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

Thermal Analysis of Bi- Metallic Piston

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ABSTRACT:

In today's world scenario, there is tremendous development in the field of automobile and every day, there is new invention is arrived to do better out transport facility. It is found that the prize of fuel is growing widely, so every company is trying to make the vehicle more fuel efficient and having best quality and comfort for the user. Also company may concentrated on very important fact, service after sale it is consider spinal code in the field of automobile. Most of the company may spend their 50% of their income on research and development to make their vehicle better. Previously this task is very expensive in absence of recent technology, for testing and design like CAD/CAM and the analysis software like Ansys software, the prediction is very difficult about any product. Also CFD is play major role for the aerodynamic designing for the automobile. Using Different CAD/CAM software one can design the product as per the requirement, can also manufacture easily on CNC machine. In previous days, once the product is design it will be at least few years remains in the market .But now a days, in every six month new model will be launched by the company due the advancement in the automotive sector.

This project work is based on bi-metallic component used in automobile; there are lots of many bimetallic components used in automobile application. In this case, piston is identified. It induces the thermal stress in the material to overcome this serious problem. Hence it is suggested that the alternative material for piston to increase its efficiency and to obtain better output for thermal values.

In this thesis we are going to plan to design an original piston and then to modification to the bimetallic piston model and then we are going to analysis in the ANSYS software.

I. INTRODUCTION

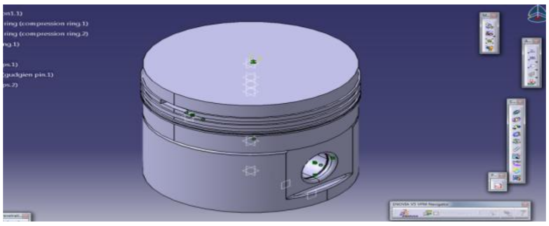
The piston is a vital component of a cylindrical engine. It reciprocates inside the cylinder bore. The piston acts as a moveable end of the combustion chamber. The cylinder head is the stationary end of the combustion chamber. 0 piston head is the top surface (closest to the cylinder head) of the piston which is subjected to pressure fluctuation, thermal stresses and mechanical load during normal engine operation. By the forces of combustion, piston reciprocates inside the cylinder bore.

In order to increase the efficiency of operation and better functionality, the piston material should satisfy the following requirements:

- Light weight
- Good wear resistance
- Good thermal conductivity
- High strength to weight ratio
- Free from rust
- Easy to cast
- Easy to machine
- Non magnetic
- Nontoxic Piston

Should be designed and fabricated with such features to satisfy the above requirements.

ORIGINAL MODEL



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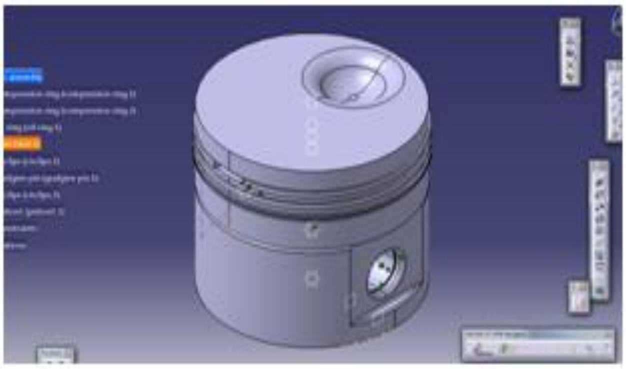
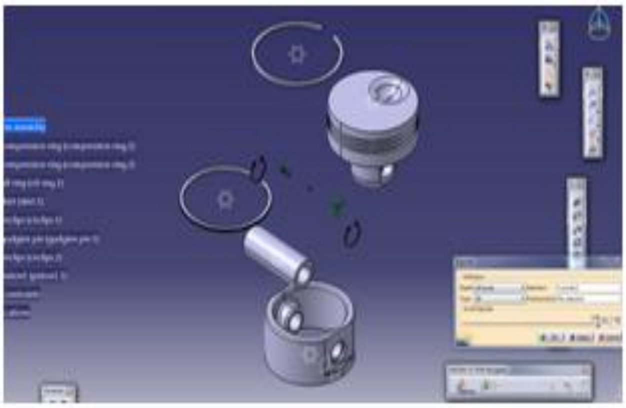
MODIFIED MODEL





MATERIAL DATA:

Zirconium

Thermal Conductivity	16.7 W m^-1 C^-1

AL2024-T6

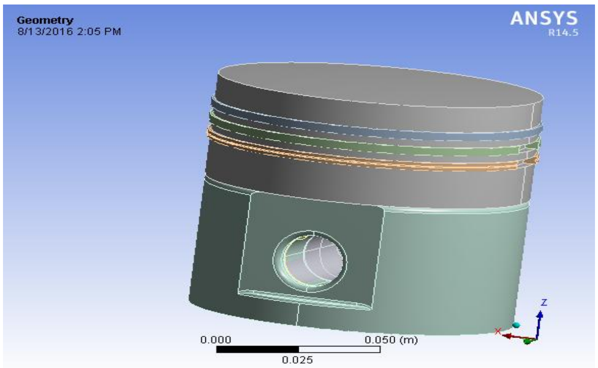
Density	2780 kg m^-3
Thermal Conductivity	151 W m^-1 C^-1

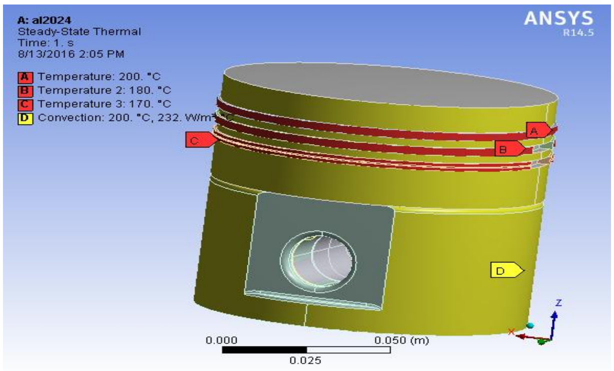
Temperature C	Young's Modulus Pa	Poisson's Ratio	Bulk Modulus Pa	Shear Modulus Pa
	7.24e+010	0.33	7.098e+010	2.7218e+010

Al 7475

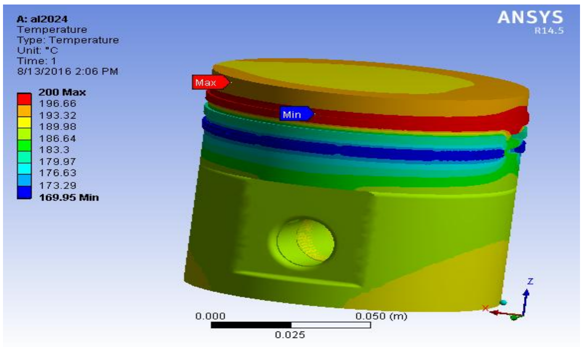
Thermal Conductivity	138 W m^-1 C^-1

Analysis of original model piston with Al 2024 + Zr: case – 1

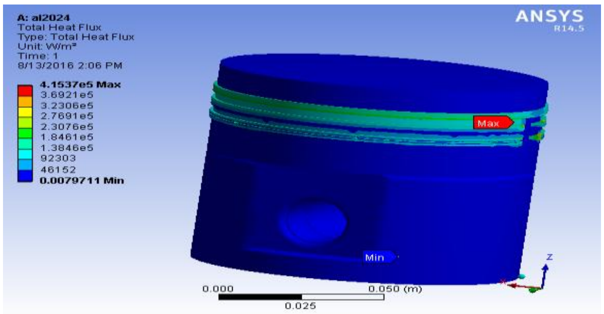




TEMPERATURE



TOTAL HEAT FLUX



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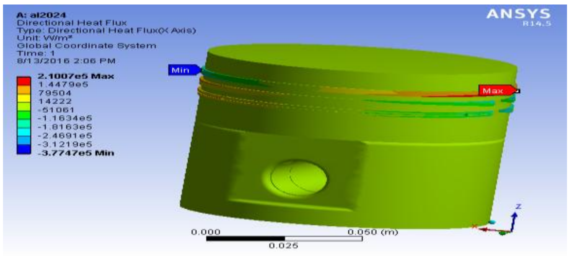
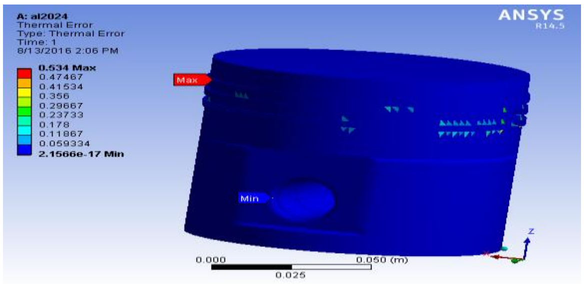
DIRECTIONAL HEAT FLUX

