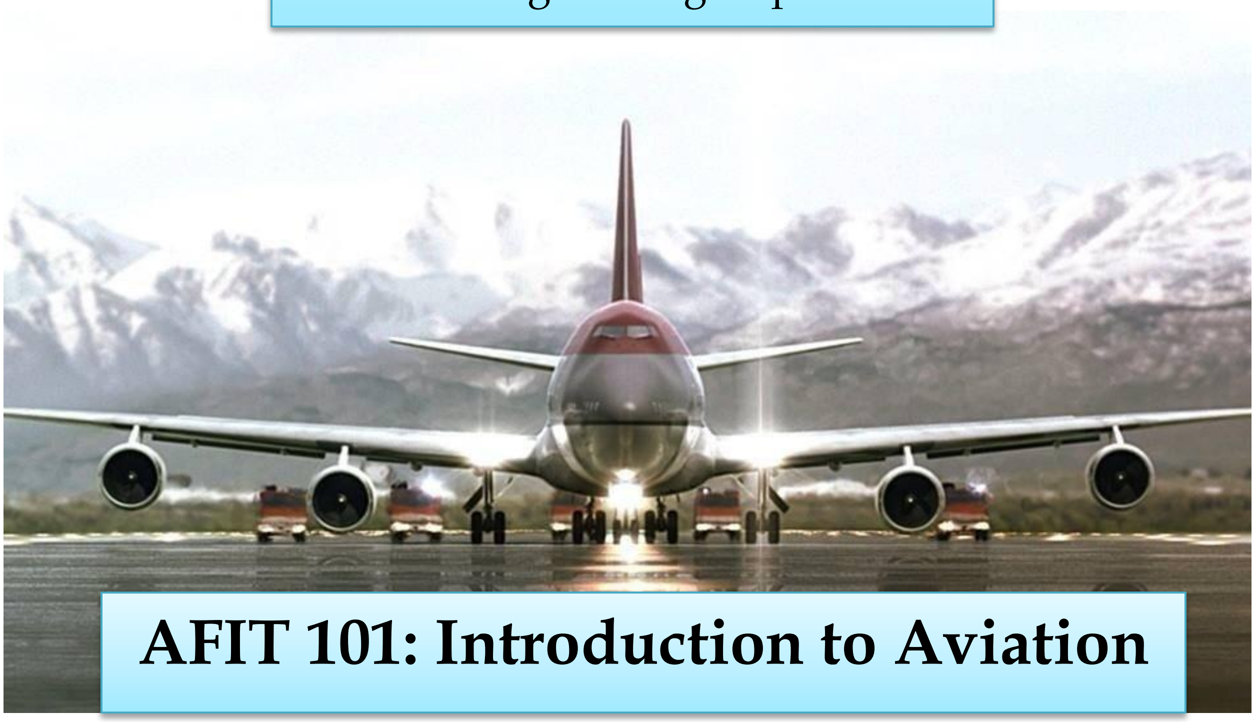
Air Force Institute of Technology

Faculty of Air Engineering

Aircraft Engineering Department



AFIT 101: Introduction to Aviation

COURSE HANDOUT

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BSc- Aeronautical Science

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MSc- Management Science and Engineering
BSc- Aeronautical Engineering(Aircraft Manufacturing)

1. History of Aviation

Aviation history deals with the development of mechanical flight. It ranges from earliest attempts at flying kite-powered devices or gliders to person-controlled and - powered flying. Humanity's desire to fly possibly first started millions of years prior to the first expression.

Humans were able to build bridges, high rising buildings, and travel through basic transportation means like sailing, but flying seemed unattainable at the time.

The earliest forms of flying were recorded in China around 200-300 AD. The Chinese created kite balloons and hot air balloons, which many sources say were used for military communication and surveillance. This went on to be the only means of flying for hundreds of years. Meanwhile, people kept on making efforts to create better and more maneuverable machines.

There are many people that are credited with making these efforts, and aviation history will never forget them. For the purpose of this course, we will learn about the most prominent contributors as well as some important contributors.

One of the most notable persons to make attempt after the Chinese is Bladud, the king of England who died while attempting to fly.

Leonardo D'Avinci also dream of flying found expression in several designs, but he did not attempt to demonstrate that flying was possible. It was in post-industrial Europe, from the late eighteenth century onwards, that serious flight attempts were made. It is believed that Leonardo da Vinci made many drawings of wings and flying machines in the late 1400s. He kept them hidden, and they weren't discovered until 400 years after his death.

After hundreds of years, the first manned hot air balloon flight was achieved by the Montgolfier brothers on November 21, 1783 in Paris, France. Manned balloons would remain the only means of flying for many years.

The attempt to develop more powerful aircraft kept on but was not successful until December 17, 1903 when the Wright Brothers (Orville and Wilbur Wright) made the first ever powered, sustained and controlled flight that is heavier than air. That is often referred to as the birth of aviation because it was on that day that modern aviation really began.

Since then, there has been significant advancement in aviation in terms of aviation regulations, automation and autopilots, fly-by-wire, sophisticated weather detection equipment, sophisticated airport facilities, fuel saving aircraft, etc.

a. Important Aviation Timelines

852 BCE – A king tries to fly: The English King Bladud is apparently killed attempting to fly.

1485–1500 – da Vinci designs planes: Leonardo da Vinci designs flying machines.

