

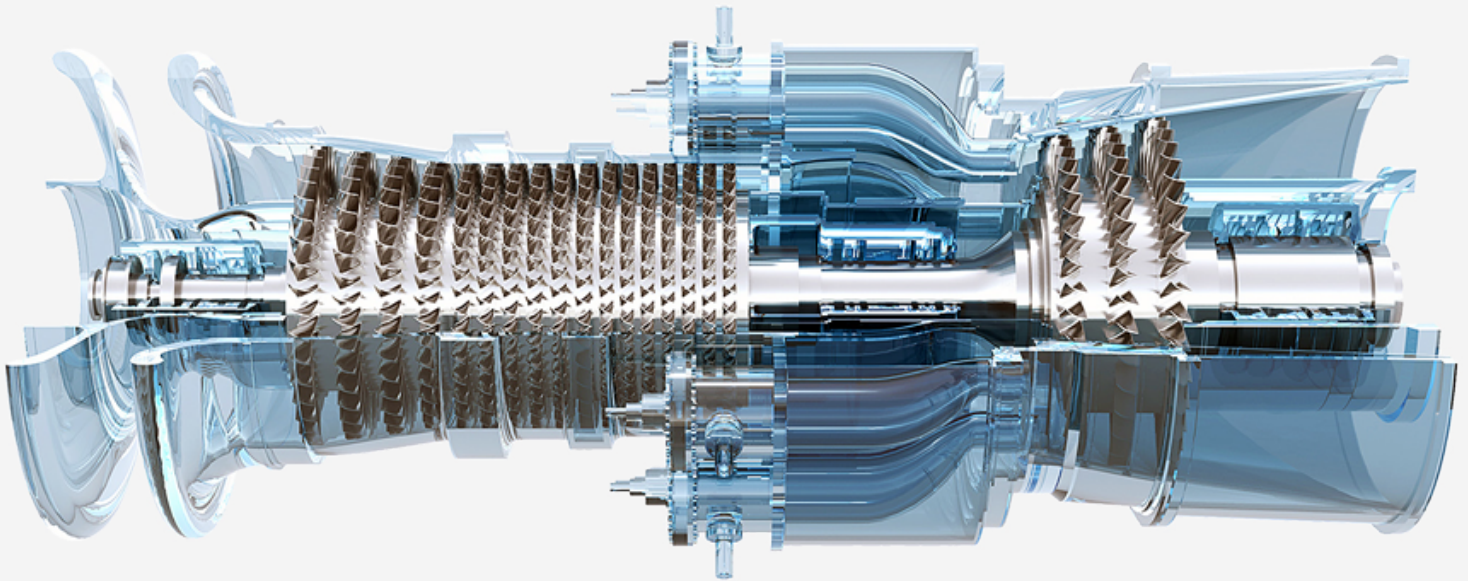
# A GAS TURBINE

A GAS TURBINE, ALSO CALLED A COMBUSTION TURBINE, IS A TYPE OF CONTINUOUS AND INTERNAL COMBUSTION ENGINE. THE MAIN ELEMENTS COMMON TO ALL GAS TURBINE ENGINES ARE:

AN UPSTREAM ROTATING GAS COMPRESSOR

A COMBUSTOR

A DOWNSTREAM TURBINE ON THE SAME SHAFT AS THE COMPRESSOR.



