World Journal of Pharmaceutical and Life Sciences
WJPLS
www.wjpls.org
SJIF Impact Factor: 7.409

CONCORDE AS TAIL-LESS SUPERSONIC [2,180km/h] AIRCRAFT MOVES AT ALTITUDE OF 60,000ft

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Article Received on 21/07/2025 **Article Revised on 11/08/2025** **Article Accepted on 01/09/2025**

ABSTRACT
Concorde was an Anglo-French supersonic [2,180km/h] passenger airliner, known for its delta-wing design and ability to fly at over twice the speed of sound [343m/s]. Developed through a partnership between British Aerospace and Aérospatiale, [aerospace [noun] the industry of building aircraft and space vehicles. The company is at the forefront of the most exciting technological advance in aerospace for many years. (also adjective) the aerospace industry] it entered service in 1976 and was operated exclusively by British Airways and Air France. Concorde offered a significantly reduced transatlantic flight time of about 3.5 hours, but due to high development costs and a major accident in 2000, the aircraft was retired in late 2003.

KEYWORDS: supersonic speed, subsonic speed, aircraft, Jet-A1 fuel, paraffin.

History: The first commercial passenger Concorde flights launched on January 21, 1976, with British Airways and Air France operating routes to Bahrain and Rio de Janeiro, respectively. However, Concorde's maiden flight of its first prototype (001) took place earlier, on March 2, 1969.

- March 2, 1969: The first Concorde prototype takes its maiden flight from Toulouse, France.
- 1973: The first Concorde makes its non-stop transatlantic crossing.
- January 21, 1976: Concorde begins its first scheduled supersonic passenger service with flights from London to Bahrain and Paris to Rio de Janeiro.
- 1977: Regular service to New York City commences.
- 2003: Concorde ceases its operations after 27 years of service.
- Manufactured: 1965–1979
- Introduction date: 21 January 1976
- First flight: 2 March 1969
- Retired: 24 October 2003; 21 years ago (last commercial flight), 26 November 2003; 21 years ago (final flight to Bristol Filton Airport).

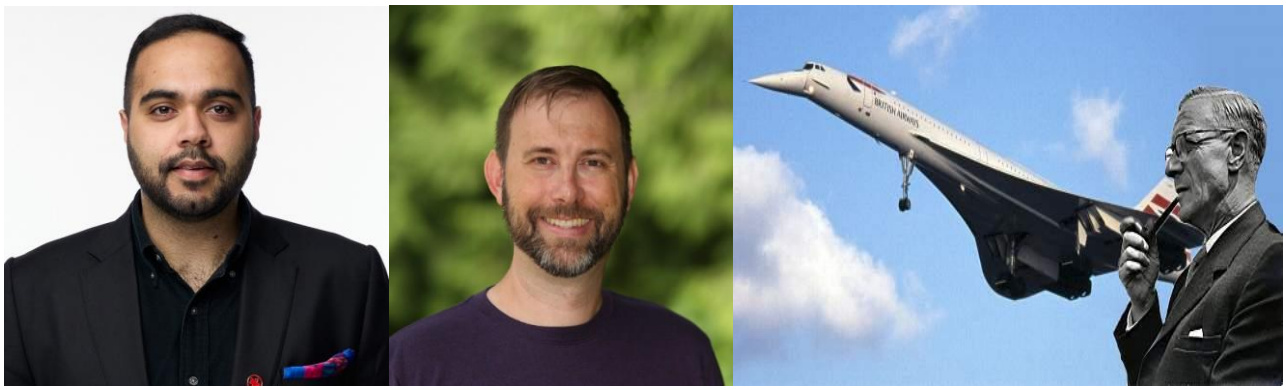

Figure-1: Concorde pillars.

Prithviraj Singh Chug is the Chief Executive Officer of Group Concorde. **Ryan Ellis** served as the Game Director for Concord. The design of the Concorde supersonic transport aircraft involved significant contributions from engineers on both the British and French sides. Key figures in the design leadership included **Sir Archibald Russell** from the British Aircraft Corporation (BAC) and **Lucien Servanty** from the French firm Sud Aviation. They led teams that developed the slender delta-wing design, which was crucial for achieving stable flight at Mach 2.04 and managing the stresses of supersonic speeds.

Sir Archibald Russell (BAC): As a veteran of delta-wing designs from projects like the Bristol Britannia and Vulcan bomber, he played a key role in the British design effort.

Lucien Servanty (Sud Aviation): He brought experience from the SO.6000 Triton experimental jet and the successful Caravelle airliner to the French side of the project.

