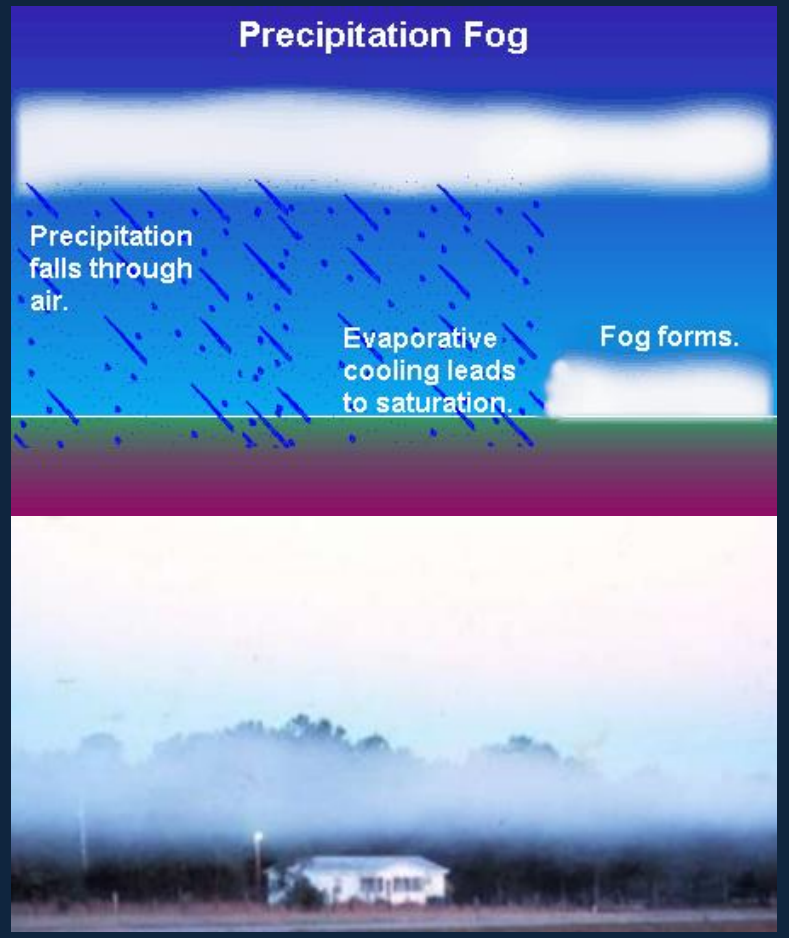
- Caused as cold air passes over a warm water surface
- Evaporation of the water, saturates the air above, condensing into fog





Precipitation-Induced Fog

- Associated with front, also known as frontal fog
- Rain falling, evaporates and saturates the air below

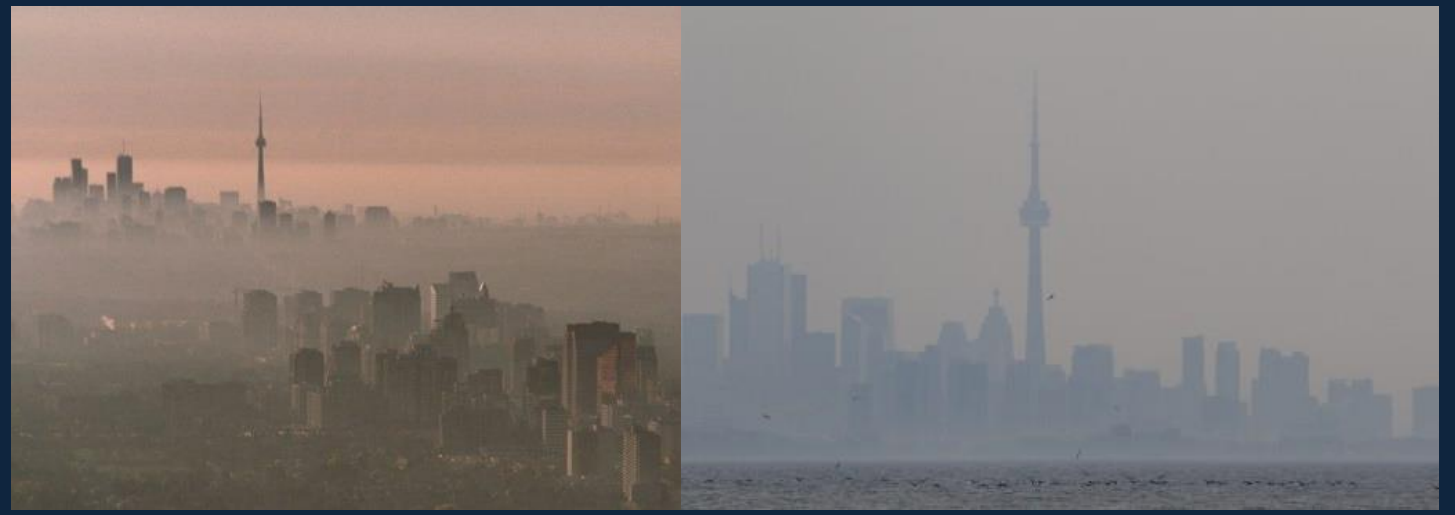


Ice Fog

- Very cold air, unable to contain any water vapour, has water added to it, condensing immediately

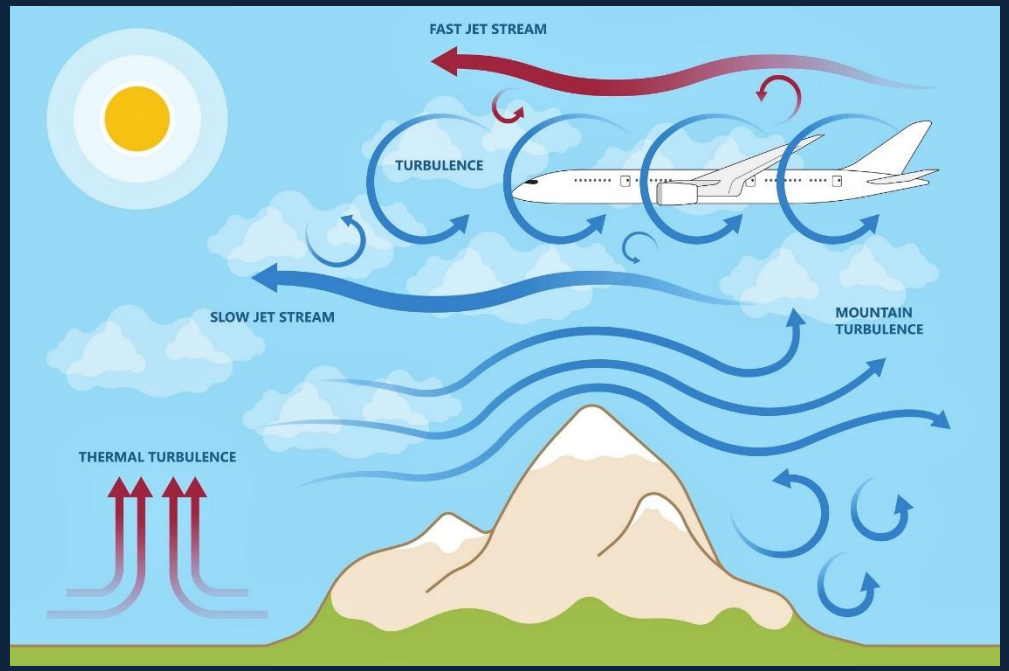
Haze

- Haze is composed of very small water droplets, dust or salt particles which are so small that they cannot be felt
- Smoke, pollutants and smog are responsible for creating haze in urban areas
- Haze will only exist in stable air, when there is not enough movement to dissipate the particles



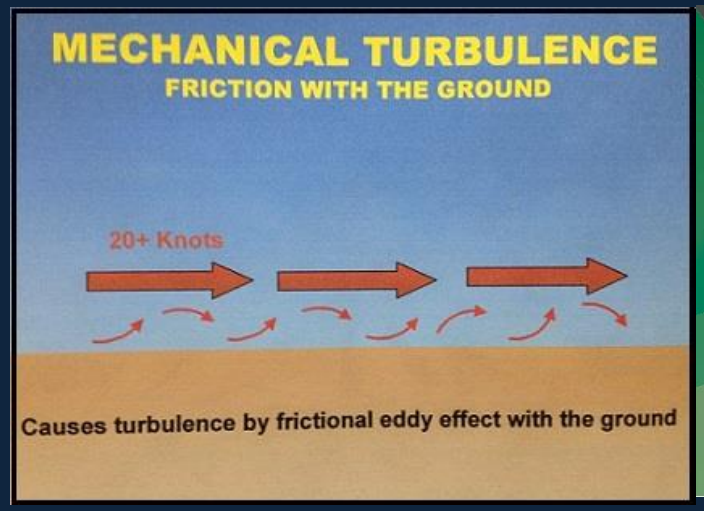
Turbulence

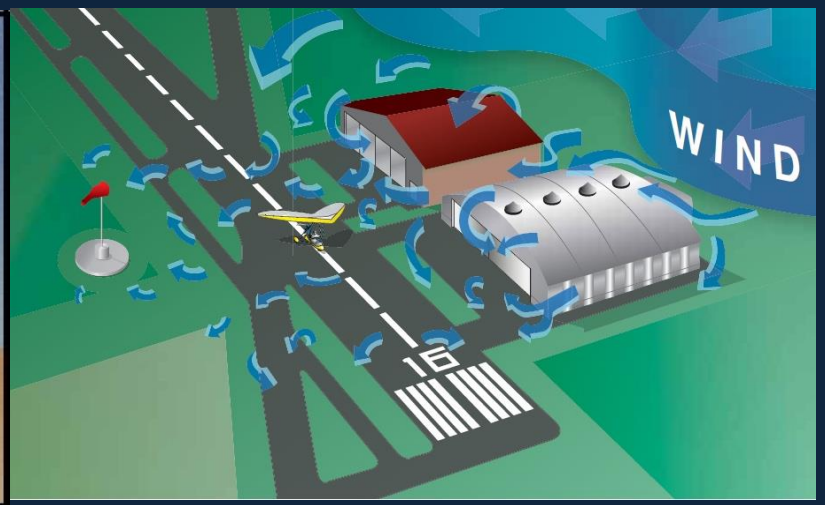
- This is one of the more unpredictable weather phenomena
- Turbulence is the irregular motion of air resulting from eddies and vertical currents
- There are five causes of turbulence
  - Mechanical Turbulence
  - Thermal Turbulence
  - Frontal Turbulence
  - Wind Shear
  - Wake Turbulence
- Another form of turbulence for your operations → Orographic Lift



Mechanical Turbulence

- The result of friction between the air and the ground, especially man-made obstacles and irregular terrain
- The intensity of these eddies depends on the strength of the surface wind, nature of the surface and stability of the air

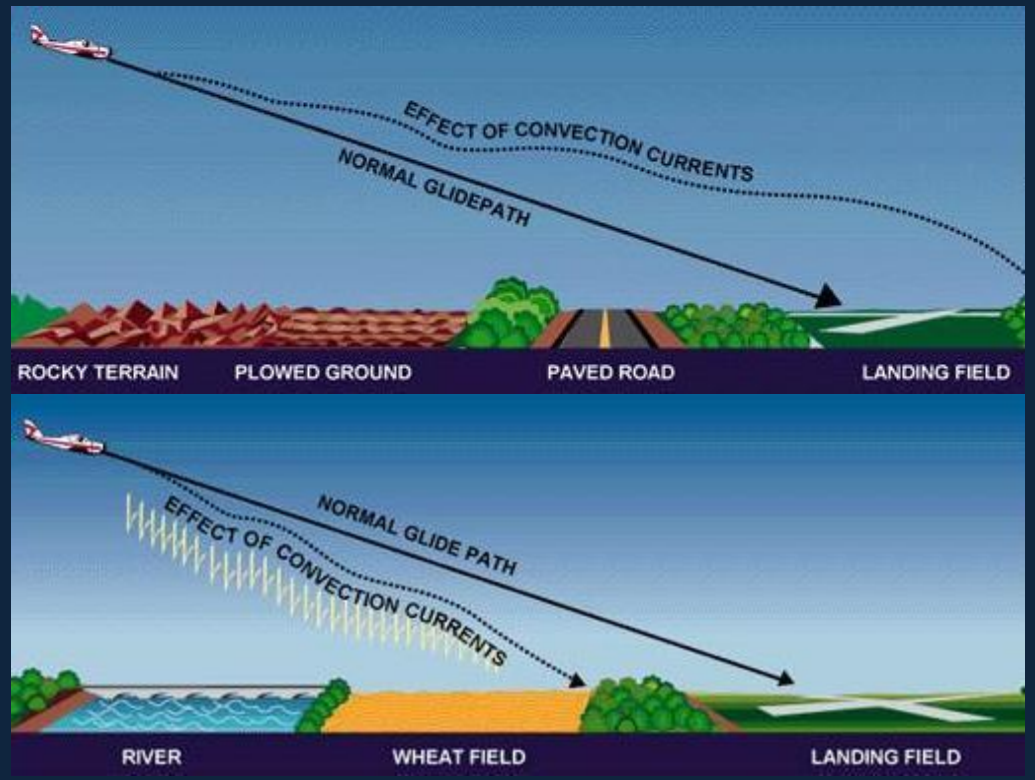




Thermal Turbulence

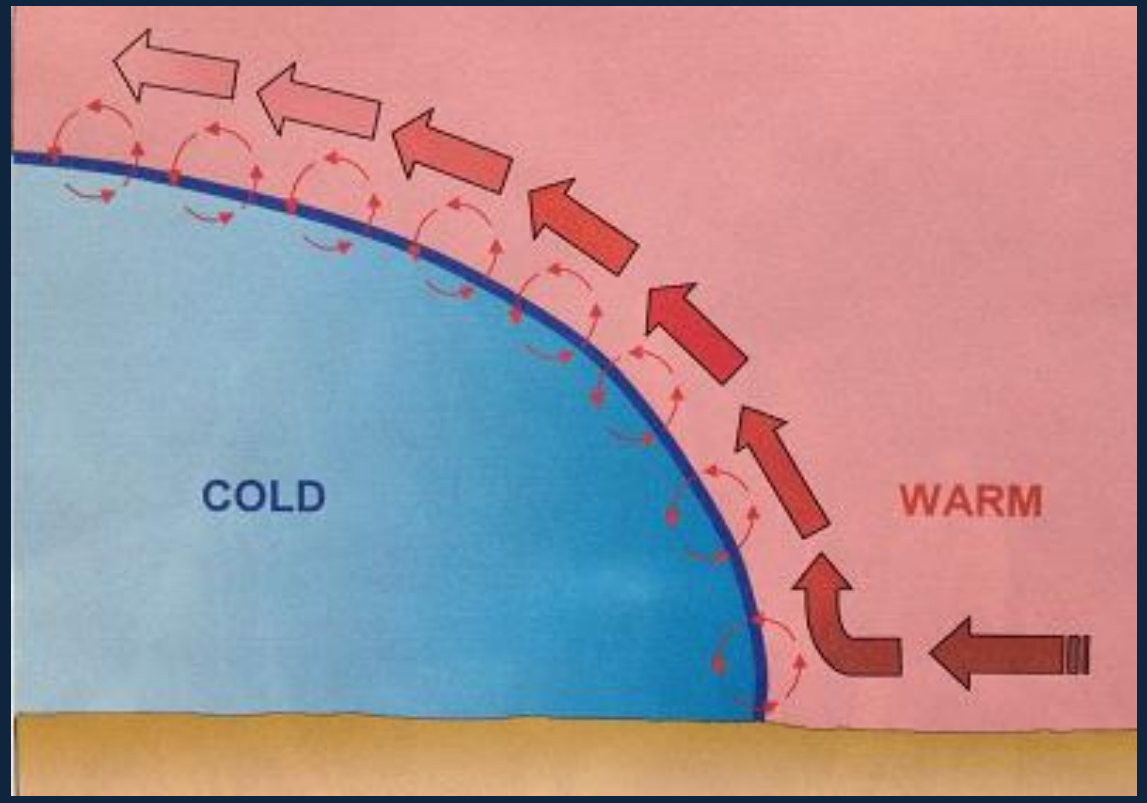
Principal of convection

- Certain surfaces are heated more rapidly than others which results in the uneven heating (and rising) of air over these surfaces
- Can be expected on warm summer days where the sun's energy heats the earth's surface unevenly