Leonardo da Vinci made many drawings of wings and flying machines in the late 1400s. He kept them hidden, and they weren't discovered until 400 years after his death.

b. Montgolfier Brothers, Wright Brothers

1783 – First hot air balloon flight: The first manned hot air balloon flight was on 21 November 21 1783, in Paris, France in a balloon created by the Montgolfier brothers.

1903 – First Powered Flight: Orville and Wilbur Wright make the first recorded powered, sustained and controlled flight in a heavier-than-air flying machine.

1927 – First trans-Atlantic flight: Charles Lindbergh completes the first solo non-stop trans-Atlantic flight.

1930 – Jet engine invented: British inventor Frank Whittle invents the jet engine.

1932 – First woman flies across Atlantic: Amelia Earhart is the first woman to fly a solo non-stop trans-Atlantic flight.

1986 – First non-stop flight around world: Dick Rutan and Jeana Yeager fly the US ultralight Voyager around the world in a 9-day non-stop flight from California to California.

2011 – World's first flying car: The Transition by Terrafugia is a roadable aircraft – an aeroplane that can take off and land at any airport and, with the push of a button, fold up its wings and drive down the road.

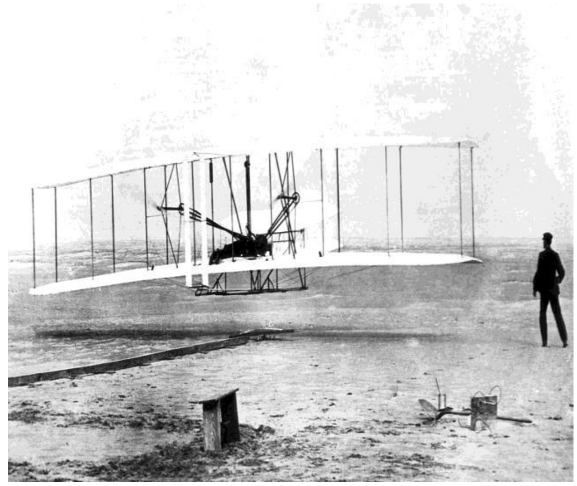
c. Lighter than Air, Heavier than Air, World Wars, Post War Eras, Digital Age, 21st Century

Lighter than air aviation**:** They are called lighter than air because they are filled with gas whose weight is lighter than air (heated air, hydrogen, or helium) in order to create lift. For instance, hot air balloon derives lift mainly from heat. Hot air balloons utilize the ability of hot air to rise. By heating the air inside the balloon with the burner, it becomes lighter than the cooler air on the outside. This causes the balloon to float upwards, as if it were in water.

Example of lighter than air is airship, free balloon, and kite balloon.

Today, lighter-than-air aircraft are used almost only for recreational purposes.

Heavier than air aviation**:** Heavier than air aircraft must have a power source to provide the thrust necessary to obtain lift. This covers all aircraft that derive lift mainly from aerodynamic forces. An example of heavier than air is the airplanes that we fly today. This is divided into engine driven and non-engine driven.



World Wars: The history of aviation changed rapidly from this point as aviation became a deciding factor in the war. Production and development of aircraft became a priority. In fact, prior to the outbreak of the war, there were approximately 193,000 personnel working in the aviation industry; after the war began, there was an increase to 450,000 employees in the industry. World War II was the catalyst for a major change in the history of aviation, as battles during the war were fought predominantly in the air and less on the ground. The development of jet engines also led to increased commercial use of aircraft, especially with the surplus of ex-military aircraft when the war ended.

Post War Eras**:** After the war, commercial flights became increasingly popular, and many airline companies simply converted ex-military aircraft to transport both people and cargo.

Digital Age: The use of digital computers in aircraft design was developed by large aerospace companies throughout the 1970s and included technique such as CAD, CAM, structural component stress analysis using FEA and for aerodynamic modelling.

21st Century: 21st century aviation has seen increasing interest in fuel savings and fuel diversification, as well as low cost airlines and facilities. Additionally, much of the developing world that did not have good access to air transport has been steadily adding aircraft and facilities.

In the beginning of the 21st century, digital technology allowed subsonic military aviation to begin eliminating the pilot in favor of remotely operated or completely autonomous unmanned aerial vehicles (UAVs).

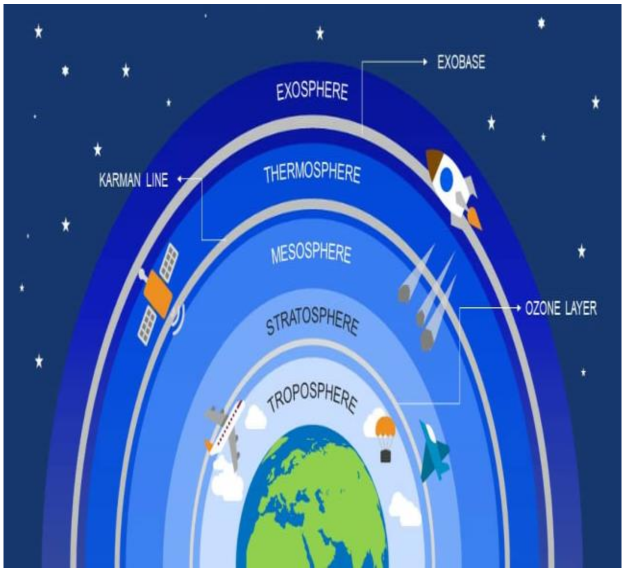
UAVs are now an established feature of modern warfare, carrying out pinpoint attacks under the control of a remote operator.

