ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

# Thermal Analysis of an Engine Gasket At Different Operating Temperatures

V.Arjun
M.Tech Student
Kakinada Institute of Technology & Science,
Divili, Andhra Pradesh, India

Mr. V.V. Ramakrishna,
Associate professor,
Kakinada Institute of Technology & Science,
Divili, Andhra Pradesh, India.

Mr. S. Rajasekhar,
Associate professor,
Kakinada Institute of Technology & Science,
Divili, Andhra Pradesh, India.

*Abstract:*

***Gasket sits between the engine block and cylinder head in an engine. Its purpose is to seal the cylinders to ensure maximum compression and avoid leakage of coolant or engine oil into the cylinders. From our project, we would like to modify the material and design of the gasket of four cylinder engine. MLS or Multiple Layers Steel (These typically consist of three layers of steel) and asbestos – Most modern head engines are produced with MLS gaskets. The contact faces are usually coated with a rubber-like coating such as Viton that adheres to the cylinder block and cylinder head while the thicker center layer is left bare. Because of the health risk of fine asbestos fibers, gasket manufacturers are forced to look for alternatives to asbestos. Various possibilities of substituting asbestos in cylinder head gaskets are characterized by different problems of development. Elastomer-bonded soft materials, i.e. combinations of Kevlar fibers, carbon fiber, pyrosic ceramic glass fiber materials can be used in cylinder head gaskets to replace soft-material layers containing asbestos. Because of its numerous specific sealing properties, another alternative to replace gasket layers containing carbon, Kevlar, pyrosic ceramic glass fiber which has been chemically and thermally treated. The comparison of result of these three materials is used to choose the better one using ANSYS 14.5.***

***In this project various optimization methods are implemented by varying the material of gasket. The modeling of gasket is done by using Pro-E design software. Finite Element analysis using ANSYS has been done to increase the thermal and structural properties gasket material.***

## I.INTRODUCTION

A Cylinder Gasket or head gasket is a gasket that sits between the engine block and cylinder head(s) in an internal combustion engine.

Its purpose is to seal the cylinders to ensure maximum compression and avoid leakage of coolant or engine oil into the cylinders; as such, it is the most critical sealing application in any engine and, as part of the combustion chamber, it shares the same strength requirements as other combustion chamber components.

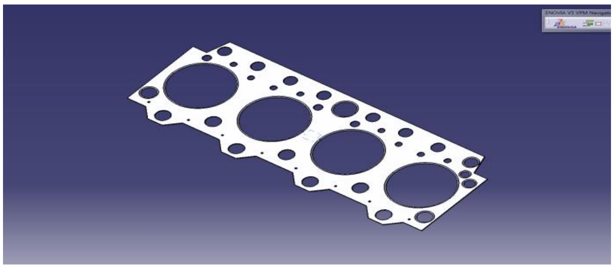
The condition of a head gasket is typically investigated by checking the compression pressure with a pressure gauge, or better, a leak-down test, and/or noting any indication of combustion gases in the cooling system on a water-cooled engine. Oil mixed with coolant and excessive coolant loss with no apparent cause, or presence of carbon monoxide or hydrocarbon gases in the expansion tank of the cooling system can also be signs of head gasket problems. A good sign of head gasket failure on water-cooled engines is the presence of a substance that resembles mayonnaise in the oil, often to be seen on the dipstick, or oil filler cap. However, the presence of this substance is not conclusive proof of head gasket failure, since oil could mix with the coolant via other routes.

A leaking head gasket can be classified as either

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

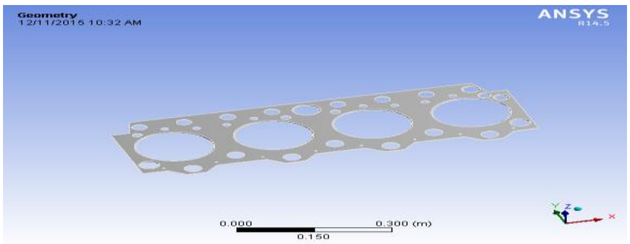
external or internal. An external leak can be identified as oil and coolant accumulating underneath the engine. The presence of coolant can be detected by shining a black light on what appears to be an oil leak; the appearance of coolant will show up under the black light. External leaks can also appear as previously described in the oil. An internal leak can usually be diagnosed by excessive coolant accumulating in the expansion tank along with the presence of hydrocarbons in the form of foam. The possibility of vapors or condensation and/or water (from the road or rain) building up (in aftermarket product installation) from an external breather or catch tank from the head (rocker cover) can also cause a buildup of froth or foam in the oil but is highly unlikely