Supersonic Speed: Concorde could reach a maximum cruising speed of Mach 2.04 (over twice the speed of sound), allowing it to travel from London to New York in about three hours. Mach speed 2.04 means the Concorde flew at more than twice the speed of sound, which was equivalent to approximately 1,354 miles per hour or 2,180 kilometers per hour. The "Mach" number is a measure of speed relative to the speed of sound, which varies based on factors like altitude, temperature, and air pressure.

Anglo-French Cooperation: The project was the result of a treaty signed in 1962 between Britain and France to share the costs and risks of developing a supersonic transport (SST) aircraft.

Manufacturer: The airframe was built by British Aerospace and Aérospatiale, while the engines were a joint effort between Rolls-Royce and SNECMA.

Iconic Design: The aircraft was an engineering and design marvel, with its distinctive delta-wing shape making it instantly recognizable.

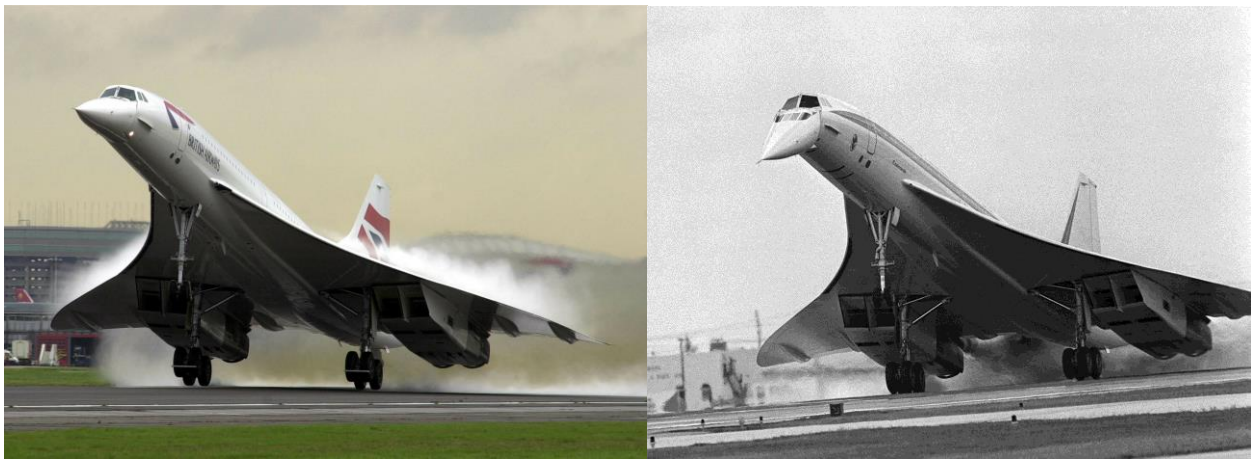

Figure-2: Concorde take-off and landing.

Service: Concorde was in service from 1976 until October 2003, flying both scheduled transatlantic routes and charter flights.

Retirement: The aircraft was retired in 2003 due to a combination of factors, including high maintenance requirements and the devastating crash of an Air France Concorde in July 2000.

Financial Viability: Despite its prestige and ability to cut travel times, Concorde was never financially profitable, and its development costs could not be recouped through operations.

Concorde is a tailless aircraft design with a narrow fuselage permitting four-abreast seating for 92 to 128 passengers. The Chief Executive Officer of Group Concorde, an air cargo representation company, is Prithviraj Chug. He holds this position and has been involved in discussions about air freight trends and the role of Group Concorde in the market. The Concorde jet could reach a maximum cruising speed of 2,180 km (1,354 miles) per hour, or Mach 2.04 (more than twice the speed of sound). This supersonic speed allowed it to significantly reduce travel time, making it possible to fly from London to New York City in about three hours.

Concorde Fuel Type: Concorde used Jet-A1 fuel, a kerosene-based fuel with a lower freezing point than typical Jet A and containing an anti-static additive.

Tank Capacity: The aircraft had 13 fuel tanks, holding a total of approximately 119,500 litres (31,569 gallons) of fuel.

Aerodynamic Stability: Fuel for Flight: The primary role of the fuel was to power the engines, just like any other jet.

Trim Tanks: Concorde also had special trim tanks (two in front and one in the tail).

Fuel Transfer: As the aircraft reached supersonic speeds, its centre of lift shifted backward. To compensate and prevent the nose from diving, fuel was pumped from the forward trim tanks to the rear trim and collector tanks. This movement of fuel shifted the centre of gravity backward, aligning it with the new centre of pressure and maintaining the aircraft's balance.

