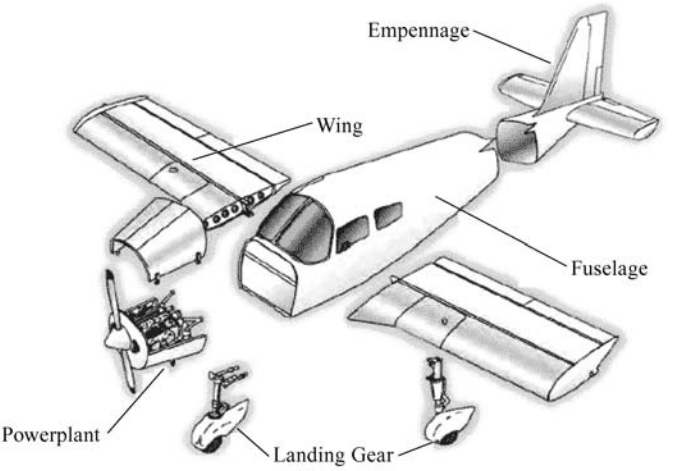
Lesson 1

Airplanes and Main Manufacturers Introduction

Airplanes in a manufacturing factory

Airplanes come in many different shapes and sizes depending on the mission of the aircraft, but all modern airplanes have certain components in common. These are the **fuselage**, wing, **tail assembly** and control **surfaces**, landing gear, and **power plants**.

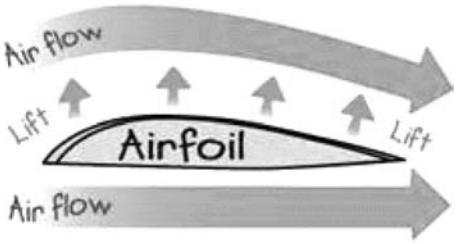


Aircraft components

For any airplane to fly, it must be able to lift the weight of the airplane, its fuel, the passengers, and the cargo. The wings generate most of the **lift** to hold the plane in the air. To generate lift, the airplane must be pushed through the air. The engines, which are usually located beneath the wings, provide the **thrust** to push the airplane forward through the air.

The fuselage is the body of the airplane that holds all the pieces of the aircraft together and many of the other large components are attached to it. The fuselage is generally **streamlined** as much as possible to reduce **drag**. Designs for fuselages vary widely. The fuselage houses the **cockpit** where the **pilot** and **flight crew** sit and it provides areas for passengers and cargo. It may also carry armaments of various sorts. Some aircraft carry fuel in the fuselage; others carry the fuel in the wings. In addition, an engine may be housed in the fuselage.

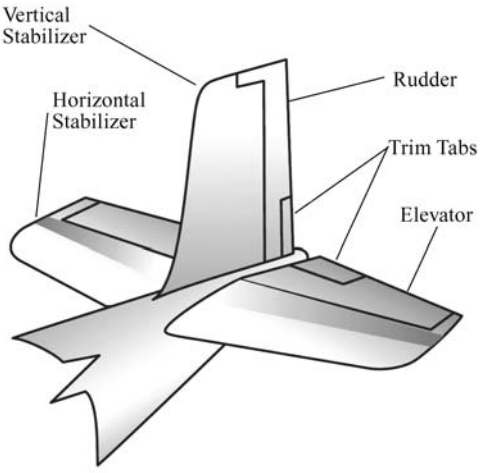
The wing provides the principal lifting force of an airplane. Lift is obtained from the **dynamic** action of the wing with respect to the air. The **cross-sectional** shape of the wing as viewed from the side is known as the **airfoil** section. The **planform** shape of the wing (the shape of the wing as viewed from above) and placement of the wing on the fuselage (including the **angle of incidence**), as well as the airfoil section shape, depend upon the airplane mission and the best compromise necessary in the overall airplane design.



The generation of lift

The control surfaces include all those surfaces of an airplane used for **attitude**, lift, and **drag** control. They include the tail assembly, the structures at the rear of the airplane that serve to control and maneuver the aircraft and structures forming part of and attached to the wing. The tail usually has a fixed horizontal piece (called the **horizontal stabilizer**) and a fixed vertical piece (called the **vertical stabilizer**). The stabilizers provide stability for the aircraft—they keep it flying straight. The vertical stabilizer keeps the **nose** of the plane from swinging from side to side (called **yaw**), while the horizontal stabilizer prevents an up-and-down motion of the nose (called **pitch**). (On the **Wright brothers'** first successful aircraft, the horizontal stabilizer was placed in front of the wings. Such a configuration is called a canard after the French word for "duck").