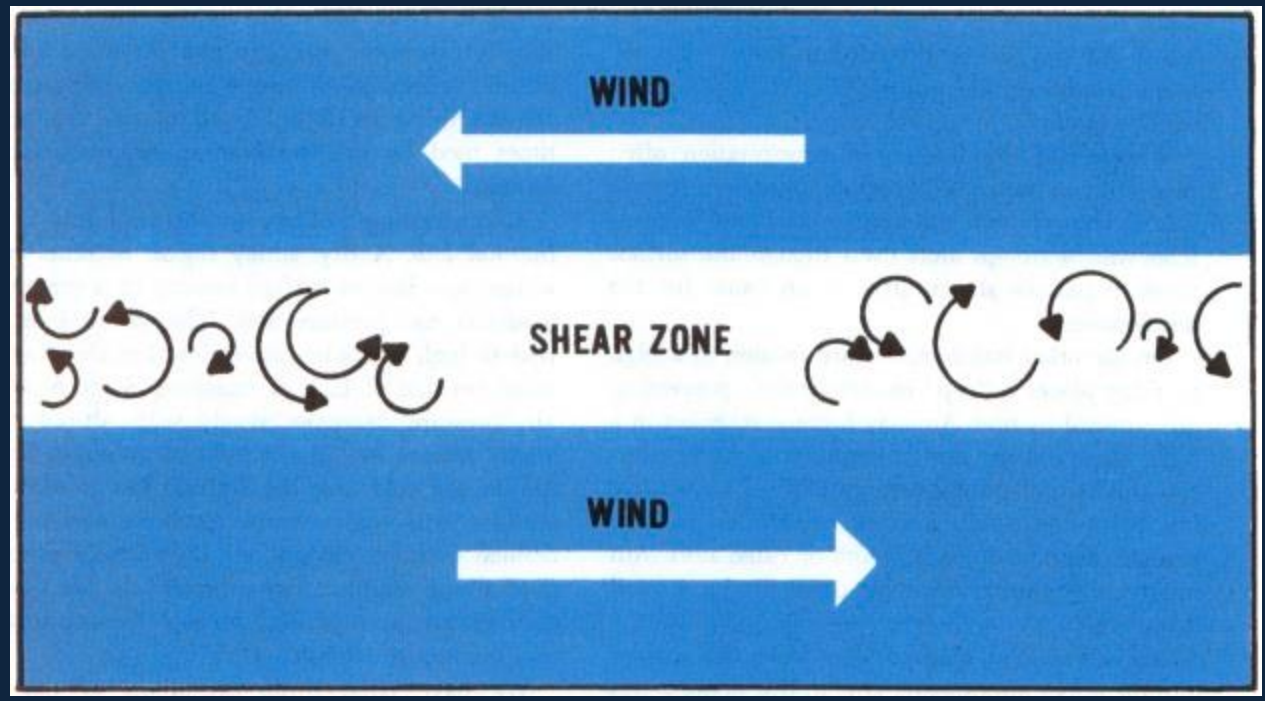
Frontal Turbulence

- Associated with the division of air masses, at the front
- Can result in severe turbulence, especially when thunderstorms are present



Wind Shear

- Dramatic changes in wind direction and/or velocity
- Often occurs at high levels, but can also be associated low to the ground

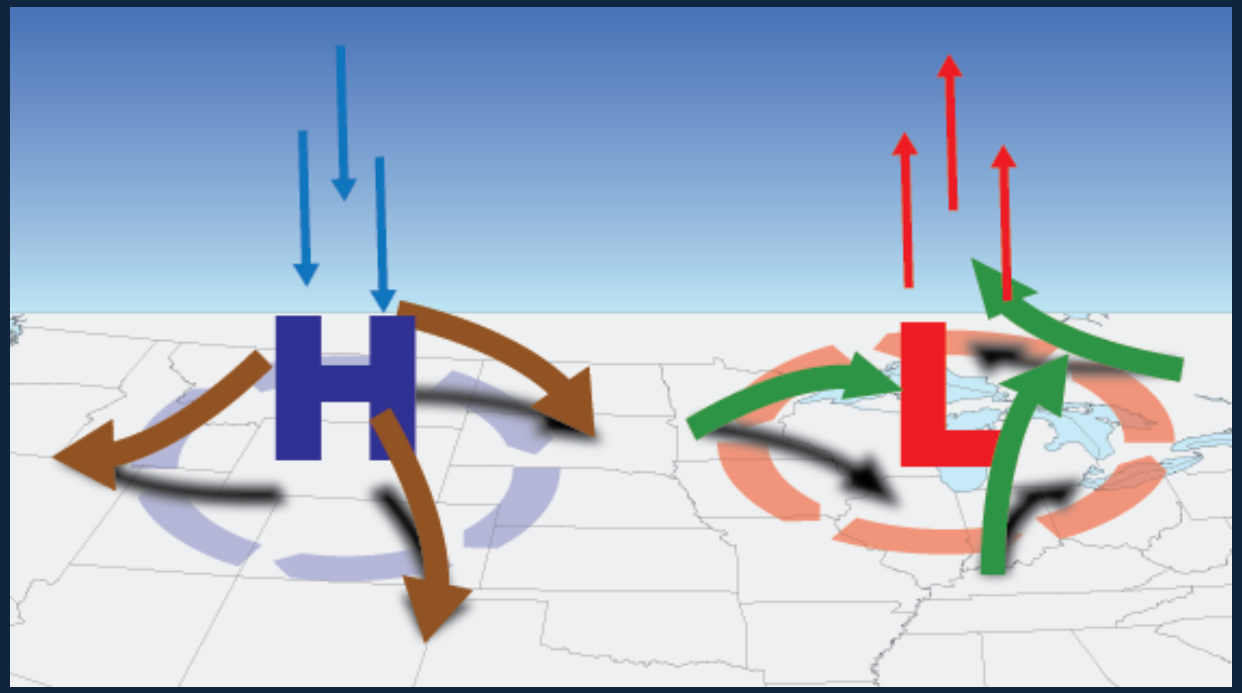


Wake Turbulence

- Rotating air mass behind aircraft
- Another reason to maintain separation from manned aircraft
- Albeit not as intense, it still forms from behind a flying RPAS as well

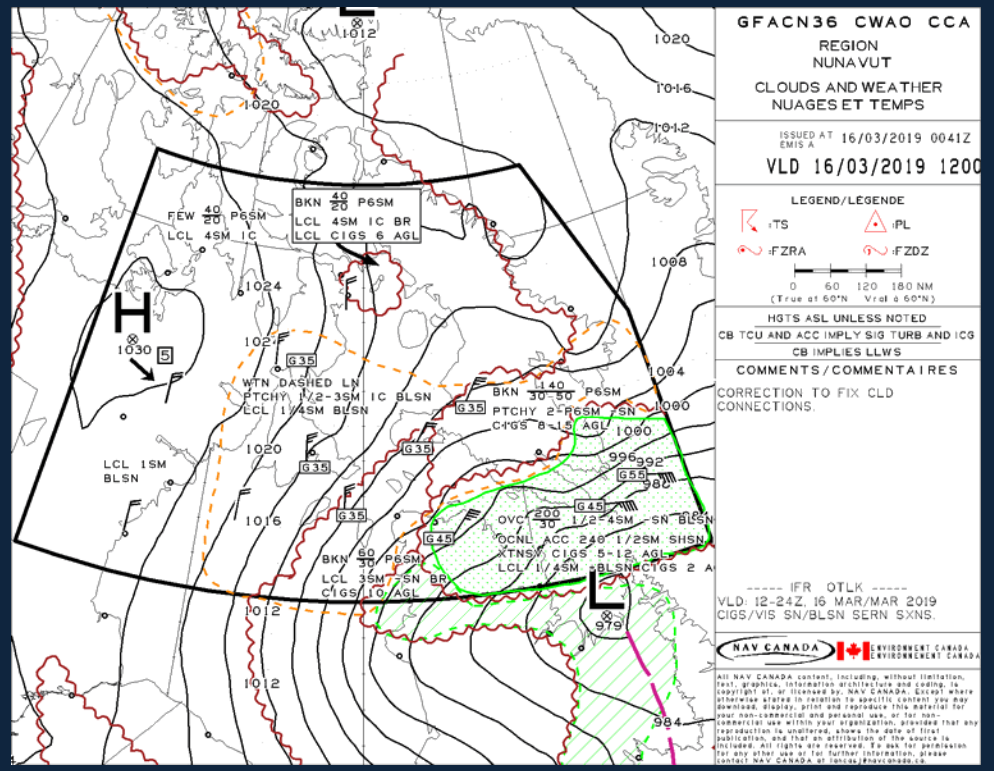
Winds

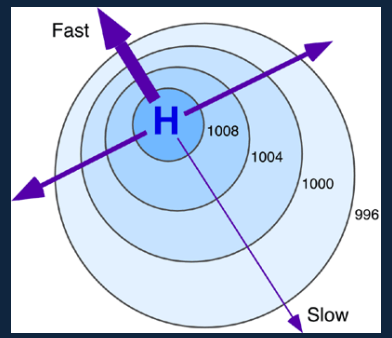
- Wind is the result of movement of air between different pressures
- Air moves from high pressure to low pressure
- The differences in pressure over geographic distance determines wind strength



Winds – Pressure Gradient

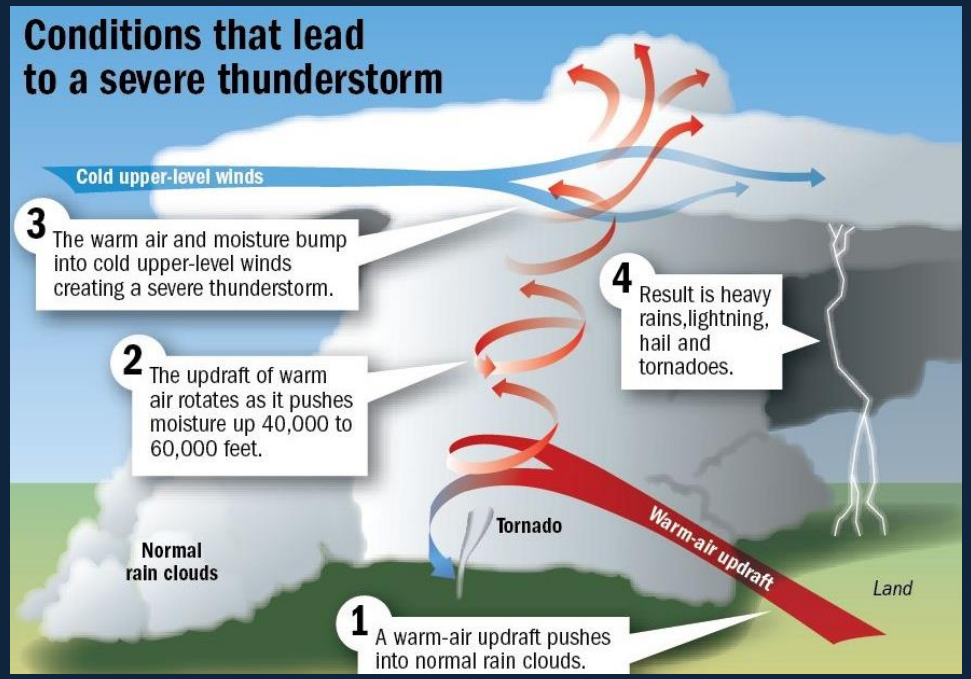
- Isobars – lines of equal pressure
- The closer together isobars are, the stronger the winds
- Winds above 3000’ AGL flow parallel to isobars





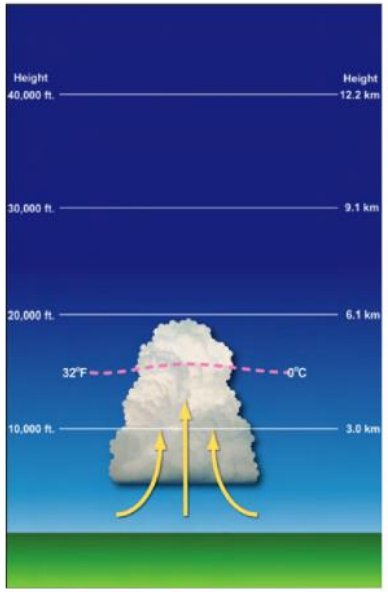
Thunderstorms

- Hazardous to all airspace users
- Three atmospheric elements required for thunderstorm development
  - Unstable air mass
  - Some form of lifting action
  - High moisture content
- Three stage of thunderstorm development



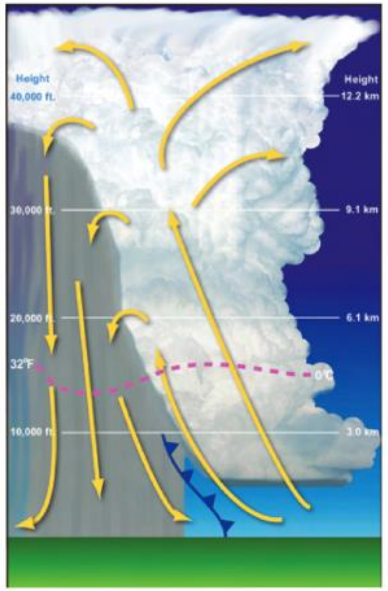
Thunderstorms

The Thunderstorm Life Cycle



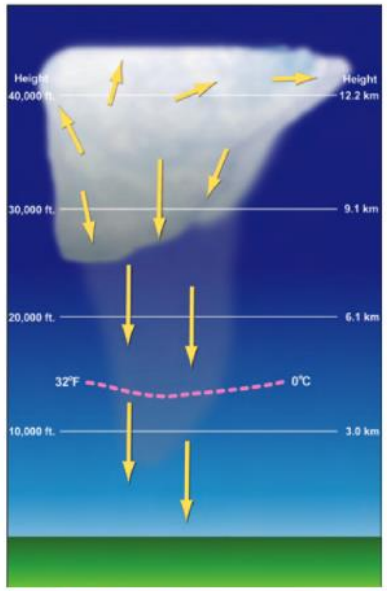
Developing Stage

- Towering cumulus cloud indicates rising air
- Usually little if any rain during this stage
- Lasts about 10 minutes
- Occasional lightning



Mature Stage

- Most likely time for hail, heavy rain, frequent lightning, strong winds, and tornadoes
- Storm occasionally has a black or dark green appearance
- Lasts an average of 10 to 20 minutes but some storms may last much longer

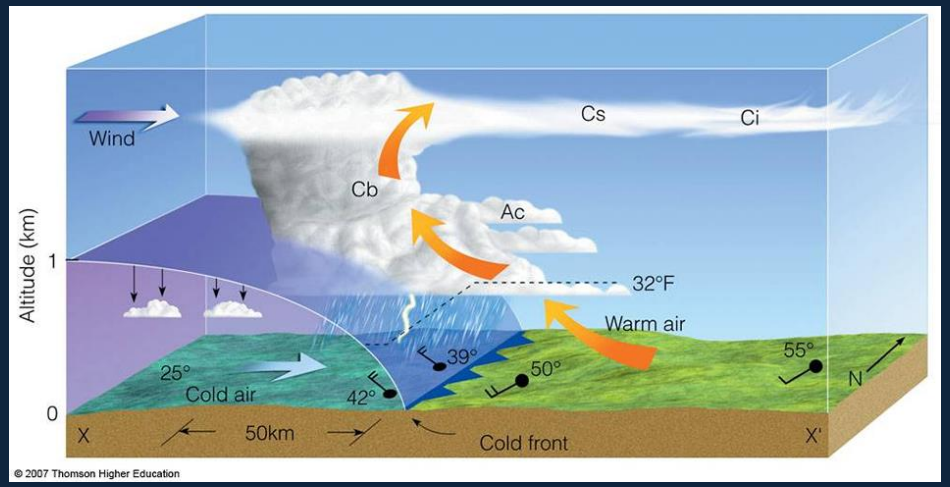


Dissipating Stage

- Downdrafts, downward flowing air, dominate the storm
- Rainfall decreases in intensity
- Can still produce a burst of strong winds
- Lightning remains a danger

Thunderstorms

- The storms are classified according to the trigger action forming them
- Typically categorized as either Frontal thunderstorms or Air Mass thunderstorms
- Frontal thunderstorms
  - Thunderstorms associated with frontal systems
  - Cold front and squall line storms are generally the most severe
- Air Mass thunderstorms
  - Caused by surface heating, orographic lift, or cooling of a moist layer aloft at night



Thunderstorms

Hazards associated with thunderstorms;