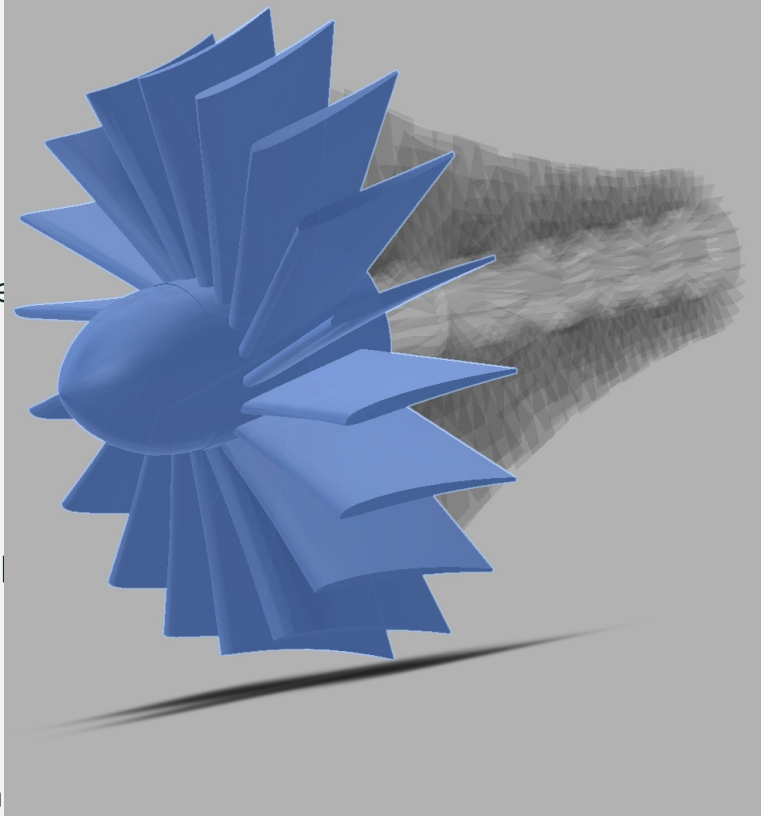
**A FOURTH COMPONENT IS OFTEN USED TO INCREASE EFFICIENCY (ON TURBOPROPS AND TURBOFANS), TO CONVERT POWER INTO MECHANICAL OR ELECTRIC FORM (ON TURBOSHAFTS AND ELECTRIC GENERATORS), OR TO ACHIEVE GREATER THRUST-TO-WEIGHT RATIO (ON AFTERBURNING ENGINES).**

The basic operation of the gas turbine is a Brayton cycle with air as the working fluid: atmospheric air flows through the compressor that brings it to higher pressure; energy is then added by spraying fuel into the air and igniting it so that the combustion generates a high-temperature flow; this high-temperature pressurized gas enters a turbine, producing a shaft work output in the process, used to drive the compressor; the unused energy comes out in the exhaust gases that can be repurposed for external work, such as directly producing thrust in a turbojet engine, or rotating a second, independent turbine (known as a power turbine) that can be connected to a fan, propeller, or electrical generator. The purpose of the gas turbine determines the design so that the most desirable split of energy between the thrust and the shaft work is achieved. The fourth step of the Brayton cycle (cooling of the working fluid) is omitted, as gas turbines are open systems that do not reuse the same air.

Gas turbines are used to power aircraft, trains, ships, electrical generators, pumps, gas compressors, and tanks.

