VIBRATIONAL ANALYSIS OF EXHAUST MUFFLER

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ABSTRACT

This paper postulates the first stage in the design of an exhaust system, With the specified properties of the different material, the exhaust system is modeled by solid works. In this paper, the structures are automotive exhaust system and the materiel used for the exhaust system is described. The result are compared the deformation of silencer parts of three specified materials for same exhaust thrust. This paper plays a vital role of deciding the life cycle of silencer.

1. Introduction: One of the objective when designing a new automobile silencer is to lengthen its durability period, which can be measured in terms of its life span and mileage. Gas combustion from an internal combustion engine will flow through the exhaust pipe which consists mainly of clamps connected to an engine. The internal force from the combustion pressure is called vibration noise which propagate through the exhaust pipe. The noise might have a different type of characteristic of vibration modes effected by idle shake and interior noise of the vehicle. Normally, the engine vibration are transmitted to the exhaust pipe and they are divided into two categories first longitudinal and second is bending vibration. Both categories must be taken into account for noise and vibration analysis. The exhaust pipe is subjected to several stresses most of which are due to vibration

Stainless steel is used for variety of automobile components by virtue of its excellent corrosion resistance, heat resistance and good appearance. Currently SUH 409L, SUS 436J1L and SUS 436L are mainly used as materiel for silencer whose corrosion resistance and thermal resistance are good.

2. NEED FOR ANALYSIS:

The automobile silencer under steady belongs to a popular 2-Wheeler manufacturer in India with the rated HP of the engine up to @7.69HP. The exhaust gases coming out from engine are at very high speed and temperature. Silencer has to reduce noise, vibration. while doing so it subjected to thermal, vibration and fatigue failures which cause cracks. So it is necessary to analyze the vibration which would further help to pursue future project to minimized crack, improving life and efficiency of silencer.

3. Material properties:

Name	**sus436j1L**
Mode type	Linear Elastic Isotropic
Default failure criterion	Max Von Mises Stress
Yield strength	2.05e+008 N/m^2
Tensile strength	3.9e+008N/m^2
Mass density	7730Kg/m^3
Elastic module	2.12e+011N/m^2
Poisson's ratio	0.2
Thermal expansion coefficient	1.6e-005/Kelvin

Name	**sus409L**

Mode type	Linear Elastic Isotropic
Default failure criterion	Max Von Mises Stress
Yield strength	1.75e+008N/m^2
Tensile strength	3.6e+008N/m^2
Mass density	7740Kg/m^3
Elastic module	2.06e+011N/m^2
Poisson's ratio	0.24
Thermal expansion coefficient	1.23e-005/Kelvin

Name	**sus436LT**
Mode type	Linear Elastic Isotropic
Default failure criterion	Max Von Mises Stress
Yield strength	2.45e+008N/m^2
Tensile strength	4.1e+008N/m^2
Mass density	7730Kg/m^3
Elastic module	2.06e+011N/m^2
Poisson's ratio	0.25
Thermal expansion coefficient	1.16e-005/Kelvin

4. Data required for analysis:

The internal force from the combustion pressure is nearly 102500000 N/M^2 for 2-wheeler vehicle and the analysis noise frequency range is 150 Hz. These two data are required in solid works for pressure distribution on the silencer.

5. Assumption:

1. The exhaust gas force is worked equally inside the silencer pipe.

2. There is no change in materiel property during analysis.

Analysis procedure: The analysis is done on each part of silencer individually by considering assumption.

Model and meshing of silencer:

A. Silencer pipe

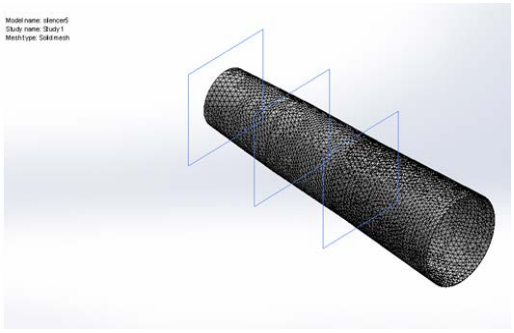


Figure: perforate pipe

After generating the mesh model of silencer then analysis is done by solid works. The deformation result obtained by solidworks for different materiel is shown below.

