

IC Engine Piston Design and Analysis

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ABSTRACT: In the present work the stress and thermal stress distribution of five different materials for the piston are defined using the Finite-Element-Method (FEM). The operative gas pressure, temperature, and material properties of the piston are the parameters used in the simulation. The requirements for these pistons belong to Bajaj Kawasaki motorcycle's four-stroke single-piston engine. The findings foresee the full tension and critical area on the multiple substance pistons using FEA. In ANSYS 15 static and thermal analyses are done by means of CATIA v5 software and analyses using ANSYS software. Based on the structural and thermal analysis findings from these Al-sic graphite A7075, A6082, A4032, AL-ghy 1250 materials, the required material is chosen.

KEYWORDS: Finite Element Analysis, Finite Element Manufacturing, Piston, Stress, Thermal Analysis.

I. INTRODUCTION

The piston (figure 1) is a core of a motor car. It is one of the major engine elements even under demanding conditions. The role of the piston is to sustain the pressure of the gas which causes the crankshafts to move through the reel. The pistons work at high temperature, high pressure and low grain speed. At a high temperature, the instantaneous temperature of up to 2500 K can be related directly to the gas piston[1]. Due to the high temperature in the construction, when pistons are working on the motor and the temperature cannot be justified, the surface temperature of the piston will exceed 600 to 700K.



Figure 1: Piston[2]

High corrosion resistance is known to Aluminium alloys[3]. These alloys are susceptible and appear to lose some of their strength to high temperatures between 200 to 250°C and 392 to 482°F. But at subzero temperatures the strength of aluminum/aluminum alloys can be increased, making them perfect low-temperature alloys. 4032 alloy is made of Aluminium. A sort of worked alloy. More material on the following data sheet 4032 Aluminium is an Aluminium alloy that is further graded as part of the 4000 Series.[4] Aluminum 4032 alloy (aluminum-silicon wrought alloy). It is normally fitted with the temperature T6. 4032 is the code for this substance of the Aluminum Association (AA). It

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is traditionally issued as EN AW-4032 under European standards. Furthermore, AlSi12, 5MgCuNi is the EN chemicals designation. DTD324B is also known as the UK Standard (BS).

1.1 Functions of piston

1. The piston is to be reciprocated with suction, compression, expansion and exhaust strokes as a close gas plug.
2. To pick up and transfer the thrust generated by the gas explosion in the piston to the connecting rod.
3. Form a guide and bear on the small end of the connecting rod and take a side pin because of the rod's obliquity[5].

1.2 Piston Working Factors

1. In order to withstand gas pressure and inertia, the piston should have tremendous power and heat resistance. To mitigate inertia forces, they should have minimum weight.
2. The piston material can dispel heat from the crown through the rings and the bearing region to the cylindrical walls easily and well. The oil and gas seal should be successful[6].
3. Piston material must have reasonable wearing properties, in order that the piston can hold the surface strong enough for working temperatures.
4. In order to survive thermal, mechanical distortion and enough area to avoid unequal wear, piston should be rigidly built. It also has thermal expansion such that discontinuities are as open as possible[7].

1.3 Design consideration

In the construction of an I.C. piston Engine, taking into account the following points:

1. The high gas pressure and inertia forces should be immune to tremendous strength.
2. To mitigate inertia powers, it should have a minimum weight.
3. The piston can be effectively enclosed by gas and oil[8].
4. Sufficient bearing area should be given to discourage unequal wear.
5. The combustion heat can be spread easily to the walls of the piston.
6. It can reciprocate at high speed without noise.
7. It should be rigid enough to avoid thermal and mechanical distortion[9].

Characteristic of Piston:

Piston need to work appropriately in a wide scope of temperatures, the reach being - 30 °C to up to 300-400 °C. In a similar time should be light enough to have low idleness and permit high motor paces. There are several mathematical qualities of the piston which are introduced beneath.

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1. Piston ovality:

Because of the burning cycle, the temperature inside the motor chambers arrives at many degrees Celsius. The piston is one of the fundamental segments which retains part of the created heat and scatters it into the motor oil. Since the piston pin pivot contains more material than the skirt hub, the warm development along the pin hub is somewhat higher than the warm extension along the skirt hub. Hence the piston is oval, the breadth along the pin pivot is between 0.3-0.8 % more modest than the width along the skirt hub.

The state of the piston is certainly not an ideal chamber. At low temperature, the freedom between the piston and the motor chamber is higher contrasted and high temperatures. Additionally, the freedom isn't consistent along the piston length, it is more modest around the piston top contrasted and the piston skirt locale. This is to permit more warm development of the piston head, since it contains more volume of metal.

The piston development inside the chamber has 3 levels of opportunity, 1 essential and 2 optional: along the vertical hub of the chamber, between the top right on target (TDC) and base perfectly focused (BDC) (essential, y-hub) around the pin hub (optional, α – point) along the skirt pivot (auxiliary, x – hub). The essential developments is creating force at the driving rod, this is wanted from the mechanical perspective. The optional developments occur because of the blend of a few components: associating bar bidirectional development and leeway among piston and chamber. Both optional developments cause rubbing with the chamber dividers and furthermore commotion, vibration (piston slap).

At the point when the driving rod pivot is clockwise, the left half of the chamber is known as the push side (TS) and the contrary side is known as the counter pushed side (ATS). Piston effects can happen on one or the other side of the chamber. Piston slap energizes the motor square and shows itself as surface vibrations, which are ultimately transmitted as clamor in the region of the motor. Another awkward is that when the piston travels through the TDC and BTC, expanded burden is created onto the driving rod, on the grounds that the piston is lined up with the driving rod focal point of pivot.

The piston pin balance is the misalignment between the focal point of the piston pin bore and the focal point of the driving rod. By having it in the plan, it improves the commotion qualities of the motor because of piston slap at TDC. This is a significant NVH (commotion vibration and brutality) worry to creation engineers who need to take out disturbing clamors anyplace they can. The subsequent explanation is to improve motor yield by lessening inside grating on the TS and ATS.

II. DISCUSSION

ANSYS V15.0 is used to evaluate the build column in CATIA and displays the findings below. Gase combustion exerts pressure on the piston head during power stroke in the combustion chamber. At the pinhole surface, fixed support was provided. And with the aid of a set pinhole support the piston travels from top to bottom down to the dead core.

III. CONCLUSION

The pistons have been analyzed for an equal stress (von-mises) stress, elastic equivalent pressure, a cumulative heat deformation flux and a temperature distribution in the structural and thermal analysis. The required substance may be based on the structural and thermal analysis findings from the Al-Sic graphite material A7075, A6082, A4032, AL-ghy1250.

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