







Design and analysis of composite materials based piston

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Abstract

For decades, the piston has been designed to impart force to the crank shaft via a piston rod by expanding gases in the cylinder. During operation, the piston must withstand cyclic gas pressure and inertial stresses, resulting in fatigue damages such as piston head cracks, piston side wear and so on. Because of their small weight and high heat transfer rate, olden pistons were composed of C.I or aluminum. Following various studies, it was discovered that when cast iron is heated, it expands and covers the clearance level, causing the engine to seize. The mechanical and thermal properties of the piston are described in this paper when the study is conducted using five distinct methods.

Introduction

A piston is an engine component that reciprocates rapidly, producing combustion and propelling the vehicle forward. The primary function of a piston is to transfer power from the cylinder's gas to the crankshaft via the connecting rod [1], [2]. To minimize weight and enhance thermal conductivity, the piston is commonly made of an aluminum alloy. The aluminum alloy piston, on the other hand, is not suitable for use at high temperatures due to its poor strength and high coefficient of thermal expansion [3]. Carbon-carbon fiber, a carbon reinforced matrix, is used as an alternative to aluminum alloy pistons to solve the challenges [4].

The Fig. 1, Fig. 2 shows the arrangement of piston and three dimensional view of piston respectively. A piston is a movable disc surrounded by a cylinder that is air tightly sealed by a piston ring [5], [6], [7], [8]. As a liquid or gas expands and contracts in the cylinder, the disc moves in the cylinder. Pistons help convert thermal energy into mechanical work and vice versa. Pistons are classified into three varieties based on their shape: flat top, dome, and dish. A piston is a lubricated sliding shaft that fits snugly into the cylinder's opening [9], [10], [11]. Its purpose is to extract the quantity contained within the cylinder, to apply pressure to a fluid within the cylinder, to cover and locate ports, or a combination of these.

Section snippets

Literature survey

B. Satish et al. [3] analyzed a piston constructed of composite material (aluminum silicon carbide alloy) that has been successfully designed and studied. A piston built of composite materials. Metal matrix composites retain a high level of strength. On aging in harsh conditions when compared to the aluminum silicon carbide alloy is a type of aluminum alloy. Has been discovered to have reduced deformations, temperature distribution and stress is good. Even though there are few aluminum alloy...

Piston specifications

The following piston specifications are considered and Fig. 3 shows the construction view of the piston shown below.

- With a precision of +0.03 GPa, the pressure range is 0.3 to 4.0 GPa....
- Temperatures in the sample vary from 25 to 2000°C, with +15°C gradients....
- 300°C/second maximum quench rates....
- Temperatures of heating and cooling can be controlled....
- For runs with a 13mm ID pressure plate up to 2.5 GPa, a sample volume of 150mm³ is required....

There must be enough room in the cylinder for the piston ...

Conclusion

The cylinders in most engines are smooth finished holes in the engine's main structural component, the block, which is often made of cast iron or aluminum. Certain engines have sleeves (liners) that can be replaced when they wear out in the cylinders. Centrifugally cast iron liners that are put in the mould during the casting process are required for aluminum blocks; these liners cannot be replaced, although they can be rebored. Piston rings are commonly found on pistons. Metal rings that fit...

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper....

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