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# Attenuation analysis and acoustic pressure levels for double expansion chamber reactive muffler: Part 2

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## Abstract

The major source responsible for noise pollution is internal combustion engine. These engines are used for various purposes such as in automobiles, locomotives, and in various manufacturing machineries. In an engine, the exhaust noise and the noise produced due to friction of various parts of the engine share maximum contribution to noise pollution. Muffler is a device used to reduce noise within the exhaust system. It is arranged along the exhaust pipe for the purpose of noise attenuation. The paper describes the propagation of pressure wave in a double expansion chamber reactive muffler. The approach is useful in analysis of damping for propagation of harmonic pressure waves. The purpose of paper is to describe the finite element analysis of double expansion chamber reactive muffler using pressure acoustics and to validate it with experimental evaluation using two-load method.

## Keywords

Reactive muffler; transmission loss; finite element analysis; acoustic pressure levels; two-load method

## Introduction

Noise pollution produced by engines becomes a major concern when used in residential areas or areas where noise creates hazard. The exhaust noise is the most harmful. Noise level greater than 80 dB is injurious for human being. Various types of muffler are used to attenuate this noise. The reduction in the level of exhaust noise depends upon the construction and the working procedure of mufflers. Therefore, design of muffler plays an important role as it affects the noise characteristics and fuel efficiency of the engine. The exhaust muffler is characterized by numerous parameters like insertion loss (IL), transmission loss (TL). TL is one of the most frequently used criteria of muffler performance because it can be predicted very easily from the known physical parameters of the muffler. The TL could be achieved by analytical, numerical, and experimental method. Analytical methods are cumbersome as the associated algebra is complicated; therefore, many times it is impossible to solve such problems by analytical methods.[1] The numerical methods are general and allow the analysis of all types of mufflers and therefore used for optimization of model of complicated shapes and cost involved is less than experimental methods. In this article, the double expansion chamber reactive muffler is examined using finite element method. The detailed design procedure is available in the literature.[2,3]

## Geometry definition

The muffler depicted in Figure 1 consists of two resonator chambers. The exhaust pipe is attached at center at both ends. The length of input output tube is 95 mm and diameter is 44 mm. The resonator chamber is having circular cross section with diameter of 110 mm and length of 95 mm. The connecting tube for both chambers is having length of 95 mm and diameter of 44 mm.

The input–output tube diameter is taken same as that of engine exhaust pipe. The exhaust fumes enters through the left pipe called as exhaust pipe and exits through right pipe called as tail pipe.

## Domain equation

The muffler model solves the problem in the frequency domain.[4] It uses the time harmonic pressure acoustics

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