

Optimal Design and Fabrication of Exhaust Muffler Using in I.C. Engine

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Abstract- IC engines are one of the major sources of noise pollution. Mufflers are generally found with exhaust system. After the combustion the high intensity gas pressure through the muffler chamber and some of the gases reflected again passes through the combustion chamber it is called back pressure. It creates vacuum pressure in combustion chamber and decreases the engine performance. Reduction of weight, increasing the capability of noise absorption from the muffler with minimal back pressure can increase the performance of the engine. The objective of this study is to optimize noise level. This project mainly targets on designing a muffler to reduce the noise. Based on new muffler design parameters, a model is fabricated and tested.

Resistance muffler is the principal device to attenuate the exhausted noise of engines used in present. In this study, a resistance muffler was designed for automotive industry. The integrated performance of design and construction of muffler has been advanced.

There are five different design criterion of mufflers design; they are acoustical criterion, aero dynamical criterion, mechanical criterion, geometrical criterion and economical criterion. The acoustical criterion specifies the minimum noise reduction required from the muffler as a function of frequency. The mechanical criterion specifies the materials from which the muffler is fabricated. So that it is durable and requires less maintenance. The economical criterion is vital in the market place.

Keywords- Design, I.C. Engine, Muffler; noise reduction.

I. INTRODUCTION

The muffler is defined as a device for reducing the amount of noise emitted by a machine. To reduce the exhaust noise, the engine exhaust is connected via exhaust pipe to silencer called muffler. The various types of mufflers used in automobiles are:

- Absorptive type (dissipative type)
- Reactive type
- combination of both absorptive and reactive type

If you've ever heard an engine running without a muffler, you know what a huge difference a muffler can make to the noise level. Inside a muffler, you'll find a deceptively simple set of tubes with some holes in them. These tubes and chambers are actually as finely tuned as a musical instrument. They are designed to reflect the sound waves produced by the engine in such a way that they partially cancel themselves out.

Automotive mufflers come in all different shapes, styles and sizes depending on the desired application. Generally automotive mufflers consist of an inlet and outlet tube separated by a larger chamber that is oval or round in geometry. Virtually all reciprocating internal combustion engines are fitted with mufflers. The muffler fitted to an engine is intended to reduce the pressure pulses associated with the exhaust gas leaving the cylinders of the engine. Generally mufflers fitted to such engines are essentially reactive devices as opposed to being dissipative devices. Reactive mufflers operate by the destructive interference of the acoustic waves propagating within them. Dissipative mufflers operate by the dissipation of acoustic energy, usually within porous fibrous materials.

Practical reactive mufflers also have some dissipative function. An ideal muffler for a reciprocating internal combustion engine should function as a low pass filter. The steady or mean flow should be allowed to pass unimpeded through the muffler while the fluctuating flow which is associated with the acoustic pressure fluctuation is impeded. If the steady flow is not significantly impeded the so-called 'back pressure' will be very low and the engine will function more efficiently. It is desirable to be able to predict the pressure drop associated with the steady flow through the muffler. Perforated tubes are commonly used inside automotive mufflers.

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II. DESIGN

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1. Various types of mufflers that are designed are

1. circular cross sectional muffler with single outlet
2. circular cross sectional muffler with dual outlet
3. oval cross sectional muffler with single outlet
4. oval cross sectional muffler with dual outlet

2. circular cross sectional muffler with single outlet

This circular cross sectional muffler is made as per the obtained dimensions

Length = 28cm
Diameter = 9cm

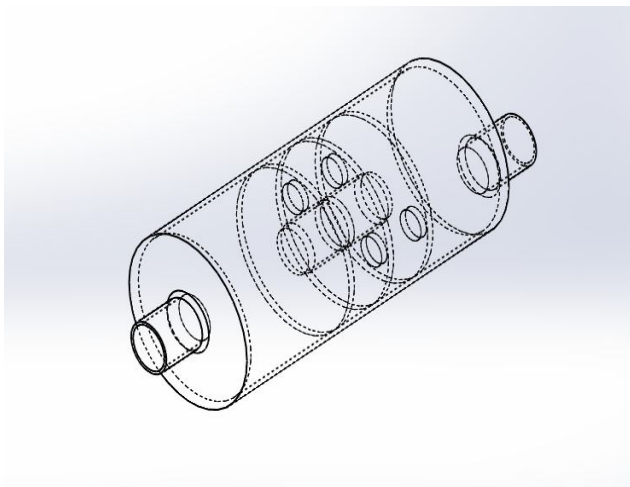


Figure 1. Wire frame model of circular cross sectional muffler with single outlet

