Design and Analysis of a Diesel Engine Outlet bi metal Value for open and closed conditions

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Abstract- *The valves used in the IC engines are of three types: Poppet or mushroom valve or Sleeve valve or Rotary valve. Of these three types, Poppet valve is most commonly used. Since both the inlet and exhaust valves are subjected to high temperatures of 1930°C to 2200°C during the power stroke, therefore, it is necessary that the materials of the valves should withstand these temperatures. The aim of the project is to design analysis of an exhaust valve for a four wheeler diesel engine using theoretical calculations. 2D drawings are drafted from the calculations and 3D model is done in solid works. Transient Thermal Analysis and Thermal analysis is done on that component using open and closed conditions. For 5000 cycles at the time of when valve is closed is 127.651 sec and valve is opened 127.659 sec. The materials used for exhaust valve for tail end will be same thru out the analysis where as head material will be silicon chromium steel and titanium carbide will be changed alternatively for head and will analysis both transient & thermal analysis for both closed and open end conditions. After developing model in solid works will be doing analysis by using cosmos simulation analysis*

Keywords- IC Engine, Exhaust Value, head end, tail end Silicon Chromium Steel, titanium carbide, Transient Thermal analysis, thermal analysis, open condition, closed condition

I. INTRODUCTION

1.1 INTRODUCTION TO IC ENGINE VALVE About Valves

Engine Valve is one of the main parts which are used in all IC Engines. Each cylinder in the engine has one inlet and one exhaust valve. Now a days engine are designed with multi valves viz., two inlet and one exhaust two inlet and Two exhaust valves which prevents air pollution and improves engine efficiency

Function of Inlet Valve

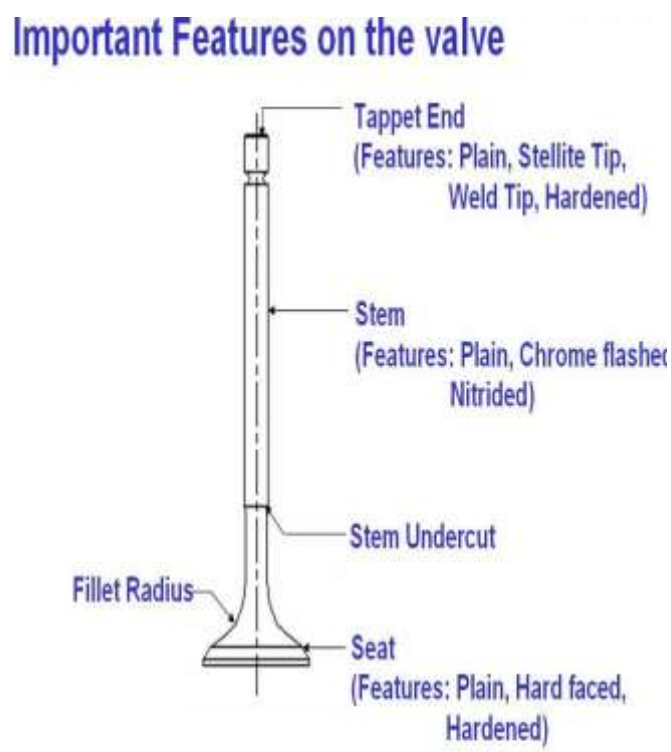
The inlet which operates by the action of Tappet movement, allows air and fuel mixture into the cylinder

Function of Exhaust valve

The exhaust valve allows burnt gases to escape from the cylinder to atmosphere.

Valve Efficiency

Depends on the following characteristics like Hardness, Face roundness and sliding properties capable to withstand high temperature etc. As compared to inlet, exhaust valve operates at high temperature as exhaust gases (around 800 Deg C) escape through it. As it resulting in early ways and gets corrosion, austenitic steel is used for manufacture of exhaust valve and martens tic steel is used for manufacture of inlet valve.The manufacturing process involves upset and forging, heat treatment and machining (turning and grinding) and special processes like TIG welding, Projection Welding, PTA Welding, Friction Welding, Induction Hardening and Nitriding.



