

# Design and Couple Field Analysis of Exhaust Manifold

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**Abstract-** The Exhaust manifold is a standout amongst the most vital part to explore the related thermal stresses and disfigurements under recreated operational conditions near the genuine circumstance on various materials. Analysis completed by reference ecological testing conditions, in various surrounding temperatures on various materials i.e. structural steel, gray cast iron. The finite element analysis programming ANSYS Workbench 17.02 used to compute the straight unfaltering state temperature appropriation under the thermal and structural analysis. thermal analysis figures the temperature appropriations and related warm amounts in an exhaust manifold. Structural analysis takes contributions from thermal analysis to ascertain misshapening, stress and strain. FEM analysis is finished by utilizing tetrahedral element of first request and united test is performed for structural load.

## INTRODUCTION

### EXHAUST MANIFOLD

The exhaust manifold of a vehicle motor is constantly displayed to hot gasses. Cast iron has been being utilized for the period of exhaust manifolds for the most part. The essential traits required for the exhaust manifold material consolidate warm exhaustion quality required to withstand the high temperature exhaust gasses, oxidation resistance, mind bogging manufacture properties and low warm capacity to update the synergist work. Ferritic stainless steel demonstrate every single one of these properties and offers gigantic weight diminishment other than. The updates in vacuum casting process has helped in the production of stainless steel manifold with section thickness of 2-5mm. Higher requests in pollution control will rise the exhaust temperatures as well and along these lines, ferritin stainless steel will be in certified use for exhaust structure creating. Ferritic stainless steel indicates improves warm exhaustion qualities when taken care of by solid course of action

sustaining with molybdenum or niobium. This procedure in like manner enhances the oxidation resistance and microstructural steadiness. Ferritic stainless steel in like manner has taken a toll great condition in view of the nonattendance of nickel in its arrangement. Another variation called the austenite stainless steel is used where ferritic stainless steel is unsuitable. Austenite stainless steel can upgrade its properties when enough carbon is added to it. Nevertheless, the higher cost limits its utilization stood out from the ferritic variety.

### TYPES OF MANIFOLDS

Engine exhaust manifolds accumulate exhaust gasses from each chamber and channel them into an exhaust outlet. The complex is planned to give minimum backpressure and turbulence. Cat things utilize dry, water cooled and air secured water cooled (ASWC) complex outlines, in light of usage and plan necessities.

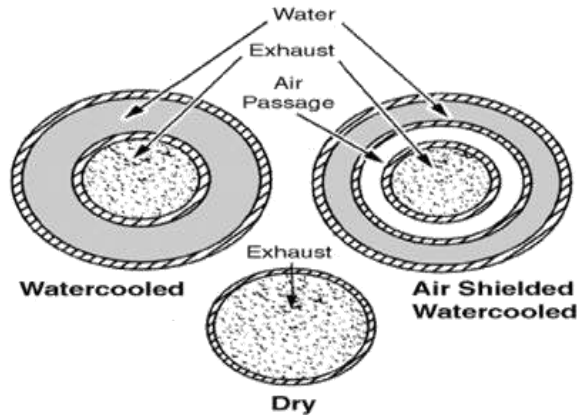
### DRY MANIFOLDS

Dry manifolds are the favored complex outline. They are financially savvy and by giving the most extreme conceivable exhaust vitality to the turbocharger, they offer the most astounding general proficiency. Dry manifolds, nonetheless, likewise transmit the most warmth and achieve the most noteworthy surface temperatures.

A couple of uses require low complex surface temperatures. For example, the Mining Safety and Health Agency (MSHA), the Atmospheres Exposable (ATEX) command and

Marine social requests require that motor surface temperatures remain underneath 200°C (400°F) for specific mines. Heat shields and covers are open for some Cat things to meet lower surface temperature essentials. Two or three marine things offer optional

water cooled manifolds. Gas engines continue running with a higher exhaust temperature diverged from diesel engines. As a result of these high exhaust temperatures, a couple of models use water cooled or air secured water



#### Water cooled Manifolds

a greater breaking point water cooling system. Water cooled manifolds additionally lessen exhaust the warm imperativeness passed on to the turbocharger. This requires the use of a fittingly organized turbocharger for most outrageous viability. The turbocharger used on dry complex applications may not be proper for use on water cooled applications.