## 3D DESIGN OF THE MODEL

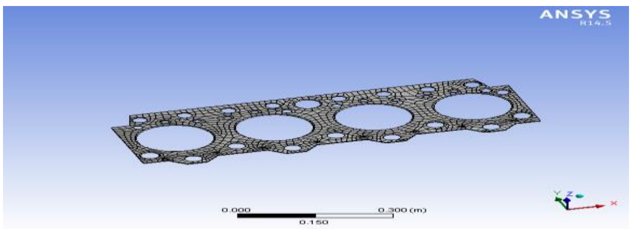


## THERMAL ANALYSIS OF CYLINDER GASKET WITH AL 7475 AT 142$^{O}$C

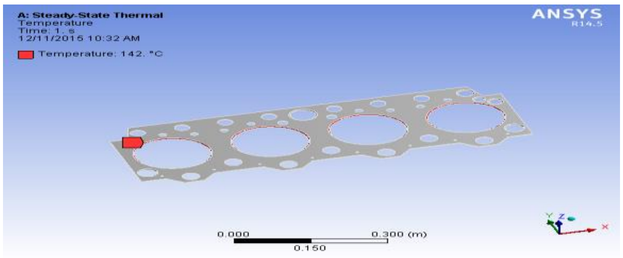
### IMPORT MODEL

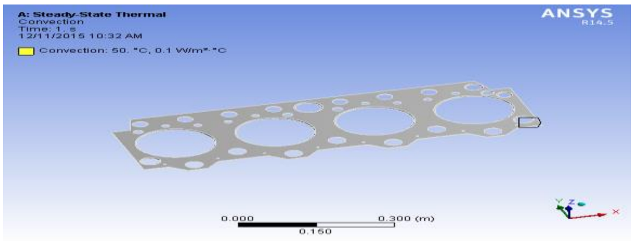



### MESH MODEL

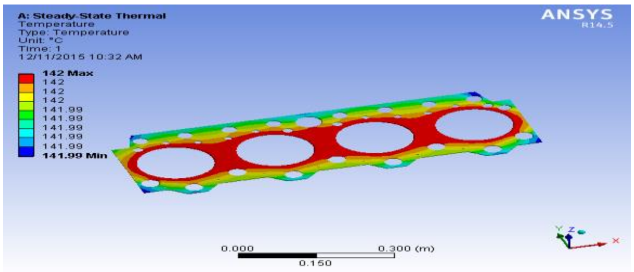



### INPUT DATA

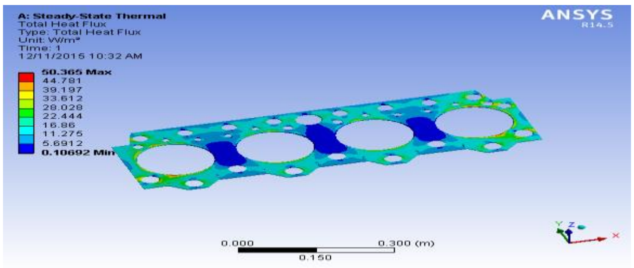


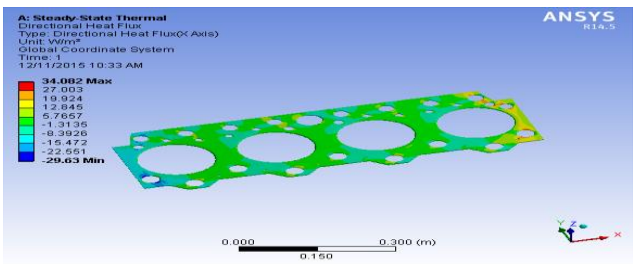

### TEMPERATURE




### TOTAL HEAT FLUX



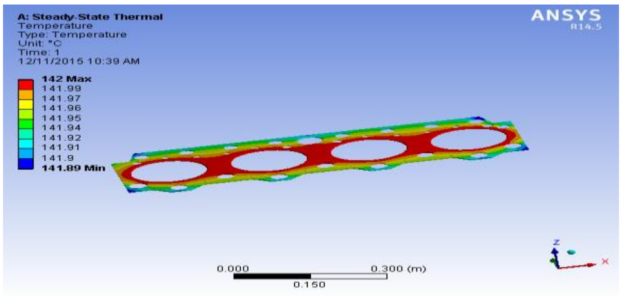

### DIRECTIONAL HEAT FLUX



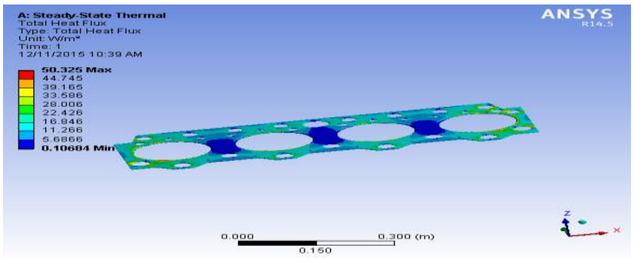
ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
*A Peer Reviewed Open Access International Journal*