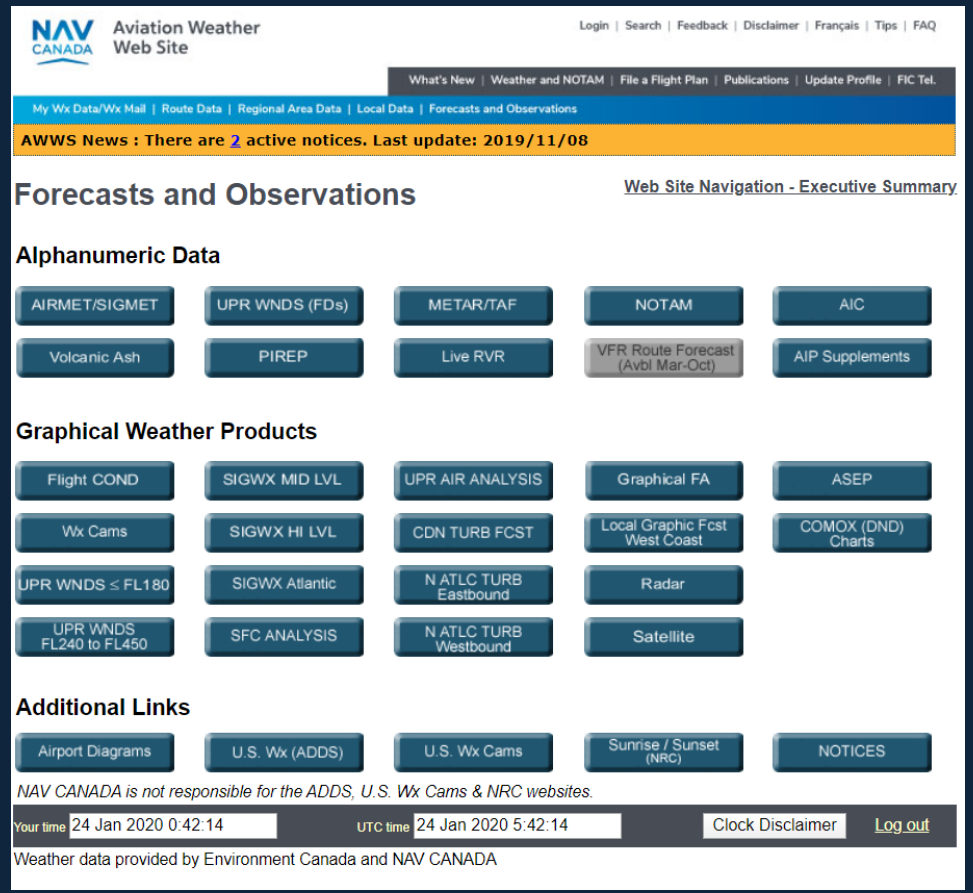
- Up and downdrafts (turbulence)
- Downburst
- Microbursts
- Wind Shear
- Gust Fronts
- Lightning (increased probability between -5°C and 5°C)
- Icing
- Hail

Weather Products

Official Sources

Aviation Weather Web Site (AWWS)

- The official aviation weather information site for Canada
- Provides coded weather information to pilots, along with NOTAM and route information, weather cameras, forecasts, upper winds and numerous other products



Official Sources

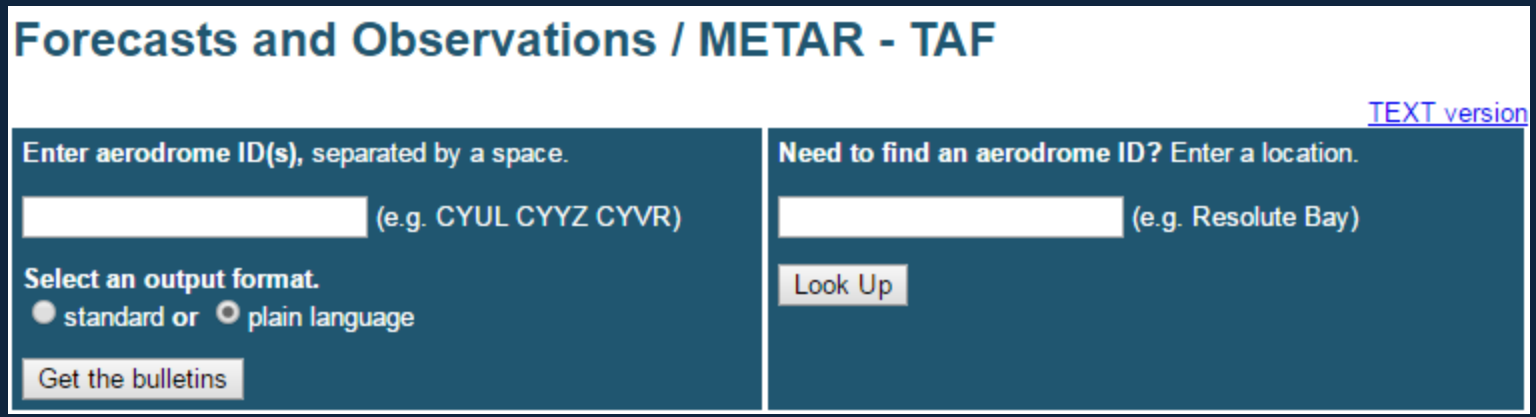
METAR – Aviation Routine Weather Report

- Standardized and coded current weather observation at a specific station

TAF – Terminal Aerodrome Forecast

- coded to the same general principles of the METAR, only apply to the terminal area surrounding the airport station (5 nm)

You can use AWWS to search for the METAR/TAF closest to you



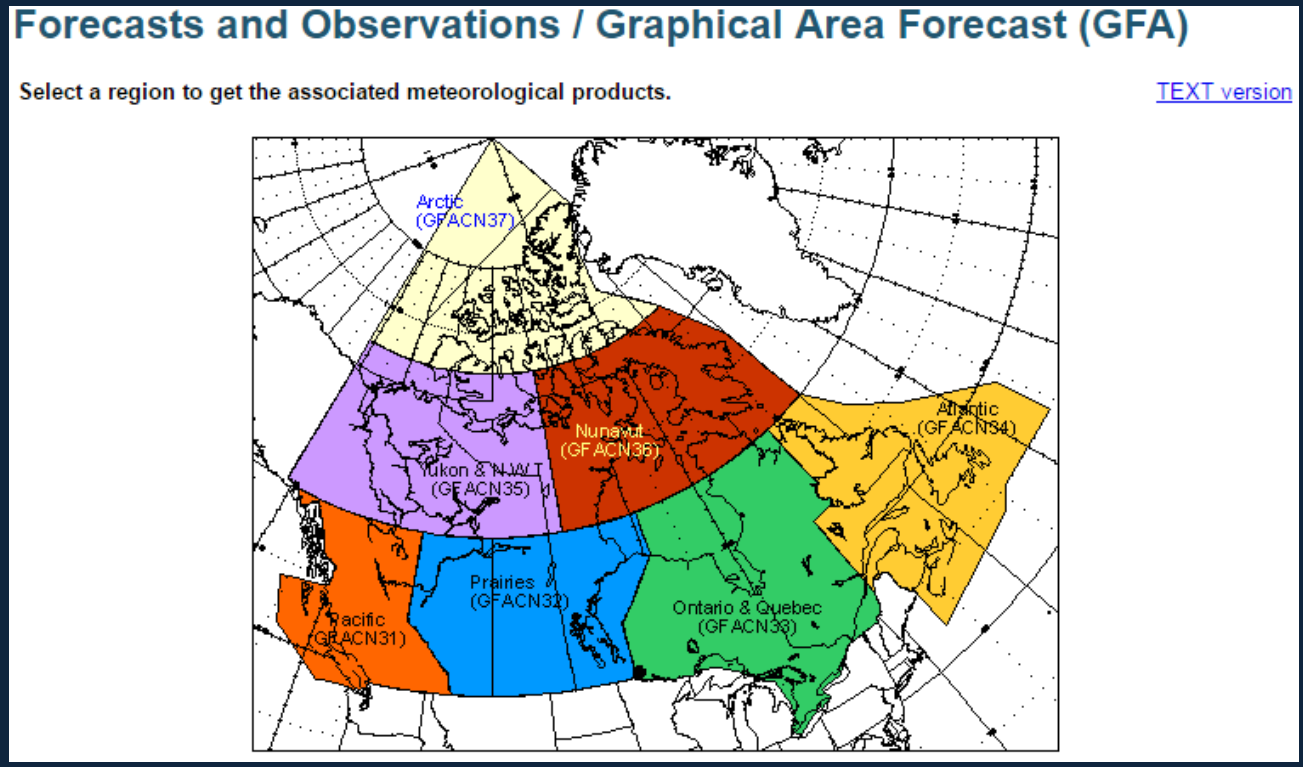
Official Sources

- **ATIS – Automatic Terminal Information Service**
  - Observations taken by a trained observer
  - Pre-recorded hourly broadcast of runway and weather information
- **AWOS – automated weather observation system**
  - Observations taken by a machine
  - Automated station that reports weather by the hour or by the minute, depending on the type
- **LWIS – Limited Weather Information System**
  - Similar to AWOS but with less information given
  - Broadcasts hourly

Official Sources

GFA - Graphic Area Forecast

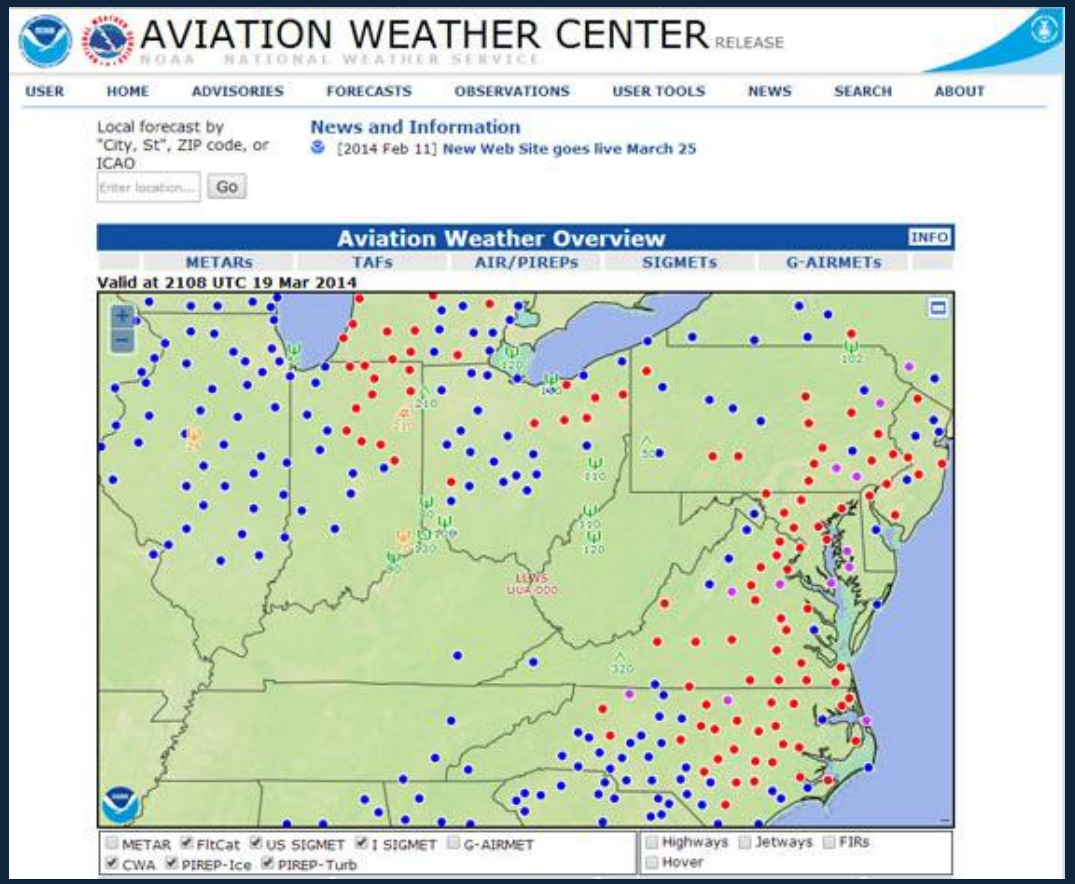
- provides forecasted weather for a large geographic area. Uses same coded weather information as the METAR/TAF but also provides graphic depictions of overall weather conditions (pressure systems, cold/warm fronts etc.)



Unofficial Sources

Aviation Digital Data Service

- The American equivalent of AWWS. Some decent graphical weather products, slightly more difficult to navigate compared to the Canadian Site.



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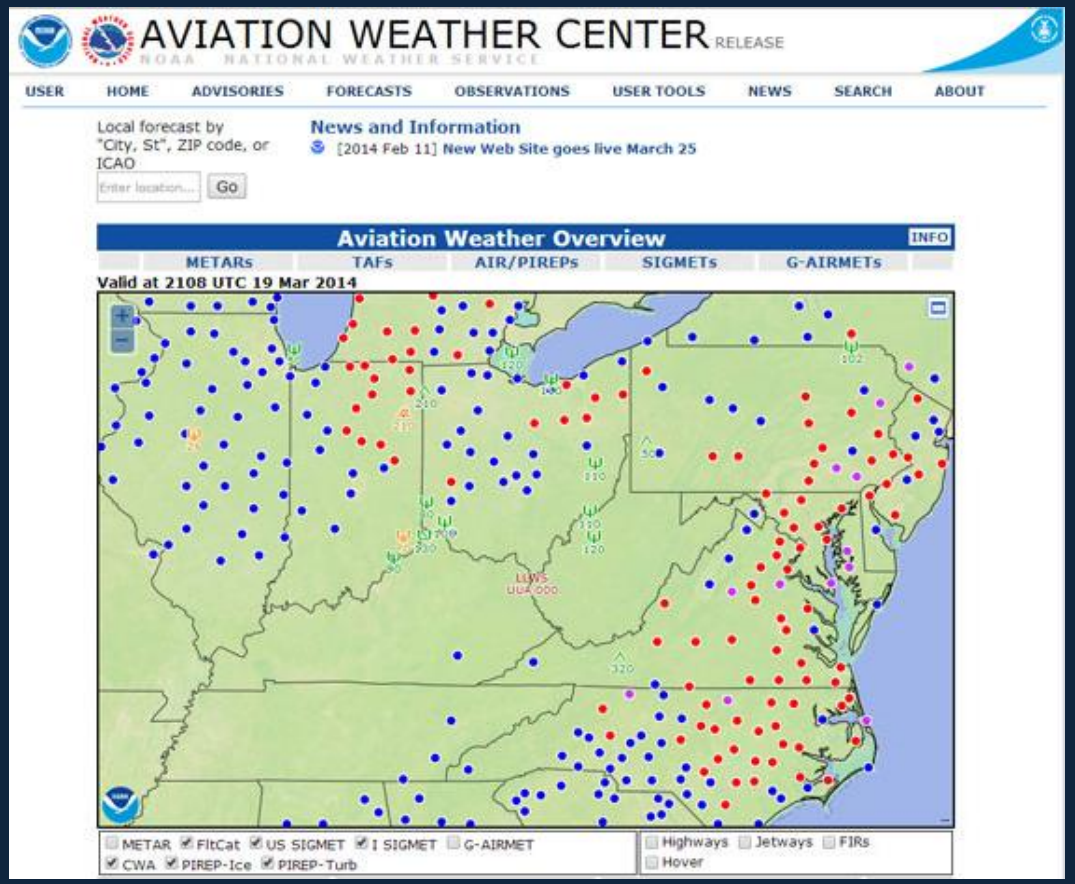
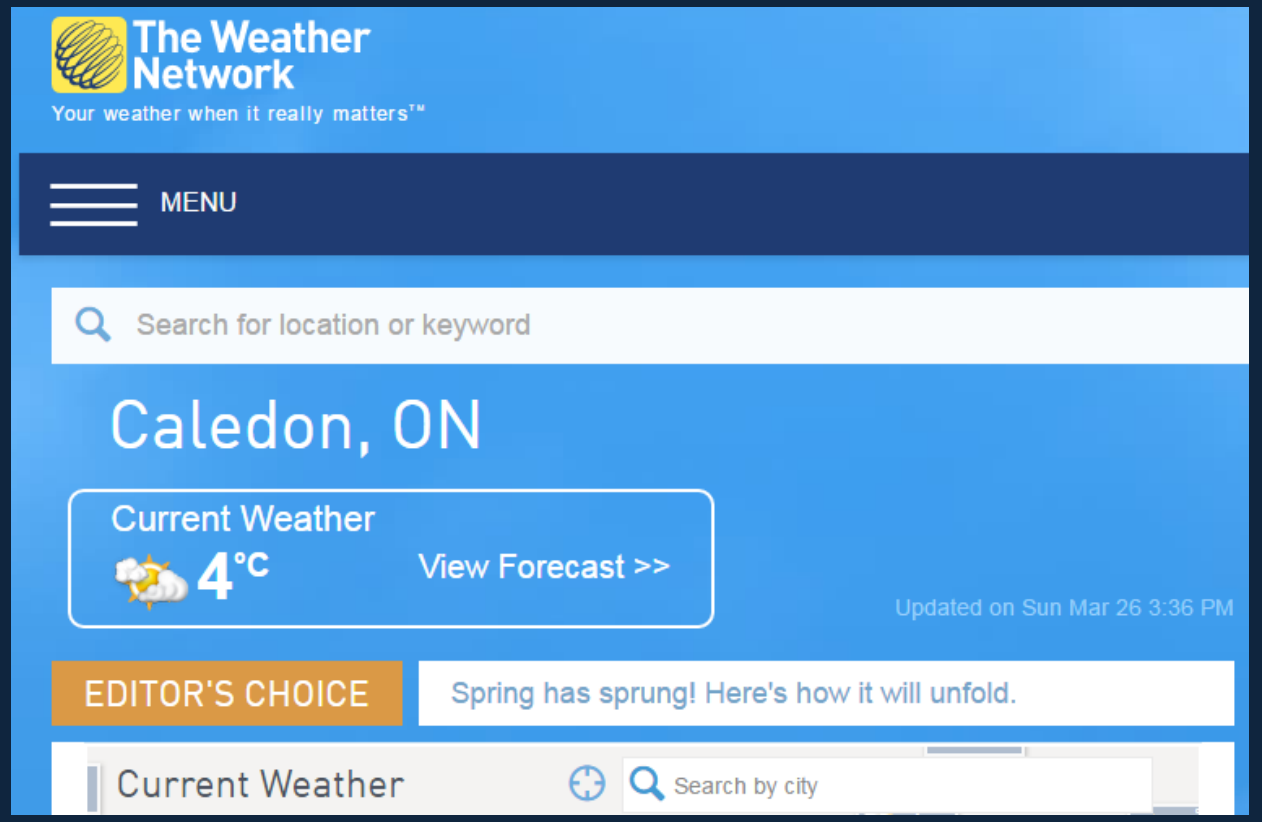


Unofficial Sources

Civilian Weather Products

- not very accurate, precise or geographically specific however very easy to use and understand.



