1. Introduction: The Simple Secret of Jet Power

At its core, a turbojet engine operates on a principle you've likely seen firsthand. Imagine inflating a balloon and then letting it go. The air rushes out the back (the *action*), and the balloon zips forward (the *reaction*). This is a perfect demonstration of Newton's Third Law of Motion: for every action, there is an equal and opposite reaction. A turbojet engine is a sophisticated and powerful application of this exact same principle.

Thrust is the forward-pushing force that propels an aircraft. In a turbojet engine, thrust is generated by taking in a large amount of air, heating it to extreme temperatures, and then expelling a high-velocity jet of gas from the rear of the engine.

This document will explain the step-by-step process of how the 40KG turbojet engine transforms simple air and fuel into powerful, continuous thrust. We will follow the journey of air as it travels through the engine, turning from a simple atmospheric gas into a propulsive force.

Let's begin with a high-level overview of the four fundamental stages of this process.

2. The Four Key Stages: A High-Level Overview

The entire operation of a turbojet engine can be broken down into four continuous stages: **Intake**, **Compression**, **Combustion**, and **Exhaust**. Each stage has a specific goal and is carried out by a key set of components.

The following table provides a summary of the entire process, from air entering the front to thrust being produced at the rear.

Stage	Primary Goal	Key Component
1. Intake	To efficiently capture a large, uniform flow of air.	Inlet runner
2. Compression	To dramatically increase the pressure and temperature of the air.	Billet wheel (Compressor)
3. Combustion	To add a massive amount of heat energy to the compressed air.	Combustion Chamber
4. Exhaust	To extract energy to power the engine's compressor and then generate forward thrust by expelling the remaining hot gas at high speed.	Exhaust Nozzle

Now, we will take a closer look at the specific actions and components involved in each of these four critical stages.

3. The Step-by-Step Journey of Air Through the Engine

3.1. Stage 1: Intake (Suck)

Goal: To capture a large, uniform flow of air for the engine.

The process begins as air from the atmosphere is drawn into the front of the engine through the **Inlet**. The primary component here, the **Inlet runner**, is carefully designed to slow the air down and slightly increase its pressure. This prepares the air by creating a smooth, stable flow, ensuring the next stage can operate as efficiently as possible.

3.2. Stage 2: Compression (Squeeze)

Goal: To squeeze the captured air, dramatically increasing its pressure and temperature.

From the inlet, the air flows directly into the compressor section. In this 40KG engine, the key component is the **Billet wheel**, the impeller of a centrifugal compressor. This wheel spins at incredibly high speed, flinging the air outwards and forcing it into a smaller and smaller space. This mechanical squeezing action significantly raises both the pressure and temperature of the air.

This stage is critical because highly compressed, high-energy air is now primed for extremely efficient and powerful combustion in the next step.

3.3. Stage 3: Combustion (Bang)

Goal: To add a massive amount of heat energy to the compressed air by burning fuel.

The high-pressure, high-temperature air from the compressor is forced into the **Combustion Chamber**. Inside this chamber, a fine mist of fuel is continuously sprayed through **Injectors**. This fuel-air mixture is then ignited by a **Glow Plug** during the engine's startup sequence. The result is a continuous, controlled explosion.

This intense combustion process causes a rapid and powerful expansion of the gases, increasing their temperature to as high as 1000°C. This superheated, high-energy gas is now ready to do work and create thrust.

3.4. Stage 4: Turbine and Exhaust (Blow)

Goal: To use the high-energy gas to first power the engine itself, and second, to generate thrust.

This final stage has two distinct but connected purposes, happening in rapid succession:

- **Powering the Engine:** Before the hot gas can exit, it first blasts through the **Turbine wheel**. This is a wheel with a series of complex blades, much like a windmill. The force of the expanding gas causes the turbine wheel to spin at immense speed. This is the clever part of the design: the turbine is connected directly to the compressor at the front of the engine by the **Turbine shaft**. The spinning of the turbine provides all the power needed to drive the compressor, making the entire process a self-sustaining cycle. To maximize efficiency, **Nozzle Guide Vanes (NGV)** are positioned just before the turbine to direct the hot gas onto the turbine blades at the perfect angle.
- **Generating Thrust:** After spinning the turbine, the hot gas has given up some of its energy, but it is still at a very high pressure and temperature. This remaining energy is used to create thrust. The gas is channeled and accelerated out of the back of the engine through the **Exhaust Nozzle**. This high-velocity jet of gas exiting the engine is the *action*. According to Newton's Third Law, this creates an

equal and opposite *reaction* that pushes the engine forward. This forward push is **Thrust**.

With the process broken down, let's see how these four stages work together in a continuous loop.

4. The Self-Sustaining Cycle

The brilliance of the turbojet engine lies in how these four stages—Intake, Compression, Combustion, and Exhaust—are linked in a continuous, self-sustaining cycle.

Once started by an electric starter motor, the engine runs on its own. The most critical part of this cycle is the mechanical link between the back and the front of the engine. The incredible energy extracted from the hot exhaust gas by the **Turbine** is immediately transmitted forward along the **Turbine shaft** to power the **Compressor**. The compressor, in turn, continuously feeds the combustion chamber with high-pressure air, which creates the hot gas needed to spin the turbine. This elegant feedback loop allows the engine to run continuously, producing powerful thrust as long as it is supplied with fuel.

5. Conclusion: From Air to Thrust

In summary, a turbojet engine is a masterful application of fundamental physics. It works by continuously executing a four-stage process:

1. **Sucking** in air.
2. **Squeezing** that air to high pressure.
3. **Adding intense heat** by burning fuel (the "bang").
4. **Blowing** the resulting hot gas out the back at extremely high speed.

This process is built on the foundational principle of action and reaction, where the force of the rearward-blasting exhaust jet creates an equal and opposite force, pushing the engine—and the aircraft—powerfully forward.