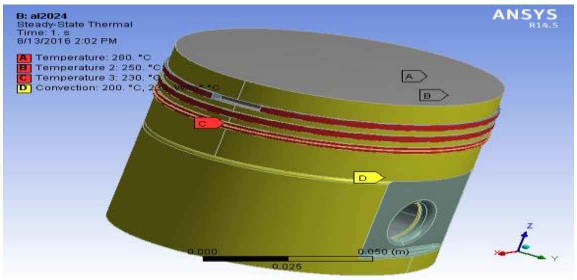


THERMAL ERROR



Analysis of original model piston with Al 2024 + Zr: case – 2

INPUT DATA



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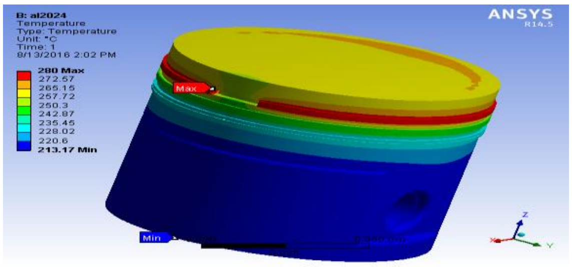

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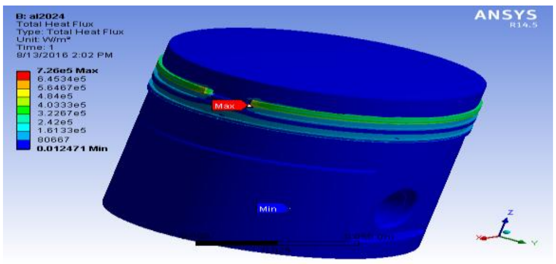

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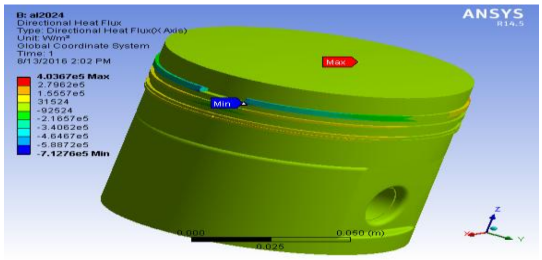

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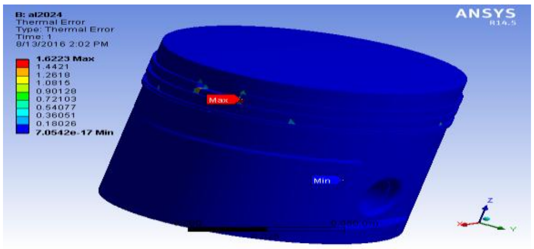
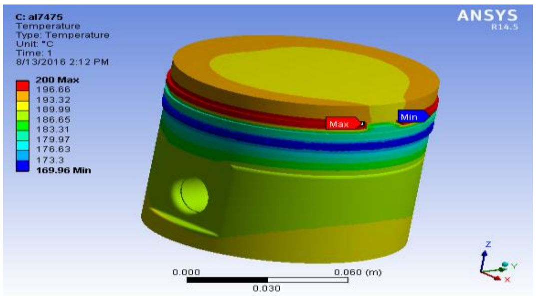


Analysis of original model piston with Al 7475 + Zr: case – 1

TEMPERATURE



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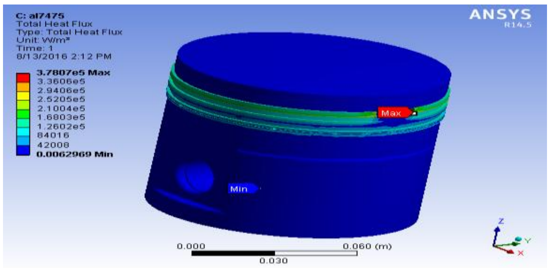

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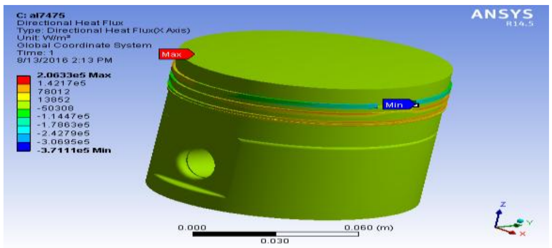