The hinged part found on the **trailing edge** of the wing is called the **aileron**. It is used to roll the wings from side to side. **Flaps** are hinged or **pivoted** parts of the **leading** and/or trailing edges of the wing used to increase lift at reduced airspeeds, primarily at **landing**



Tail assembly

and **takeoff**. **Spoilers** are devices used to disrupt the **airflow** over the wing so as to reduce the lift on an airplane wing quickly. By operating independently on each wing, they may provide an **alternate form** of roll control. **Slats** at the front part of the wing are used at takeoff and landing to produce additional lift.

At the rear of both the aileron surfaces and **elevators** and **rudders** are small moving sections called **trim tabs** that are attached by hinges. Their function is to (1) balance the airplane if it is too nose heavy, tail heavy, or wing heavy to fly in a stable cruise condition; (2) maintain the elevator, rudder, and ailerons at whatever setting the pilot wishes without the pilot maintaining pressure on the controls; and (3) help move the elevators, rudder, and ailerons and thus relieve the pilot of the effort necessary to move the surfaces.

The landing gear, or **undercarriage**, supports the airplane when it is resting on the ground or in water and during the takeoff and landing. The gear may be fixed or retractable. The wheels of most airplanes are attached to **shock-absorbing struts** that use oil or air to cushion the **blow** of landing. Special types of landing gear include skis for snow and floats for water. For carrier landings, **arrester hooks** are used.

Forward motion, or thrust, is generated by a thrust-producing device or power plant to sustain flight. The power plant consists of the engine (and propeller, if present) and the related **accessories**.

The main engine types are the reciprocating (or piston type), and the reaction, or jet, engine such as the **ram jet**, **pulse jet**, **turbojet**, **turboprop**, and **rocket** engine. The propeller converts the energy of a reciprocating engine's rotating **crankshaft** into a **thrust force**. Usually the engines are located in **cowled pods** hung beneath the wings, but some aircraft, like fighter aircraft, will have the engines buried in the fuselage.

Other configurations have sometime been used. For instance, the Wright brothers' 1903 Flyer had pusher propellers (propellers at the rear of the plane) and the elevators at the front of the aircraft. Many fighter aircraft also combine the horizontal stabilizer and el-

Landing grar

evator into a single **stabilator** surface. There are many possible aircraft configurations, but any configuration must provide for the four forces needed for flight.

The Boeing Company

Boeing Commercial Airplanes, a business unit of The Boeing Company, is committed to being the leader in commercial aviation by offering airplanes and services that deliver superior design, efficiency and value to customers around the world. There are more than 12,100 Boeing Commercial Jetliners in service, flying passengers and freight more efficiently than competing models in the market.

Boeing traces its history to aviation pioneer **William Boeing** who, in 1916, built the company's first airplane, a seaplane for two with a range of 320 **nautical miles** (515 km). Since then, Boeing has defined the modern jetliner and introduced the **twin-aisle** cabin, the glass cockpit and countless other innovations.

Today, Boeing Commercial Airplanes offers a family of technologically advanced airplanes, including one that can seat more than 500 and another that boasts the longest range in the world, at more than 9, 300 nautical miles (14, 966 km).

Meanwhile, Boeing Commercial Airplanes and its global network of suppliers are hard at work building the airplane of tomorrow, a **next-generation** jet that will set the standard for fuel-efficiency and passenger comfort.

Boeing Commercial Airplanes employs about 65, 400 people under the leadership of President and CEO James (Jim) F. Albaugh. The business unit brought in revenues exceeding $28 billion in 2008.

With headquarters in Renton, Wash., Boeing Commercial Airplanes has operations in more than a dozen cities and countries. The business unit comprises five airplane programs, VIP-derivative airplanes, extensive fabrication and assembly facilities, and a glob-

Boeing aircraft family

Boeing Company's founders

al customer support organization.

Air transport contributes 2 percent of human-produced CO_2 emissions and this could reach 3 percent by 2050, according to updated figures from the Intergovernmental Panel on Climate Change (IPCC). The industry is now working towards carbon-neutral growth—no increase in carbon emissions in spite of traffic growth—as a first step towards a future of carbon-free energy. Boeing takes this commitment very seriously. Today, more than 75 percent of our commercial airplane research and development efforts are focused on advancing environmentally progressive innovations. See below for more information.

Aircraft entering today's fleet are 70 percent more fuel efficient than early commercial jet airplanes, consuming about 3.5 liters per passenger per 100km. Technological innovation is a fundamental part of this industry.