#### Air Shielded Water cooled Manifolds

Air ensured water cooled manifolds (ASWC) impact usage of a securing to air pit between the exhaust complex and the water shield. Motor water streams around the air shield however does not come into arrange contact with the inward mind boggling. This reduces the imperative coat water cooling burden and keeps up higher exhaust imperativeness open to the turbocharger.

#### Heat Shielding

Warmth ensuring may be used as a technique for securing hot surfaces and protecting parts or heads from extravagant warmth. The usage of warmth shields depends upon numerous factors including, however not obliged to, foundation sort, condition and legitimate requirements. Gatekeepers may additionally be a compelling methodologies for giving security. Shields that are laid out and given by Caterpillar are fit to this reason. Any client fitted shields must be definitively made and connected with

guarantee that harm to the motor does not happen. Wraps and shields, particularly those not gave by Caterpillar, must be watchful about developing bit skin temperature. Enormous breeze current around the shield can encourage lessen increments to some degree skin temperature.

#### Blankets (Soft Manifold Shields)

Spreads are made of a securing layer of material with a warm texture outer layer. Most covers will be held set up with stainless steel springs or wire which will be bound over the blankets. Blankets will bind both warmth and nose Caterpillar does not endorse utilization of spreads on exhaust manifolds, turbochargers or other motor parts. The utilization of complex covers as often as possible achieves inconvenient dissatisfaction of exhaust complex parts. Uncommon cases may be made if the insurance is given and embraced to a particular application by Caterpillar; for these things, Caterpillar uses exhaust and turbocharger parts that are created utilizing materials prepared for withstanding higher temperatures. Cat engines that utilization wraps and shields are made to lower exhaust gas temperature confine.

#### Hard Wrap (Hard Manifold Shields)

Caterpillar does not endorse utilization of spreads on exhaust manifolds, turbochargers or other motor parts. The utilization of complex covers frequently realizes awkward frustration of exhaust complex parts. Exceptions may be made if the insurance is given and avowed to a particular application by Caterpillar; for these things, Caterpillar uses exhaust and turbocharger sections that are created utilizing materials fit for withstanding higher temperatures. Cat engines that utilization wraps and shields are created to a lower exhaust gas temperature restrict.

#### Guards and Shields

Watches and shields are typically influenced utilizing punctured sheet to metal. They are introduced with an air crevice between the shield and the hot surface. With satisfactory wind stream around the engine, the warmth exchange from iron to air will bring down the temperature of the shield extensively.

#### APPLICATIONS

### Exhaust Systems for Specific Applications

Some engine applications face more foundation challenges than others. Marine foundations, for instance, are overseen no space and require great security from water entering the exhaust structure. The information that takes after areas some of these difficulties and can be important to marine based and what's more some land based foundations.

### Marine Dry Exhaust System

The marine dry exhaust structure, when in doubt, resembles an average arrive based vapor system and will be subject to a comparable exhaust system design considerations starting at now discussed here. Marine Exhaust Ejector Automatic Ventilation System

A reasonably fundamental system utilizing an engine's exhaust for ventilating an engine room can be sorted out with most dry vapor structures. Ventilation work can be presented around the engine vapor directing in a way that the exhaust stream makes a vacuum that is utilized to draw the hot spruce up of the upper piece of the engine room. This methodology has been used viably in marine applications with minimal engine rooms and unimportant ventilation essentials. An exhaust ejector structure may draw out a measure of ventilating air around identical to the flood of vapor gas.