3. circular cross sectional muffler with dual outlet

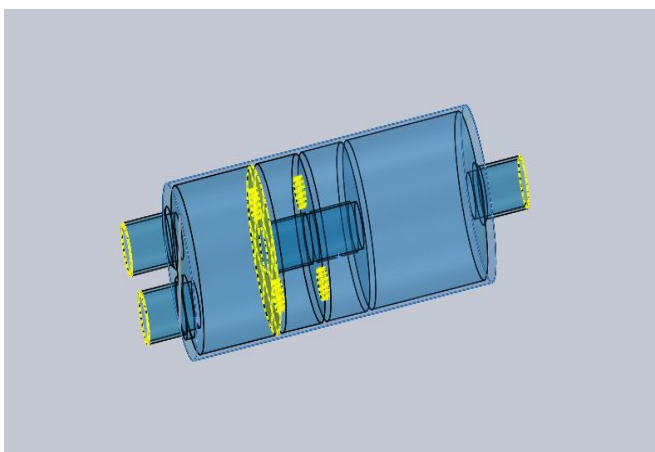


Figure 2. Isometric view of circular cross sectional muffler with dual outlet

4. Oval cross sectional muffler with single outlet

This circular cross sectional muffler is made as per the obtained dimensions

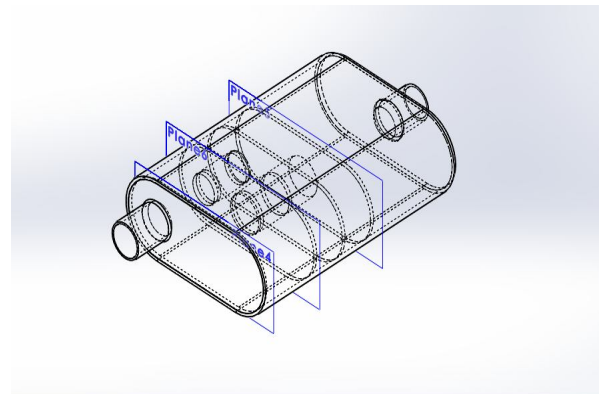


Figure 3. wire frame model of Oval cross sectional muffler with single outlet

5. Oval cross sectional muffler with dual outlet

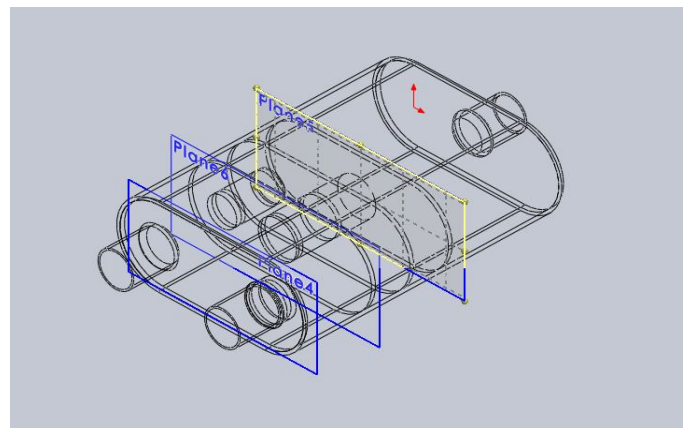


Figure 4. Wire frame model of Oval cross sectional muffler with dual outlet

III. TESTING EQUIPMENT

Two-Stroke petrol engine



Figure 5. Stroke Honda engine

Designed with Honda's ingenious Mini 4-Stroke technology, each engine efficiently delivers a powerful, quiet, cleaner performance. Its low vibration reduces work fatigue, making it the ideal power plant for an incredible array of applications “from hand-held and portable equipment including brush cutters, mowers and pumps, to hobbyist applications such as radio-controlled vehicles. The revolutionary Honda Mini 4-Stroke can enhance the attractiveness, quality and value of almost any product.

Table 1. Engine specification

SPECIFICATIONS	
CRANKSHAFT CTION	HORIZONTAL ORIENTATION
ENGINE TYPE	AIR-COOLED 2- STROKE OHV
BORE X STROKE	41.8 X 36 MM
DISPLACEMENT	50 CM3
NET POWER OUTPUT*	2.5 HP @ 7,000 RPM
NET TORQUE	2.0 LB-FT (2.7 NM) @ 4,500 RPM
PTO SHAFT ROTATION	COUNTERCLOCKWISE (FROM PTO SHAFT SIDE)
COMPRESSION RATIO	8.0:1
CARBURETOR	FLOAT TYPE
STARTING SYSTEM	PULL STARTER
LUBRICATION SYSTEM	FORCED SPLASH
GOVERNOR SYSTEM	CENTRIFUGAL MECHANICAL
AIR CLEANER	SEMI-DRY
OIL CAPACITY	0.26 US QT (0.25L)
FUEL	PETROL

IV. FABRICATION OF MUFFLER



Figure 6. Making of muffler

1. Rolling:-

The thin flat galvanized iron sheet is rolled into a form of a cylinder by rolling process. The sheet is placed over an anvil and beaten with hammer repeatedly to obtained the desired shape.