Material name	**sus436j1L**	**sus409L**	**sus436LT**
Deformation in X-direction	6.0261e-006	5.9943e-006	4.6342e-006
Deformation in Y-direction	0.80182	0.80419	0.80357
Deformation in Z-direction	0.80332	0.80566	0.80619

B: Perforated Pipe

Figure perforate pipe

After generating the mesh model of resonator by solid
works the deformation result are obtained as shown below.

Material name	sus436j1L	sus409L	sus436LT
Deformation in X-direction	0.36114	0.3557	0.35579
Deformation in Y-direction	0.36671	0.35646	0.35654
Deformation in Z-direction	0.68787	.68625	0.68624

B:Baffle And Mentel pipe:

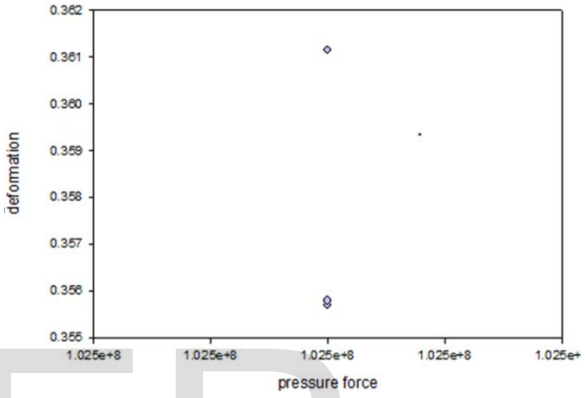
Figure: maffle and baffle

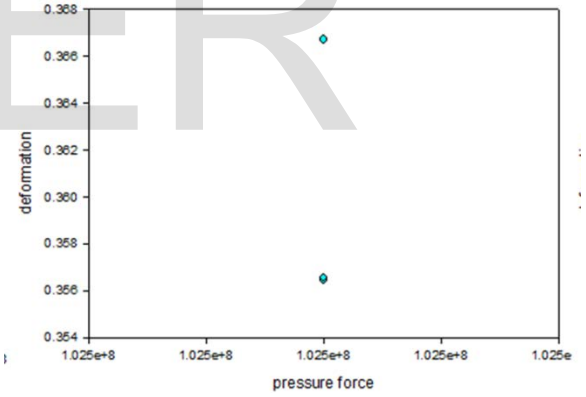
After generating the mesh model of resonator by solidworks the deformation result are obtained as shown below.

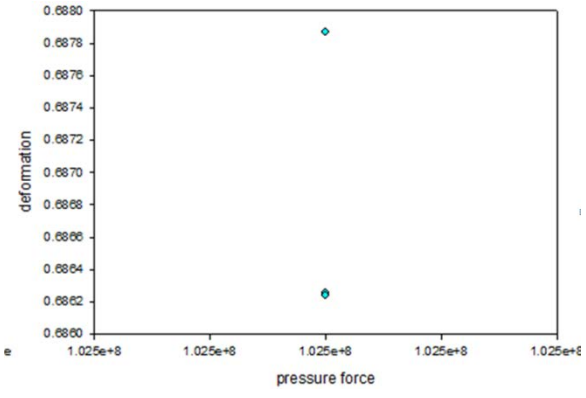
Material name	sus436j1L	sus409L	sus436LT
Deformation in X-direction	0.7037	0.69936	0.69853
Deformation in Y-direction	0.50479	0.49237	0.49018
Deformation in Z-direction	0.49344	0.49081	0.48933

Result:

B. Deformation for PERRFORATE PIPE







Similarly deformation graph can be draw for mental and baffle and silencer pipe.

Conclusion:

1.On the basic of vibration analysis of three materials SUS 436J1L have higher deformation then other two material SUS 409L , SUS 436LT and SUS 436LT is the minimum deformation so it is better option for silencer part for manufacturing due to higher life cycle.

2.The value of frequency of materiel SUS 436J1L is the highest at last node of each part of exhaust muffler so it will create more noise so it is not more suitable to reduce the amount of noise emitted by vehicle

References:

[1] Vibrational analysis of automotive Exhaust Silencer based on FEM and FFT Analyzer.

[2] Automobile Vibrations and Acoutic Noise Reduction via Modal Analysis Technique International journal(1-3-2012)

[3] IJAUERD Designing and Optimization of Exhaust Muffler in Automobiles.

[4] On The theoretical vibration analysis of exhaust system