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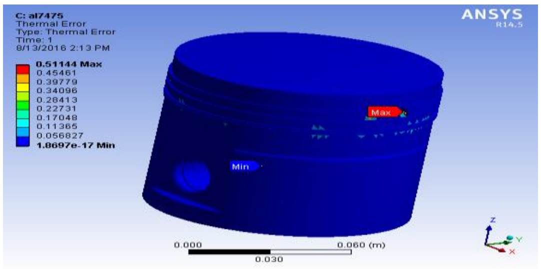
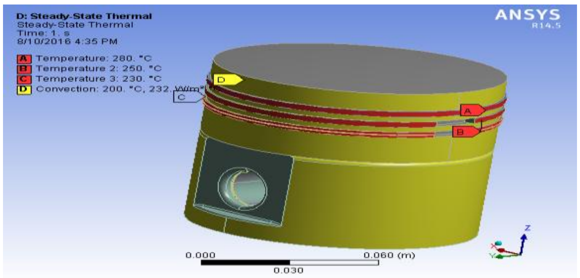
THERMAL ERROR



Analysis of original model piston with Al 7475 + Zr: case – 2

INPUT DATA



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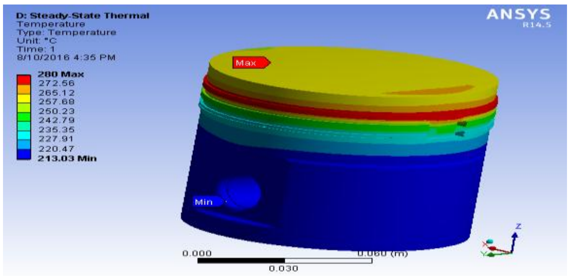

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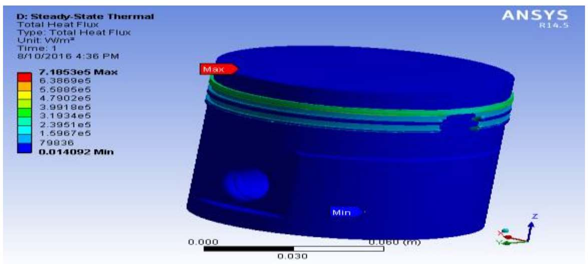

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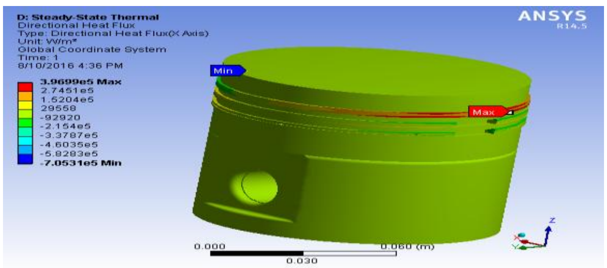

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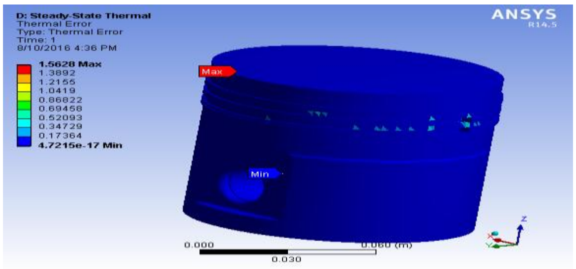
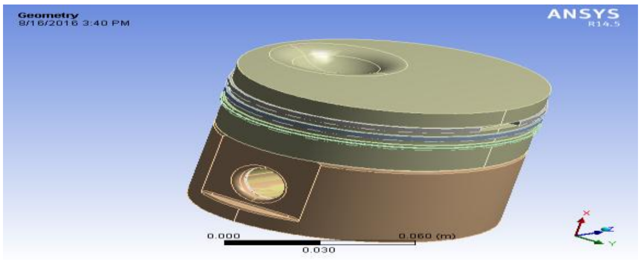


Analysis of modified model piston with Al 2024 + Zr: case – 1

IMPORTED FILE



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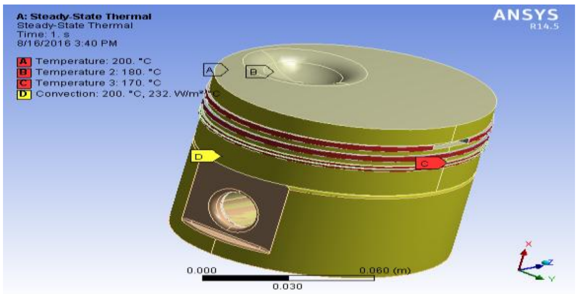