## THERMAL ANALYSIS OF CYLINDER GASKET WITH STAINLESS STEEL AT 142$^{O}$C

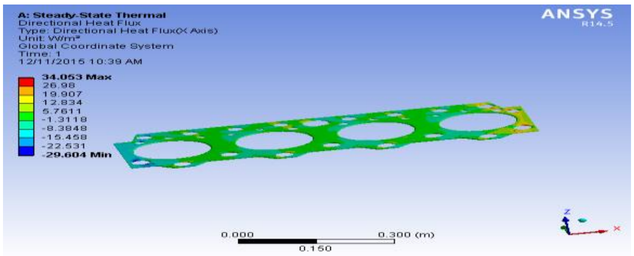
TEMPERATURE




Total Heat Flux

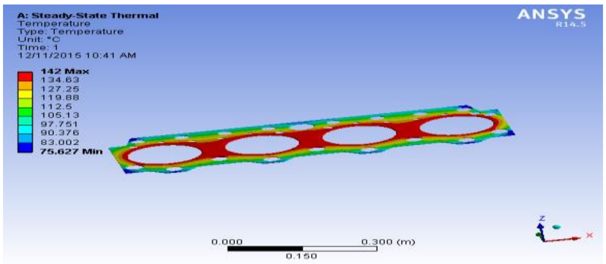



DIRECTIONAL HEAT FLUX

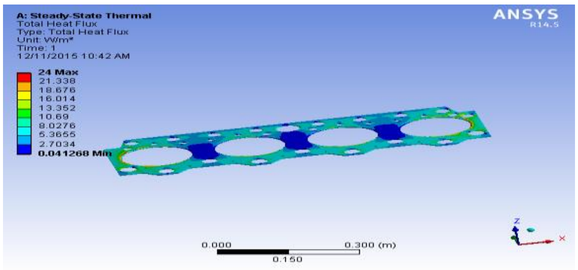



## THERMAL ANALYSIS OF CYLINDER GASKET WITH PYROSIC GLASS CERAMIC AT 142$^{O}$C

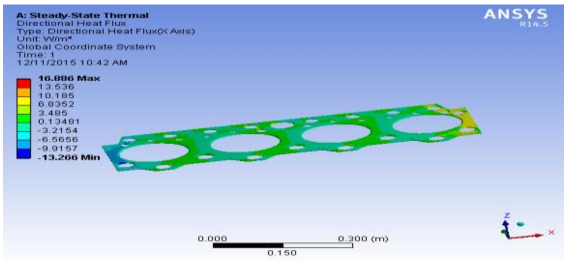
TEMPERATURE




TOTAL HEAT FLUX

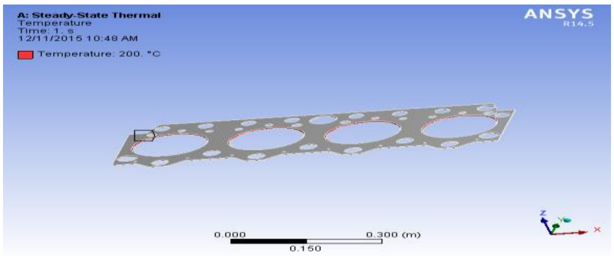


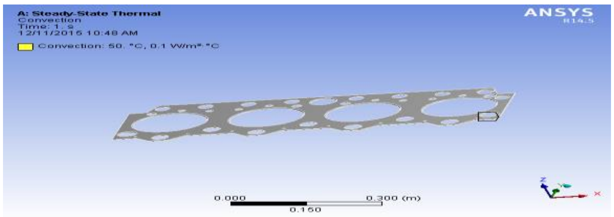

DIRECTIONAL HEAT FLUX



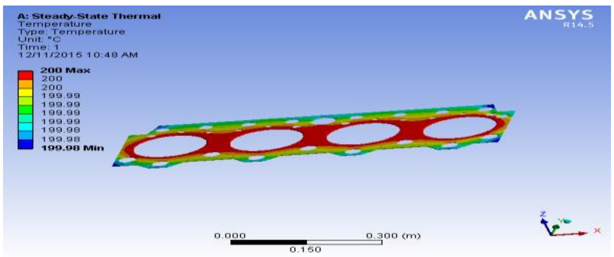

## THERMAL ANALYSIS OF CYLINDER GASKET WITH AL 7475 AT 200$^{O}$C

INPUT DATA



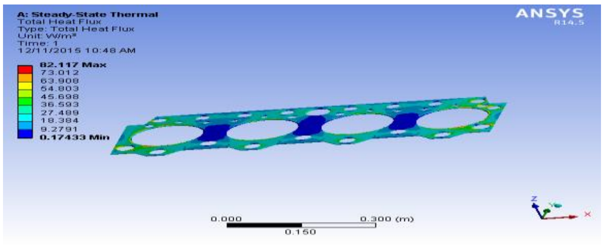




TEMPERATURE

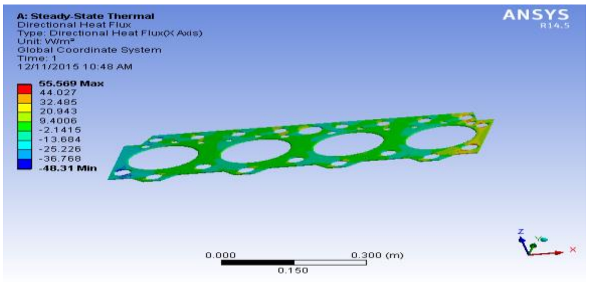


ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
*A Peer Reviewed Open Access International Journal*

