

## Design of Aerospike Engines: Overcoming Challenges to Revolutionize Spaceflight

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### DESCRIPTION

The aerospike engine is a revolutionary type of rocket engine that has the potential to transform space travel. Unlike traditional rocket engines that use a nozzle to expand gases and create thrust, the aerospike engine uses a shape similar to a spike. This design allows the engine to maintain its efficiency over a wider range of altitudes, making it ideal for spacecraft that need to travel to various altitudes. Several prototypes of the aerospike engine have been developed, and it has been used by private companies such as Space-X and Blue Origin.

One of the most significant advantages of the aerospike engine is its ability to maintain its efficiency over a wider range of altitudes. Traditional rocket engines are designed to be most efficient at a specific altitude, and their efficiency drops off as they move away from that altitude. This means that spacecraft that need to travel to various altitudes must use different engines, which can add weight and complexity to the spacecraft. The aerospike engine, on the other hand, can maintain its efficiency over a wider range of altitudes, reducing the need for multiple engines.

The aerospike engine works by using the expansion of gases to create thrust. The gases are heated and then expelled out of the engine at high speeds, creating a force that propels the spacecraft forward. As the gases expand, they push against the sides of the spike, creating a cone of thrust. This cone of thrust is more efficient than a traditional rocket engine because it can maintain its efficiency over a wider range of altitudes.

Another advantage of the aerospike engine is its simplicity. Traditional rocket engines require a nozzle, which is a complex and expensive component. The aerospike engine, on the other hand, does not require a nozzle, making it simpler and less expensive to manufacture. This simplicity also means that the aerospike engine is more reliable than traditional rocket engines, as there are fewer components that can fail.

More recently, private companies such as Space-X and Blue Origin have started using aerospike engines in their spacecraft. Space-X is currently developing the Starship spacecraft, which is

designed to take humans to Mars and beyond. The Starship will be powered by Raptor engines, which are a type of aerospike engine. The Raptor engine is a highly advanced version of the aerospike engine, and it is designed to be more efficient and more powerful than traditional rocket engines. The Raptor engine uses methane as fuel, which is a more efficient and less expensive fuel than the traditional rocket fuel, which is usually a combination of liquid hydrogen and liquid oxygen.

Blue Origin is also developing a spacecraft that will be powered by an aerospike engine. Blue Origin's engine, called the BE-4, is designed to be used on their New Glenn spacecraft. The New Glenn is a heavy-lift rocket that is designed to compete with Space-X's Falcon Heavy. The BE-4 engine is designed to be more efficient than traditional rocket engines, which will give the New Glenn an advantage in the commercial space market.

The development of the aerospike engine has the potential to revolutionize space travel. The engine's ability to maintain its efficiency over a wider range of altitudes has numerous practical applications. For example, the engine can be used to power reusable launch vehicles that can take off and land like an airplane. The aerospike engine's efficiency also means that less fuel is required for a given mission, which can reduce the cost of space travel.

The aerospike engine has been under development for several decades, and various prototypes have been developed and tested. The first successful aerospike engine test was conducted in the 1990s by the NASA-led Linear Aerospike SR-71 Experiment (LASRE) program. The LASRE program successfully demonstrated the effectiveness of the aerospike engine at high altitudes and speeds.

Since then, private companies such as Space-X and Blue Origin have taken up the development of the aerospike engine. Space-X's Raptor engine, which uses an aerospike design, is currently being developed to power the company's Starship spacecraft. The Starship is designed to take humans to Mars and beyond and is expected to play a critical role in future space exploration. Blue Origin's BE-4 engine is also an aerospike engine and is being developed to power the company's New Glenn spacecraft.

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**Received:** 01-Mar-2023, Manuscript No. JAAE-23-23027; **Editor assigned:** 03-Mar-2023, PreQC No. JAAE-23-23027 (PQ); **Reviewed:** 17-Mar-2023, QC No. JAAE-23-23027; **Revised:** 24-Mar-2023, Manuscript No. JAAE-23-23027 (R); **Published:** 31-Mar-2023, DOI: 10.35248/2168-9792.23.12.305

**Citation:** Sun Q (2023) Design of Aerospike Engines: Overcoming Challenges to Revolutionize Spaceflight. J Aeronaut Aerospace Eng. 12:305.

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The New Glenn is a heavy-lift rocket that is expected to compete with Space-X's Falcon Heavy in the commercial space market.

Blue Origin's BE-4 engine has been in development for several years and is expected to be a game-changer in the space industry due to its efficiency and power.

The development of the aerospike engine has not been without its challenges, however. One of the major challenges is the complexity of the engine's design. Although the aerospike engine does not require a traditional nozzle, it requires precise control of the exhaust gases to maintain its efficiency. This requires advanced control systems and software, which can be challenging to develop and test. Another challenge is the manufacturing process. The aerospike engine's complex design requires precise manufacturing techniques, which can be expensive and time-consuming. This is especially true for the engine's spike, which must be precisely shaped and cooled to withstand the extreme temperatures and pressures of the exhaust gases.

Despite these challenges, the development of the aerospike engine is continuing. The engine's potential to revolutionize space travel has attracted the attention of private companies, government agencies, and research institutions around the world. With continued development and testing, the aerospike engine could become the preferred engine for future space missions. In conclusion, the aerospike engine is a unique and efficient type of rocket engine that has the potential to revolutionize space travel. Its ability to maintain efficiency over a wider range of altitudes makes it an ideal engine for spacecraft that need to travel to various altitudes. The simplicity of the engine makes it less expensive and more reliable than traditional rocket engines. The aerospike engine has already been successfully tested and is being developed by private companies such as Space-X and Blue Origin for use in their spacecraft. Although the development of the aerospike engine has its challenges, its potential benefits for space travel are enormous, and it is likely to play a critical role in future space missions.