1.2 INTRODUCTION TO CAD

Computer-aided design (CAD), also known as computer-aided design and drafting (CADD), is the use of computer technology for the process of design and design-documentation.

Computer Aided Drafting describes the process of drafting with a computer. CADD software, or environments, provide the user with input-tools for the purpose of streamlining design processes; Drafting, documentation, and manufacturing processes. CADD output is often in the form of electronic files for print or machining operations. The development of CADD-based software is in direct correlation with the processes it seeks to economize; industry-based software (construction, manufacturing, etc.) typically uses vector-based (linear) environments whereas graphic-based software utilizes raster-based (pixelated) environments.

1.3 INTRODUCTION TO SOLIDWORKS

Solid Works is a solid modeler, and utilizes a parametric feature-based approach which was initially developed by PTC (Creo /Pro-Engineer) to create models and assemblies. The software is written on Para solid-kernel.

Parameters refer to constraints whose values determine the shape or geometry of the model or assembly. Parameters can be either numeric parameters, such as line lengths or circle diameters, or geometric parameters, such as tangent, parallel, concentric, horizontal or vertical, etc. Numeric parameters can be associated with each other through the use of relations, which allows them to capture design intent.
Design intent is how the creator of the part wants it to respond to changes and updates. For example, you would want the hole at the top of a beverage can to stay at the top surface, regardless of the height or size of the can. Solid Works allows the user to specify that the hole is a feature on the top surface, and will then honor their design intent no matter what height they later assign to the can.

DIFFERENT MODULES IN SOLIDWORKS

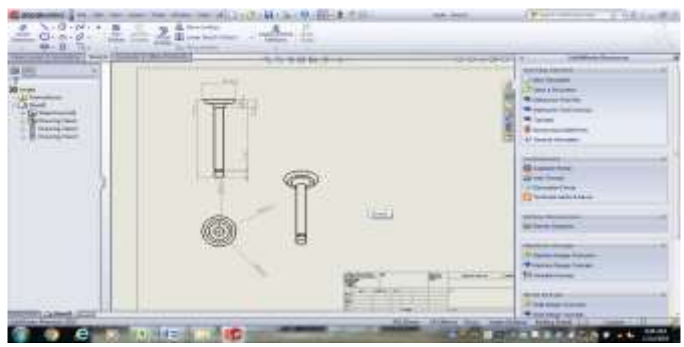
- Part design
- Assembly
- Drawing
- Sheet metal
- Surface
- Simulation (cosmos)

II. 3D MODEL OF OUTLET VALVE

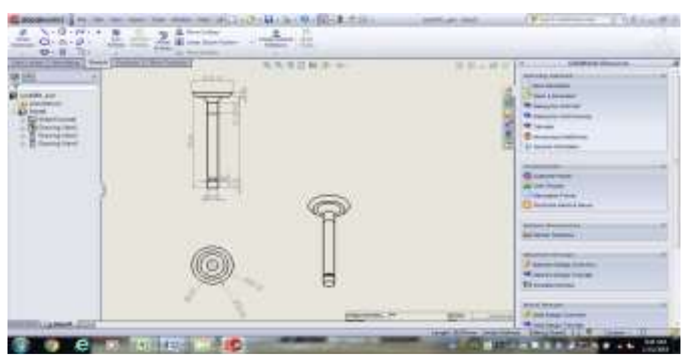
Single material

BI-Metal valve

Drafting



Bi metal drafting



WHAT IS COSMOSWORKS?

Cosmos works is a useful software for design analysis in mechanical engineering. That's an introduction for you who would like to learn more about COSMOS Works. COSMOS Works is a design analysis automation application fully integrated with Solid Works.

This software uses the Finite Element Method (FEM) to simulate the working conditions of your designs and predict their behavior. FEM requires the solution of large systems of equations. Powered by fast solvers, COSMOS Works makes it possible for designers to quickly check the integrity of their designs and search for the optimum solution.