### Marine Wet Exhaust System

Wet exhaust structures blend the vapor gasses with the ocean water released from the ocean water side of the motor's coat water warm exchanger. Clamminess of exhaust gasses and seawater is released from the watercraft at or irrelevantly underneath the vessels waterline. With an all things considered little stature refinement between the motor's vapor release elbow and the vessels waterline, it is hard to graph a framework which will dependably shield water from entering the motor through the exhaust structure. While diverse specific vapor parts are accessible to keep up a key partition from this issue, the most comprehensively saw non specific methodology are exhaust risers and water lift silencers.

### Introduction to CATIA

CATIA is a totally automation programming which relates with the mechanical field. It is graphical UI which is definitely not hard to learn moreover the

item is feature based and parametric solid illustrating. We can draw 2D and 3D models of an area and in like way the social affair of the parts ought to be conceivable in it.

The shape or geometry of the model or assembling is poor upon the qualities which are suggested as objectives. Modules, for instance, sketcher module used to design 2D illustrations, part layout module is used to diagram the 3D models of geometry, and Assembly work arrangement is used to accumulate the different parts which are pulled in the part plot module. Kinematics is used to give the entertainment or development to the part bodies which are arranged and amassed to some degree and get together layout modules.



### Introduction to (FEA)

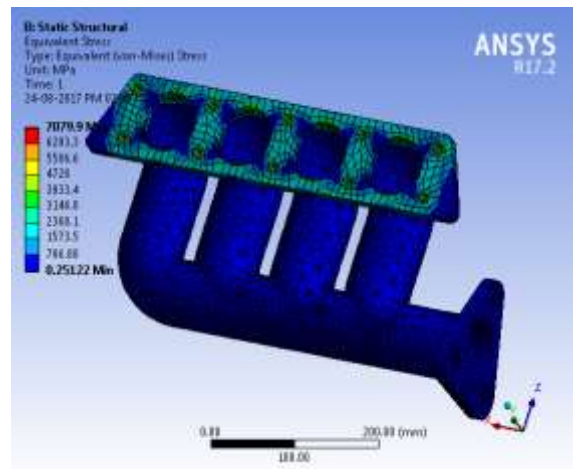
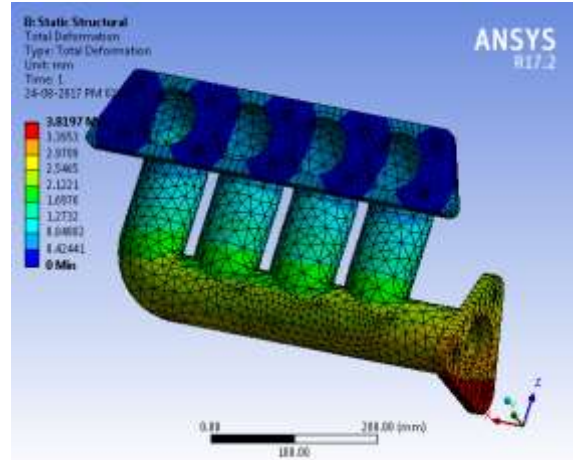
FEA is the pragmatic use of the limited component strategy (FEM), which is used by planners, and researchers to logically show and numerically secure amazingly complex auxiliary, fluid, and multiphase inconveniences. FEA programming can be utilized as a part of full-estimate type of organizations, yet is most for the most part used as a feature of the aeronautical, biomechanical and train enterprises. A limited component (FE) variant contains a game plan of variables, known as "center points", which outline the condition of the diagram. Joined with these center points are simply the limited components which outline the limited detail work and consolidate the material and fundamental properties of the model, portraying response of it in particular circumstances. The thickness of the limited component work may likewise contrast all through the material, dependent upon the anticipated change in strain levels of a particular segment. Regions that delight in over the top changes in worry for the most extreme segment

require a higher work thickness than the individuals who delight in almost no weight rendition. Elements of side interest may likewise involve break elements of ahead of time attempted material, filets, corners, entangled factor of converge, and high-strain ranges.