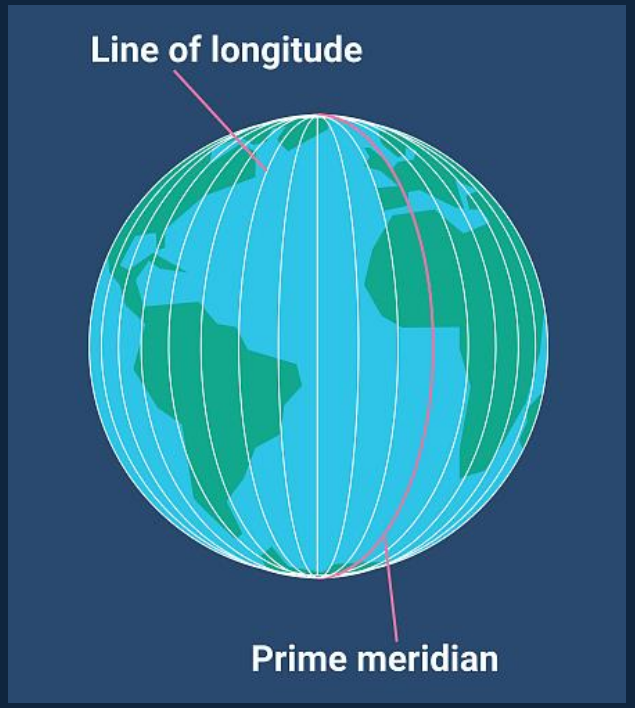
Navigation


9:41 AM Tue Sep 15
100%
Edit
Search
Routes
Clear
Map
Weather
Synth View
Resize
Flight
Instr.
Nearest
Tools
Config.
931 hPa
140
130
120
110
103
90
80
70
[GS] kt
LSYP
AO02
AO03
LIMW
7000
6750
6520
6250
6000
2000
1000
0
-1000
-2000
[ALT] ft
[VS] / min
-5
-10
148
150
180
210
240
270
300
330
60
90
120
Route
Calibrate
DEP/ARR
Bearing
Distance
Next waypoint
Track
Groundspeed
Altitude (GPS)
D04/A28
141 °
2.3 NM
WP007
Martigny
145 °
103 kt
6,519 ft

Navigation - Definitions

Longitude

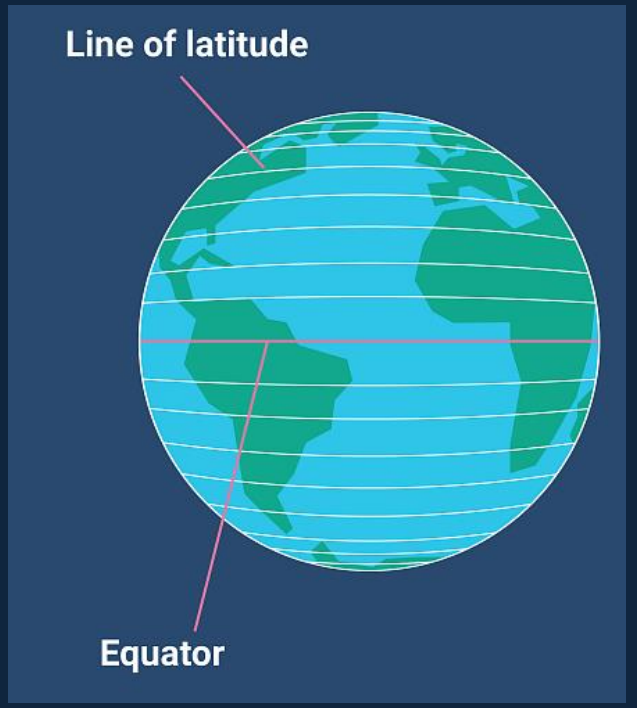
- An imaginary line running from the North to the South Pole measuring degrees East and West of the Prime Meridian.
- Longitude is measured in
- Degrees (°)
- Minutes (‘)
- Seconds (“)
- Remember these are angular measures and NOT TIMES
- With that being said, one hour of time is also equal to 15° of Longitude
- A Meridian of Longitude is measured from 0° to 180° East or West



Navigation - Definitions

Latitude

- A parallel of Latitude is an imaginary line which runs around the circumference of the Earth, East and West and are parallel to the Equator
- Latitude is measured in
- Degrees (°)
- Minutes (‘)
- Seconds (“)
- 1 minute of Latitude equals 1 NM
- 60 minutes of Latitude equals 1°
- 60 seconds equals 1 minute of latitude
- Parallels of Latitude run from 1° North/South of the Equator to 90°.



Navigation - Definitions

Magnetic Variation

- The angular difference between true north and magnetic north at a particular place.

Track

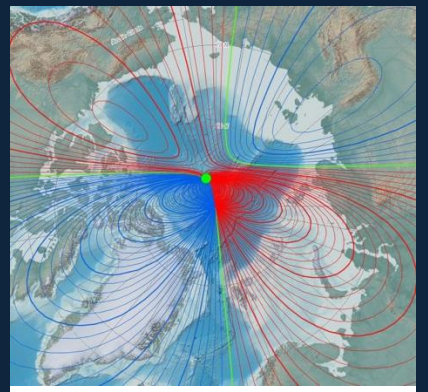
- Refers to the direction of the aircraft travel over the earth's surface. Measured relative to North in a clockwise fashion

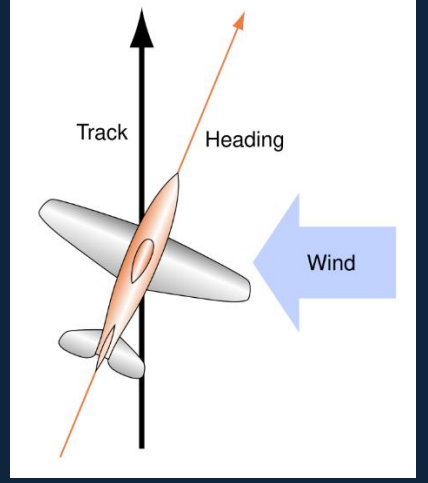
Magnetic Track/Heading

- Refers to a track (or heading) along the ground measured relative to magnetic north.

Heading: (aka. Bearing)

- Refers to the direction the aircraft is pointed. Direction in turn is expressed in relation to the north – 360° and measured in a clockwise fashion.





Navigation - Definitions

Airspeed

- The speed of an aircraft relative to the air through which it is moving

Bearing

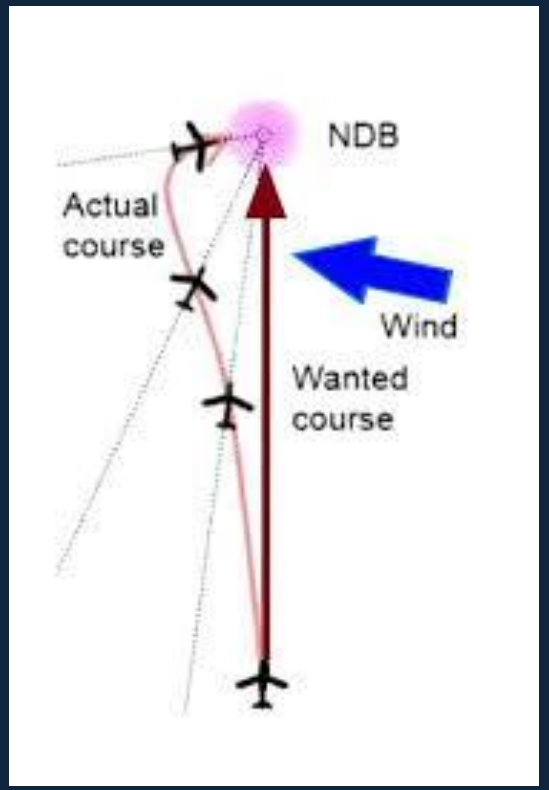
- The direction or position of something, or the direction of movement, relative to a fixed point. It is usually measured in degrees, typically with magnetic north as zero

Wind Velocity

- The speed of the wind relative to the earth's surface

Drift

- Unwanted deviation from course due to wind.



Navigation - Basics

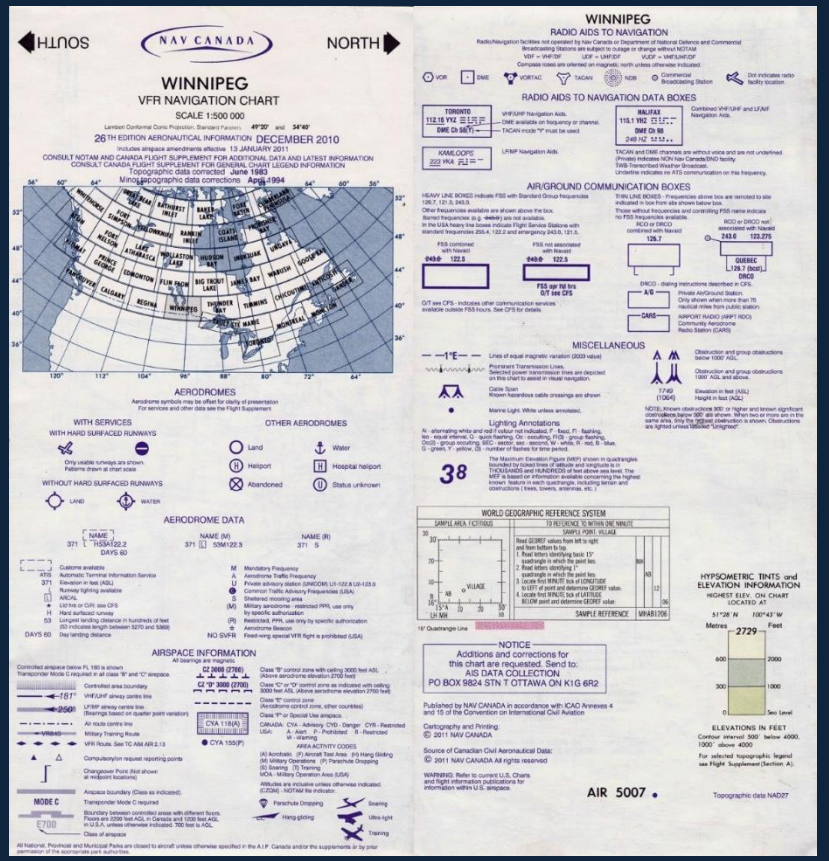
- Operating within VLOS will make navigation somewhat simpler
- Your position is known, provided you keep the aircraft within VLOS at all times, you can navigate back to your position

Navigation - Basics

- **Charts will be critical to successfully complying with the exemption/CARs in regards to keeping away from controlled airspace**
- **For general aviation pilots there are two types:**
  - VNC: VFR Navigation Chart – used for large areas – ie. One chart covers most of southern Ontario
    - Scale of 1:500,000
    - Units of Measurement: nautical miles (6076ft or 1852m)
  - VTA: VFR Terminal Area – used for congested airspace – ie. Greater Toronto Area, Montreal etc.
    - Scale of 1:250,000
    - Units of Measurement: nautical miles (6076ft or 1852m)

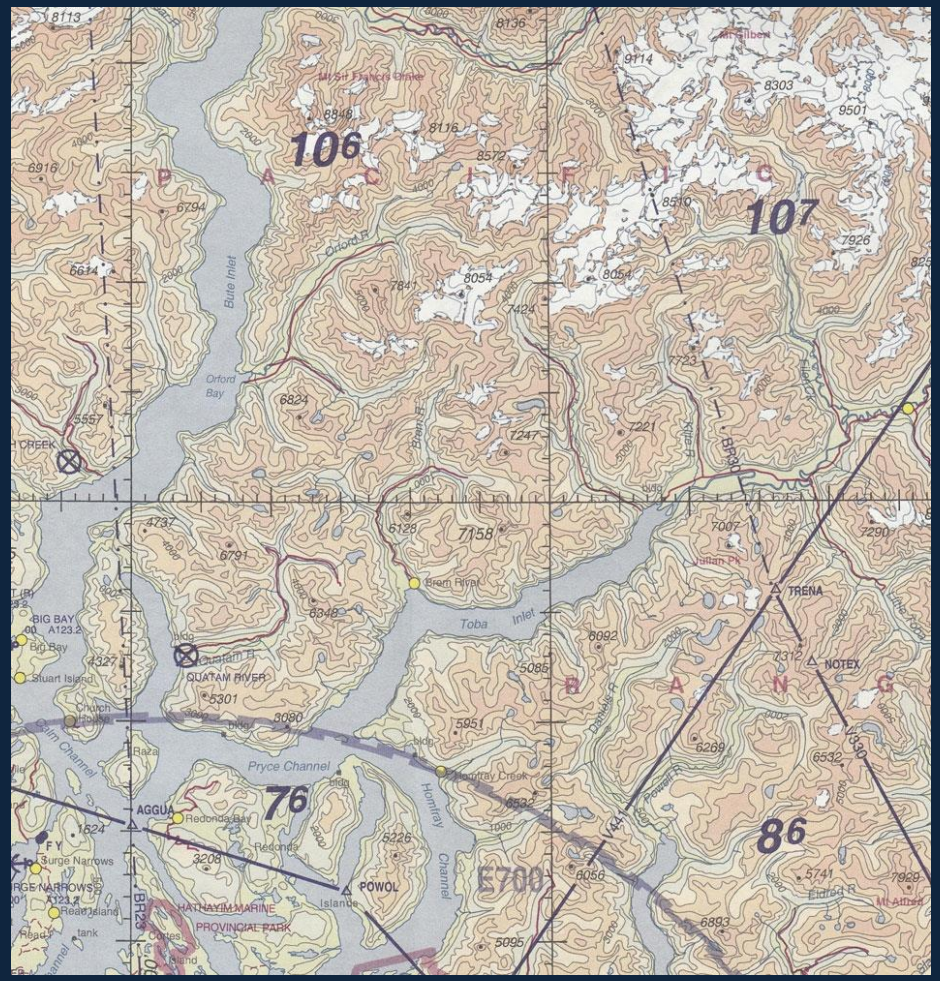
VNC/VTA Legend

- Validity/currency
- Types of aerodromes
- Depiction of airspace classes
- Class F - activities
- Air/ground frequencies
- Miscellaneous
  - Towers
  - Powerlines
  - Elevation always in ASL unless otherwise noted
- Hypsometric tinting



Vancouver VNC

- Spot elevations
- Contour lines



- Abandoned/Closed Aerodrome

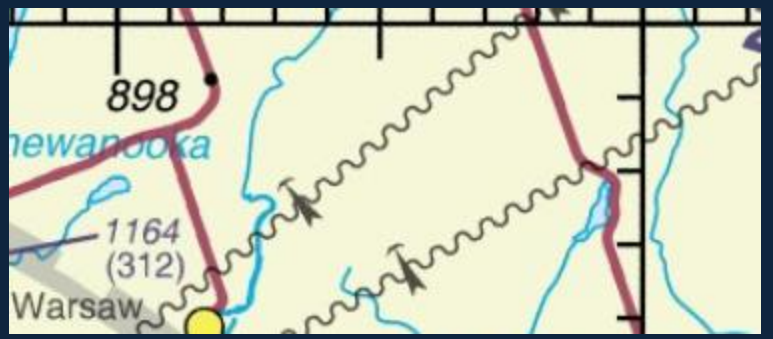
- Airport with services; Rodney (New Glasgow) Restricted use, Elevation: 670', Lighted, Main Runway 1700', ATF 123.200, No winter maintenance

- London Airport, Customs Available, ATIS available, Elevation 912, ARCAL, Lighted, Main runway 8800', Tower 119.4, limited hours, otherwise Mandatory Frequency

Obstacles


1285
(345)


749
(496)
Unlighted
(280)
Unlighted
821
(529)
761
(473)
621
(335)
697
(443)
(694)
Unlighted