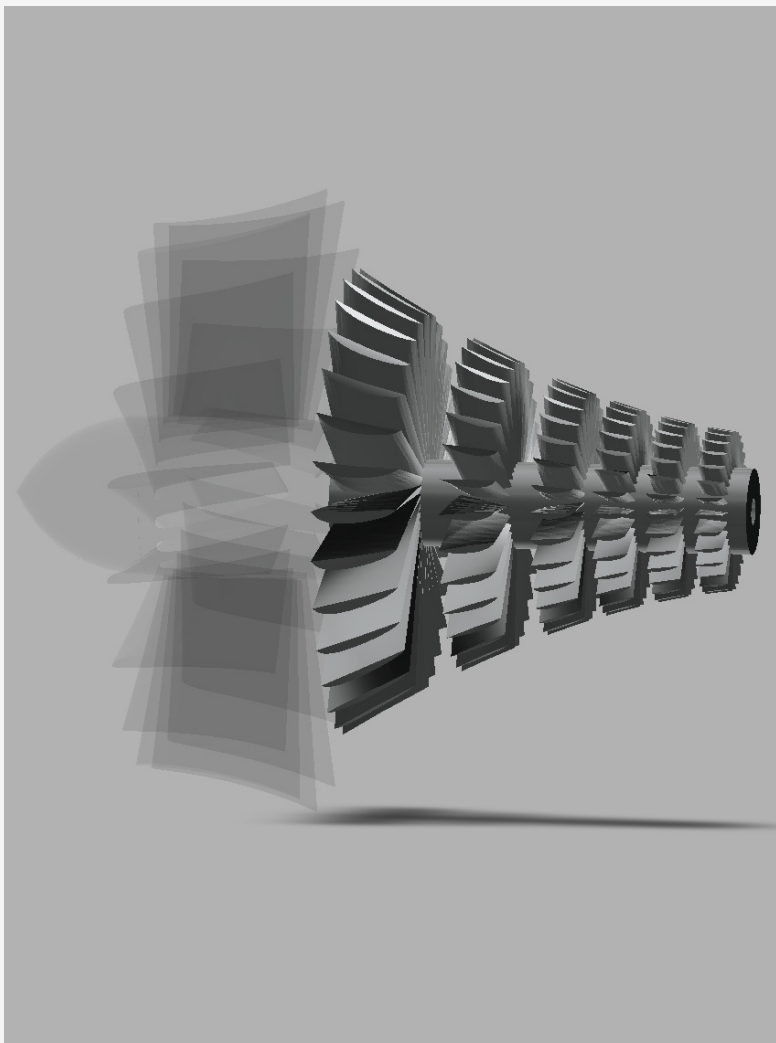
# GAS TURBINE ENGINE COMPRESSORS

As the name suggests, gas turbine engine compressors provide the compression part of the gas turbine engine thermodynamic cycle. There are three basic categories of gas turbine engine compressor: axial compressor, centrifugal compressor and mixed flow compressor. A fourth, unusual, type is the free-piston gas generator, which combines the functions of compressor and combustion chamber in one unit.