III. ANALYSIS IMAGES

5.1 Transient Thermal Analysis (Closed condition)

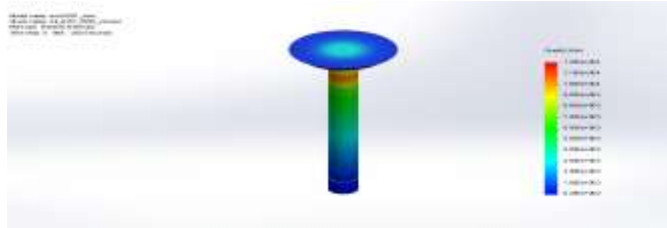
Material:
- Tip - EN52 Steel
- Head - EN52 Steel
- Importing

Meshing

5.2. Closed conditionEN52 @ 558 Temp Kelvin with Tail EN52 & Head EN52

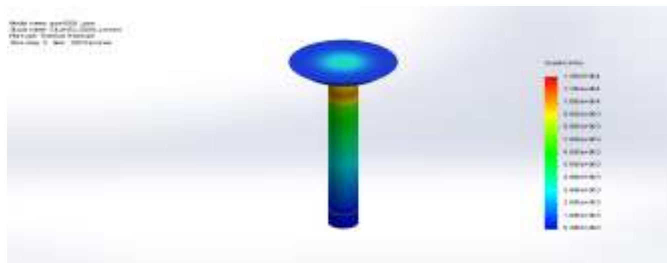
Temp Gradient Resultant=12004 k/m	Thermal Flux Resultant = 252084 (w/m2)

5.2.1 Closed condition @ 558 Temp Kelvin with Tail EN52 & Head Silicon Chromium Steel



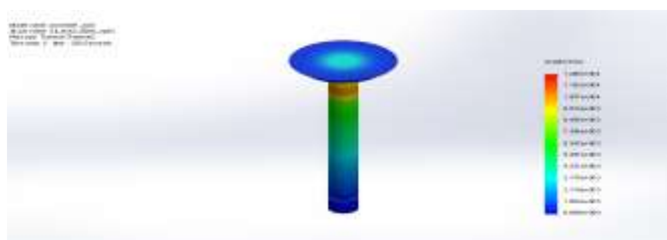
Temp Gradiant Resultant=10841.9 k/m	Thermal Flux Resultant = 331388 (w/m2)

5.2.2 Closed condition @ 558 Temp Kelvin with Tail EN52 & Head Titanium carbide



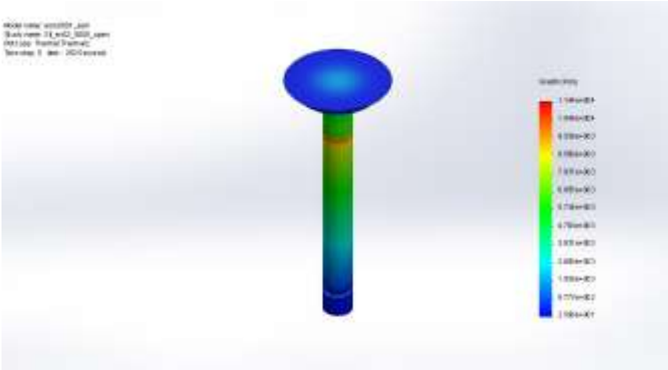
Temp Gradient Resultant=10182 k/m	Thermal Flux Resultant = 294840(w/m2)

5.2.3 Open condition @ 580 Temp Kelvin with Tail EN52 & Head EN52



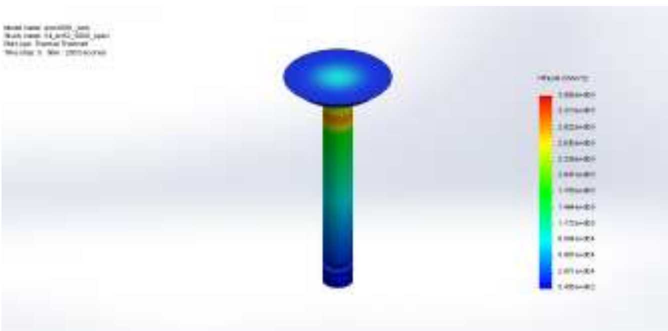
Temp Gradient Resultant=12678 k/m	Thermal Flux Resultant = 266245(w/m2)