898
1164
(312)
Warsaw


Anne
V2-221-46
Bay
885
(308)
WIND TURBINE FARM
977 TO 1001 ASL
Unlighted

Navigation Publications

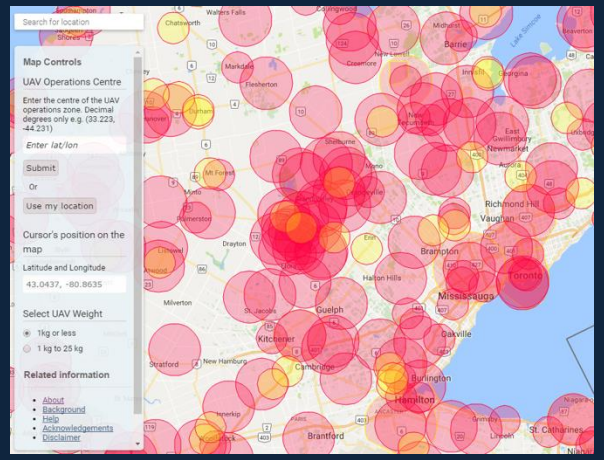
- Additional sources can be used to aid in Navigation and pre-flight planning
- Any unofficial sources however do not replace the need for official publications to be consulted to ensure accuracy
- The following are some examples of other Official and Unofficial sources

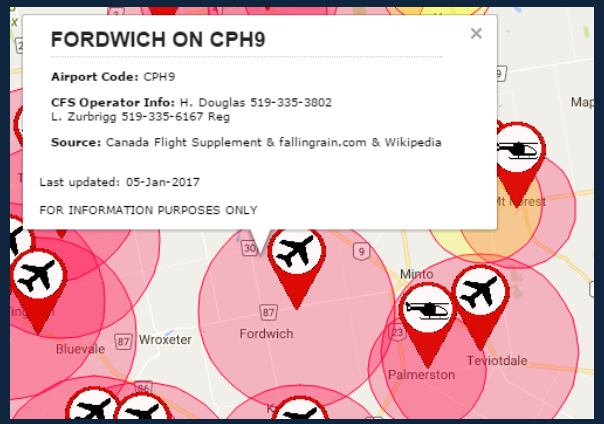
Foreflight

- An **official** source for NavCanada publications (CFS, VNC, VTA)
- Used by general aviation and commercial pilots
- Works only on Apple devices
- Yearly subscription of $100.00/yr

Drone Site Selection Tool

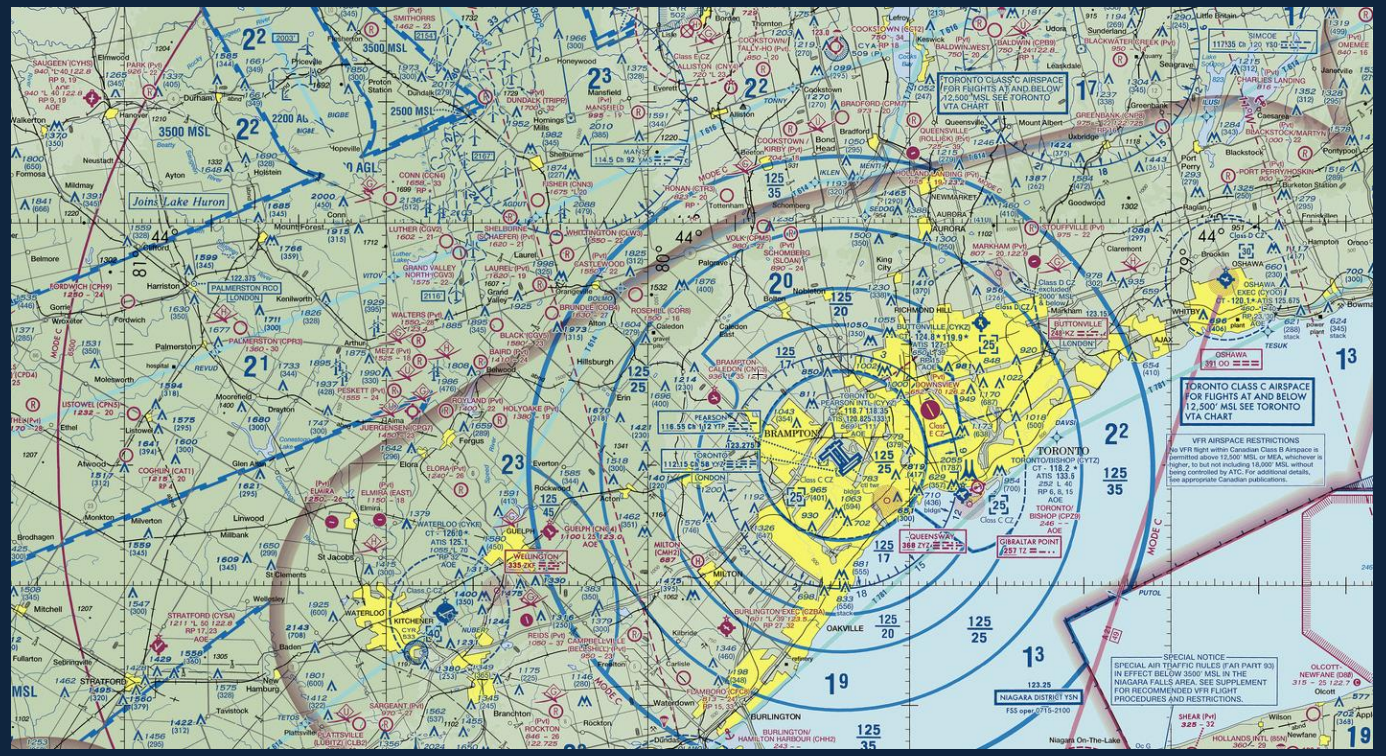
- Provided by the National Research Council (NRC)
- Uses Google Maps and plots out known aerodromes and restricted airspace
- **Not an official source** of information but can guide pre-flight planning
- Free to use





SkyVector

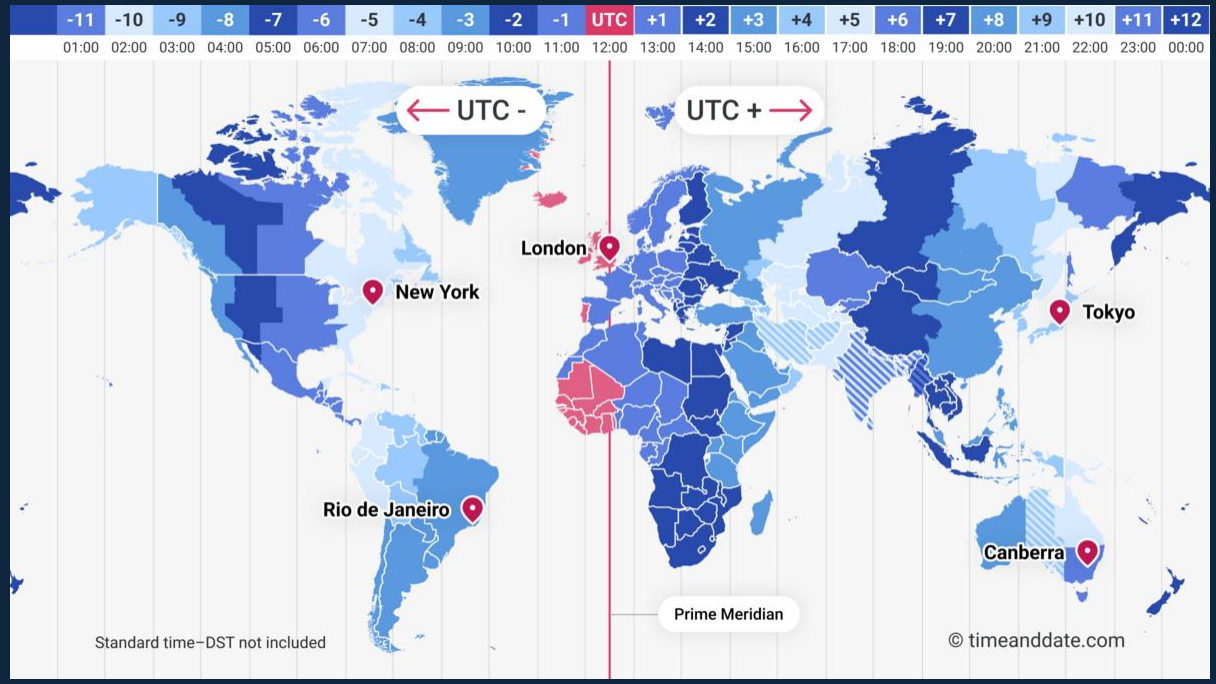
- Similar to Foreflight however uses only American Charts
- Not an official source
- Free to use, works on Android and Apple Devices



Time

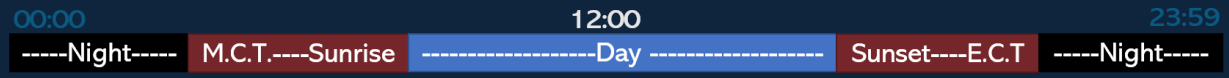
24 hour clock

- Since aviation is global we use Universal Coordinated time (UTC)
- Aka. Zulu time (Z) or Greenwich Mean Time (GMT)
- Time zone for Toronto is Eastern Standard Time (EST) or Eastern Daylight Time (EDT)
- UTC -5 or UTC -4



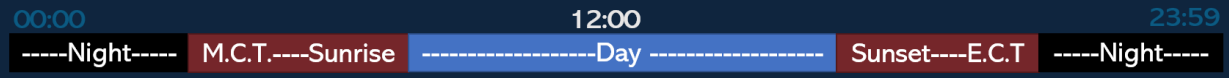
Sunrise and Sunset

- The exact sunrise and sunset times vary by your location
- These times determine whether your flight becomes a day-flight or a night-flight
  - Day – “The time between the beginning of morning civil twilight and the end of evening civil twilight” CARs 101.1
    - Morning civil twilight (ie. dawn) begins approximately 25 minutes before sunrise
  - Night – “The time between the end of evening civil twilight and the beginning of morning civil twilight” CARs 101.1
    - Evening civil twilight (ie. Dusk) ends approximately 25 minutes after sunset

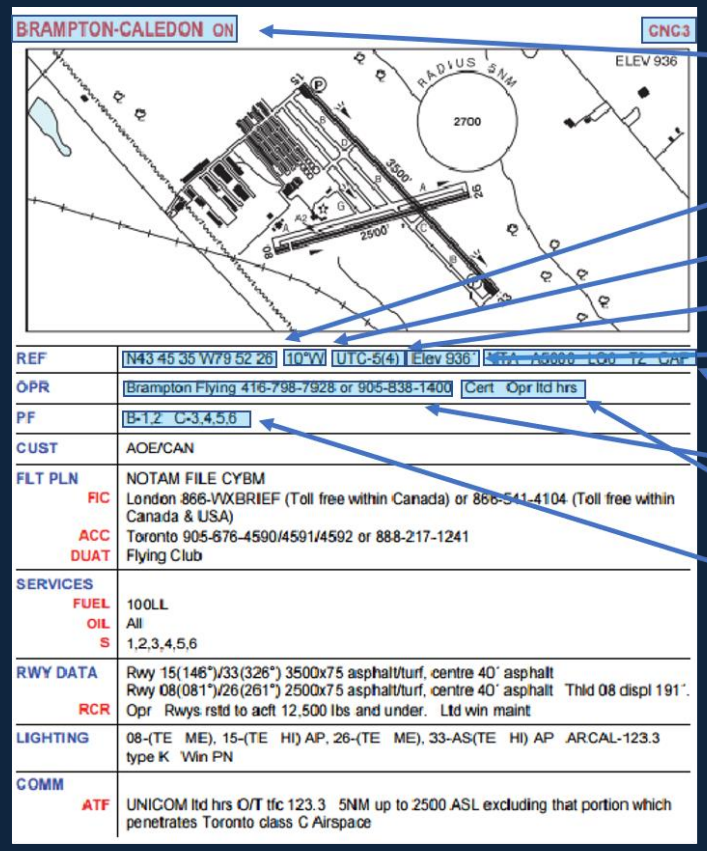


Sunrise and Sunset

- There are several ways to determine local sunrise and sunset times
  - Using the morning and evening civil twilight charts from the AIM → not necessary to know for RPAS flying
  - Hand held GPS units specified for aviation use
  - Use the internet
    - Specifically from the **National Research Council Canada** website
      - https://www.nrc-cnrc.gc.ca/eng/services/sunrise/index.html
      - Gives both sunrise/sunset and morning/evening civil twilight times based on the date and location



Canadian Flight Supplement



Airport Name and Province

Airport Identifier

Coordinates

Magnetic Variation

Time Zone

Airport Elevation

Charts airport is listed on

Airport operator and number

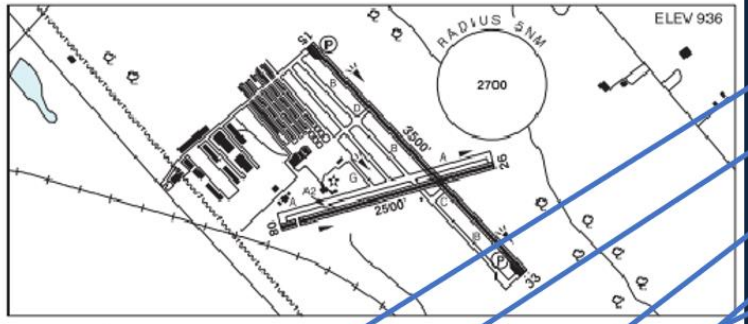
Certified airport with limited hours

Public Facilities

A – Available in Terminal Building
B – On aerodrome
C – 5nm of Aerodrome
D – 30nm of Aerodrome
1 – Telephone
2 – Food
3 – Taxi
4 – Medical Services
5 – Hotel
6 – Car Rental
7 – Public Wi-fi
8 – Public internet access

Canadian Flight Supplement

BRAMPTON-CALEDON ON CNC3



REF	N43 45 35 W79 52 26 10°W UTC-5(4) Elev 936´ VTA A5000 LO6 T2 CAP
OPR	Brampton Flying 416-798-7928 or 905-838-1400 Cert Opr ltd hrs
PF	B-1,2 C-3,4,5,6
CUST	AOE/CAN
FLT PLN	NOTAM FILE CYBM
FIC	London 866-WXBRIEF (Toll free within Canada) or 866-541-4104 (Toll free within Canada & USA)
ACC	Toronto 905-676-4590/4591/4592 or 888-217-1241
DUAT	Flying Club
SERVICES	
FUEL	100LL
OIL	All
S	1,2,3,4,5,6
RWY DATA	Rwy 15(146°)/33(326°) 3500x75 asphalt/turf, centre 40´ asphalt Rwy 08(081°)/26(261°) 2500x75 asphalt/turf, centre 40´ asphalt Thld 08 displ 191´.
RCR	Opr Rwys rstd to acft 12,500 lbs and under. Ltd win maint
LIGHTING	08-(TE ME), 15-(TE HI) AP, 26-(TE ME), 33-AS(TE HI) AP ARCAL-123.3 type K Win PN
COMM	
ATF	UNICOM ltd hrs O/T tfc 123.3 5NM up to 2500 ASL excluding that portion which penetrates Toronto class C Airspace

- Customs Available
- NOTAM file name
- Flight Information Centre
- Area Control Centre phone number
- Direct User Access Terminal Service
- Aircraft Repair Services Available
- Runway information
- Airport Lighting
- Communication frequencies