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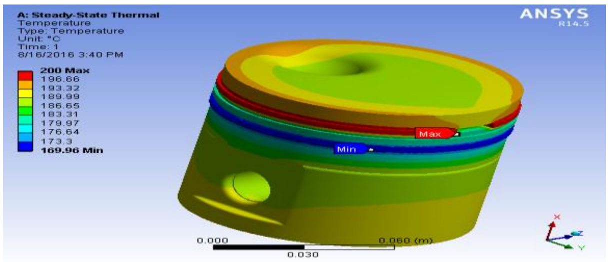

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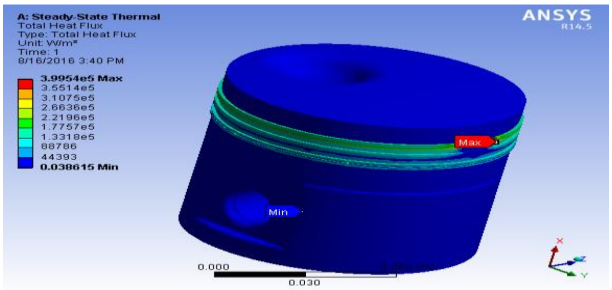

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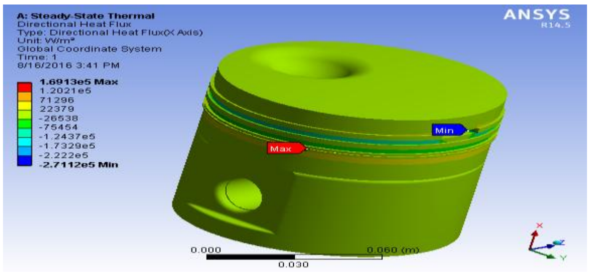

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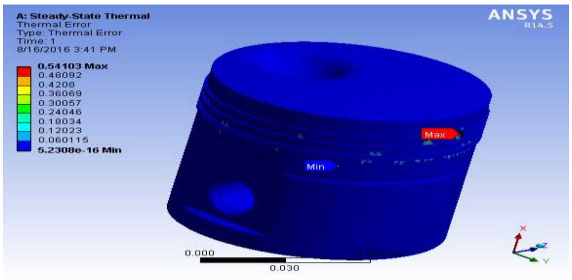

Analysis of modified model piston with Al 2024 + Zr: case – 2

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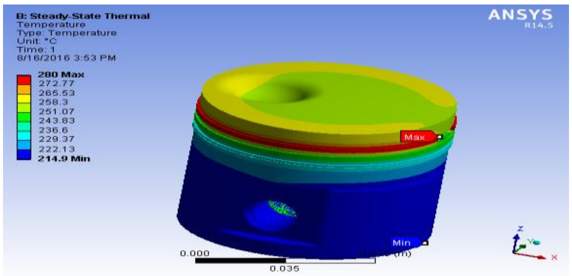

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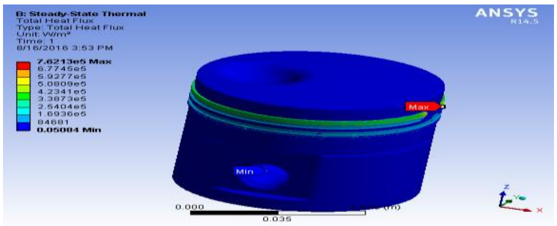

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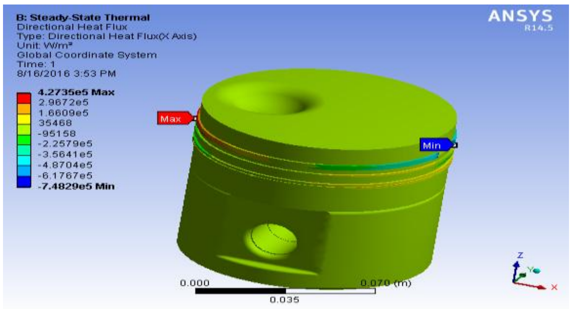