2. The Atmosphere

The atmosphere is an envelope of air that surrounds the Earth. It is as much a part of the Earth as the seas or the land, but air differs from land and water as it is a mixture of gases. It has mass, weight, and indefinite shape.

The atmosphere is composed of 78 percent nitrogen, 21percent oxygen, and 1 percent other gases, such as argon or helium. Some of these elements are heavier than others. The heavier elements, such as oxygen, settle to the surface of the Earth, while the lighter elements are lifted up to the region of higher altitude. Most of the atmosphere's oxygen is contained below 35,000 feet altitude.

a. Layers of the Atmosphere



Five Layers of the Atmosphere

Troposphere

This is the lowest part of the atmosphere - the part we live in. It extends from the surface to about 10km upwards. It contains most of our weather - clouds, rain, and snow. Most clouds exist here because 99% of the atmosphere's water is found here. In this part of the atmosphere the temperature gets colder as the distance above the earth increases.

Stratosphere

Above the troposphere lies the stratosphere where jet airplanes fly. Temperatures increase with altitude because of increasing amounts of ozone. The ozone layer within the stratosphere absorbs harmful ultraviolet rays of sunlight and protects us from the likes of skin cancer and other health conditions.

Mesosphere

As the mesosphere extends upward above the stratosphere, temperatures decrease. The coldest parts of our atmosphere are located in this layer and can reach –90°C.

Thermosphere

The thermosphere is a region in which temperatures again increase with height. This temperature increase is caused by the absorption of energetic ultraviolet and X-Ray radiation from the

Astronauts orbiting Earth in the space station or space shuttle spend their time in this layer

Exosphere

The upper layer of our atmosphere, where atoms and molecules escape into space, is called the exosphere.

b. Properties of the Atmosphere

Pressure: Force per unit area (N/m^2)

It is the force exerted over a given area or object. Pressure is measured in Pascal, Pound Force per Square Inch (PSI), Bars (or millibars), Inches of Mercury, etc.

An important consideration is that atmospheric pressure varies with altitude. The higher an object rises above sea level, the lower the pressure.

Temperature: The degree of hotness or coldness of a body measured on a definite scale. (Kelvin (K), °C, °F).

As altitude increases, temperature decreases in the troposphere.

Density: Density is a term that means weight per unit volume (kg/m3). The density of gases is governed by the following rules:

(1) Density varies in direct proportion with the pressure.

(2) Density varies inversely with the temperature.

Therefore, air at high altitudes is less dense than air at low altitudes, and a mass of hot air is less dense than a mass of cool air. Changes in density affect the aerodynamic performance of aircraft. With the same horsepower, an aircraft can fly faster at a high altitude where the density is low than at a low altitude where the density is great. This is because air offers less resistance to the aircraft when it contains a smaller number of air particles per unit volume.

Humidity: Humidity is the amount of water vapor in the air (in Percentage). The maximum amount of water vapor that air can hold varies with the temperature. The higher the temperature of the air, the more water vapor it can absorb.

c. International Standard Atmosphere (ISA) Assumptions

ISA is a hypothetical model that represents an ideal atmosphere as defined by the International Civil Aviation Organization (ICAO), devoid of water vapor, wind, and turbulence.

The ISA is based the following values of pressure, density, and temperature at mean sea level each of which decreases with increase in height:

Standard Pressure of 1013.2 mb:

Pressure is taken to fall at about 34 mb/1000ft in the lower atmosphere.

Standard Temperature of +15 °C:

Temperature falls at a rate of 2 °C per 1,000 feet until after the troposphere.

Density = 1.225 kg/m^3.

Sample Calculations

i. The surface/sea level temperature and pressure in AFIT Kaduna are 15°C and 1013.25 respectively on a standard day. What would be the temperature and pressure at 1000, 2000, 3000 and 3500ft. on this day?