2. Cutting:-

The galvanized iron sheet is cut into circular shape to form the casing at both the ends of the cylinder. The diameter is as per the dimensions ie; $d=9\text{cm}$.



Figure 7. Fabricated mufflers

V. RESULTS

1. Variation of sound with respect to speed (without muffler)

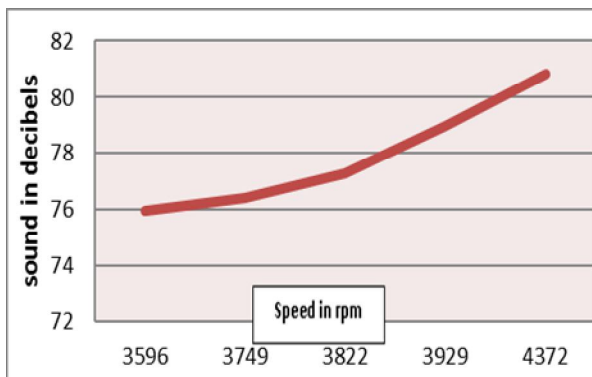


Figure 8. Variation of sound with respect to speed (without muffler)

2. Variation of sound with respect to speed (with single outlet)

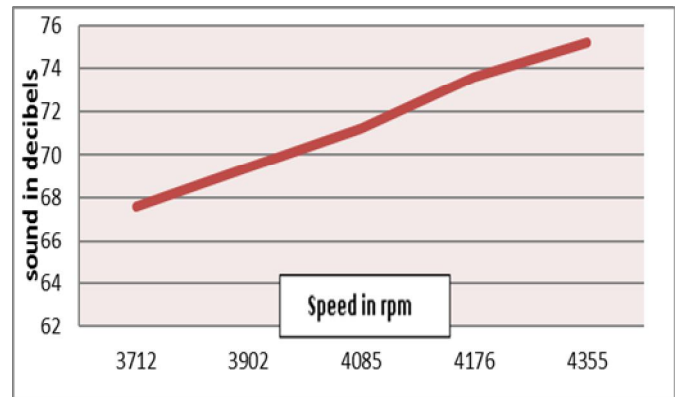


Figure 9. Variation of sound with respect to speed (with single outlet)

3. Variation of sound with respect to speed (with dual outlet)

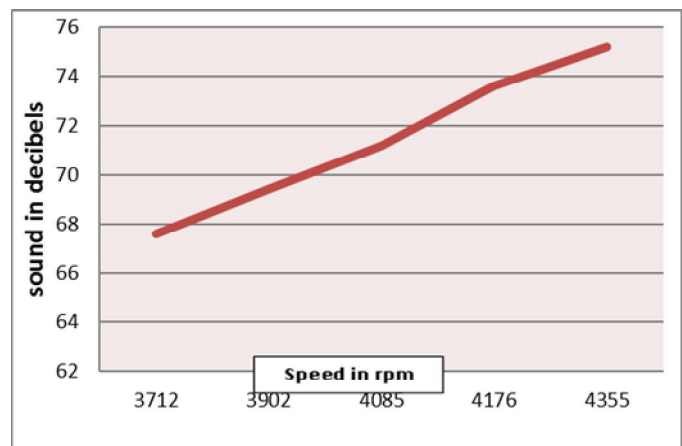


Figure 10. Variation of sound with respect to speed (with dual outlet)

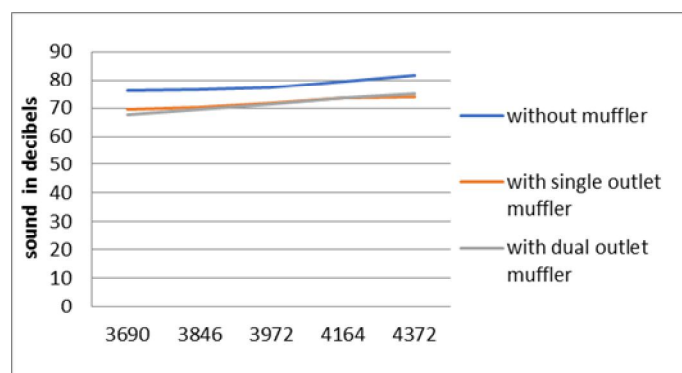


Figure 11. Comparison results

VI. CONCLUSION

The various designs of reactive type mufflers are made as per the dimensions. among them two types of mufflers are fabricated they are circular croo sectional mufflers having single exhaust outlet and dual exhaust outlet.

both the fabricated muffler models are tested separately and the obtained practical results matches the theoretical results and we have seen noise level reduction upto a great extent. And the results are as follows.

- Transmission loss theoretically is 5.19 decibels
- Transmission loss practically 6.06 decibels (single outlet)
- Transmission loss practically 6.44 decibels (dual outlet)

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