TOTAL HEAT FLUX

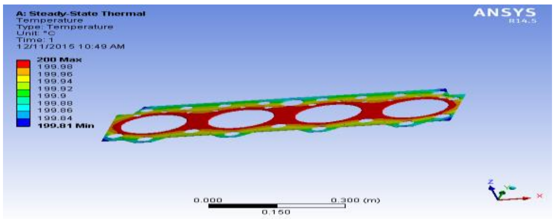



DIRECTIONAL HEAT FLUX

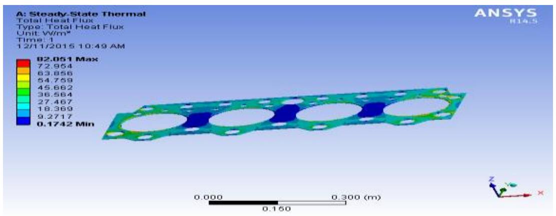



## THERMAL ANALYSIS OF CYLINDER GASKET WITH STAINLESS STEEL AT 200$^{O}$C

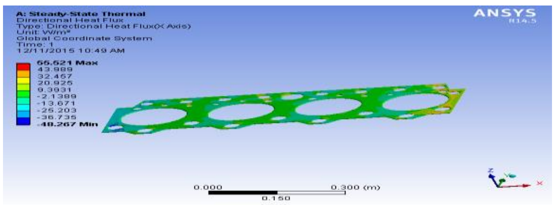
TEMPERATURE




TOTAL HEAT FLUX

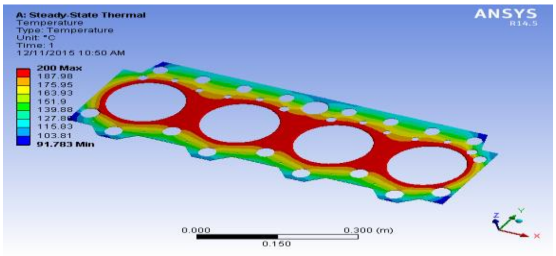



DIRECTIONAL HEAT FLUX

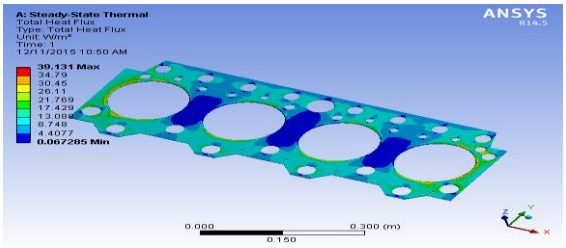



## THERMAL ANALYSIS OF CYLINDER GASKET WITH PYROSIC GLASS CERAMIC AT 200$^{O}$C

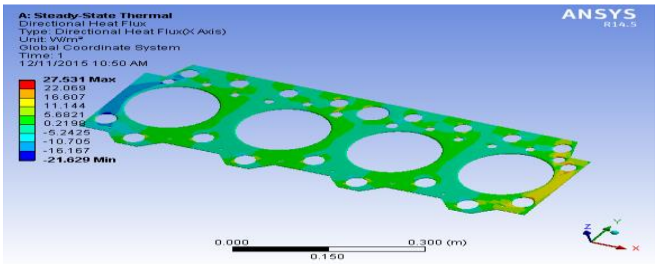
TEMPERATURE




TOTAL HEAT FLUX

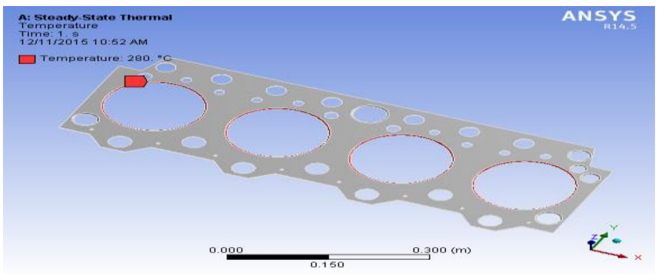



DIRECTIONAL HEAT FLUX

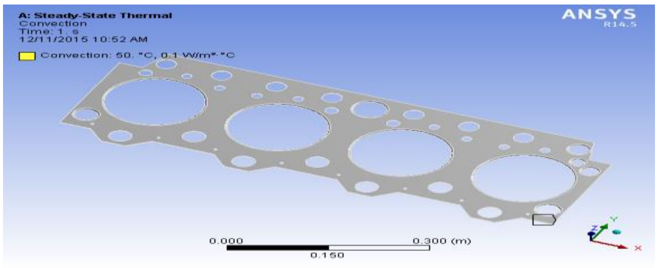



## THERMAL ANALYSIS OF CYLINDER GASKET WITH AL 7475 AT 280$^{O}$C

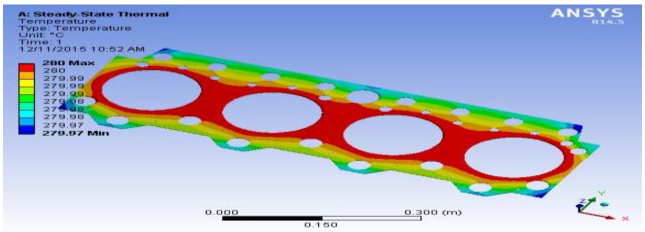
INPUT DATA



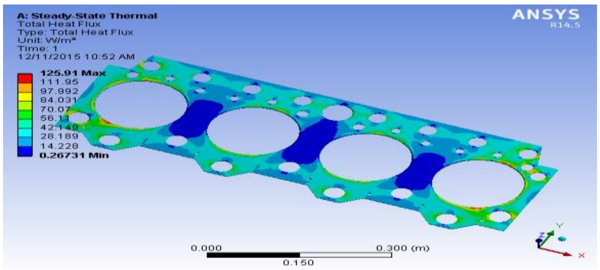
ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
*A Peer Reviewed Open Access International Journal*