Deceleration: When the aircraft slowed down and the centre of lift moved forward again, fuel was transferred from the rear back to the front to keep the plane stable.

Concorde used Jet-A1 fuel, a type of kerosene, and its fuel system was unique in that it not only powered the engines but also played a critical role in aerodynamic stability. During supersonic flight, fuel was transferred from forward trim tanks to rear tanks to shift the plane's centre of gravity backward, balancing the shift in the centre of lift and preventing a nose-heavy condition. This fuel transfer system is a key feature that allowed Concorde to fly safely and balanced at supersonic speeds. Jet A-1 fuel is a kerosene-based fuel, primarily composed of hydrocarbons, including paraffins (**both n-paraffins and isoparaffins), naphthenes (cycloparaffins), and aromatics**. These hydrocarbons are derived from crude oil through fractional distillation. The specific blend is carefully controlled to meet international standards, and unlike some other fuels, it also contains a static dissipator additive and has a lower freezing point. "Napthene" is a common misspelling for two different chemical terms: Naphthene, a class of cyclic saturated hydrocarbons found in petroleum and also called cycloalkanes, and Naphthalene, a specific polycyclic aromatic hydrocarbon used in mothballs and produced from coal tar or petroleum.

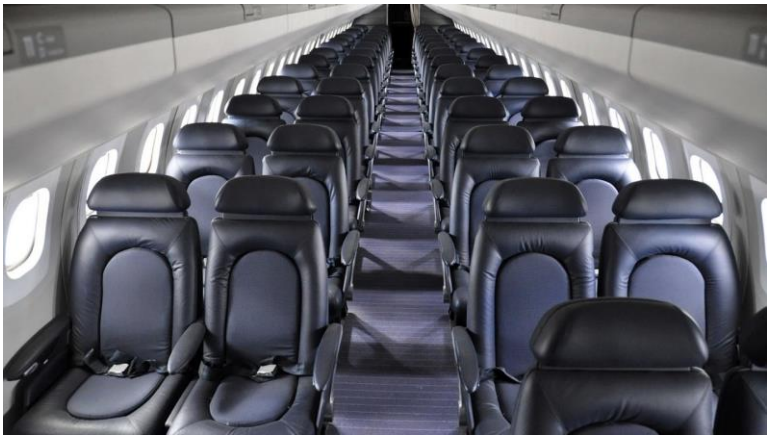

Figure-3: Concorde seat.

The context of your query determines which chemical is being referred to, as one is a type of hydrocarbon in crude oil and the other is a distinct compound with a strong smell.

Naphthenes (Cycloalkanes): Naphthenes are saturated hydrocarbons that form one or more rings of carbon atoms.
General Formula: They follow the general formula C_nH2_n.

Source: Naphthenes are a significant component of crude oil and are important in refining processes for producing gasoline. Examples: Common examples include cyclopentane and cyclohexane.

Naphthalene: Naphthalene is a specific polycyclic aromatic hydrocarbon ($C_{10}H_8$) composed of two fused benzene rings.
Properties: It's a white solid with a strong, pungent odour.
Uses: Naphthalene is best known for its use as the primary ingredient in mothballs.

Source: It's produced from the fractional distillation of coal tar or cracked petroleum.

Hydrocarbons: Jet A-1 is a mixture of various hydrocarbon molecules, predominantly those with 9 to 16 carbon atoms.

Paraffins: These are saturated hydrocarbons, including straight-chain (n-paraffins) and branched (isoparaffins) forms, which make up a significant portion of the fuel.

Naphthenes (Cycloparaffins): These are cyclic hydrocarbons found in the fuel mixture.

Aromatics: These are cyclic hydrocarbons with a ring structure, including compounds like naphthalenes, and they are present in a controlled proportion, typically ≤25%.

Olefins: These unsaturated hydrocarbons usually comprise a very small fraction (<1%) of the total fuel.