SOLUTION

Temperature lapse rate: 2 °C per 1,000 feet

Pressure lapse rate: 34 mbar per 1,000 feet

At 1000 feet: Temperature = 15°C - 2°C = **13°C**

Pressure = 1013.25mbar – 34mbar = **979.25mbar**

At 2000 feet: Temperature = 15°C – (2 x 2°C) = **11°C**

Pressure = 1013.25mbar – (34 x 2) = **945.25mbar**

At 3000 feet: Temperature = 15°C – (2 x 3°C) = **9°C**

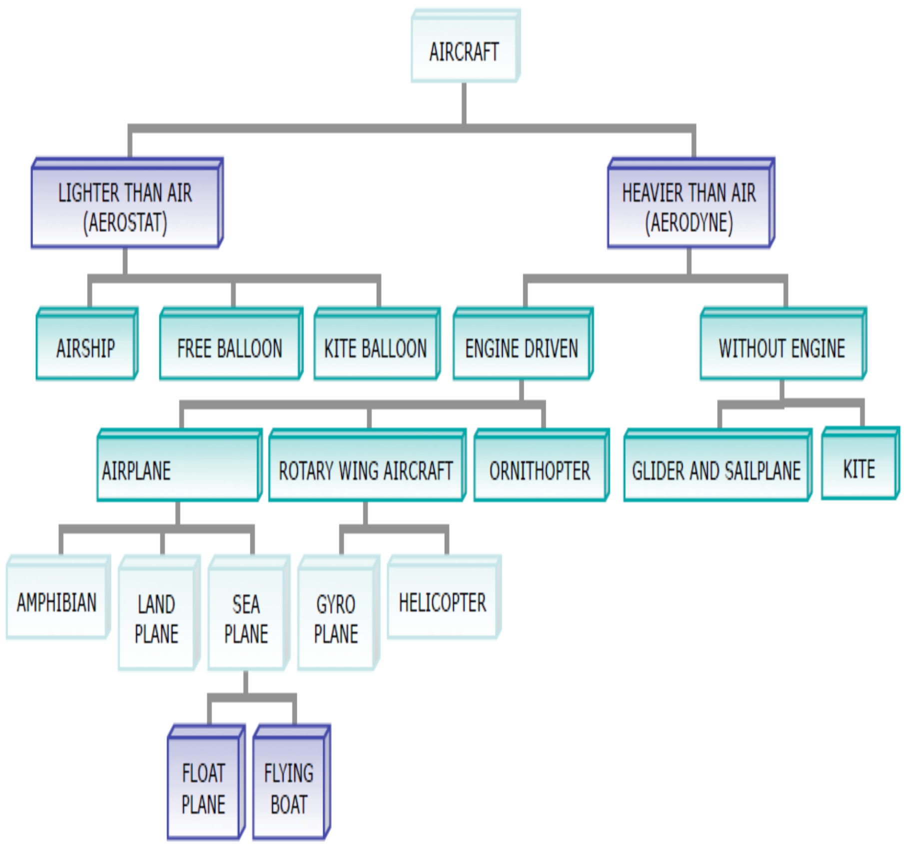
Pressure = 1013.25mbar – (34 x 3) = **911.25mbar**

At 3500 feet: Temperature = 15°C - (2 x 3.5°C)= **8°C** ,Pressure = 1013.25mbar - (34 x 3.5)=**894.25mbar**

3. Aircraft Types, Categorization and the Aviation Industry

a. Types of Aircraft

What is an aircraft? An aircraft is any machine capable of atmospheric flight. An Airplane any of a class of fixed-wing aircraft that is heavier than air, propelled by a screw propeller or a jet engine.



Types of Aircraft

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Hot Air Balloon

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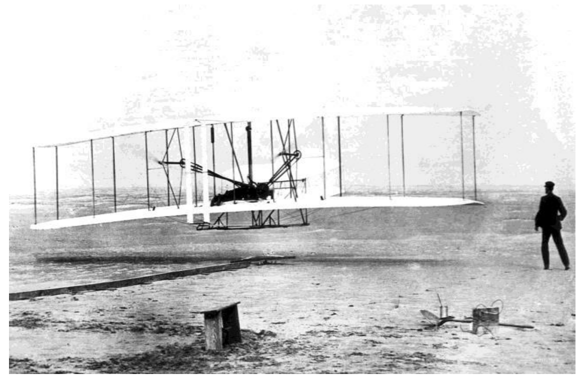


First powered, controlled flight

b. Classifications of aircraft

Apart from Aircraft types, aircraft are often categorized based on classification

Classification Based On Mach Number

What is a Mach number? Mach number is the ratio of speed of a body to the speed of sounds.

Aircraft are classified based on their maximum Mach number.

Subsonic ($M<1$) speeds are less than the speed of sound. Transonic ($M\sim1$) speeds are approximately the speed of sound. Supersonic ($M>1$) speeds are greater than the speed of sound. Hypersonic ($M>>5$) are much greater than speed of sound, usually up to five times greater.

Classification Based On Purpose

Aircraft are mainly classified based on their purpose as follows:

i. Passenger Transport

ii. Business jets

iii. Cargo Transport

iv. Military Aircraft

v. Trainers

Classification Based On Range

Aircraft are classified based on their range as follows:
Short range (<500 km)
Medium range (<3000km)
Long range (>3000 km)

c. Types of Air Operations

Scheduled and non-schedule air operation:

Scheduled Air Transportation is the regular transportation of persons, property, or cargo by an airline company. The airline company schedules regular flights in and out of an airport, which is usually a high commercial airport. Scheduled Air Transportation is accomplished by the scheduling of flights at regular times and days of the year on a consistent basis.

A Non-scheduled (charter) airline is a company that offers unscheduled air transport services of passengers or goods at an hourly or per mile / kilometer charge for chartering the entire aircraft along with crew. A non-scheduled airline may hold domestic or international licenses or both and operates under the regulations prescribed by its respective Civil Aviation Authority.

d. Organization of Airports

There are two types of airports—towered and non-towered.

These types can be further subdivided to:

Civil Airports—airports that are open to the general public.

Military/Federal Government airports—airports operated by the military, National Aeronautics and Space Administration (NASA), or other agencies of the Federal Government.

Private airports—airports designated for private or restricted use only, not open to the general public.

Towered Airport

A towered airport has an operating control tower. Air traffic control (ATC) is responsible for providing the safe, orderly, and expeditious flow of air traffic at airports where the type of operations and/or volume of traffic requires such a service. Pilots operating from a towered airport are required to maintain two-way radio communication with air traffic controllers, and to acknowledge and comply with their instructions. Pilots must advise ATC if they cannot comply with the instructions issued and request amended instructions. A pilot may deviate from an air traffic instruction in an emergency, but must advise ATC of the deviation as soon as possible.

Non-towered Airport

A non-towered airport does not have an operating control tower. Two-way radio communications are not required, although it is a good operating practice for pilots to transmit their intentions on the specified frequency for the benefit of other traffic in the area. The key to communicating at an airport without an operating control tower is selection of the correct common frequency. The acronym CTAF, which stands for Common Traffic Advisory Frequency, is synonymous with this program. A CTAF is a frequency designated for the purpose of carrying out airport advisory practices while operating to or from an airport without an operating control tower.