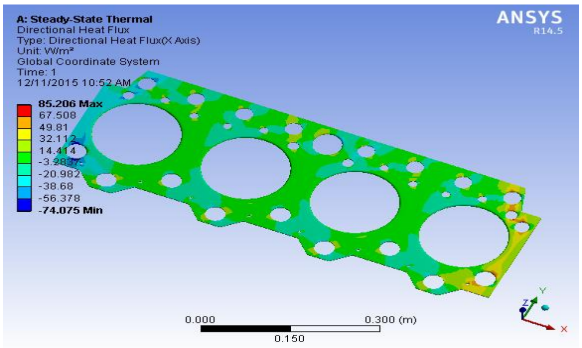

TEMPERATURE




TOTAL HEAT FLUX

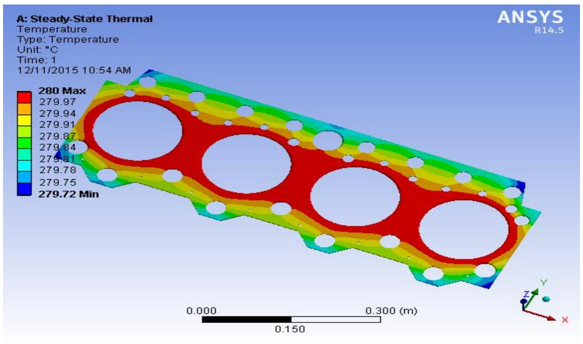



DIRECTIONAL HEAT FLUX

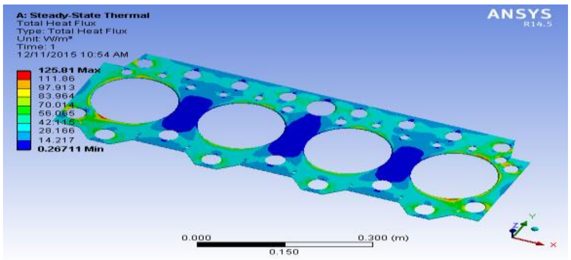



## THERMAL ANALYSIS OF CYLINDER GASKET WITH STAINLESS STEEL AT 280$^{O}$C

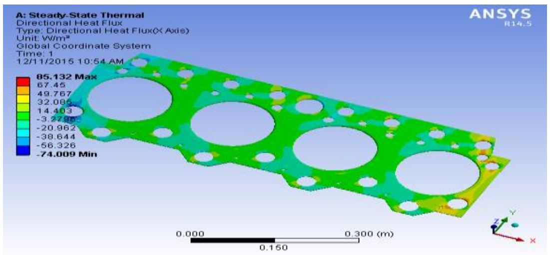
TEMPERATURE




TOTAL HEAT FLUX

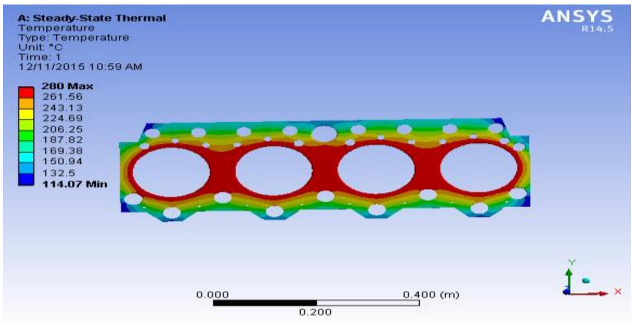



DIRECTIONAL HEAT FLUX



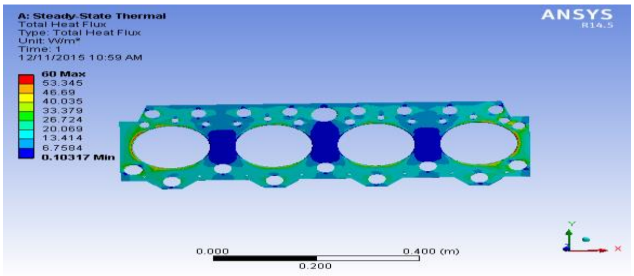