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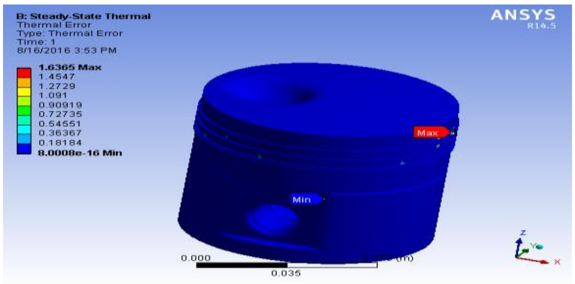
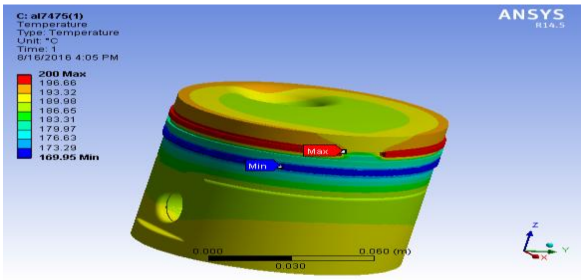
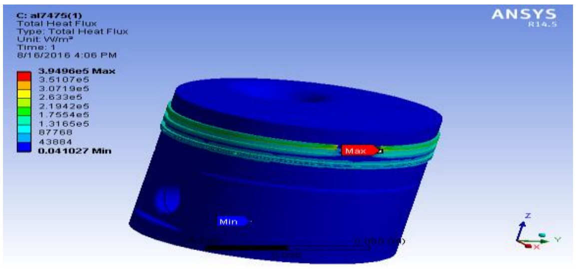


Analysis of modified model piston with Al 7475 + Zr: case – 1

TEMPERATURE



TOTAL HEAT FLUX



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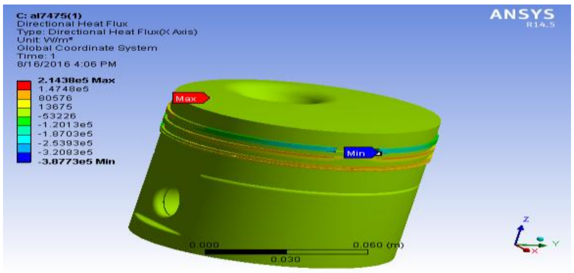

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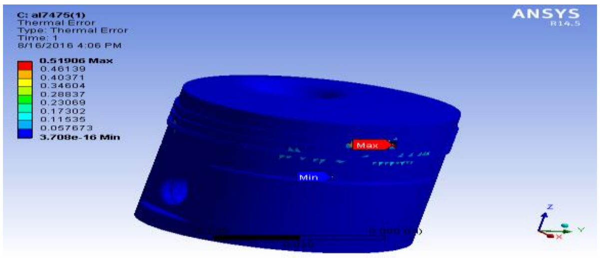

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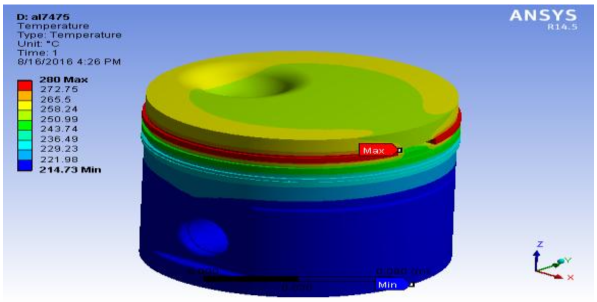
Analysis of modified model piston with Al 7475 + Zr: case – 2

TEMPERATURE



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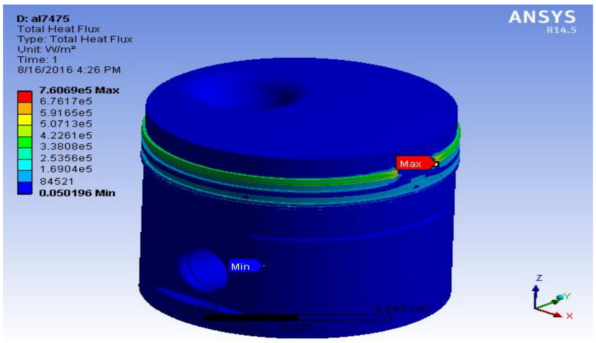