4. Basic Aerodynamics

a. Forces acting on an aircraft in flight

Simply put, Aerodynamics is the way objects move through air. Therefore, aerodynamics of flight is the way airplane moves through air.

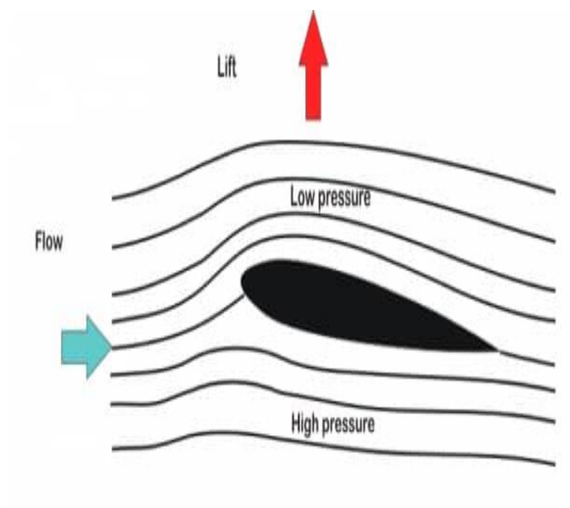
Other definition: Is the study of the motion of air and its interaction with solid objects, such as an airplane.

What makes an airplane fly?

The four forces of flight are Lift, Weight, Thrust, and Drag and they explain how an aircraft is able to fly. These forces make the aircraft to move up and down, and faster or slower.

Lift: Lift is the force that lets an object move up. It is the force that is the opposite of weight. Everything that flies must have lift. For an aircraft to move upward, it must have more lift than weight. But how is lift created?

b. How does an aircraft generate lift?



Lift Generation

Bernoulli's principle: Bernoulli's principle states that as the speed of a moving fluid (liquid or gas) increases, the pressure within the fluid decreases.
Bernoulli's principle helps explain that an aircraft can achieve lift because of the shape of its wings. They are shaped so that that air flows faster over the top of the wing and slower underneath. Fast moving air equals low air pressure while slow moving air equals high air pressure. The high air pressure underneath the wings will therefore push the aircraft up through the lower air pressure.

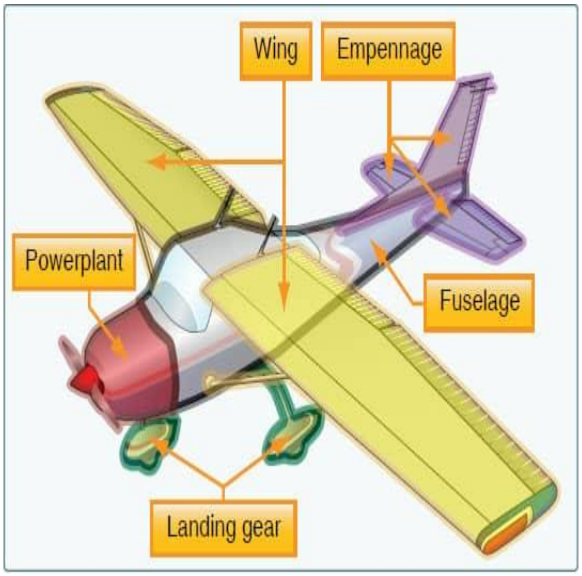
Weight: Weight is the force of gravity. It acts in a downward direction toward the center of the Earth. Weight is also the downward force that an aircraft must overcome to fly.

Thrust: Thrust is the force that is the opposite of drag. It is the push that moves something forward. For an aircraft to keep moving forward, it must have more thrust than drag. A small airplane might get its thrust from a propeller. A larger airplane might get its thrust from jet engines.

Drag: Drag is the force that acts opposite to the direction of motion. Drag is caused by friction and differences in air pressure.

When an airplane is flying straight and level at a constant speed, the lift it produces balances its weight, and the thrust it produces balances its drag. However, this balance of forces changes as the airplane rises and descends, as it speeds up and slows down, and as it turns. In such state the aircraft will be travelling at a steady height, at a uniform velocity, and fixed heading

5. Aircraft Basic Structural Parts and Construction



Basic Structural Parts

a. Wing

The wings of an aircraft are surfaces which are designed to produce lift when moved rapidly through the air. The particular design for any given aircraft depends on a number of factors, such as size, weight, use of the aircraft, desired speed in flight and at landing, and desired rate of climb.

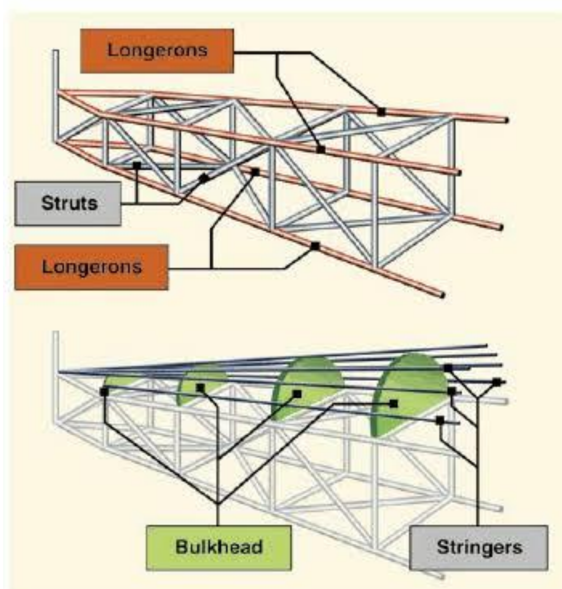
The main structural parts of a wing are the spars, the ribs or bulkheads, and the stringers.