## THERMAL ANALYSIS OF CYLINDER GASKET WITH PYROSIC GLASS CERAMIC AT 280$^{O}$C

TEMPERATURE

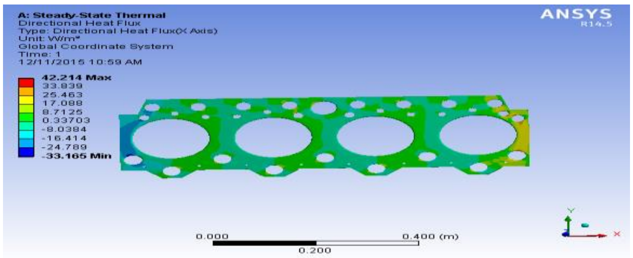



TOTAL HEAT FLUX

ISSN No: 2348-4845
International Journal & Magazine of Engineering,
Technology, Management and Research
A Peer Reviewed Open Access International Journal

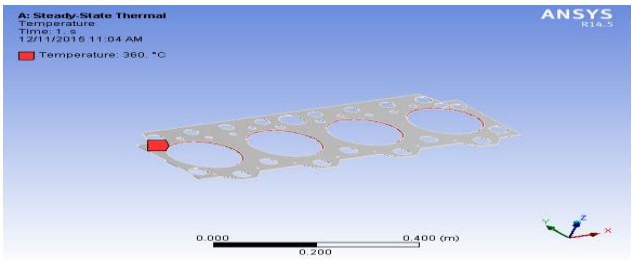


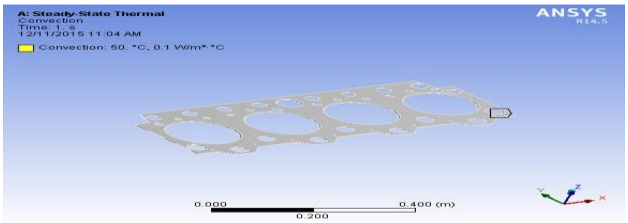
DIRECTIONAL HEAT FLUX



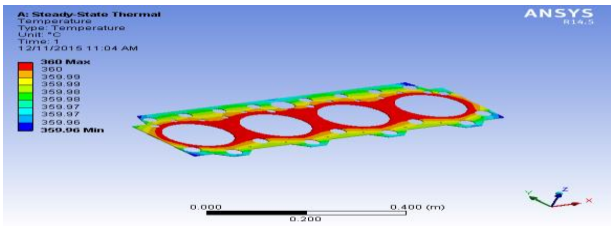
## THERMAL ANALYSIS OF CYLINDER GASKET WITH AL 7475 AT 360$^{O}$C

