

# Selection and Optimization of Gasket Materials

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**ABSTRACT:** Our project work deals with the failures of a gasket used in an automobile which had been involved in an engine temperature. The gasket was found to thermal stress according to changing of various temperatures. The investigation was carried out in order to establish whether the failure will be the cause or a consequence of the engine temperature. To find out the cause of fracture of the gasket, a Finite Element Method (FEM) should be carried out to predict the stress state of the gasket under (steady state) thermal effect loading. During working condition thermal effect will be produced under normal operation of engine. The gasket model was design by using SOLIDWORKS, Different material will be applied and analysis part was done with ANSYS and also theoretical calculations were proved to be correct. As an added advantage we also reduced the cost of gasket unit with the material we have suggested.

**KEYWORDS:** Gasket, FEM, ANSYS, Stress, and Temperature.

## I. INTRODUCTION

Gasket acts well as the excellent seal between the surfaces. Since it is compressed together, the strength should be considered carefully by regard of that of the other components of the combustion chamber. The space between the surfaces or the cylinders is nearly none for the leakage. The excellent tightness does great favours to the performance of the whole equipment. Referring to the materials used for the manufacturing of this part, they would be multiple layer steel, graphite or asbestos. Multiple layer steel usually has three layers of the steel and occupies the contact faces coated with a rubber-like coating. To be frankly, the multiple layer steel is mostly used, especially for the typical modern cylinder. And the one made of the graphite or asbestos, which called the composite cylinder head gasket, is easy to be with more blowouts. Whatever, it plays its role perfectly in the engine.

Head gasket plays an important role at ensuring the maximum compression between the engine block and the cylinder head, leading to the appreciated no-leakage. It is also called as cylinder head gasket, which has been widely applied in various combustion systems, including the car's internal combustion engine. The cylinder head gasket here aims to transfer the gases and the heat and prevent the internal leakage.

## II. LITERATURE REVIEW

**L.Vijayabaskar et al**(2016) carried out to perform a thermal analysis test on cylinder head gasket of four stroke engine. This analysis can be used for knowing the failures occur in the cylinder head gasket and make the comparison between two gasket materials. Mainly the deformation in the gasket materials occur due to the temperature different. In this report, the commercial FEM software, ANSYS, is introduced in to the numerical simulation of the thermal analysis. The gasket diagram is done by using PRO-E software. The imported diagram from the PRO-E software is used for

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analysis. Inner and outer temperature value of gasket is taken by the experimental method. Thermocouple sensor is used for determination of temperature. The gasket material is done by 3D solid.

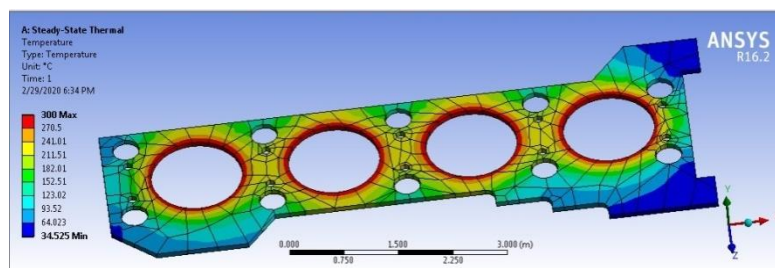
**Dr M K Rodge et al** (2016) Proposed that Cylinder head gasket is one of the most important components in order to produce effective seal. It is always important to select the proper material for the cylinder head gasket so that it should not affect on the other components of the engine while assembling. Structural steel is the commonly used material for the cylinder head gasket. Generally nonlinear analysis is performed in order to produce more accurate results. Most of the time we have to face the problem of breakage of gasket while tightening the bolts since we have to apply sufficient bolt load for the proper sealing. Sometimes modification of the shape of the cylinder head gasket is also required to achieve flexibility in the model and to avoid the breakage during tightening of the bolt. In this paper we have considered the multilayer cylinder head gasket of single cylinder diesel engine for the analysis. Nonlinear analysis for the cylinder head gasket is performed to reduce the bore distortion as well as to achieve the optimum contact pressure on the cylinder head gasket. Modeling has done in the CRE-O 2.0 and for the analysis ANSYS 15 software is used.

### III. METHODOLOGY

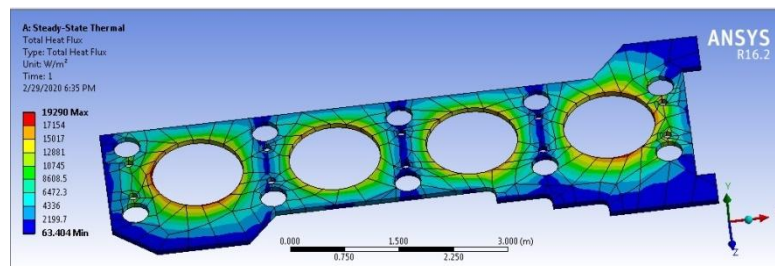
For these three materials for gasket we select Carbon steel (AISI 316L), Stainless steel (grade 321), Chromium (CR12). That materials to analysis the thermal expansion of gasket for different materials and find the thermal stress and temperature deformation of this three materials of gasket. By comparing this three temperature distribution which material is good and cost reduction.

