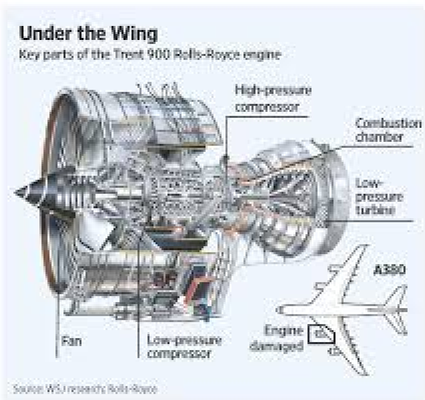
Final draft:

Airbus A380 Engine
Audience: Aerospace Engineering students and aviation enthusiasts
Description Type: Technical Component Description



Engine of the Airbus A380: The Rolls-Royce Trent 900

The Airbus A380, the largest commercial passenger aircraft currently in service, is powered by four Rolls-Royce Trent 900 high-bypass turbofan engines, each producing up to 76,500 lb of thrust (Rolls-Royce plc., 2023). Though they look like simple pods beneath the wings, each engine is a precisely sequenced machine that converts fuel into the thrust needed to lift over 560 tonnes of aircraft. Understanding how it works is clearest when followed in the order air itself travels through it: fan → compressor → combustor → turbine → exhaust.

(See Figure 1 for a labeled cross-sectional diagram of airflow paths.)

Bypass Design and the Fan

The Trent 900's high-bypass design is the foundation of its fuel efficiency. Incoming air is split into two streams: a smaller portion enters the engine core for combustion, while a much larger portion — nearly nine times as much, giving the engine a bypass ratio of approximately 9:1 — travels around the core entirely. This bypass air generates the majority of the engine's thrust.

At the front of the engine, the fan measures approximately 116 in. in diameter and spins at roughly 2,200 rpm (Rolls-Royce plc., 2023). Its wide-chord, hollow titanium blades are engineered to accelerate large volumes of air rearward while also withstanding bird strikes and blade-off events. The fan divides incoming air into the bypass and core streams described above. Importantly, the fan is not driven by its own motor; instead, the low-pressure turbine at the engine's rear drives it through a long central shaft.

Compressor System

Air entering the core moves first through a two-stage compressor system consisting of an intermediate-pressure (IP) compressor and a high-pressure (HP) compressor, each mounted on separate concentric shafts (shafts that share the same centerline but rotate independently). Each compressor contains alternating rows of rotating blades and stationary vanes that work together to progressively squeeze the air into a smaller, denser volume. By the time air exits the HP compressor, its pressure has increased by a factor of approximately 40. This extreme compression is essential because fuel burns far more energetically — and efficiently — in highly compressed air.

Combustion Chamber

The compressed air enters the annular (ring-shaped) combustion chamber that surrounds the engine's core. Fuel is injected through nozzles and ignited during engine start; afterward, the flame sustains itself continuously. Combustion temperatures exceed 1,700 °C — far beyond the melting point of the metal walls — so the combustor uses a technique called film cooling: thousands of small holes in the chamber walls bleed cooler bypass air across the inner surface, forming a protective thermal barrier. The result is a high-energy, high-pressure gas stream that expands rearward into the turbine section.

Turbine Section

The turbine's job is to extract enough energy from the hot exhaust gases to drive both the compressors and the fan. It is divided into three stages — high-pressure (HP), intermediate-pressure (IP), and low-pressure (LP) — each consisting of a row of stationary guide vanes followed by rotating blades. The vanes redirect the gas flow onto the blades at the most efficient angle, and as the gas expands through each stage, it transfers rotational energy to the turbine shaft. The HP turbine drives the HP compressor; the IP turbine drives the IP compressor; and the LP turbine drives the fan. This three-shaft architecture — a signature of Rolls-Royce Trent engines — allows each rotating assembly to spin at its own optimal speed rather than being locked together, which meaningfully improves overall efficiency.

Exhaust and Thrust

After passing through all three turbine stages, the remaining gases exit through the central exhaust nozzle, still contributing a portion of forward thrust. Simultaneously, the much larger bypass airstream that traveled around the core exits through a surrounding annular nozzle. The combined rearward momentum of both streams — bypass air and core exhaust — produces the engine's total thrust of up to 76,500 lb per engine, or roughly 306,000 lb across all four (Rolls-Royce plc., 2023).

References

Rolls-Royce plc. (2023). *Trent 900: Product specification overview.* https://www.rolls-royce.com/products-and-services/civil-aerospace/airlines/trent-900

Figure 1. Cross-sectional view of the Rolls-Royce Trent 900 illustrating primary airflow paths from fan inlet to exhaust nozzle. Adapted from Rolls-Royce plc. (2023).

First draft:

Engine of the Airbus A380

Audience: *Engineering students and aviation enthusiasts*

Description Type: *Technical component description*

The Airbus A380, the largest commercial passenger aircraft in service, relies on four Rolls-Royce Trent 970 high-bypass turbofan engines, each producing up to 76,500 pounds of thrust. Although they appear as large pods beneath the wings, each engine contains a precisely coordinated sequence of rotating machinery that converts fuel into the enormous forward force required to lift an aircraft weighing more than 560 tonnes.

The Trent 970's high-bypass design is central to its efficiency. Incoming air is split into two streams: a smaller portion that enters the engine core and a much larger portion—nearly nine times as much—that bypasses the core entirely. This bypass air produces the majority of the engine's thrust, making the fan the most important thrust-generating component.

At the front of the engine, the fan measures about 116 inches in diameter and spins at roughly 2,200 rpm. Its wide titanium blades accelerate huge volumes of air rearward, dividing it into bypass and core flows. The fan is powered not by its own motor but by the low-pressure turbine located deep in the engine, connected through a long shaft.

Air entering the core moves first through the compressor system, which consists of intermediate-pressure and high-pressure compressors mounted on separate concentric shafts. Each compressor contains alternating rows of rotating and stationary blades that progressively squeeze the air into a smaller volume. By the time the air leaves the high-pressure compressor, its pressure has increased by a factor of about 40. This high pressure is essential for efficient combustion, since fuel burns far more energetically in compressed air.

The compressed air then enters the annular combustion chamber. Fuel is sprayed through nozzles and ignited during startup; afterward, the flame sustains itself. Combustion temperatures exceed 1,700°C, so the combustor is engineered with cooling airflow patterns that shield its walls from direct exposure. The resulting high-energy gas stream expands rearward into the turbine section.

The turbine extracts energy from the hot gases to power the compressors and the fan. It is divided into high-pressure, intermediate-pressure, and low-pressure stages, each consisting of stationary vanes and rotating blades. As gases expand through these stages, they transfer energy to the turbine shafts. The high-pressure turbine drives the high-pressure compressor; the intermediate-pressure turbine drives its corresponding compressor; and the low-pressure turbine drives the fan. This three-shaft architecture, characteristic of Rolls-Royce Trent engines, allows each rotating assembly to operate at its optimal speed, improving overall efficiency.

After passing through the turbines, the remaining gases exit through the exhaust nozzle, still contributing some thrust. Meanwhile, the much larger bypass airflow travels around the core and exits through a surrounding annular nozzle. The combined momentum of the bypass stream and the core exhaust produces the engine’s total thrust.