INPUT DATA

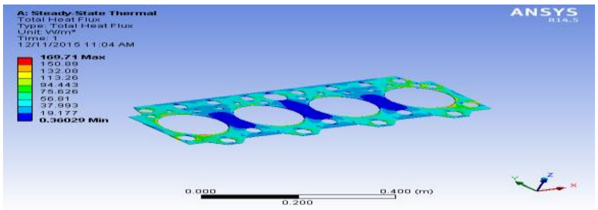




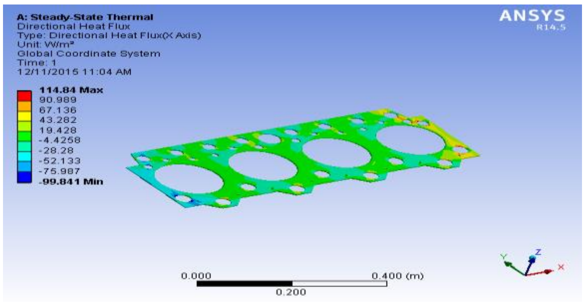
TEMPERATURE



TOTAL HEAT FLUX

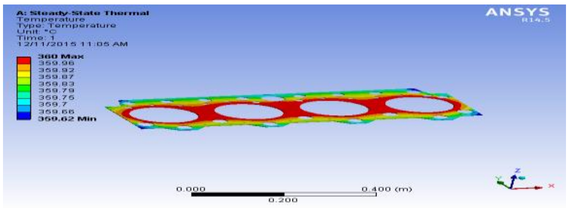


DIRECTIONAL HEAT FLUX

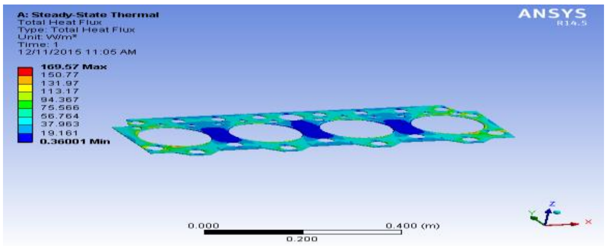


## THERMAL ANALYSIS OF CYLINDER GASKET WITH STAINLESS STEEL AT 360$^{O}$C

TEMPERATURE

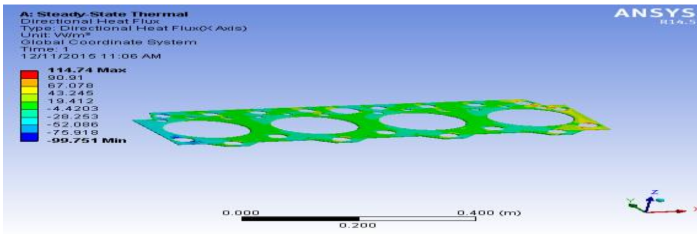


TOTAL HEAT FLUX



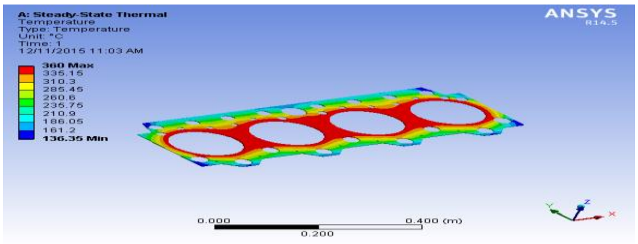
ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

DIRECTIONAL HEAT FLUX

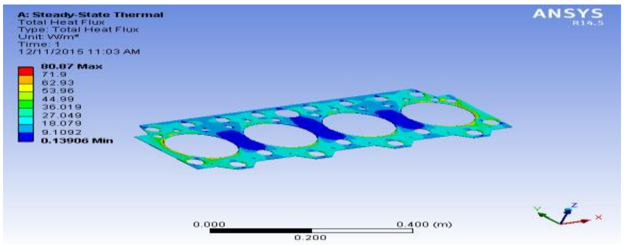



## THERMAL ANALYSIS OF CYLINDER GASKET WITH PYROSIC GLASS CERAMIC AT 360$^{O}$C

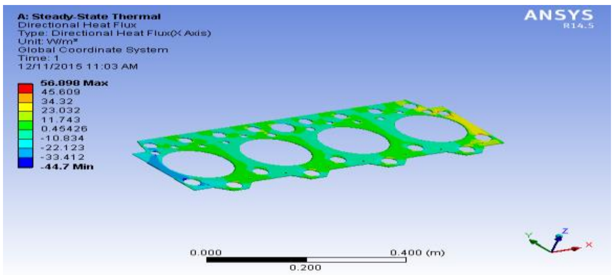
TEMPERATURE




TOTAL HEAT FLUX




DIRECTIONAL HEAT FLUX




## RESULTS TABLE

## THERMAL ANALYSIS OF CYLINDER GASKET AT 142$^{O}$C

| | TEMPERATURE | | TOTAL HEAT FLUX | | DIRECTIONAL HEAT FLUX | |
|---|---|---|---|---|---|---|
| | MIN | MAX | MIN | MAX | MIN | MAX |
| AL 7475 | 141.99 | 142 | 0.10692 | 50.365 | -29.63 | 34.082 |
| STAINLESS STEEL | 141.89 | 142 | 0.10684 | 50.325 | -29.604 | 34.053 |
| PYROSIC GLASS CERAMIC | 75.627 | 142 | 0.041268 | 24 | -13.206 | 16.886 |