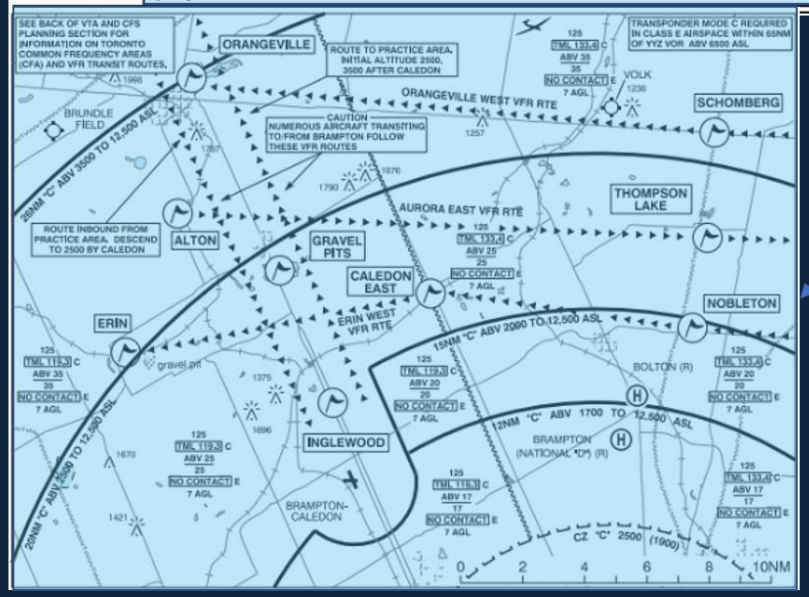
Canadian Flight Supplement

Procedures

Cautionary Notes

BRAMPTON-CALEDON ON (Cont'd) CNC3

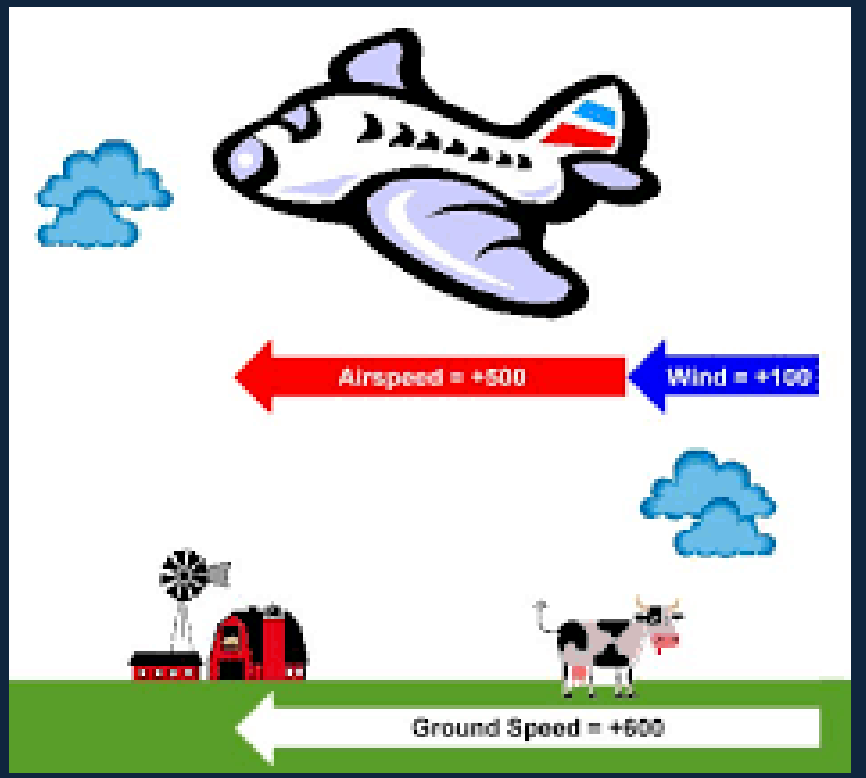
PRO	Circuit hgt 1700 ASL. Call opr prior to ARCAL ops when wln wx might affect rwy cond. Due to close proximity to Toronto/Lester B. Pearson Intl., there may be periods when ATC will be unable to approve use of the inst apch pro. Helicopters arr/dep via active rwy then taxi to/fr designated helicopter area btwn Golf & Bravo at Alpha. Acft with main gear track 18˚ and over use Rwy 15/33 then turn around bay and backtrack to twy D and apron.
CAUTION	Painted & lgtd twr 1696 ASL (400 AGL) aprx 4NM WNW. Narrow twys (18˚) exc twy D (24˚).



Terminal Procedures

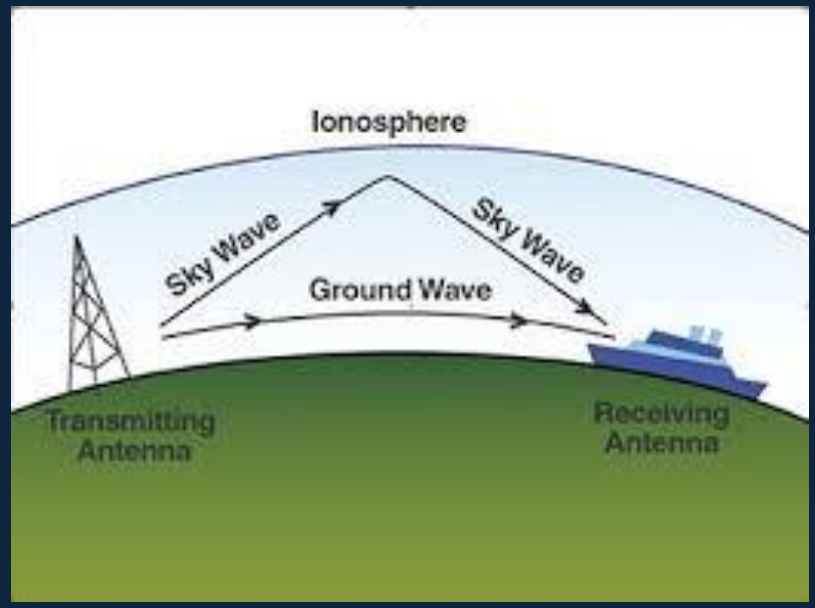
Ground vs Air Speed

- Since you are affected by winds, the speed shown on your airspeed indicator and your actual speed over the ground can vary



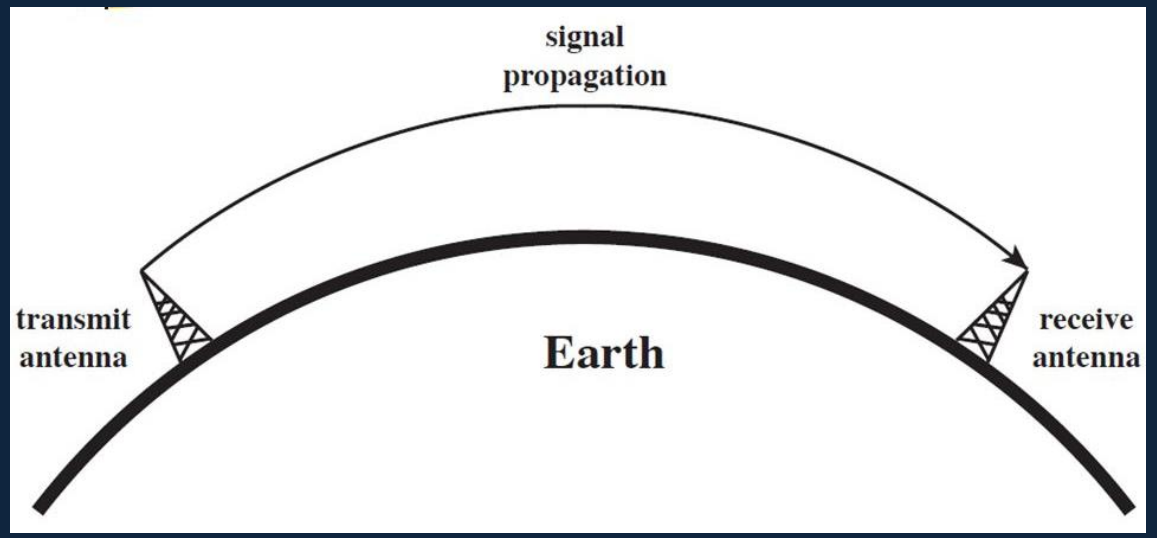
Radio Wave Characteristics

- Radio Propagation – the behavior of radio waves as they travel in the atmosphere
- Waves transmitted by ground stations in low, medium and high frequency can be split into two types
  - Ground waves
  - Sky waves



Radio Wave Characteristics

- **Ground Waves**
  - Follows the surface of the earth
  - Travel in a straight line
  - Due to phenomenon called **diffraction**, they bend around obstacles in their path
  - Surface **attenuation**
    - Ground waves losing some energy to the earths surface and slows down
    - The higher the frequency used, the greater the attenuation
    - Also helps bend the waves to enable it to follow the curvature of the earth
  - Waves continue until they are undetectable due to attenuation



Factors Effecting Radio Reception Wave

- **Night time**
  - sky waves travel at a flatter angle
  - causing a greater skip distance and signal distance than during the day
- **Sunspot activity or other electromagnetic disturbances**
  - upsets reflecting ability of ionosphere
  - Waves not reflected back to earth and fade out
- **Precipitation static**
  - Electric discharges in the surrounding air as result of frictional contact with liquid and solid particles in the atmosphere
    - Such as dust, sand, ice crystals, rain, snow crystals, wet snow, and freezing rain
  - Occurs through flying into cloud or precipitation or contact with an external electric field (summer – thunderstorms or winter – ice crystals)

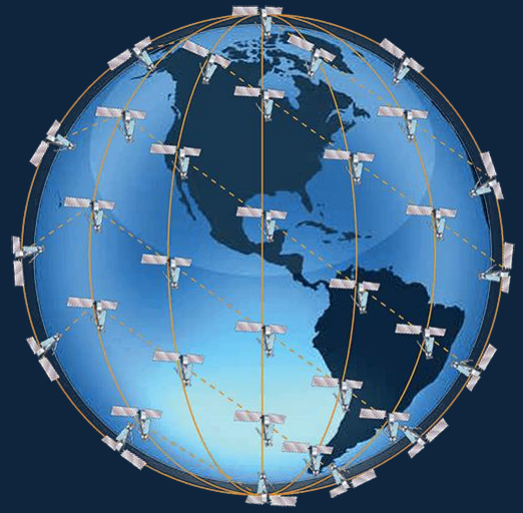
Radio Frequency Environment

- Have you ever been listening to AM radio while driving and it momentarily gets garbled as you drive underneath some powerlines
  - This is also a form of interference
- You can asses an RF Environment by:
  - Use an RF spectrum analyzer
  - Visually inspecting operation site
    - Look out for
      - Powerlines
      - Cellphone towers
      - large metal objects
      - Other remote controlled aircraft

What else do you think could be an issue?

Global Navigation Satellite System (GNSS/GPS)

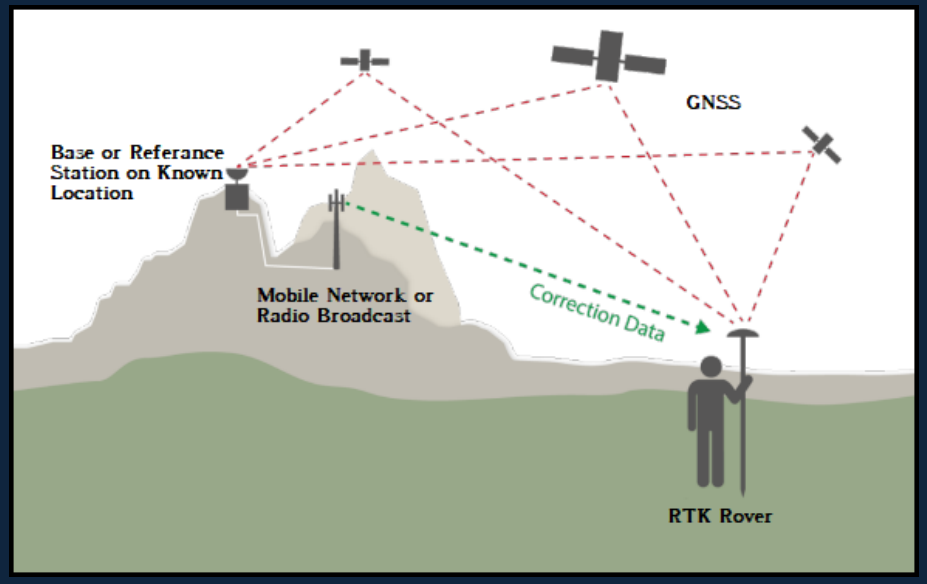
- GNSS includes satellites provided by various countries or commercial groups as well as ground systems to augment and monitor the satellites
  - Based on satellite ranging
  - Constellation of 24 satellites orbiting the earth (GPS)
  - More networks include Galileo, GLONASS, BeiDou
  - Works by timing how long it takes a radio signal to reach the receiver
  - For accuracy, satellites use atomic clocks (the most stable and accurate time reference)
  - Requires 4 satellites to triangulate your position and altitude



Ground Based Augmentation Systems

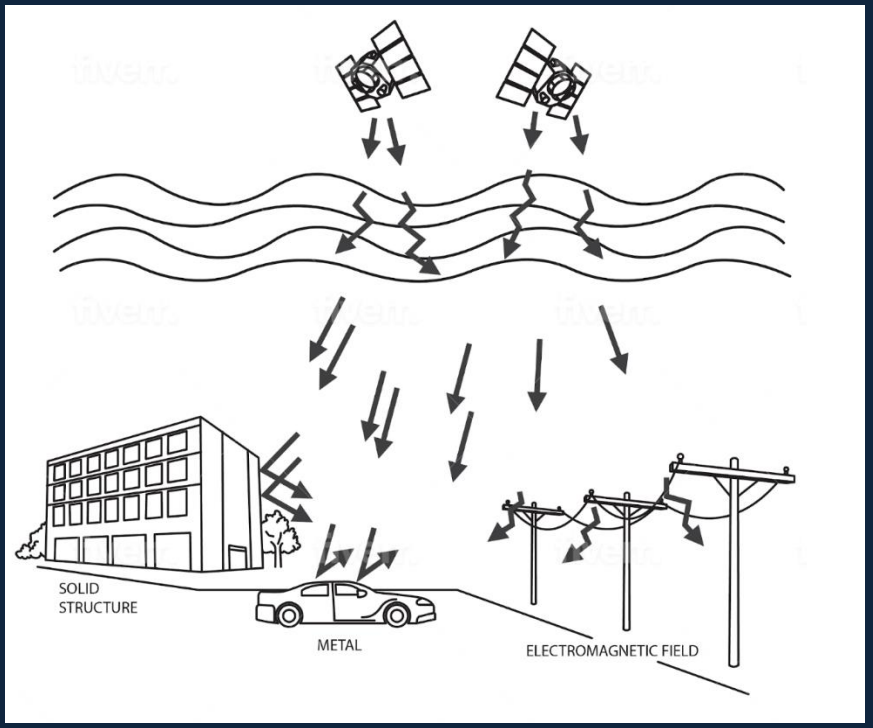
Differential GPS (DGPS)

- Used to boost the accuracy of the system
- GPS receiver on the ground, stationary known point used as a reference, measures distances to satellites and calculates corrections to match the actual positions of any other GPS receivers in the area
- For example: If your RPAS is trying to land somewhere using GPS and there is a DGPS station around the area, it will automatically send corrections to your GPS and improve the accuracy on your landing



GPS Signal Loss and Interference

- Used to be more of an issue when GPS initially came out but as technology has progressed it does not happen as often
- What will happen during a loss in GPS signal?
  - RPAS will have to be flown manually
  - If it is on autopilot, you will lose response from the RPAS
    - Will usually “return to home”, if you have set it properly
- Some causes of signal loss and affect performance can be:
  - Weather / Heavy cloud cover
  - Congested area of tall buildings
  - Number of satellites
  - Solar storms



Radiotelephony

Restricted Operator Certificate With Aeronautical Qualification (ROC-A)

- An ROC-A is required by operators of radiotelephone equipment on board aircraft and at aeronautical land (fixed and mobile) radio stations using aeronautical mobile frequencies.
- The radiotelephone equipment at such stations shall be of a type that requires only simple external switching, has a power output not exceeding 250 watts effective radiated power (e.r.p.) – equivalent to 400 watts peak envelope power (PEP) – and where all frequency-determining elements are preset within the transceiver.

Industry Canada / Industrie Canada

CERTIFICATE OF PROFICIENCY IN RADIO / CERTIFICAT DE COMPÉTENCE EN RADIO

Certificate - Certificat: RESTRICTED OPERATOR

Number - Numéro: 123456789

Certificate Holder - Titulaire du certificat: Doe, John

Qualifications or Restrictions - Compétences ou restrictions: AERONAUTICAL

Restricted Operator Certificate With Aeronautical Qualification (ROC-A)

Eligibility

- There are no nationality or age restrictions as to who may take the examination or hold an ROC-A. Candidates must attest that they do not have a disability that would impair their ability to operate a radio station safely.

3.3 Documentation

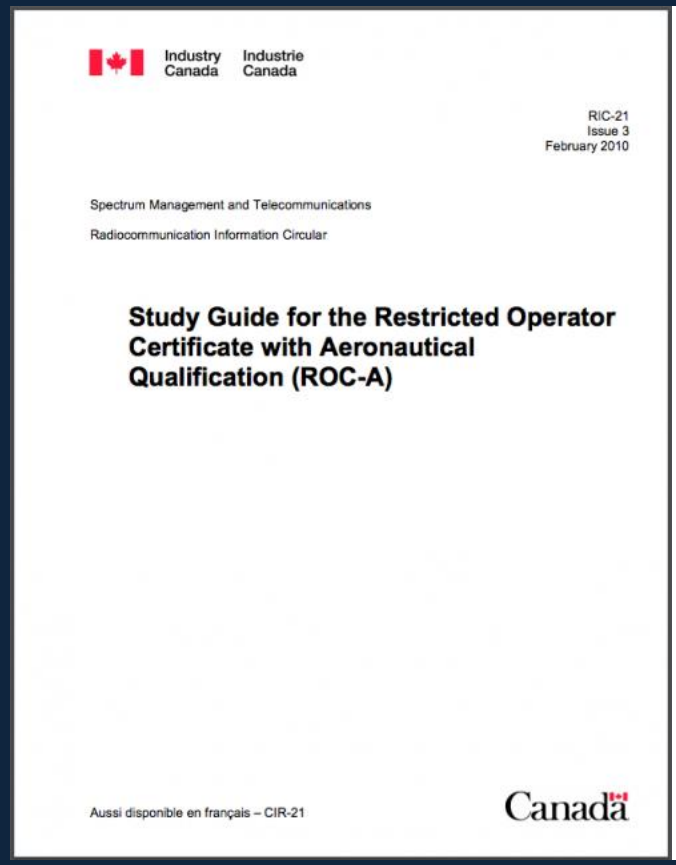
- Identification must be presented at the examination. A valid passport, driver's license, birth certificate, baptismal certificate, citizenship certificate or landed immigrant identification card will all be accepted as proof of identity, at the discretion of the examiner.