### IV. EXPERIMENTAL RESULTS

Figures show the results of thermal analysis of the materials. Fig 1, 2, 3 shows the thermal analysis of cylinder head gasket for different materials



1 (a) Temperature distribution of CR 12 steel



1 (b) Total Heat flux of CR 12

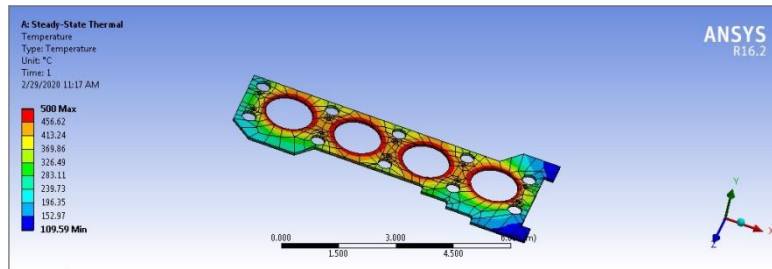
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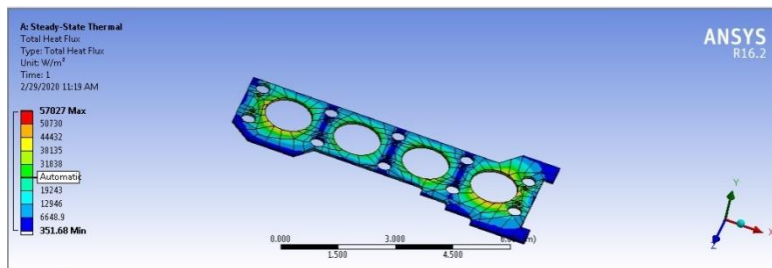
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Fig.1. Thermal analysis of cylinder head gasket(Chromium steel)(a) Temperature distribution of CR 12 steel(b) Total Heat flux of CR 12

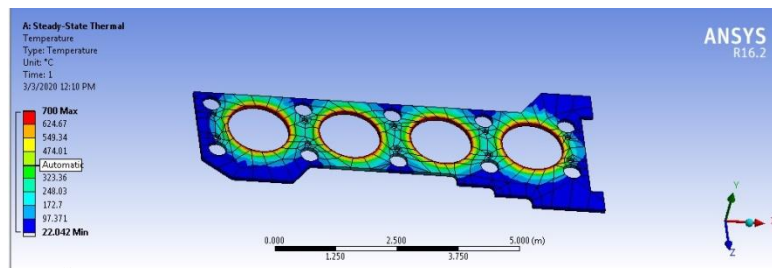


2 (a) Temperature distribution of Carbon steel

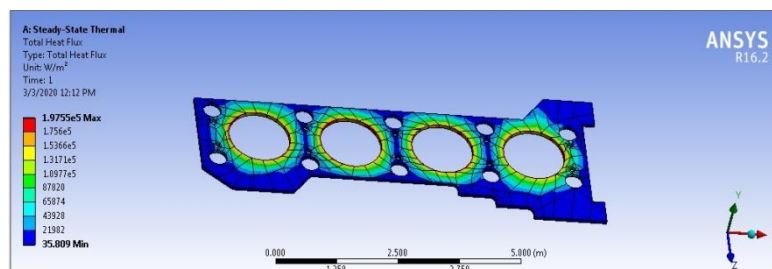


2 (b) Total Heat flux of Carbon steel

Fig.2. Thermal analysis of cylinder head gasket (carbon steel)(a) Temperature distribution of Carbon steel (b) Total Heat flux of Carbon steel



3 (a) Temperature distribution of Stainless steel



3 (b) Total Heat flux of stainless Steel

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Fig. 3 Thermal analysis of cylinder head gasket (Stainless steel)(a) Temperature distribution of Stainless steel(b) Total Heat flux of stainless Steel

Material s	Temperature		Total Heat Flux	
	min	max	min	max
units	°C	°C	W/m <sup>2</sup>	W/m <sup>2</sup>
Carbon steel AISI 316L	109.59	500	351.68	57027
Stainless Steel 321	22.04	700	358.9	1.975E <sup>5</sup>
Chromium CR12	34.5	300	63.4	19290

## V. CONCLUSION

Extensive damage caused by a blown head gasket can be the most detrimental form of engine problems. If a faulty head gasket is not detected early, a required repair of the engine block, the cylinder head, or a complete engine replacement could be required.

As analyzed this three materials carbon steel (AISI 316L), stainless steel (GRADE 321) and chromium CR12. The stainless steel has the temperature is high when compare the others and Heat flux is higher than the other material. So in this project stainless steel (GRADE 321) gasket is better efficiency than comparing the other materials. This is shown above the result table.

As we are reducing the heat transfer by using stainless steel as gasket and at the same time we find the causes and failure

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