Boeing is actively driving the development of sustainable **biofuels** for use by the aviation industry. Technology is advancing faster than expected. Many airlines could be flying on a percentage of biofuels within the next five to ten years.

Advanced technologies for generating and harnessing energy are reducing the need to produce electricity from non-renewable resources. Boeing is developing applications within key energy harvesting technologies, including **electrodynamic**, **thermoelectric**, **piezoelectric**, **hydrogen** fuel cells and solar cells.

Boeing continually pursues noise-reducing innovations, making each new airplane quieter than its **predecessor**. New technologies promise even greater improvements.

Today's airspace systems are inefficient. Though safe, the current model is serving increased demand with **outmoded** technologies—the result: system congestion and delays that waste fuel and increase emissions. Boeing is helping solve this complex problem by

collaborating with governments and industry partners.

Boeing is working to continually improve the environmental performance of our operations, our products and the aviation system overall. We have a plan and a set of commitments to which we hold ourselves accountable.

The Airbus Company

Airbus is one of the world's leading aircraft manufacturers, and it consistently captures approximately half or more of all orders for airliners with more than 100 seats.

Airbus' mission is to provide the aircraft best suited to the market's needs and to support these aircraft with the highest quality of service. The Airbus product line comprises 14 aircraft models, from the 100-seat single-aisle A318 jetliner to the 525-seat A380—which is the largest civil airliner in service.

Airbus made 483 deliveries in 2008, surpassing the previous year's total by 30. Its total number of aircraft provided to customers worldwide was above the 5,600 mark as of April 2009, with combined orders reaching more than 9,200 single-aisle and **widebody** Airbus jetliners.

Airbus also has expanded into the military transport aircraft sector. The A400M multirole military **airlifter**—being produced under management of the Airbus Military company—will replace ageing fleets of C-130 Hercules and C-160 Transalls. In addition, aerial tankers for in-flight refueling and transport missions are available in aircraft variants derived from the A310 and A330.

The A318 brings all the benefits of Airbus commonality and comfort to the 100-seat market segment.

The A318 retains all of the A320 Family's advantages while providing highly efficient operations in the 100-seat airliner category.

With an overall length of 31.44 metres (103 ft. 2 in.), the A318 has the shortest fuselage of the A320 product line.

The A318 seats 107 passengers in a typical two-class cabin layout, with eight in first class and 99 in economy.

The A319 provides a new standard of service to markets where only the smallest jets have operated.

The A319 brings a new standard of comfort and performance to markets previously only served by the smallest jet aircraft.

The A319 operational flexibility provides range possibilities of 3,700 **nm.**/6,800 km., and longer for non-stop trans-Atlantic flights.

The A319 offers a variety of seating configurations, from an all business-class layout to an optional high-density version.

The founding member of the best-selling Airbus single-aisle Family, the A320 is the on-

ly all-new aircraft in its category.

Airbus innovation means better performance and reliability with reduced fuel burn and easier maintenance.

The A320's 3.96-metre-wide (13 ft.) fuselage provides wider seats and more room for carry-on baggage in the cabin, and the ability to load containerized cargo in the **lower hold.**

The A320 set a new generation of comfort standards, accommodating 12 first class and 138 economy passengers in the widest cabin available for single-aisle jetliners.

With lower operating costs and more profitability available than with any other aircraft in its class, the A310 also offers wide body passenger comfort and exceptional cargo capacity.

The A310 offers maximum comfort, versatility and efficiency—making it the world's most profitable jetliner in the 200-seat size category.

The A310 uses the Airbus 222-inch widebody fuselage cross-section, providing the optimum balance between aerodynamic efficiency, passenger comfort and underfloor cargo capacity.

The A310 accommodates 220 passengers in a typical two-class layout with 20 first-class and 200 economy-class seats.

The shortest fuselage member of the A330 series provides airlines with excellent range and cargo capacity.

The A330-200 offers superior payload/range capability and greater cargo volume on medium-capacity routes to extended-range operations.

The shortest-fuselage version of Airbus' A330 series, the A330-200 has an overall length of 59 metres (193 ft. 7 in.), with a range of up to 6,750 nm./12,500 km.

The A330-200 typically carries 253 passengers in a first/business/economy class layout, while the aircraft's two-class configuration seats 293 passengers.

The A340-200 enabled airlines to open long-range non-stop routes between cities that previously needed **intermediate stops.**

The A340-200 is the shortest-fuselage version of the A340 series, with an overall length of 59.3 metres (194 ft. 10 in.).