b. Fuselage

The fuselage is the main structure or body of the aircraft. It provides space for cargo, controls, accessories, passengers, and other equipment. In single engine aircraft, it also houses the power-plant. In multi-engine aircraft the engine may either be in the fuselage, attached to the fuselage, or suspended from the wing structure. They vary principally in size and arrangement of the different compartments. There are two general types of fuselage construction, the truss type, and the monocoque type.

i. Truss Type

The truss type fuselage frame (figure 1-4) is usually constructed of steel tubing welded together in such a manner that all members of the truss can carry both tension and compression loads.



ii. Monocoque Type

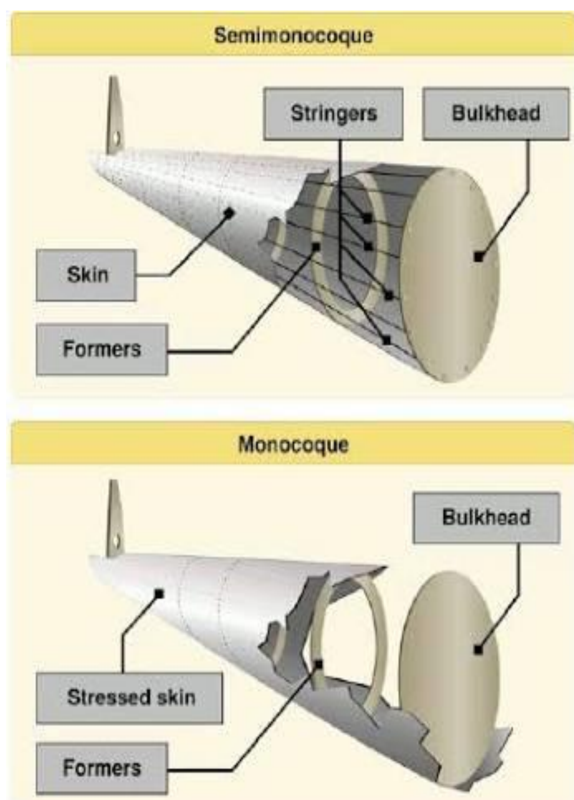
The monocoque (single shell) fuselage relies largely on the strength of the skin or covering to carry the primary stresses. The design may be divided into three classes: (1) True Monocoque, (2) semi monocoque, or (3) reinforced shell.
True Monocoque: The true monocoque construction uses formers, frame assemblies, and bulkheads to give shape to the fuselage, but the skin carries the primary stresses.

Semi Monocoque: The semimonocoque fuselage is constructed primarily of the alloys of aluminum and magnesium, although steel and titanium are found in areas of high temperatures. Primary bending loads are taken by the LONGERONS, which usually extend across several points of support. The longerons are supplemented by other longitudinal members, called STRINGERS. Stringers are more numerous and lighter in weight than longerons.

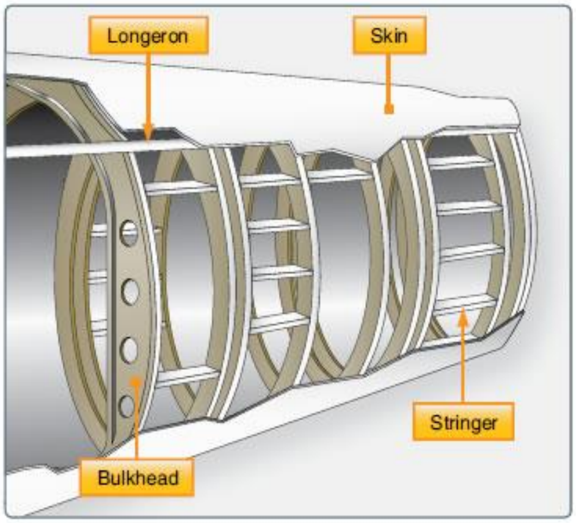
The vertical structural members are referred to as BULKHEADS, FRAMES AND FORMERS. The heaviest of these vertical members are located at intervals to carry concentrated loads and at points where fittings are used to attach other units, such as the wings, powerplants, and stabilizers.

Most aircraft are considered to be of semimonocoque type construction.
The reinforced shell: The reinforced shell has the skin reinforced by a complete framework of structural members.
A longeron is a load-bearing component of a framework.

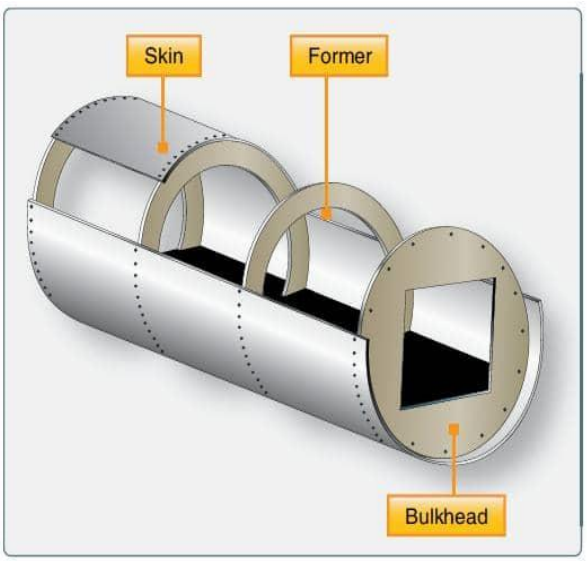
Stringers are attached to formers (also called frames) and run in the longitudinal direction of the aircraft. They are primarily responsible for transferring the aerodynamic loads acting on the skin onto the frames and formers.