5.2.4 Open condition @ 580 Temp Kelvin with Tail EN52 & Head Silicon Chromium Steel



Temp Gradient Resultant=1142 k/m	Thermal Flux Resultant = 350507(w/m2)

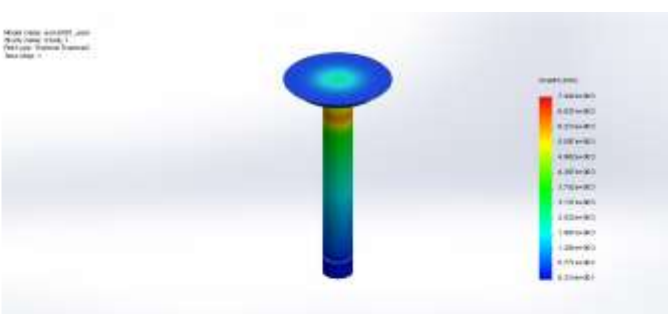
5.2.5 Open condition @ 580 Temp Kelvin with Tail EN52 & Head Titanium Carbide



Temp Gradient Resultant=10735 k/m	Thermal Flux Resultant = 311626(w/m2)

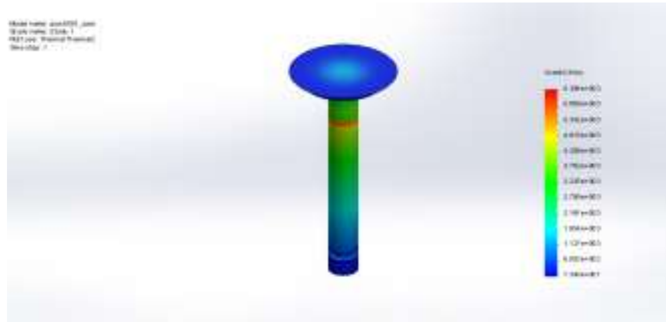
6. Thermal Analysis (Closed Condition)

6.1.1 Closed condition @ 560 Temp Kelvin with Tail EN52 & Head EN52.



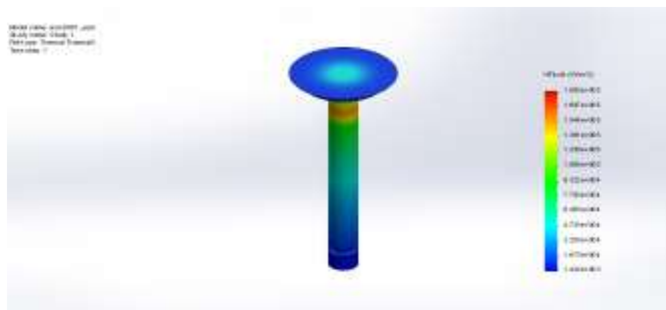
Temp Gradient Resultant=7441.88 k/m	Thermal Flux Resultant = 156280 (w/m2)

6.1.2 Closed condition @ 560 Temp Kelvin with Tail EN52 & Head Silicon Chromium Steel.



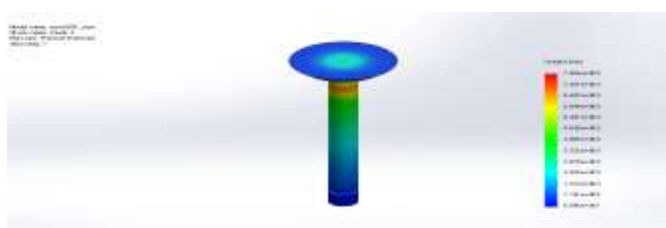
Temp Gradient Resultant=6396.1 k/m	Thermal Flux Resultant = 211258(w/m2)

