

# Design and Development of Automobile Silencer for Effective Vibration and Noise Control

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## Abstract:

A Silencer is a part of the exhaust system of an automobile that plays a vital role. It needs to have modes that are located away from the frequencies that the engine operates at, whether the engine be idling or running at the maximum amount of revolutions per second. The purpose of the design project performed was to determine which modes are very high and may affect the automobile adversely while in operation. Research was performed prior to the test to determine which frequencies to look for modes at. It was determined to conduct the experiment so data from 20 Hz to 20 KHz could be collected. The force was generated by running the engine at different speed. Acceleration is measured by using FFT analyzer by selecting the points on the Silencer were chosen, after looking at the data and determined to be under damped. Therefore, our design study suggests increasing the mass, increase the damping, or providing a negative stiffness to make the silencer more damped.

The purpose of this report is also to the study the harmful effects of noise caused by it on Engine. In India, the transportation sector is growing rapidly and number of vehicles on Indian roads is increasing at very fast rate. This has lead to overcrowded roads and noise pollution. Engine vibration is one of the major source of noise in vehicles. So, it is necessary to study noise generated by four stroke petrol engine. The study of noise generated by four stroke petrol engine is carried out with or without mufflers to check the effectiveness of the muffler.

*Keywords* — Modes, FFT, Acceleration, mass, stiffness, damping, noise, muffler, effectiveness.

## INTRODUCTION

The Automobile silencer under study belongs to a popular 2-Wheeler manufacturer in India with the rated HP of the engine upto @13.5HP. The exhaust gases coming out from engine are at very high speed and temperature. Silencer has to reduce noise, vibrations. While doing so it is subjected to thermal, vibration and fatigue failures which cause cracks. So it is

necessary to analyze the vibrations which would further help to pursue future projects to minimize cracks, improving life and efficiency of silencer.

The purpose of the exhaust system is simple: to channel the fiercely hot products of fuel combustion away from the engine or generator, car's occupants out into the atmosphere. The exhaust system has a secondary purpose- to reduce the amount of noise made. The exhaust gases leave the

engine at incredibly high speeds. Moreover, with the opening and shutting of the exhaust valves with each cycle of combustion for each cylinder, the gas pressure alternates from high to low causing a vibration- and hence sound. Silencer has to muffle the vibrations of the exhaust gases, reduce their velocity and thus reduce the amount of noise emitted from the engines. The pulsating low from each cylinder's exhaust process of an automobile petrol or diesel engine sets up pressure waves in the exhaust system-the exhaust port and the manifold having average pressure levels higher than the atmospheric.

**OBJECTIVE: -**

1. To study major causes of failures of Automobile Silencer.
2. Identify and study using software tools (for simulation/ analysis), the nature and characteristics of vibrations.
3. Evaluate the influence of the vibrations over the design of the silencer
4. Review the existing design and consider improvement for negotiating the harmful influences of the phenomenon

**RESULT AND DISCUSSION**

With help of softwares like FFT Analyzer/Labview or other equivalent , the silencer can be tested for vibration and other related terms. The standard or reference data available for the past design/ validation as standards or reference or standards followed by automotive manufacturers normally proves to be very useful while considering experimentation. The validation would be carried out on two wheeler silencer of Hero Honda Splendor and obtained experimental results will be compared with software results.

The validation of the silencer is done by physical prototype development. While the

Silencer is made available in the physical form, the trials and testing would address the phase of validation. The correlation between the experimental and theoretical results will be analyzed and recommendations can be made for future scope of work. Normally the above would pursued while during validation.

Considering the use of softwares like FFT/ Labview or equivalent towards the measurement of vibration. The values obtained by from the test bench would be evaluated for arriving at an appropriate design with a development of a full-scale working prototype which would be typically produced by modifying the existing component in the physical form (silencer). The same would be used for validation further.

Mode Order	1	2	3	4
Frequency by FEM (Hz)	65.7 2	141.6	172.9	286.7
Frequency (Hz) FFT	68.3 5	147.0 3	179.5 3	297.7 3

Table.1 Comparison of Modal frequency by FEM & FFT Analyser:

**CONCLUSION**

The silencer natural frequencies have been calculated by using the ANSYS package and

by FFT analyzer. By both the method the natural frequencies are nearly same and that are useful while the design of silencer to avoid the resonance.

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