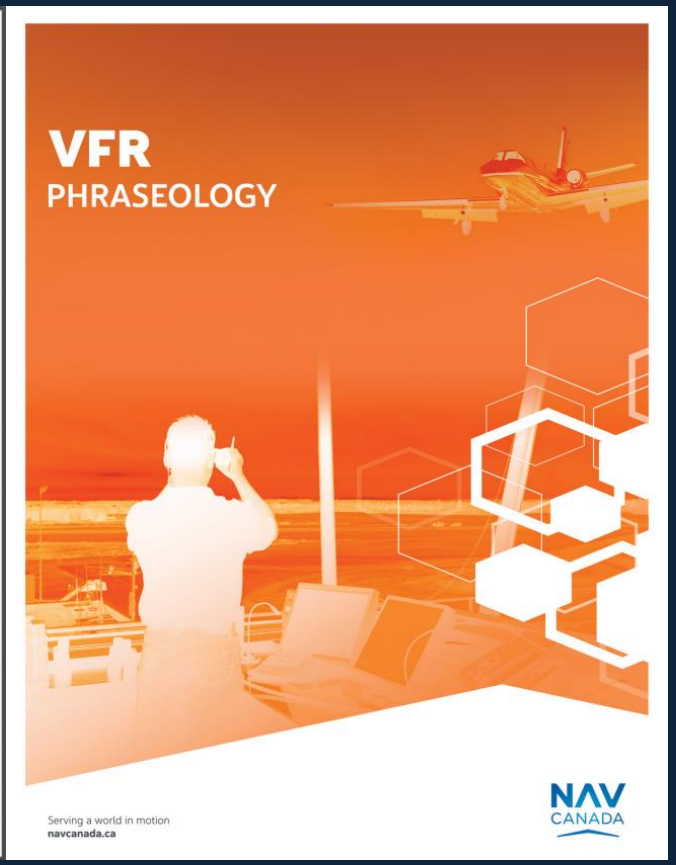
Restricted Operator Certificate With Aeronautical Qualification (ROC-A)

Examination

- Examinations for the ROC-A are to be conducted by examiners accredited by Industry Canada. These examiners are typically individuals who are engaged in the aeronautical industry.
- Please visit Industry Canada's website at www.ic.gc.ca/radio-operator to find an examiner near you.
- The examination may consist of written, practical and oral exercises. The candidate must satisfy an examiner that he or she:
  - is capable of operating radiotelephone equipment;
  - possesses a general knowledge of radiotelephone operating procedures and of international regulations applicable to the aeronautical service, specifically those regulations relating to the safety of life; and
  - possesses a general knowledge of the *Radiocommunication Act* and the regulations made thereunder.

Restricted Operator Certificate With Aeronautical Qualification (ROC-A)





Terminology

Phonetic Alphabet

Alphabet	Pronunciation	Alphabet	Pronunciation
A – Alfa	AL fah	N – November	No VEM ber
B – Bravo	BRAH VOH	O – Oscar	OSS cahr
C – Charlie	CHAR lee	P – Papa	Pah PAH
D – Delta	DELL tah	Q – Quebec	Keh BECK
E – Echo	ECK oh	R – Romeo	ROW me oh
F – Foxtrot	FOKS trot	S – Sierra	See AIR ah
G – Golf	GOLF	T – Tango	TANG go
H – Hotel	Hoh TELL	U – Uniform	YOU nee form
I – India	IN dee ah	V – Victor	VIK tah
J – Juliett	JEW lee ETT	W – Whiskey	WISS key
K – Kilo	KEY loh	X – X-Ray	ECKS Ray
L – Lima	LEE mah	Y – Yankee	YANG key
M – Mike	MIKE	Z – Zulu	ZOO loo

Terminology

Numbers

Term	Pronunciation	Term	Pronunciation
0	ZE RO	7	SEV en
1	WUN	8	AIT
2	TOO	9	NIN er
3	TREE	decimal	DAY SEE MAL
4	FOW er	hundred	HUN dred
5	FIFE	thousand	TOU SAND
6	SIX		

Altitude	Pronunciation	Time	Pronunciation
2 000	Two Thousand	1700Z	One Seven Zero Zero Zulu
2 500	Two Thousand Five Hundred	**Distance**	**Pronunciation**
11 000	One One Thousand	25 Nautical Miles	Two Five Miles
FL180	Flight Level One Eight Zero	25 Nautical Miles DME	Two Five D M E
Heading	**Pronunciation**	**Speed**	**Pronunciation**
005 Magnetic	Heading Zero Zero Five	110 Knots	Speed One One Zero Knots
180 True	Heading One Eight Zero True		

Decimals

Numbers with a decimal point, such as an altimeter setting or radio frequency may be spoken as:

29.95	TWO NINER DECIMAL NINER FIFE	or	TWO NINE NINE FIVE
127.7	ONE TWO SEVEN DECIMAL SEVEN	or	ONE TWO SEVEN SEVEN

Terminology

You may group numbers together if the number is an aircraft type number, flight number, wind speed, cloud height, vertical visibility or direction of traffic using the 12-hour clock system.

Example	Pronunciation
Airbus 320	Airbus Three Twenty
West Jet 620	West Jet Six Twenty
Wind 270/10	Wind Two Seven Zero at Ten
BKN035	Thirty Five Hundred Broken
Traffic 10 O'clock	Traffic Ten O'clock

Proper Radio Etiquette

- Listen on frequency before speaking to avoid making a call while another aircraft is also transmitting
- Think about and plan what you are going to say before beginning transmission
- After pressing the push-to-talk button, a slight pause before beginning to speak (and again when you are finished) ensures that your entire transmission will be heard and not cut off
- Use a normal, conversational tone and volume of speech
- Keep calls brief using concise, standard phraseology
- Remember that the information being relayed may need to be written down, speak slightly slower than during normal conversation, and transmit no more than three ideas (phrases, information, instructions) at once
- Only operational transmissions should be made (i.e. Avoid general conversation)

Examples of Routine Calls

Routine blind broadcast

- Let say for example you're taking photos of cottages in Muskoka
- You radio call could be something like this
  - Muskoka area Traffic, Drone registration number C12345678, approximately 5nm Northeast of Muskoka airport, 400ft, we'll be circling around this area for the next 20 minutes.

Routine call to ATC

- Initial contact – Aircraft: (ATS unit call sign) THIS IS (Aircraft call sign)
- ATC: (Aircraft call sign) (ATS unit call sign) Go Ahead / Stand By
  - Depends on how busy they are
- Once they give you the go ahead then you can state your intentions
  - Such as letting them know where and when you'll be flying, you should have already contacted them before hand but it is good to let them know again
- They should acknowledge it and/or state any restrictions applicable

Examples of Routine Calls

Mayday

To be used when the aircraft is threatened by serious and/or imminent danger and requires immediate assistance. Mayday signifies a distress situation.

Aircraft: MAYDAY MAYDAY MAYDAY (aircraft call sign) (situation/location/request/intentions) (number of persons on board) (fuel/endurance)

Mayday mayday mayday, Cessna 172 Foxtrot Oscar India Juliet, engine fire, landing in field two miles southwest of Gander, three persons on board, endurance two hours

Pan Pan

To be used when there is concern for the safety of an aircraft, vehicle or person on board or within sight, and does not require immediate assistance. Pan Pan signifies an urgency message.

Aircraft: PAN PAN PAN PAN PAN PAN (aircraft call sign) (situation/location/request/intentions) (number of persons on board) (fuel/endurance)

Pan pan, pan pan, pan pan, Helicopter Foxtrot Golf November Bravo, passenger aboard in medical distress, request land threshold one nine, two persons on board

Emergency Broadcasts

Who do I contact in case of an emergency?

Primary emergency contact: the nearest Aerodrome, Flight Service Station, or Tower

Example

Mayday mayday mayday, Drone registration number C12345678, Rogue RPAS lateral/vertical flyaway, 3 miles West of the field, Endurance 30 minutes

- In the event of a total loss of control, or otherwise dangerous operational situation, NAV Canada and Transport Canada expect RPAS users to use their best judgment to maintain flight safety.
- This includes communicating and taking immediate action to mitigate additional risks to the Air Navigation System, and other aviation system users.
- Follow-up communication and reporting to both NAV CANADA and Transport Canada is mandatory if you experience any instances of lateral fly away, vertical fly away, or total loss of control

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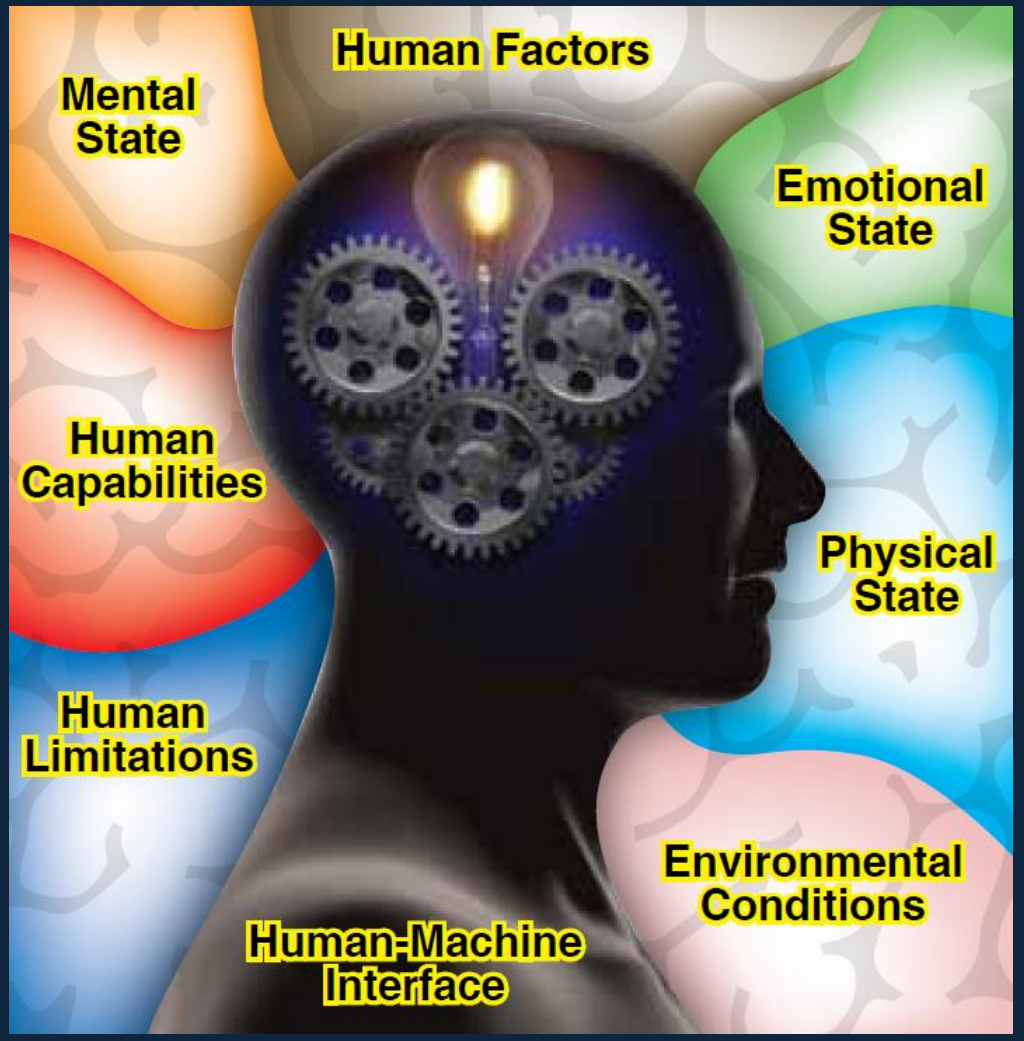
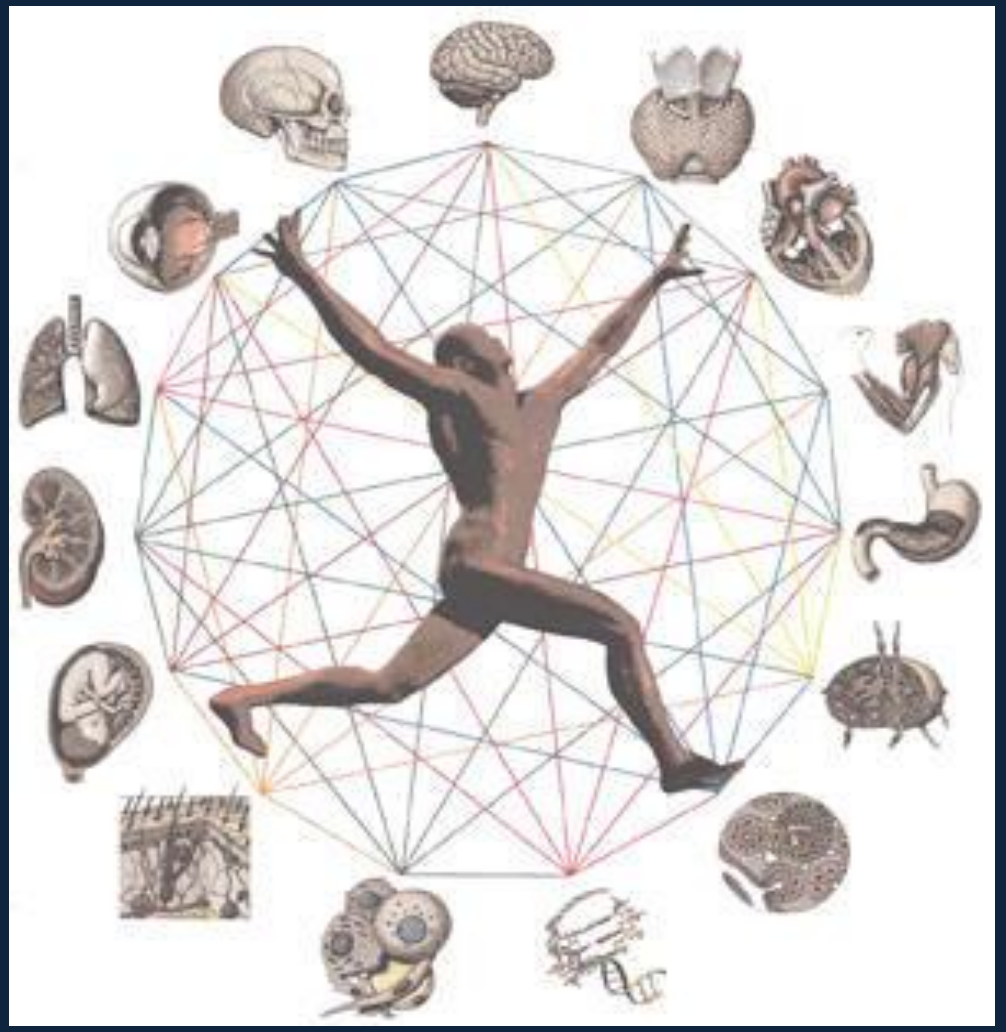
Human Factors



Aviation Physiology



Aviation Physiology

- Due to the nature of RPAS operations, visual scanning techniques are key to successful and safe operation in avoiding other aircraft and obstacles
- Tunnel Vision can affect RPAS operators – focusing on just the RPAS alone will not be sufficient for avoiding traffic and obstacles
- Effective scanning is accomplished by a series of short, regularly-spaced eye movements that bring successive areas of the sky into the central visual field.
- To be most effective, the gaze should be shifted and refocused at regular intervals

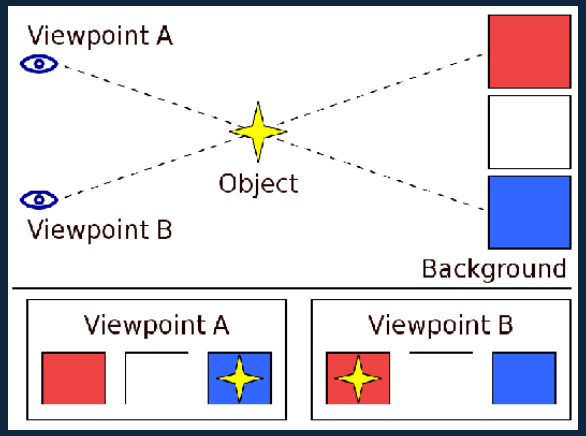
Visual Scanning

Visual Illusions

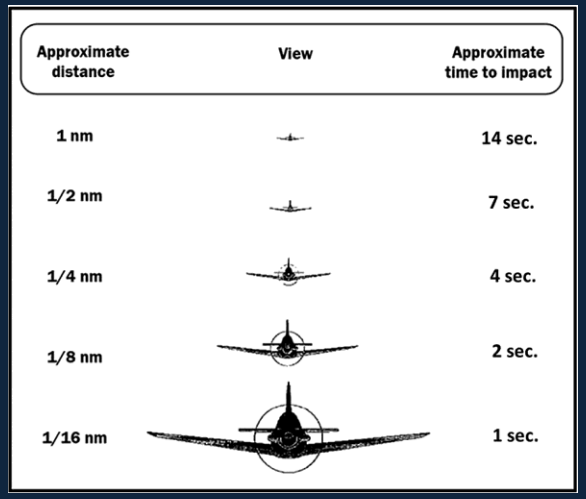
- **Autokinesis**
  - An illusion of the eye at night
  - When a pilot's eye stares at a light against a dark background with no other visual references around it, such as a star or the light from another aircraft, the pilot will get the impression that the light is moving.
- **White Out Illusion**
  - Occurs during the winter when there is snow covering the ground and white cloud cover makes the horizon seem like it disappeared
- **Black Out Illusion**
  - Similar to white out illusion but can occur any time of the year