6.1.3 Closed condition @ 560 Temp Kelvin with Tail EN52 & Head Titanium Carbide.



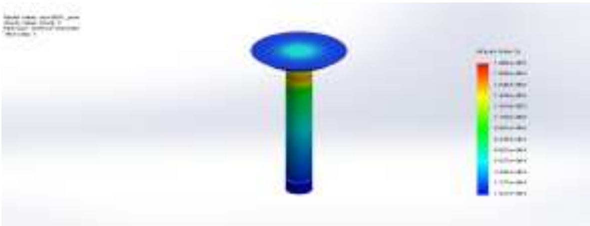
Temp Gradient Resultant=6001.34 k/m	Thermal Flux Resultant = 185015(w/m2)

6.1.4 Open condition @ 578 Temp Kelvin with Tail EN52 & Head EN52.

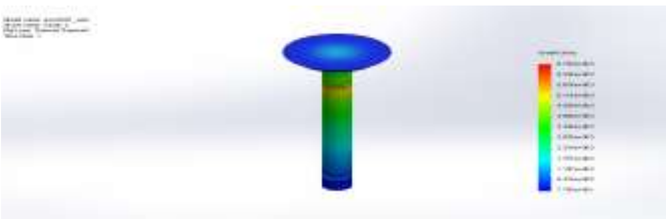


Temp Gradient Resultant=7903.79 k/m	Thermal Flux Resultant = 165980(w/m2)

6.1.5 Open condition @ 578 Temp Kelvin with Tail EN52 & Head Silicon Chromium Steel.



6.1.6 Open condition @ 578 Temp Kelvin with Tail EN52 & Head Titanium Carbide



Temp Gradient Resultant=6373.83 k/m	Thermal Flux Resultant = 196481(w/m2)

III. RESULT

Transient Thermal Analysis

Closed Conditions

	Temperature	Temp Gradient (K/M)	Thermal Flux (W/M^2)
EN52 Steel	558	12004	252084
EN52 and Silicon Chrominium Steel	558	10841.9	331388
EN52 and Titanium Carbide	558	10182	294840

Open Conditions	Temperature	Temp Gradient (K/M)	Thermal Flux(W/M
EN52 Steel	580	12678	266245
EN52 and Silicon Chrominium Steel	580	11442	350507
EN52 and Titanium Carbide	580	10735	311626

Temp Gradient Resultant=6793.1 k/m	Thermal Flux Resultant = 224371(w/m2)

THERMAL ANALYSIS CLOS CON	Temperature	Temp Gradient (K/M)	Thermal Flux(W/M^2)
EN52 Steel	560	7441.88	156280
EN52 and Silicon Chrominium Steel	560	6396.1	211258
EN52 and Titanium Carbide	560	6001.34	185015

OPEN CONDITION	Temperature	Temp Gradient (K/M)	Thermal Flux(W/M^2)
EN52 Steel	578	7903.79	165980
EN52 and Silicon Chrominium Steel	578	6793.1	224371
EN52 and Titanium Carbide	578	6373.83	196481

IV. CONCLUSION

We designed the diesel engine exhaust valve by using the formulas. We have done the model for the designed model by using Solid Works software We conducted Transient thermal analysis at closing and opening condition using Bimetal and Single metal for the valve. We have also conducted thermal analysis Thermal analysis of the exhaust valve shows that the maximum temperature of the exhaust valve occurs at the stem of the valve. . By observing the transient thermal analysis results, the results are same for closed and open conditions using Bimetal and Single metal. By comparing the closed and open conditions, the heat transfer rate is good in the closed condition than in open conditionBy observ the transient thermal analysis the heat flux are more for Head- Silicon Chrominium Steel and Tip-EN52 Steel is better heat flu values comparatively all heat fluxes.For thermal analysis the h flux are more for Head-Silicon Chromium Steel and Tip-EN52 Steel is better heat flux values comparatively all heat fluxes. Finally we have concluded that for the Bi Metal valves the head manufacturing with Silicon Chromium Steel and tip with EN52 is better for future conditions

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