Gas Turbine Engine

Both piston (reciprocating) engines and gas turbine engines are internal combustion engines. They have a similar cycle of operation that consists of induction, compression, combustion, expansion, and exhaust. In a piston engine, each of these events is a separate distinct occurrence in each cylinder. Also in a piston engine, an ignition event must occur during each cycle in each cylinder. Unlike reciprocating engines, in gas turbine engines these phases of power occur simultaneously and continuously instead of successively one cycle at a time. Additionally, ignition occurs during the starting cycle and is continuous thereafter. The basic gas turbine engine contains four sections: intake, compression, combustion, and exhaust. *[Figure 14-1]*

To start the engine, the compressor section is rotated by an electrical starter on small engines or an air-driven starter on large engines. As compressor rates per minute (rpm) accelerates, air is brought in through the inlet duct, compressed to a high pressure, and delivered to the combustion section (combustion chambers). Fuel is then injected by a fuel controller through spray nozzles and ignited by igniter plugs. (Not all of the compressed air is used to support combustion. Some of the compressed air bypasses the burner section and circulates within the engine to provide internal cooling, enhanced thrust, and noise abatement. In turbojet engines, by-pass airflow may be augmented by the action of a fan located at the engine's intake.) The fuel/air mixture in the combustion chamber is then burned in a continuous combustion process and produces a very high temperature, typically around 4,000° Fahrenheit (F), which heats the entire air mass to 1,600 – 2,400 °F. The mixture of hot air and gases expands and is directed to the turbine blades forcing the turbine section to rotate, which in turn drives the compressor by means of a direct shaft, a concentric shaft, or a combination of both. After powering the turbine section, the high velocity excess exhaust exits the tail pipe or exhaust section. (The exhaust section of a turbojet engine may also incorporate a system of moving doors to redirect airflow for the purpose of slowing an airplane down after landing or back-powering it away from a gate. They are referred to as thrust reversers). Once the turbine section is powered by gases from the burner section, the starter is disengaged, and the igniters are turned off. Combustion continues until the engine is shut down by turning off the fuel supply.

NOTE: Because compression produces heat, some pneumatic aircraft systems tap into the source of hot (480 °F) compressed air from the engine compressor (bleed air) and use it for engine anti-ice, airfoil anti-ice, aircraft pressurization, and other ancillary systems after further conditioning its internal pressure and temperature.

High-pressure exhaust gases can be used to provide jet thrust as in a turbojet engine. Or, the gases can be directed through an additional turbine to drive a propeller through reduction gearing, as in a turbopropeller (turboprop) engine.

Turboprop Engines

The turbojet engine excels the reciprocating engine in top speed and altitude performance. On the other hand, the turbojet engine has limited takeoff and initial climb performance as compared to that of a reciprocating engine. In the matter of takeoff and initial climb performance, the reciprocating engine is superior to the turbojet engine. Turbojet engines are most efficient at high speeds and high altitudes, while propellers are most efficient at slow and medium speeds (less than 400 miles per hour (mph)). Propellers also improve takeoff and climb performance. The development of the turboprop engine was an attempt to combine in one engine the best characteristics of both the turbojet and propeller-driven reciprocating engine.

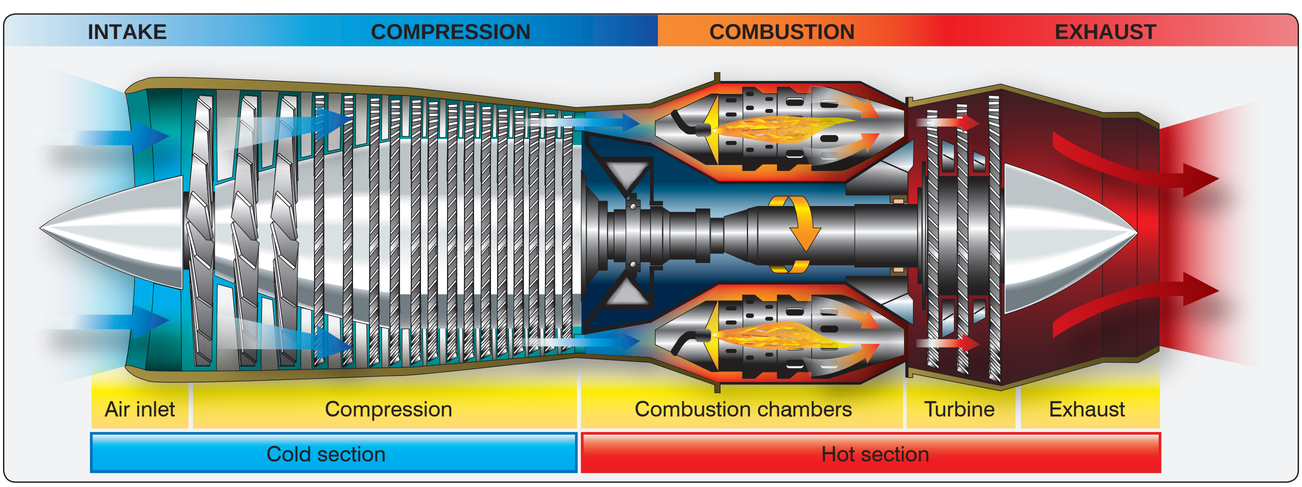

Figure 14-1. *Basic components of a gas turbine engine.*