EVALUATING THE HEAT RESISTANCE OF THE MUDFLIER HEAT SHIELD ON THE HERO XTREME 200R MOTORCYCLE: AN INVENTIVE METHOD

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ABSTRACT - Because of differences in the strokes during the combustion cycle, pressure fluctuations occur in the exhaust systems of combustion engines. A conduit is a fundamental component of an exhaust system that transports combustion byproducts away from the engine. The path of the exhaust gasses is determined by the engine. The goal of this study is to determine the best exhaust system arrangement for a passenger car engine in order to generate the requisite pressure pulses. SOLIDWORKS is used to design and compute the exhaust system for a compact utility passenger vehicle. This is done to identify the ideal system size. To proceed, we will use ANSYS software to do a Computational Fluid Dynamics (CFD) analysis of a typical exhaust system found in a typical family car. The Design of Experiments methodology can be used to determine the ideal exhaust system layout. The goal of the improved design will be demonstrated by experimental confirmation. A computational fluid dynamics (CFD) research provided recommendations for reducing the present pressure drop by 13%.

Keywords: Muffler Heat Shield, pressure fluctuations, Computational Fluid Dynamics (CFD)

1. INTRODUCTION

Placement of heat shields in a gaseous atmosphere or in close proximity to the object can significantly reduce the amount of heat that escapes. In order to reduce the amount of heat lost through radiation, convection, and/or conduction into the surrounding air, heat shields are frequently used. Within a solid or liquid, heat is transferred by means of conduction. Convective heat transfer refers to the process by which heat is transmitted from a solid surface to a fluid in motion. Radiant heat transmission is the mechanism by which excess energy from atoms is transferred to a distant object. A metallic panel or other type of partition can be used to provide a thermal barrier between the source of heat and the area or object that needs protection. This metal sheet is often made from a high thermal conductivity substance. The pace at which heat travels from the heat source across the barrier's surface is determined by the properties of both the barrier and the heat source. Depending on the conditions, the barrier's surface can either reflect or absorb the heat The importance of effectively managing the excessive heat created by several car components is emphasized in the automotive industry.

To prevent dangerous buildups of temperature, heat shields work to scatter or divert the source of the heat away from the region in question. The exhaust system of an internal combustion engine-powered automobile is the second most significant source of heat after the engine itself. The vehicle's exhaust and the engine's cooling system make up this system. Component surfaces can reach temperatures of 900 degrees Celsius when exposed to hot exhaust fumes. Drain insulation is critical for preserving essential and thermally susceptible regions in close proximity from excessive heat. Furthermore It's possible that heat shields can keep the temperature in the vents of engine mounts to a comfortable level. The engine compartment is kept at a constant temperature by the aerodynamic flow created by the vehicle's speed. When braking or climbing a steep slope, it is especially important to keep the engine cool to prevent damage to the engine mounts and other parts of the vehicle. Implementing heat shields and doing detailed thermal assessments can improve engine mount ventilation

Types of Muffler Heat Shield

The heat shield, characterized by its persistent and determined nature

Heat Shield Applications

The main goal of thermal management is to improve passenger comfort and reduce the risk of overheating in critical automobile components. The primary goal of using heat shielding materials is to lessen the amount of heat that radiates, convects, and conducts from the engine compartment to the rest of the vehicle.

Major Application Areas Are follows

- A gadget that keeps the exhaust manifold from getting too hot.
- A device that can bring the temperature of catalytic converters down to safe levels.
- Turbochargers necessitate unique approaches to thermal management.
- Fire-safe igniting systems for engines.

2. LITERATURE SURVEY

Prof. Ganesha B. B., Mr. Bharath M. N. (September2017),presented a Paper on "Design and Thermal Analysis of Motor Bike Exhaust Silencer-A Review" The exhaust systems of cars release the byproducts of gasoline combustion into the atmosphere, which may subject passengers to potentially hazardous high temperatures. The durability of subsystem components is crucial for ensuring consistent heat dispersion throughout the exhaust system. This dissertation seeks to mitigate the formation of localized areas of elevated temperature, specifically on the outer surface of a silencer, by investigating the heat transfer process that takes place when hot gases flow through silencers and devising a silencer configuration or surface that accomplishes this objective.

Dhiraj kumar K. More, Dr. Prashant D. Deshmukh, R.O.Gawande (June 2016) presented a paper on "Thermal Analysis of Two Wheeler Exhaust Silencer using Computer Aided Engineering" Vehicle exhaust systems endure elevated temperatures as they enable the emission of high-temperature gases generated during fuel combustion. During the design of the exhaust silencer, it is crucial to focus on specific areas to ensure an even distribution of heat throughout the entire exhaust system and to enhance the longevity of its components. The objective of the proposed research was to gain a deeper understanding of the heat transfer processes occurring in an exhaust system and to develop a pathway for the silencer that would mitigate the adverse impacts of localized high temperatures, particularly at the junction with the exhaust manifold the exhaust manifold.