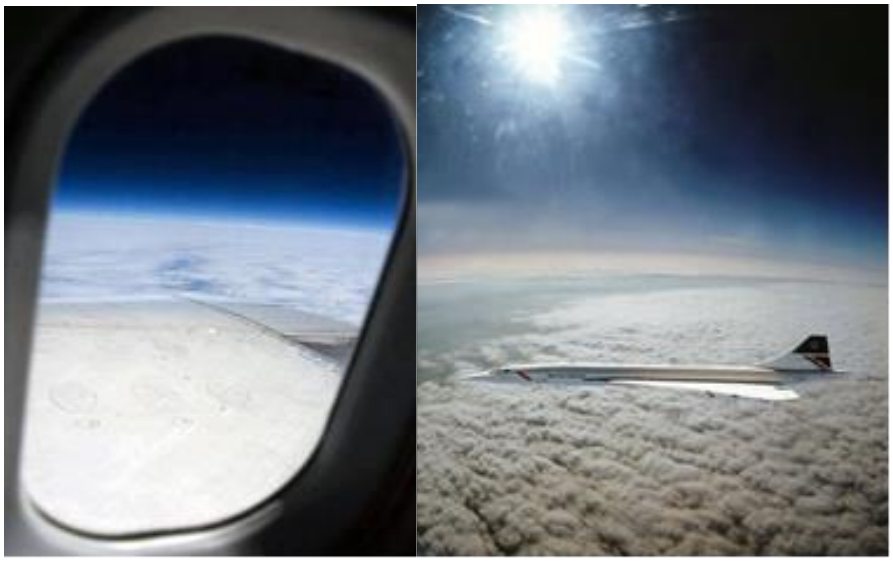

Figure-4: Concorde view at 60000ft.

Additives: **Static Dissipater Agent:** Jet A-1 contains an additive to reduce the risk of static electricity build-up during handling and transfer, making it safer for aviation use.

Derivation: **Fractional Distillation:** Jet A-1 is produced from crude oil through a process where the oil is heated, and different components are separated based on their boiling points.

Concorde's typical cruising altitude was between 55,000 and 60,000 feet (16,800 to 18,300 meters), flying at Mach 2.02 for optimum fuel consumption and performance. This altitude was almost double that of conventional aircraft, offering passengers a view of the Earth's curvature and providing a smooth, turbulence-free flight.

Normal Operating Altitude: 55,000 to 60,000 feet (16,800 to 18,300 meters).

Benefits: Smooth Flight: Flying above most weather conditions eliminated turbulence.

Unique Views: Passengers could see the Earth's curvature.

Efficiency: This altitude, combined with Mach 2.02 speed, allowed for optimum fuel consumption.

Comparison to Subsonic Jets: This cruising altitude was significantly higher than traditional commercial jets, which typically fly between 30,000 and 40,000 feet. Subsonic speed refers to any speed less than the speed of sound in a given medium, typically expressed as a Mach number (M) of less than 1. In this regime, the fluid particles (like air) have time to move out of the way before the object arrives, resulting in predictable and stable airflow around the object, as is common for most commercial airliners.

Engineering Marvel: The Concorde's ability to reach these altitudes was a testament to its advanced engineering.

Supersonic Operation: The aircraft was designed to operate in the upper atmosphere where air density is low, allowing for high speeds with efficient operation and minimal drag. Supersonic refers to traveling faster than the speed of sound, while subsonic means traveling slower than the speed of sound. Speeds are measured using the Mach number, where Mach 1 equals the speed of sound. Therefore, any speed less than Mach 1 is subsonic, and any speed greater than Mach 1 is supersonic.

Subsonic Speed
Definition: A speed less than the speed of sound [343m/s].
Mach Number: Less than Mach 1 (< 1).
Examples: Most commercial airliners, propeller-driven aircraft, balloons, and airships operate at subsonic speeds.

Supersonic Speed
Definition: A speed greater than the speed of sound.
Mach Number: Greater than Mach 1 (> 1).
Examples: Some military aircraft, such as fighter jets, are designed to reach supersonic speeds for short periods.
Mach Number: A dimensionless quantity representing the ratio of the speed of an object or fluid to the local speed of sound.

Figure-5: Concorde pilot and crew.

Speed of Sound: The speed of sound varies depending on the medium's properties, such as temperature, pressure, and density. At sea level, the speed of sound in dry air is approximately 343.2 meters per second or 767 miles per hour.

Other Regimes.

Transonic: The speed range where an object approaches and briefly exceeds the speed of sound (around Mach 0.8 to 1.3).

Hypersonic: Speeds five times or more the speed of sound (Mach 5 and above).