Ansysis result

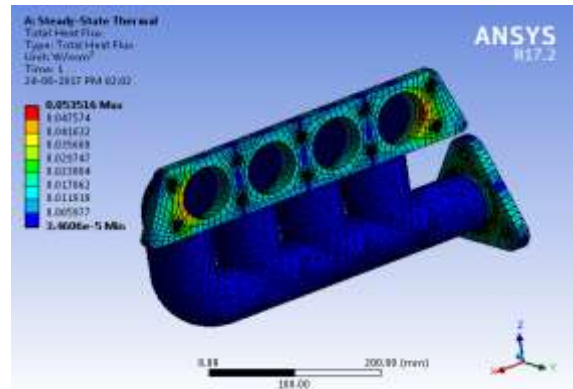
Structural steel

Deformation & Equivalent stress



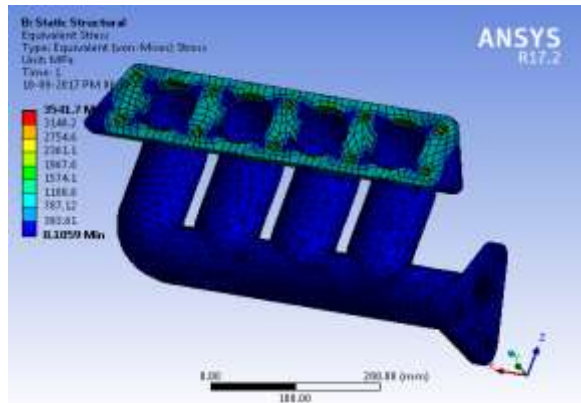
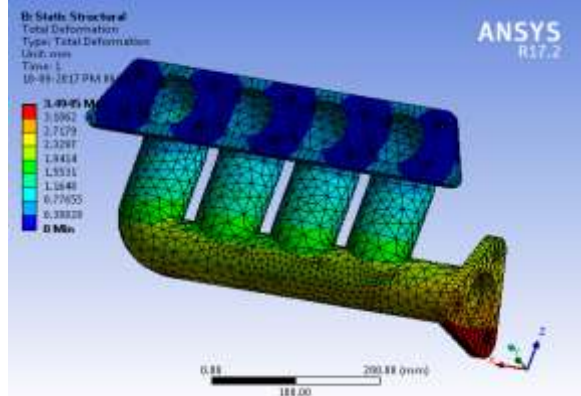
Thermal analysis

Total heat flux



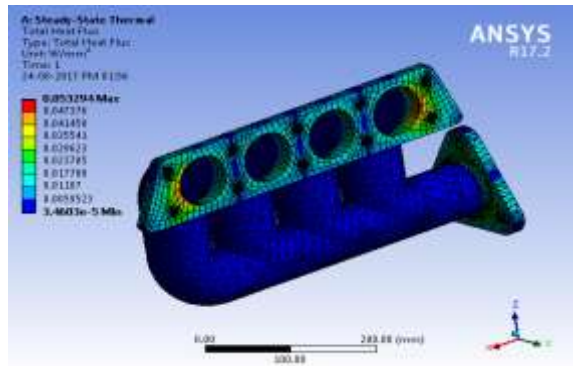
Gray cast iron

Deformation & Equivalent stress



Thermal analysis

Total heat flux



Structural analysis Result

Sl no	material	Structural steel	Gray cast iron
1	Total deformation	3.8197 mm	3.4945 mm
2	Equivalent stress	7079.9 MPa	3541.7 Map
3	Equivalent strain	3.5507e-002mm/mm	0.032293m/m/mm

Thermal analysis result

Sl no	material	Structural steel	Gray cast iron
2	Heat flux	5.3516e-002 W/mm <sup>2</sup>	5.3294e-002 W/mm <sup>2</sup>

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CONCLUSION

Basic examination and Thermal examination has been performed on the ventilation framework to find the disfigurements in the game plan of ventilation framework. Examination was done by considering the two remarkable materials auxiliary steel and dim cast press. Dark cast press has seen to have additionally curving while appeared differently in relation to others. Auxiliary steel is awesome material for this outline.

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AUTHOR DETAILS