Kunchala Krishna, Roktutpal Borah, (Oct2016) ,presented a paper on "Analysis of diverse material for optimum exhaust heat shielding effect in an engine". The initial stage of this study involved doing a thermal analysis on the engine's heat shielding system. The materials employed in this system include steel alloys, aluminum silicon alloys, and magnesium zirconium oxide. An investigation is conducted on multiple heat shielding materials and their contrasting effects. Various materials have been utilized to investigate the thermal properties of heat shielding systems. In future iterations, engine casings will use novel heat shield combinations composed of aluminum, zirconium, and steel alloys. The objective is to mitigate fuel use and environmental contamination by eliminating the origin of the auditory disturbance.

Jagdeesh H.K., Manjunatha K, Mahesh reddy (Nov2015), presented a paper on "Numerical and Experimental Investigation on Thermal Behavior of Exhaust Heat Shield". I.P.Kandylas, A.M.Stamatelos (Dec1998),presented a paper on "Engine exhaust system design based on heat transfer computation". This study investigates the mechanisms of heat transfer, specifically radiation, convection, and conduction, within the exhaust heat shield. Attempts are undertaken to optimize. The research primarily focuses on the thermal properties of the exhaust heat shield. The main objective of this study was to examine the temperature distribution within the heat shield, particularly the pathways via which heat is transmitted by conduction, convection, and radiation. The live display of the prototype also showcased the presentation of the temperature dispersion. The Finite Element Method (FEM) yields the temperature distribution within the heat shield. The component's dynamic behavior is exposed using modal analysis. The natural frequency was found to be sufficiently stable for utilization in automotive applications

MaheshS.Vasava, P.V.Jotaniya (Jun2015), presented a paper on “Heat Transfer Analysis in Automotive Exhaust System using Liquid Jet Cooling”. The researchers employed a custom liquid jet cooling apparatus to evaluate heat transport in an automotive exhaust system. Evaluation Vehicle exhaust pipes employ liquid jet cooling systems to enhance heat transfer. The research demonstrates that heat transfer in exhaust systems is a crucial concern in the design of exhaust system components. The temperature of the exhaust system might impact the corrosion mechanism on the silencer and exhaust pipe. One can enhance the efficiency of the silencer and exhaust pipe by controlling the back pressure produced in the exhaust pipe through reducing the temperature of the exhaust. Regulating the temperature of the exhaust gas can effectively prolong the lifespan of the catalytic converter. Moreover, it is asserted that a liquid jet cooling system has the capability to regulate the temperature of both the engine and the exhaust gases.

S.Rajadurai1, M.Afnas, S.Ananth, S.Surendhar (March2014), presented a paper on “Materials for Automotive Exhaust System”. This study investigates the impact of incorporating titanium (Ti), molybdenum (Mo), manganese (Mn), and silicon (Si) into traditional steel on different components of an exhaust system. This text provides a comprehensive examination of the materials often employed for both typical and specialized purposes. A comparison is made between the qualities of mild steel, stainless steel, and aluminized steel. This study examines the various uses of numerous materials, namely Inconel, Fe Cr Alloy, 18CrCb, and A286. We are investigating the mechanical, chemical, and physical properties of the materials utilized in the exhaust system. The effects of enhancements to the fundamental medication were also delineated.

M.Rezaei (Feb2013), presented a paper on “Experimental and finiteelement vibration analysis of exhaust man if old heat shield” .Using finite element analysis and experimental techniques, this research looks into how engine vibration stresses contribute to heat shield failure. Plate vibration techniques can be applied to analyze heat shields due to their composition of thin shells. In the range of engine speeds, two of the initial resonance frequencies of the heat shield have been identified. Moreover, the places with the highest amount of bending generally correlate with the largest gaps in the heat shield.

Bin Zou, Yaqian Hu, Zhien Liu, Fuwu Yan and ChaoWang (Aug 2013), presented a paper on “The Impact of Temperature Effecton Exhaust Manifold Thermal The principles of conduction, convection, and radiation are the primary mechanisms that govern the transfer of heat in exhaust heat shields The process of optimization has commenced formally. The research primarily centers around the thermal characteristics of the exhaust heat shield. The main objective of this study was to analyze the individual impacts of radiation, convection, and conduction on the overall temperature distribution of the heat shield. Observers can monitor the real-time distribution of temperature through the use of the experimental display. The precise temperature distribution across the heat shield is established by the Finite Element Method (FEM) study. The examination of the dynamic characteristics of a component is referred to as "modal analysis." The frequency was selected based on its reliability, rendering it ideal for automotive applications.