General Specifications

- Crew: 3 (2 pilots and 1 flight engineer)
- Capacity: 92–120 passengers
- Length: 202 ft 4 in (61.66 m)
- Wingspan: 84 ft 0 in (25.6 m)
- Height: 40 ft 0 in (12.2 m)
- Wing area: 3,856.2 sq ft (358.25 m2)
- Empty weight: 173,504 lb (78,700 kg)
- Gross weight: 245,000 lb (111,130 kg)
- Max take-off weight: 408,010 lb (185,070 kg)
- Fuel capacity: 210,940 lb (95,680 kg); 119,600 L (26,300 imp gal; 31,600 US gal)
- Fuselage internal length: 129 ft 0 in (39.32 m)
- Fuselage width: maximum of 9 ft 5 in (2.87 m) external, 8 ft 7 in (2.62 m) internal
- Fuselage height: maximum of 10 ft 10 in (3.30 m) external, 6 ft 5 in (1.96 m) internal
- Maximum taxiing weight: 412,000 lb (187,000 kg)
- Powerplant: 4 × Rolls-Royce/Snecma Olympus 593 Mk 610 turbojets with reheat, 31,000 lbf (140 kN) thrust each dry, 38,050 lbf (169.3 kN) with afterburner

Performance

- Maximum speed: 1,354 mph (2,180 km/h, 1,177 kn)
- Maximum speed: Mach 2.04 (temperature limited)
- Cruise speed: 1,341 mph (2,158 km/h, 1,165 kn)
- Range: 4,488.0 mi (7,222.8 km, 3,900.0 nmi)
- Service ceiling: 60,000 ft (18,300 m)
- Rate of climb: 3,300–4,900 ft/min (17–25 m/s) at sea level
- Lift-to-drag: Low speed– 3.94; Approach– 4.35; 250 kn, 10,000 ft– 9.27; Mach 0.94– 11.47, Mach 2.04– 7.14
- Fuel consumption: 47 lb/mi (13.2 kg/km)
- Thrust/weight: 0.373
- Maximum nose tip temperature: 127°C (260°F; 400 K)
- Runway requirement (with maximum load): 3,600 m (11,800 ft)

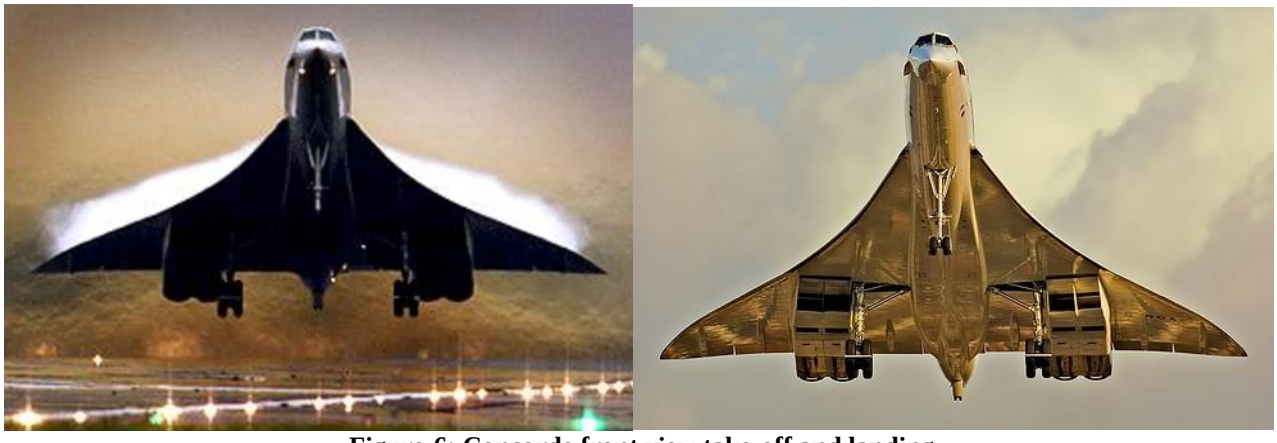

Figure-6: Concorde front view take-off and landing.

Passenger capacity: The Concorde passenger capacity was 92 to 128 passengers, though a common configuration for the narrow fuselage was 100 passengers. The aircraft typically carried a maximum of

100 passengers in a two-cabin first-class layout, with 40 in the front and 60 in the rear cabin.

Designed for Luxury, Not Mass Transit: Concorde was a narrow-bodied aircraft with a unique design, accommodating a relatively small number of passengers for its size.

Standard Configuration: The typical and most frequently cited passenger capacity was around 100, split into two cabins.

Narrow Fuselage: The tight interior was a result of the supersonic design, similar in cross-section to a smaller, high-end business jet.

First-Class Service: The limited seating was designed to provide an exclusive, first-class experience for travelers.

Low Passenger Numbers Were a Challenge: Despite its advanced speed, the limited capacity and high ticket costs meant that fully booked flights were infrequent, contributing to the aircraft's eventual retirement.

CONCLUSION

Concorde is a tail-less supersonic aircraft of speed 2180 kmph and moves at 60000ft altitude.

REFERENCE

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