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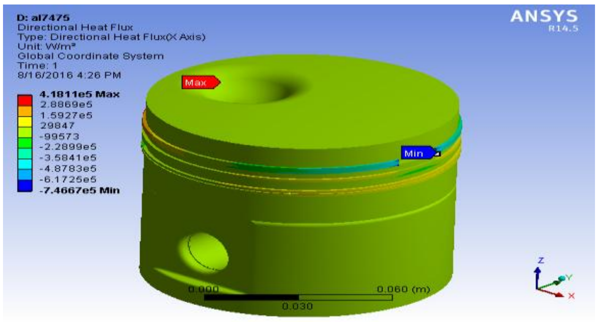

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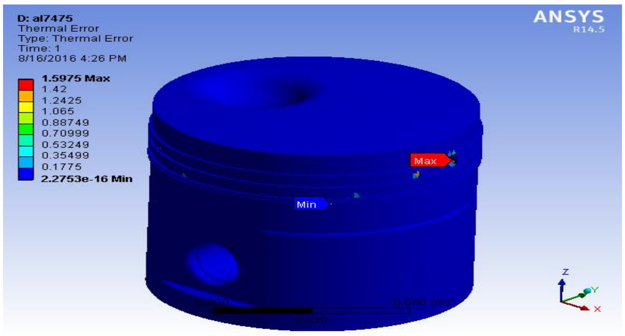

TABLES

MODEL 1

materials		temperature		Total heat flux		Directional heat flux		error	
		Min	Max	Min	Max	Min	Max	Min	Max
Al 2024	Case1	169.95	200	0.0079711	$4.1537e^{5}$	$-3.7747e^{5}$	$2.1007e^{5}$	$2.1566e^{-17}$	0.534
	Case2	213.17	280	0.012471	$7.26e^{5}$	$-7.1276e^{5}$	$4.0367e^{5}$	$7.0542e^{-17}$	1.6223
Al7475	Case1	169.96	200	0.0062969	$3.7807e^{5}$	$-3.7111e^{5}$	$2.0633e^{5}$	$1.8697e^{-17}$	0.51144
	Case2	213.03	280	0.014092	$7.1853e^{5}$	$-7.0531e^{5}$	$3.9699e^{5}$	$4.7215e^{-17}$	1.5628

MODEL 2

materials		temperature		Total heat flux		Directional heat flux		error	
		Min	Max	Min	Max	Min	Max	Min	Max
Al 2024	Case1	169.96	200	0.038615	$3.9954e^{5}$	$-2.7112e^{5}$	$1.6913e^{5}$	$5.2308e^{-16}$	0.54103
	Case2	214.9	280	0.05084	$7.6213e^{5}$	$-7.4829e^{5}$	$4.2735e^{5}$	$8.008e^{-16}$	1.6365
Al7475	Case1	169.95	200	0.041027	$3.9496e^{5}$	$-3.8773e^{5}$	$2.1438e^{5}$	$3.708e^{-16}$	0.5106
	Case2	214.73	280	0.050196	$7.6069e^{5}$	$-7.4667e^{5}$	$4.1811e^{5}$	$2.2753e^{-16}$	1.5975

CONCLUSION

This project work is based on bi-metallic component used in automobile; there are lots of many bimetallic components used in automobile application. Here in this thesis we have designed two types of bi-metallic pistons and analysis is done with AL 2024 +Zr and AL 7475 +Zr materials. As from the results obtained if we compare the values of tables and graphs.

As if we check the results only for the original model, analysis is done with 2 materials, i.e. AL 2024 +Zr and AL 7475 +Zr. Here if we compare the results of temperature, total heat flux, directional heat flux and thermal error, we can conclude that the AL 2024 +Zr has the best thermal properties, and gives the max life.

As if we check the results only for the modified model, analysis is done with 2 materials, i.e. AL 2024 +Zr and AL 7475 +Zr. Here if we compare the results of temperature, total heat flux, directional heat flux and thermal error, we can conclude that the AL 7475 +Zr have the best thermal properties, and give the max life.

As if we check the results for the original model with modified model, analysis is done with AL 2024 +Zr material. Here if we compare the results of temperature, total heat flux, directional heat flux and thermal error, we can conclude that the modified model have the best thermal properties, and give the max life.

As if we check the results for the original model with modified model, analysis is done with AL 7475 +Zr material. Here if we compare the results of temperature, total heat flux, directional heat flux and thermal error, we can conclude that the modified model have the best thermal properties, and give the max life.

As So as if we check all the results obtained we can conclude that the modified model has the best results than the original model, when compared with the temperature's, total heat flux, directional heat flux and thermal error.

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