Semi-Monocoque and Monocoque Construction



Semi-Monocoque Construction



Monocoque Construction

c. Empennage

The empennage is also called the tail section and most aircraft designs consist of a tail cone, fixed surfaces, and movable surfaces. The cone is made up of structural members like those of the fuselage; however, cones- are usually of lighter construction since they receive less stress than the fuselage.

d. Landing Gear

The landing gear is the assembly that supports the aircraft during landing or whiles it is resting or moving about on the ground. The landing gear has shock struts to absorb the shock of landing and taxiing. By means of a gear-retraction mechanism, the landing gear attaches to the aircraft structure and enables the gear to extend and retract. The landing gear arrangement either has a tailwheel or a nose wheel. Brakes installed in the wheels enable the aircraft to be slowed or stopped during movement on the ground.

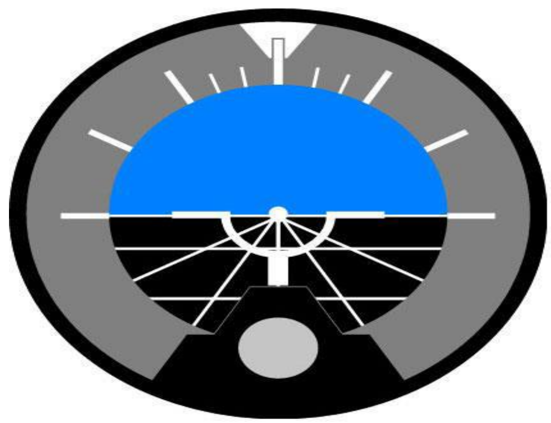
6. Basic Aircraft Flying Instruments

Airspeed Indicator

The Airspeed Indicator, or ASI, displays the aircraft's indicated air speed, or how fast it is travelling through the air. The ASI in most aircraft displays the speed in Knots, but yours may be different and show Miles per Hour.

You will see that the instrument has a number of different colors in a band around the speed numbers. These are important and tell you important information about safety of the aircraft. The green band indicates normal safe operating speeds for flight. The start of this band is known as Vs1, or the stalling speed with flaps up. The white band indicates a safe speed to deploy wing flaps. Never do this when your speed is greater than the white band as it may damage your flaps. The start of this band is known as Vs0, or the stalling speed with flaps and landing gear deployed. The yellow band indicates that you are travelling faster than the aircraft is designed for. This is known as the caution range, and ends with a red bar. Anything beyond this red bar is beyond the aircraft's maximum safe speed and should be avoided.

Attitude Indicator (Artificial Horizon)



The Artificial Horizon, or Attitude Indicator, is a useful cockpit instrument if you ever find yourself in conditions that preclude you from full visual flying, such as when caught in cloud or when doing instrument flying in obscured visibility. It gives you an instant, truthful indication as to whether your aircraft is turning, climbing or descending, and should be trusted over all other senses if you are disorientated or lost. The instrument shows a basic view of your aircraft and wings, and the horizon. If the aircraft is turning, the wings will tilt in relation to the horizon. If the aircraft is descending, the aircraft will move below the horizon, and if climbing it will be above the horizon. The markings around the edge of the attitude indicator show the angle of bank as an additional reference when turning the aircraft in non-visual conditions.

Altimeter

One of the simplest instruments to understand, the Altimeter displays your aircraft's current altitude. The large hand indicates hundreds of feet, whilst the small hand indicates thousands of feet. Also on this instrument is your pressure setting, which should be adjusted as directed by air traffic control to the current QNH or QFE in the area you are operating. If you alter this, you will notice your altitude change in line with that pressure setting, and it is of vital importance to do this in order to maintain safe separation from other aircraft.

Vertical Speed Indicator

A Vertical Speed Indicator (VSI), also known as a Rate of Climb and Descent Indicator (RCDI) is an instrument which indicates the rate of climb or descent of an aircraft.

Turn Coordinator

The turn coordinator, as the name suggests, shows the level of bank of your wings by tilting the small plane left or right. What appears like straight and level flight to your eyes may actually be a turn when you reference this instrument, even in good visibility. The markings on the edge of the indicator show the rate of turn, with the first mark indicating straight-and-level, and the second mark Rate 1. You can use this to time a turn if you want to make a new heading (useful if you need to make a 180 degree U-turn) – simply bank the aircraft until the wings on the turn coordinator line up with the Rate 1 mark. Then time the number of seconds you have been turning. It takes 30 seconds to turn 90 degrees, 1 minute to turn 180 degrees, or 2 minutes to do a full 360 degree turn.

Heading Indicator or Directional Gyro (Gyroscope)

The heading indicator shows the entire compass range in one view, spinning as you turn to show your current heading. It doesn't suffer from external forces like the magnetic compass, and does not speed up or slow down as it turns. It clearly marks headings in 30 degree intervals, with N, S, E and W also marked.

You will notice a small knob underneath this instrument. The Direction Indicator is prone to getting out of sync quite easily, as it is influenced by forces of movement and vibration. Therefore you must correctly align this instrument regularly by referencing the magnetic compass. Do this before taking off, and regularly during flight when the wings are level and your speed is steady.