Modal Analysis”. Modal analysis and temperature effects on the exhaust manifold are the focus of this investigation At first, temperature field boundary conditions are used to simulate the heat conduction process in FEM software Computational Fluid Dynamics (CFD) software is then used to create a visual representation of the temperature's effect. Finally, temperature is factored into the modal analysis that is performed. We compare and contrast the vibrational patterns and frequencies of hot and cold modalities in this investigation. The findings highlighted the importance of temperature in product design and demonstrated the large impact temperature has on the manifold mode.

P. Srinivas, Venkata Ramesh Mamilla, G. Lakshmi NarayanaRao, Sowdager MoinAhmed (June2016), presented a paper on “Design and Analysis of an Automobile Exhaust Muffler”.A dynamic modal analysis was conducted in CAE to study the mode forms, stresses, and deformations of an actual exhaust muffler. The muffler guard is engineered and validated using the SolidWorks software. The muffler exhibits excellent craftsmanship and is appropriately sized. Computational fluid dynamics (CFD) simulations indicate that a double expansion chamber surpasses a single one in terms of performance. The double-expansion chamber exhibits a transmission loss of 42.48, which significantly exceeds the minimal requirement and demonstrates considerable potential. We examined potential future opportunities, including the development of a compact yet highly efficient muffler. This enables the muffler to be reduced to a compact size suitable for a motorcycle. Additionally, it is feasible to compute the pressure in the other direction Reduced dimensions of mufflers result in decreased production expenses. Consequently, the required space for the muffler is diminished.

Dragos Tutunea, Madalina Calbureanu, Lungu Mihai (June 2016), presented a paper on “Computational fluid dynamics analysis of a resistance muffler”. The main technique for reducing the exhaust noise of the engines addressed in this examination is a resistance muffler. This paper is about the development of a resistance muffler for use in automobiles. The researchers investigated how the inner flow field of the muffler affects its performance using Computational Fluid Dynamics (CFD). This approach predicts pressure decrease by simulating the internal pressure distribution of the muffler. The evolution of muffler design and construction has resulted in integrated performance. selected for The temperature, pressure, density, and velocity distributions of the exhaust muffler are precisely reproduced by models. This is crucial since detecting possible faults before the exhaust muffler is constructed minimizes costs and manufacturing delays.

Dattatray Dilip Giripunje, Prof. Dr. Vilas B. Shinde,Swapnil S. Kulkarni (Sept 2013), presented a paper on“Thermal analysis for motor-bike exhaust silencer for ensuring reductionin hotspots through design enhancement”. A major goal of this proposed dissertation is to evaluate the heat transfer that occurs during the flow of hot gases across the silencer, with a focus on the front end where it connects to the exhaust manifold. Comparing the results of a real laboratory investigation with those obtained by computer analysis or methodologies is one way to verify the design. Due to the geometry of the silencer, the results of the study and the physical experimentation are highly correlated, validating the design. The temperature of the exhaust silencer has been the focus of most studies. The primary objective was to perform structural and vibrational analyses, as well as to investigate the impact of temperature on the exhaust silencer. Several research projects have zeroed down on the best ways to optimize the materials used in exhaust systems. However, the heat shield of the muffler is rarely thoroughly examined. An excellent opportunity to increase one's knowledge of muffler heat shield performance optimization and thermal efficiency has presented itself.

3. METHODOLOGYOF THEPROPOSEDWORK

- The intended task might be segmented into distinct phases.
- An investigation is conducted to examine the impact of the manifold, exhaust pipes, and muffler on the dissipation of heat from exhaust gases.
- An analysis of the symptoms and repercussions of heat shield malfunction.
- Various Computational Fluid Dynamics (CFD) and Finite Element Analysis (FEA) methods are assessed.
- Developing a thermal insulator specifically designed for the exhaust system of a motorcycle.
- The ANSYS model of the heat shield.

- Conduct a finite element analysis on the heat shield using ANSYS.
- A finite element analysis is conducted on a heat shield using ANSYS software, considering several factors that can lead to failure due to vibration.
- Conducting a computational fluid dynamics (CFD) simulation to analyze the heat shield's thermal loading, its response to thermal overloading, and the overload temperature.
- Recommendations are made to enhance the structural and thermal efficiency of the heat shield.
- The enhanced heat shield is being compared to the original prototype.

4. CONCLUSION

Through our examination of the pertinent literature, we found that several experts have dedicated their research to thoroughly analyzing silencers using various approaches. Therefore, there is a chance to examine the effectiveness of the muffler heat barrier. We will enhance the performance of the muffler heat shield by utilizing Finite Element Analysis (FEA) and Computational Fluid Dynamics (CFD) to optimize its design.

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