Perspective Illusions

- **Parallax Illusions**
  - A displacement or difference in the apparent position of an object viewed along two different lines of sight
  - Nearby objects show a larger parallax than farther objects when observed from different positions

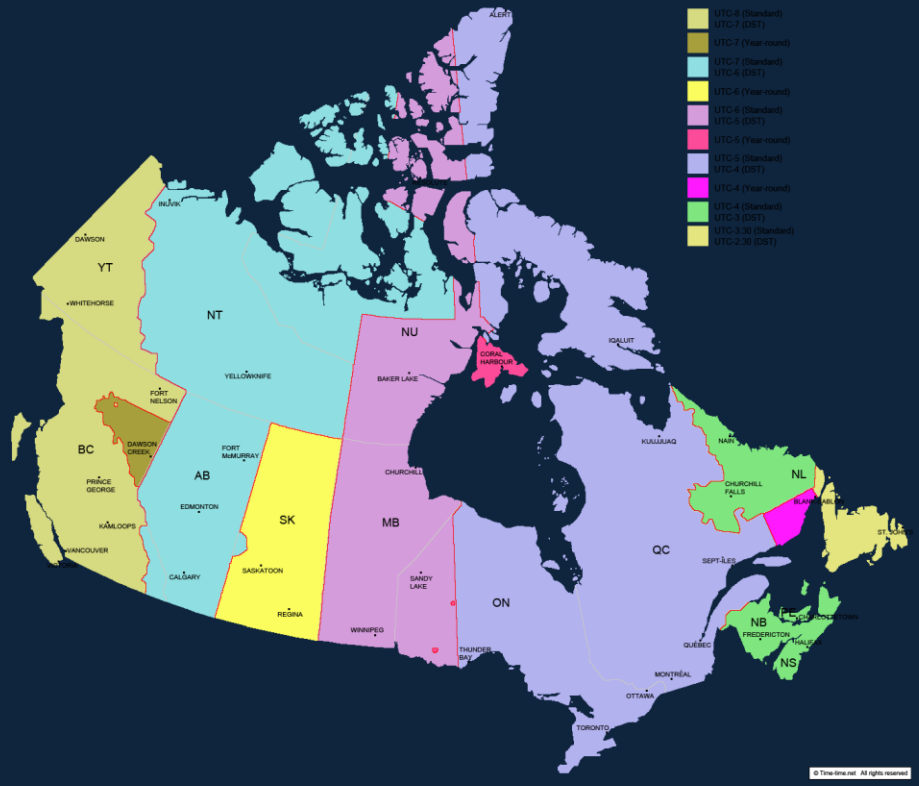


- **Collision Geometry**
  - If an aircraft looks like it is stationary in the sky but getting larger, it is coming towards you



Some Factors that Affect Alertness

- Jet lag and your circadian rhythm
  - Travelling East to West or West to East, which do you think is more tiring?



Some Factors that Affect Alertness

- Jet lag and your circadian rhythm
  - Travelling West to East is more tiring
  - Fatigue
  - Lack of sleep

What else?

Fatigue

- One of the most common physiological problem for operators and crew of a RPAS
- Fatigue can be caused by;

- Lack of Sleep
- Stress
- Temperature
- Monotony
- Pressures at work
- Poor Nutrition
- Prolonged working hours
- Humidity
- Heavy Workloads
- Family Issues

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Fatigue

- Acute fatigue can be treated by a proper sleep and proper meals
- Monitoring and addressing these two items can reduce the onset of fatigue
- A sound physical condition, healthy mental attitude, proper diet and adequate rest are an operator's best defence against fatigue
- Never operate a RPAS when being affected by fatigue, your ability to operate safely will be severely affected

IMSAFE Checklist

The IMSAFE Checklist

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

The Pilot and the Operating Environment

Temperature, Medication, Substance Abuse, Noise, Toxic Hazards

Medications – Prescribed and Over-the-Counter

- Some of the more notable medications that affect one's ability to fly are:
  - Tranquilizers and sedatives – for stress relief
  - Amphetamines – work against effects of sleepiness
  - Drugs for allergies, colds, and other ailments

- Main concern is whether the medications, or the illness itself, can affect flight safety
- Medication may have serious side-effects that can impair your ability to fly
  - Its important to let your physician/pharmacist know that you are a pilot and ask about any side-effects

- 602.03 No person shall act as a crew member of an aircraft while using any drug that impairs the person's faculties to the extent that the safety of the aircraft or of persons on board the aircraft is endangered in any way.
  - However it is usually recommended not to fly within 24 hours of taking medication
  - For general anesthetics – you will need permission from your doctor before going back to flying

ILLICIT DRUG USE IS INCOMPATIBLE WITH AVIATION SAFETY

Alcohol

- Taken in even small amounts, alcohol will reduce judgement, comprehension and attention skills, lessen sense of responsibility, slows reflexes, and reduces coordination
- A hangover is also a performance inhibiting state
  - Any operation of machinery with a hangover constitutes as a serious hazard
- “12 hours bottle to throttle”
- Overall, the effect to safe flight operations will be severe effected
- Never operate a RPAS when under the influence of alcohol and seek help if you’re unable to properly control its use

Other Medical Restrictions

How long do I need to wait before flying?

- Scuba Diving – 24 hours
- Anesthetics
  - Local Anesthetics – 24 hours for extensive procedures (ex. wisdom teeth removal)
  - General Anesthetics – until given permission by your doctor
- Blood Donations – 48 hours
- Immunizations
  - Feeling well and no adverse reactions – may resume flying immediately without restriction
  - Feeling unwell or experience an adverse reaction – 24 hours and be assessed by a health-care provider prior to flying
- Pregnancy
  - Can continue to fly up to 30 weeks into their pregnancy and may resume her flying privileges 6 weeks after delivery, , provided the pregnancy is normal and without complications

Aviation Psychology

Factors That Influence Decision-Making

- Time available
- Situational awareness
- Knowledge
- Workload
- Stress
- Margin for error
- Attitudes
- …anything else you can think of?

Sensory Isolation

- An operator of a RPAS is deprived of a range of sensory cues that are available to the pilot of a manned aircraft due to the separation between aircraft and operator

- Sensory cues that are lost therefore include ambient visual information, kinesthetic/vestibular input, and sound

Sensory Isolation and Situational Awareness

Situational Awareness

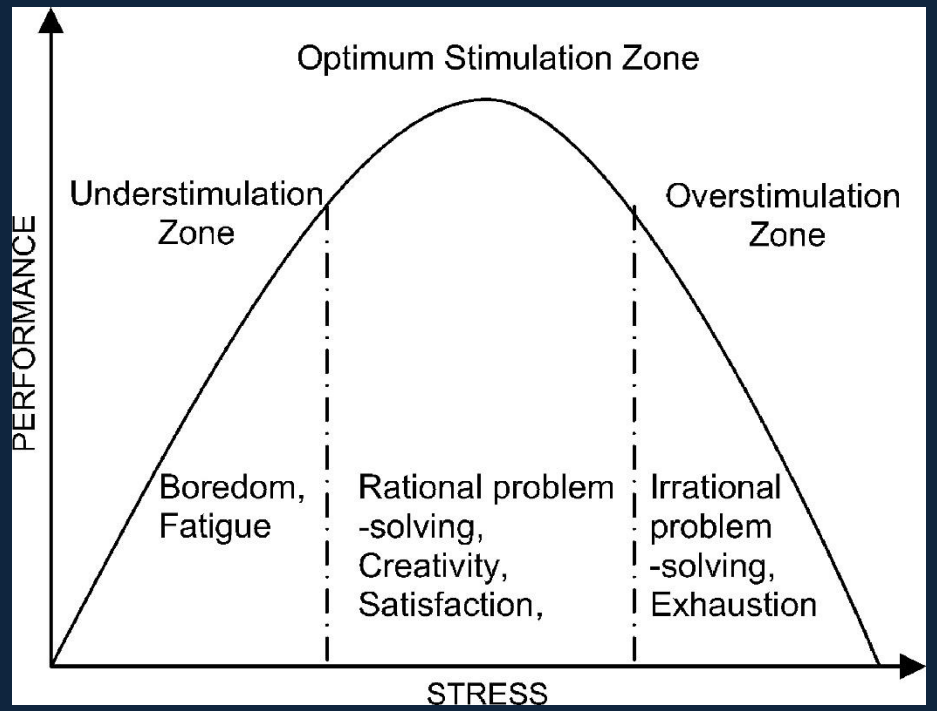
- Means appreciating all you need to know about what is going on when the full scope of your task - flying, controlling or maintaining an aircraft - is taken into account
- For a pilot, situational awareness means having a mental picture of:
  - the existing inter-relationship of location, flight conditions, configuration and energy state of your aircraft as well as any other factors that could be about to affect its safety such as proximate terrain, obstructions, airspace reservations and weather systems
- With sensory isolation, full situational awareness is difficult to achieve
  - How can a RPAS pilot smell the smoke from wiring in the RPAS?
  - How can an odd vibration be felt or heard by a remote RPAS pilot?

Situational Isolation

- One benefit of this isolation however is the lack of physical and psychological phenomena that are experienced by pilots and aircrew in a manned aircraft
- Motion sickness, gravitational forces (G-Forces) and sensory illusions are not required to be considered due to the fixed position of the pilot on the ground
- However, there are several other factors that must be considered that affect humans, regardless of being on the ground or in the air

Stress

- Defined as the state of dynamic tension created when you respond to perceived demands and pressures from outside and from within yourself
- We all know that too much stress is bad for you but some amounts of stress are beneficial as they improve our motivation, attention, and performance



Stress

- Four types of stress
  - Low stress
    - Normally not an issue but can cause dangerous complacency in extreme cases
  - Acute stress
    - Most common and of greatest concern to pilots
    - Results from pressures perceived to have just occurred, currently occurring, or thinking of what is about to happen
  - Chronic stress
    - Usually very bad type, going on long term, and often destroying people and families emotionally or physically by death
  - Traumatic stress
    - Accompanies traumatic events such as the death of a loved one, sexual assult, robbery, a financial crisis, or the loss of a home

Risk Management

What is the safest airline in the world?

Risk Management

Risk Management

- the identification, assessment and prioritization of risks followed by coordinated and economical application of resources to minimize, monitor and control the probability and/or impact of unfortunate events, or to maximize the realization of opportunities
- You cannot eliminate risk – however you can make educated decisions about how to minimize and therefore mitigate the risk

For example:

The RPAS you are operating is hacked and is controlled by a third party and is flown into an airline carrying 400 people

The likelihood of this scenario is remote, but the consequences would be catastrophic, therefore the risk is low

Likelihood	Negligible	Minor	Marginal	Critical	Catastrophic
Near Certain	Low	Medium	High	High	High
Highly Likely	Low	Medium	Medium	High	High
Likely	Low	Low	Medium	Medium	High
Unlikely	Low	Low	Low	Medium	Medium
Remote	Low	Low	Low	Low	Low

Consequence

Risk Management

- The RPAS you are operating has a hard landing due to high winds
- The likelihood of this scenario is highly likely, but the consequences would be negligible, therefore the risk is also low
- You are operating close to a control zone, with marginal weather and inadvertently enter controlled airspace
- The likelihood of this scenario is highly likely, and the consequences could also be significant (critical) – therefore we need to mitigate this risk. We could institute a policy dictating the need for higher weather limits when close to controlled airspace
- Prior to operations you should asses the situation for the risk level
- If the risk is deemed unacceptable, then you take action to reduce the risk
- This could include, but not limited to, cancelling the flight operation
- Never make concessions on flight safety

Likelihood	Negligible	Minor	Marginal	Critical	Catastrophic
Near Certain	Low	Medium	High	High	High
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Remote	Low	Low	Low	Low	Low

Consequence

Risk Management

- You could create different tools for risk assessment
- For example, a scorecard with an increase in the score as your risk increases
- Anything higher than 30 would result in a consultation of the operation with another pilot, and anything higher than 40 would result in cancellation of the flight until risks are reduced

Flight Risk Assessment	Score
First flight after maintenance	5
First flight after a hard landing	5
Less than 50% battery remaining	12
UAV Unlighted	3
First time physically on site	10
Unmapped obstacle on site	5
500 ft from urban area	10
1,000 ft from urban area	5
1,500 ft from urban area	3
Operating less than 1,000' from controlled airspace	10
Operating less than 1 nm from controlled airspace	5
Operating within a TCA	10
Night operation	7
Only one observer	12
4+ observers	3
Civilians within 500 ft of operation	12
Civilians within 1500 ft of operation	5
Less than 5 nm from aerodrome	5
Forecasted wind higher than 15kts	5
Forecasted gust higher than 20kts	7
Actual wind higher than 15 kts	7
Acutal wind gusts +20kts	10
Cloud lower than 3,000'	5
Visbility less than 5nm	5
Preciption forecasted	10
Operator has less than 500 hours total time	7
Operator has less than 20 hours in past 30 days	10

Interpersonal Relationships

INTERPERSONAL

- Relationship with Self & Others
- Conflict Management
- Positive Vibrations
- Self Awareness
- Collaboration
- Belonging
- Esteem
- Power
- Fun

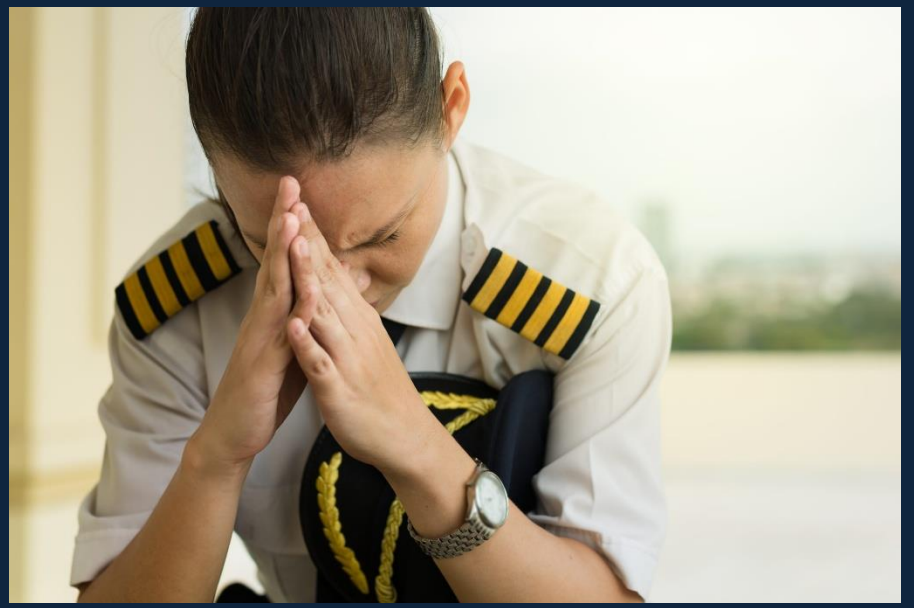
Interpersonal Relationships

Crew Resource Management (CRM)

- The effective use of all available resources for flight crew personnel to assure a safe and efficient operation, reducing error, avoiding stress and increasing efficiency.
- This means that the crew is less of a hierarchy and more of a team
- All crew members have important and valuable skills that need to be used, for the safe operation of the flight
- You should use all the resources available to you

Operating Pressures

- This can include
  - Family relationships
  - Peer groups
  - Employers
  - Customers
- Remember to:
  - Resolve differences peacefully
  - Promote open communication
- Safety should be more important than the hierarchy or a person's position in an organization



Interaction with Public

- Due to the unique nature of RPAS operators, interacting with the public during flight operations in almost inevitable
- The safety of flight operations is paramount
- Any attempt to disrupt safe operations of the aircraft needs to be addressed in prompt and serious manner
- If you believe that this poses a risk to safe operation, then you need to take steps to reduce the risk

Interaction with Other Airspace Users

- As users of the airspace it's your responsibility to comply with regulations, use common sense and good airmanship to continue to hold Canada's National Airspace system to the safe levels that are expected
- As operators of unmanned aircraft, you will also be held to a higher standard than manned aircraft operators
- As operators of RPAS you have the responsibility to ensure that you represent your group in the highest regard