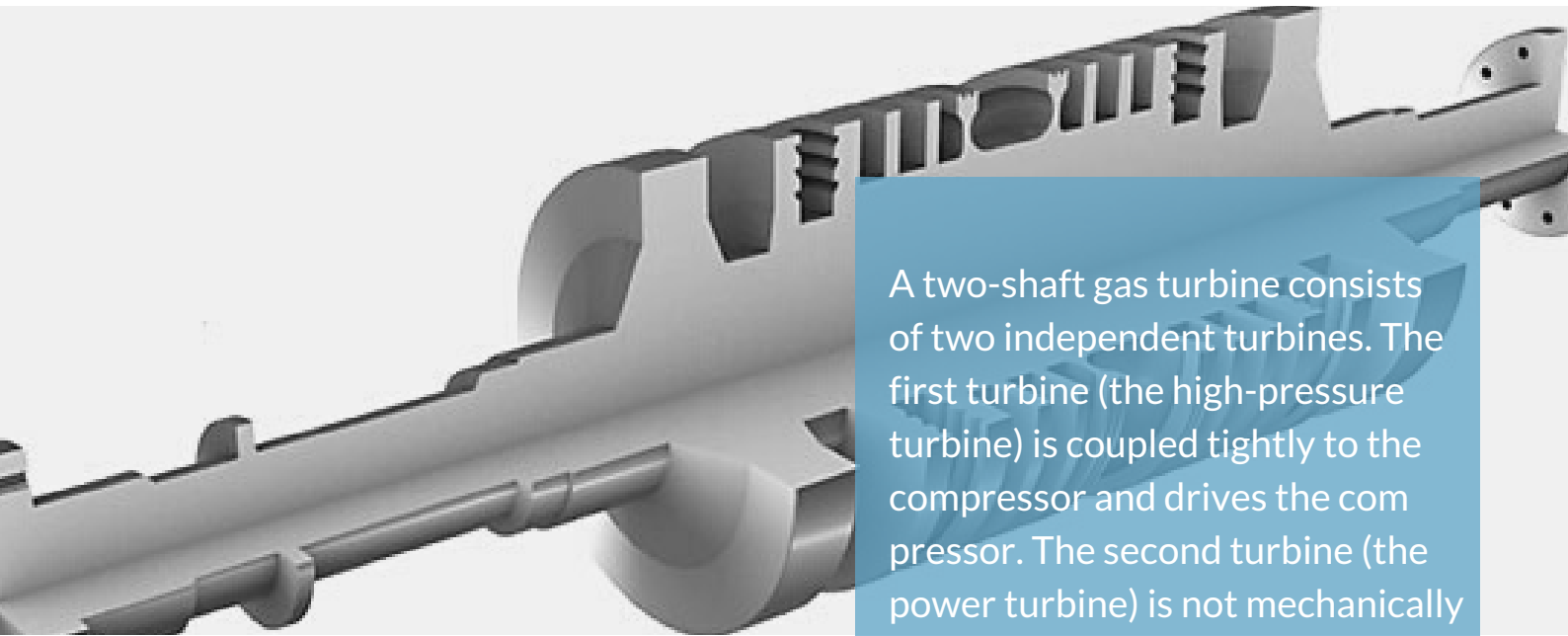


## AXIAL COMPRESSOR

An axial compressor is a gas compressor that can continuously pressurize gases. It is a rotating, airfoil-based compressor in which the gas or working fluid principally flows parallel to the axis of rotation, or axially. This differs from other rotating compressors such as centrifugal compressor, axi-centrifugal compressors and mixed-flow compressors where the fluid flow will include a "radial component" through the compressor. The energy level of the fluid increases as it flows through the compressor due to the action of the rotor blades which exert a torque on the fluid. The stationary blades slow the fluid, converting the circumferential component of flow into pressure. Compressors are typically driven by an electric motor or a steam or a gas turbine



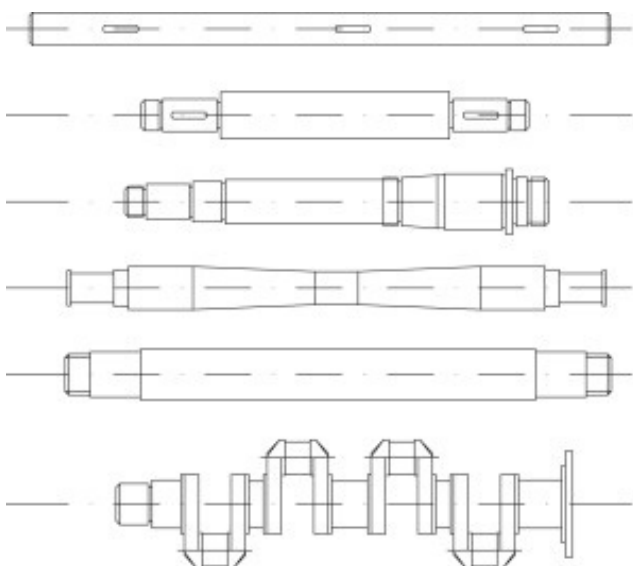
# GAS TURBINE SHAFT



A two-shaft gas turbine consists of two independent turbines. The first turbine (the high-pressure turbine) is coupled tightly to the compressor and drives the compressor. The second turbine (the power turbine) is not mechanically coupled with the high-pressure turbine, and generates the effective power of the system.

## Steam turbine shaft

Turbine shafts are mainly machined through turning and groove-cutting operations with some amounts of drilling. Large amounts of metal are removed and demanding grooves have to be cut.



# Turbine blade



A turbine blade is the individual component which makes up the turbine section of a gas turbine or steam turbine. The blades are responsible for extracting energy from the high temperature, high pressure gas produced by the combustor. The turbine blades are often the limiting component of gas turbines.] To survive in this difficult environment, turbine blades often use exotic materials like superalloys and many different methods of cooling that can be categorized as internal and external cooling, and thermal barrier coatings. Blade fatigue is a major source of failure in steam turbines and gas turbines. Fatigue is caused by the stress induced by vibration and resonance within the operating range of machinery. To protect blades from these high dynamic stresses, friction dampers are used.



**Blades of wind turbines and water turbines are designed to operate in different conditions, which typically involve lower rotational speeds and temperatures.**

In a gas turbine engine, a single turbine section is made up of a disk or hub that holds many turbine blades. That turbine section is connected to a compressor section via a shaft (or "spool"), and that compressor section can either be axial or centrifugal. Air is compressed, raising the pressure and temperature, through the compressor stages of the engine. The temperature is then greatly increased by combustion of fuel inside the combustor, which sits between the compressor stages and the turbine stages.