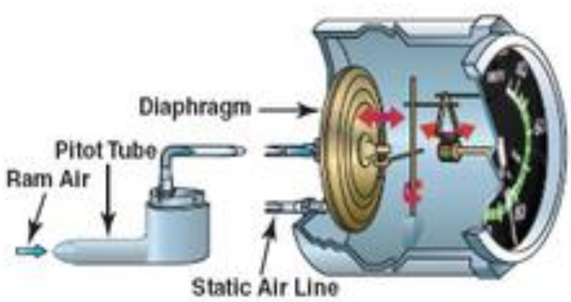
Principle of Air Speed Indicator

The airspeed indicator works by comparing dynamic pressure (ram air pressure) and static pressure.

The airspeed indicator is part of the pitot-static system, a differential pressure system that measures both dynamic air pressure from the pitot tube and static pressure from a static port. Inside the casing of the instrument is a sealed diaphragm that receives both static and dynamic pressure from the pitot tube.

Static pressure is also measured from inside the casing but outside of the diaphragm. The static pressures from both inside and outside of the diaphragm cancel each other out, leaving a measurement of total dynamic pressure, or ram air pressure.

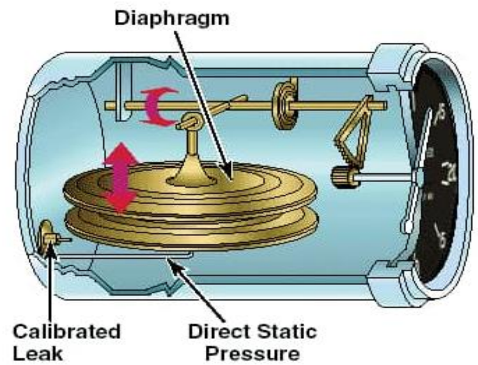
As the airplane accelerates, the dynamic pressure from the pitot tube increases, causing the diaphragm to expand. Through mechanical linkage, this measurement of increased airspeed is shown in the airspeed indicator needle.



ASI Principle

Principle of the Altimeter

Altimeters are aneroid barometers calibrated to indicate altitude instead of pressure. It is based on the principle of decrease of atmospheric pressure with gain in altitude. The sealed diaphragms inside the casing expand and contract with increase and decrease in altitude respectively. This expansion is magnified with the help of gears and levers to move the indicator over the dial.



Altimeter Principle

7. The Aviation Industry

The aviation industry is a service industry providing transport services.

a. Major Actors in the Air Transport Industry and their Relationship

Airlines and airports are the two main actors in the industry. Airlines offer the actual transport service; airports provide the ground infrastructure to handle aircraft movements.

The airlines and airports are enclosed by the manufacturing and supplying industry. The manufacturing industry and aviation suppliers assemble aircrafts and provide spare products.

b. Relevance of the Aviation Industry

i. Contributing to global economic prosperity

Aviation provides the only rapid worldwide transportation network, which makes it essential for global business.

It generates economic growth, creates jobs, and facilitates international trade and tourism.

c. Stakeholders of the Industry

In the aviation industry, three main groups of actors can be distinguished: the aircraft manufacturing industry, airlines and airports. These stakeholders are briefly introduced below:

i. The aircraft manufacturing industry: The aircraft manufacturing industry is characterized by two dominant manufacturers: Boeing and Airbus. These two companies represent the only manufacturers on the market, particularly regarding wide-body aircraft. Profit margins of aircraft manufacturers are commonly higher than those of airlines and airports. The manufacturing industry is characterized by extremely high capital requirements and a high research and a high research and development (R&D) intensity.

ii. In the aviation industry, airlines represent the most visible group of actors. Even though every airline offers the same core service (the transport of passengers or cargo from one destination to another), by no means the group of airlines is a homogeneous one. Between airlines, fundamental differences exist in regard to the underlying business model, i.e. the service level offered, the regional reach, and the main function.

iii. Airlines are complemented by airports, which are providers of ground infrastructure (e.g. runways and terminals). Airports have an extremely high specificity of their infrastructure investment. A large number of national and international airports still are under public ownership; noteworthy privatization trends have only recently been observed.

d. An Approved Maintenance Organization

Approved Maintenance Organization (AMO)—An organization approved to perform specific aircraft maintenance activities by the Authority. These activities may include the inspection, overhaul, maintenance, repair and/or alteration and release to service of aircraft or aeronautical products.

Five Major Functions:

i. Technical Services: Engineering, planning, training, technical publications, and computing. Short interval checks and minor modifications.

ii. Aircraft Maintenance: Flight line, hangar, and maintenance control

a. Flight line Maintenance: Turnaround maintenance and servicing, daily checks,

b. Hangar Maintenance: Repairs, modifications, engine changes, painting, and corrosion control.

c. Maintenance Control Center: Tracks all flights in and out, as well as maintenance need.

iii. Overhaul Shops: Off-aircraft maintenance, repair, and overhaul

a. Engine Shop: Repair on types of engines and APUs

b. Avionics Shop: Radios, navigation, radar, communication, and electrical components.

c. Mechanical Component Shop: Actuators, hydraulic systems, flight control surfaces, fuel systems, oxygen, pneumatics, etc.

d. Structures: Sheet metal and other structural elements

iv. Materiel Services: Ordering and maintaining supplies, handling warranties, and moving repairable and consumable parts through the system.

v. Maintenance Program Evaluation: Monitoring activity for the organization, its workers and its suppliers.