Research Paper Engineering

Non Linear Finite Element Analysis of Rocker Cover Gasket

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ABSTRACT

Finite element analysis of gasket predicts non-linear behaviour of gasket under working conditions. Analysis is done considering two non-linear methods i.e. contact, and geometric non linearity. Contact behaviour of gasket under pressure provides further enlightenment for design of gasket.

Keywords : gasket analysis, FEA analysis, finite element analysis, non linear

INTRODUCTION

Customer demands have greatly increased quality needs during past few years. The engine has to run for long hours in harsh conditions with minimum or no maintenance. Gasket plays an important role in oil and water sealing in engines. The design requirements of gasket state that there should be no leakage of oil or water. It requires 100% sticking contact between the gasket and sealing surface. Paper mainly focuses on the analysis of sealing behaviour of the gasket.

Background

An oil cooled engine's Rocker assembly mainly engine head and rocker cover between which the gasket is sandwiched. Inside the rocker cover is the assembly of rocker arm, push rod and valves and springs. As the engine works the oil flows from the push rod to the rocker arm and through it over the assembly to provide lubrication. This oil spreads in the whole assembly over rocker cover and in the head. The main aim of the rocker cover gasket is to stop the flow of gasket outside gasket. As it is spread over oil it does not apply pressure on the gasket. So pressure in gasket does not play an important role. But the geometry of the gasket plays an important role in the sealing.

Experimental analysis mainly includes manufacturing the gasket and checking it actually on the engine. Engine has to be run for long hours to actually check single gasket.

Earlier finite element analysis mainly included one dimensional linear analysis of the gasket. Stress strain analysis does not reveal the behaviour of the gasket at the contact region. Even pressure analysis does not enlighten the behaviour of the gasket in contact region.

This paper mainly focuses on the way to check the sticking behaviour of contact between the head and the gasket. Failure of rocker cover gasket is mainly due to sliding or no contact.

Analysis Technique

A 3D model of cut section including head, gasket and rocker cover is imported from PROE into Ansys workbench software. The assembly also includes bolt, washer and rocker body.

Fig 1: 3D model of the rocker cover, head, and gasket assembly

Head, gasket and rocker cover expanded view

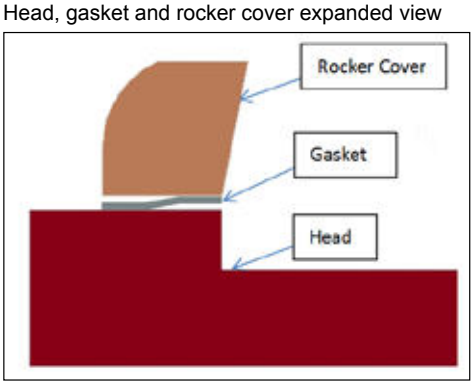

Fig 2: Exploded view of rocker cover, gasket and Head.

The whole geometry is meshed.

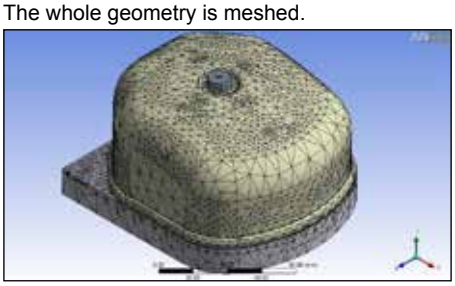

Fig 3: Meshed model

Fine and quality meshing of gasket is done as it is matter of interest. Hex Dominant Method was used for meshing to achieve the desired meshing result.

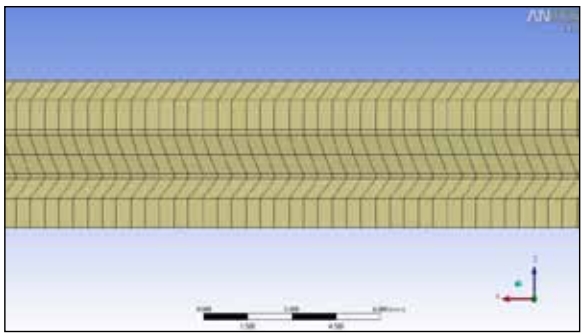

Fig 4: Exploded view of fine meshed gasket.

Table 1
Controls used

Sr. No	Control	Method
1	Contact(between Gasket and Head)	
	· Type	Rough
	· Behaviour	Symmetric
	· Formulation	Augmented lagrange
	· Interface Treatment	Adjust to Touch
2	Analysis Settings	
	· Solver type	Iterative
	· Large Deflection	On

Results
Non-linear analysis of gasket gives good results. The ansys results can be seen from the image file below

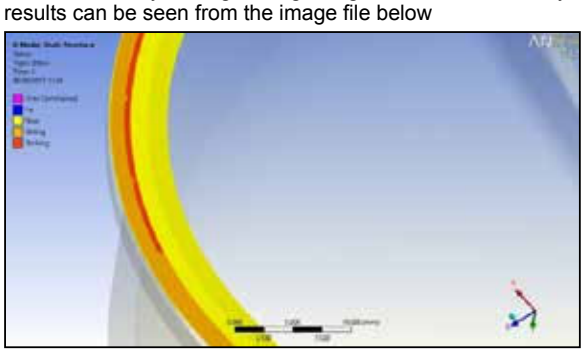

Fig 5: Figure shows gasket behaviour under pressure a) Red colour: Sticking nature b)Orange colour: Sliding nature c)Yellow colour: Near contact nature d)Blue Colour: No Contact Nature.

Sticking Region (Red colour region)
In this region the gasket is sticking to the surface and therefore there will be no leakage through the gasket.

Sliding Region (Orange colour region)
In this region the gasket is sliding over the surface of the head body. Therefore there may be leakage through the gasket by seepage.

Near region (Yellow colour region)
In this region the gasket is far near the gasket and not touching the gasket and therefore there will be leakage from the gasket if flow is high.

Far Region (Blue colour region)
In this region the gasket is far away from the gasket with no contact. Therefore there is easy leakage from this region.

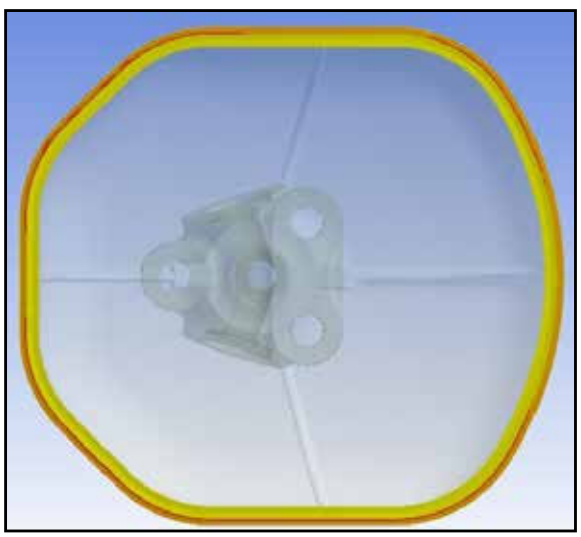

Fig 6: Contact plot of the entire gasket

It can be seen from the results that the gasket has 70% gasket has sticking contact while 30% of gasket has sliding contact. Therefore there are possibilities of minute leakages through seepages in the gasket.

Future Scope
Next time the problem can be solved by considering the material non-linearity also. This can be easily cross checked with the practical results by using Fuji film or piezoelectric sensor film.

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