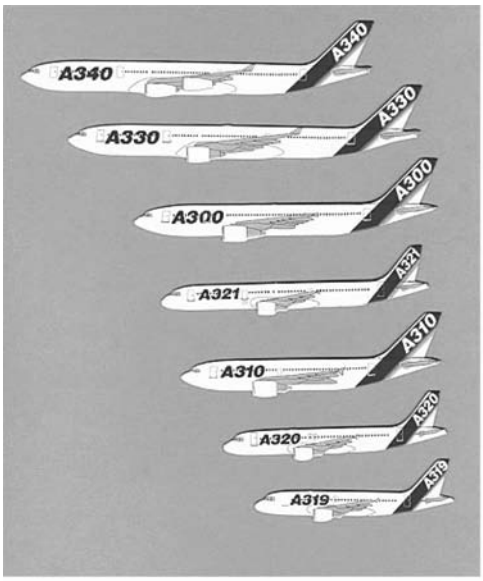
The typical seating configuration for the A340-200 includes 216 passengers in a three-class cabin arrangement.

The A380 Navigator has enjoyed huge popularity and allowed many thousands of visitors worldwide to follow the design and industrial development of Airbus' 21st century **flagship** and share the excitement of the programme as it progressed.

Now that the A380 is in regular commercial service, the role of the A380 Navigator has come to an end. The dedicated site, which was created to follow the progress of the A380, is no longer being updated. We thank you for the enthusiastic interest you have shown for the A380 and encourage you to browse back through the milestones of this exceptional aircraft programme, review its development and continue to enjoy its many photos and videos.

The successful entry into service of the A380 is a tribute to the giant leap forward in technology and innovation embodied in the A380, which makes it the new industry's tech-

Airbus future aircrafts



Airbus aircraft family

nology benchmark. This is highlighted by the more than 380 patent applications filed for A380 technologies.

Since its first flight in April 2005, the A380 has flown at air shows and carried out several worldwide tours, demonstrating its airport compatibility, its magnificent handling qualities and **eco-friendly** operation, and meeting with an enthusiastic welcome in every one of the 71 airports it visited.

The "Gentle Giant" as the media dubbed it, now belongs to the airlines and passengers who fly it. As more and more A380s are delivered and enter into service, its majestic and quiet flight will become a normal sight at airports all around the world.

The Bombardier Company

Bombardier is a global transportation company, present in more than 60 countries on five continents. It operates two industry-leading businesses:

- Aerospace
- Rail transportation

Our 66,900 employees design, manufacture, sell and support the widest range of world-class products in these two sectors. This includes commercial and business jets, as well as rail transportation equipment, systems and services.

With more than 32,500 employees and well-positioned in global markets, Bombardier Aerospace ranks as the world's third largest civil aircraft manufacturer. Our high-performance aircraft and services set the standard of excellence in several markets, including:

- Business aircraft

Bombardier business jet

- Commercial aircraft
- **Amphibious** aircraft
- Jet travel solutions
- Specialized aircraft solutions
- Aircraft services and training

The Embraer Company

Embraer was Brazil's largest exporter from 1999 to 2001 and the second largest in 2002, 2003 and 2004. It currently employs more than 16, 853 people, 94.7% based in Brazil.

Embraer has become one of the largest aircraft manufacturers in the world by focusing on specific market segments with high growth potential in commercial, defense, and **executive aviation**. We develop and adapt successful aircraft platforms and judiciously introduce new technology whenever it creates value by lowering **acquisition price**, reducing direct operating costs, or delivering higher reliability, comfort, and safety.

"E"series aircraft

As a result, our aircraft provide excellent performance with day-in and day-out reliability, while being economical to acquire and cost-effective to operate and maintain. Equally important, we provide a superior product package, with comprehensive aircraft and after-sales support for parts, services, and technical assistance.

New Words & Phrases

fuselage 机身
tail assembly 尾翼组件
surface 舵面
power plant 动力装置(一般简称发动机或引擎)
lift 升力
thrust 推力
streamline 使……成流线型
drag 阻力
cockpit 驾驶舱
pilot 飞行员
flight crew 飞行机组人员(一般包括飞行员和空中乘务员)
dynamic 动态的
cross-sectional 横截面的
airfoil 翼面
planform 俯视图
angle of incidence 入射角;安装角
attitude 姿态
horizontal stabilizer 水平安定面
vertical stabilizer 垂直安定面
nose 机头
yaw 偏航
pitch 俯仰
Wright brother 莱特兄弟
trailing edge 后缘
aileron 副翼
flap 襟翼
pivoted 转动的;回转的;装在枢轴上的
leading 前面的;前端的
landing 着陆
takeoff 起飞
spoiler 扰流板
airflow 气流
alternate form 备用方式