## THERMAL ANALYSIS OF CYLINDER GASKET AT 200 $^{O}$C

## THERMAL ANALYSIS OF CYLINDER GASKET AT 280 $^{O}$C

| | TEMPERATURE | | TOTAL HEAT FLUX | | DIRECTIONAL HEAT FLUX | |
|---|---|---|---|---|---|---|
| | MIN | MAX | MIN | MAX | MIN | MAX |
| AL 7475 | 279.97 | 280 | 0.26731 | 125.91 | -74.075 | 85.206 |
| STAINLESS STEEL | 279.72 | 280 | 0.26711 | 125.81 | -74.009 | 85.132 |
| PYROSIC GLASS CERAMIC | 114.07 | 280 | 0.10317 | 60 | -33.165 | 42.214 |

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

## THERMAL ANALYSIS OF CYLINDER GASKET AT 360 $^{O}$C

| | TEMPERATURE | | TOTAL HEAT FLUX | | DIRECTIONAL HEAT FLUX | |
|---|---|---|---|---|---|---|
| | MIN | MAX | MIN | MAX | MIN | MAX |
| AL 7475 | 359.96 | 360 | 0.36029 | 169.71 | -99.841 | 114.84 |
| STAINLESS STEEL | 359.62 | 360 | 0.36001 | 169.57 | -99.751 | 114.74 |
| PYROSIC GLASS CERAMIC | 136.35 | 360 | 0.13906 | 80.87 | -44.7 | 56.898 |

**Conclusion:** In this thesis we have considered a 4 cylinder gasket. This is designed in Catia and has been analyzed at various temperatures at various materials in Ansys software. As this gasket plays a key role in the cylinder. Here we are doing thermal analysis on cylinder gasket of a 4 cylinder engine.

As here we have considered the cylinder gasket at 142ºC with 3 materials AL 7475, stainless steel and pyrosic glass ceramic. As if we observe the results obtained and the results plotted in the graph form, we can clearly observe that the total heat flux (24) and directional heat flux (16.886) is very less to the material pyrosic glass ceramic. Here we can conclude that the cylinder gasket made with pyrosic glass ceramic material with stands and have better life output.

As here we have considered the cylinder gasket at 200ºC with 3 materials AL 7475, stainless steel and pyrosic glass ceramic. As if we observe the results obtained and the results plotted in the graph form, we can clearly observe that the total heat flux (39.131) and directional heat flux (27.531) is very less to the material pyrosic glass ceramic. Here we can conclude that the cylinder gasket made with pyrosic glass ceramic material with stands and have better life output.

As here we have considered the cylinder gasket at 280ºC with 3 materials AL 7475, stainless steel and pyrosic glass ceramic. As if we observe the results obtained and the results plotted in the graph form, we can clearly observe that the total heat flux (60) and directional heat flux (42.214) is very less to the material pyrosic glass ceramic. Here we can conclude that the cylinder gasket made with pyrosic glass ceramic material with stands and have better life output.

As here we have considered the cylinder gasket at 360ºC with 3 materials AL 7475, stainless steel and pyrosic glass ceramic. As if we observe the results obtained and the results plotted in the graph form, we can clearly observe that the total heat flux (80.87) and directional heat flux (56.898) is very less to the material pyrosic glass ceramic. Here we can conclude that the cylinder gasket made with pyrosic glass ceramic material with stands and have better life output.

So from all the analysis at all the temperatures i.e. at the condition of engine at higher speeds and even at low speed if the variations of temperatures here we can conclude that the cylinder gasket made with pyrosic glass ceramic material could with stand at high temperatures and give better life efficiency and better life output.

## REFRENCES

Chevy Small-Block V-8 Interchange Manual, 2nd Edition by David Lewis, Motor Books International, 2009

Cylinder Head Gasket Simulation: A Development Tool, SAE International, 1992

Multi-layer Steel Gasket Technology for Engine Cylinder Head and Manifold Applications, Society of Automotive Engineers, 1989

1. Diesel Engine Maintenance Training Manual, Bureau of Ships, BoD – Books on Demand, 15-Jan-2015
2. How to Build and Modify Chevrolet Small-Block V-8 Cylinder Heads by David Vizard, Motor Books International
3. Bickford, John H. (1997). Gaskets and Gasketed Joints. CRC Press. p. 57. ISBN 0-8247-9877-5.
4. Nunney, M. J. (1998). Light & Heavy Vehicle Technology. Elsevier. p. 23. ISBN 0-7506-3827-3.

**STUDENT**
**V.Arjun** received the B.Tech degree in mechanical engineering, from Sarada institute of science technology and management college of engineering, JNTUK, Srikakulam, Andhra pradesh, India, in 2013, and persuing m.tech in Thermal Engineering from Kakinda Institute Of Technology And Science college of engineering, Divili, Andhra pradesh, India.

**GUIDE 1**
**Mr. V.V. Ramakrishna, Associate professor,** Kakinada Institute of Technology & Science, Divili, Andhra Pradesh, India.

**GUIDE 2**
**Mr. S. Rajasekhar,Associate professor,** Kakinada Institute of Technology & Science, Divili, Andhra Pradesh, India.