

Title:

A general reference rear-muffler model for exhaust system pre-design.

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Abstract:

At early stages in exhaust system development the internal details of the mufflers are not likely to be fully defined, whereas it is still necessary to produce a reasonable estimate of the acoustic characteristics of the whole system. This is usually accomplished by assuming either ideal cavities or empty expansion chambers whose dimensions are consistent with the space allowance previewed in the global design of the vehicle. However, such simplistic models are not totally convenient for these purposes: when ideal cavities are assumed, it is possible to estimate properly the low-frequency resonances of the whole exhaust line, but at the cost of overestimating the medium-to-high frequency attenuation, whereas the use of empty expansion chambers introduces a considerable number of spurious characteristic frequencies which make it difficult to evaluate properly the results.

In this paper, efforts in order to define a reference muffler model able to provide, with a few general data, a realistic approximation to the expectable behaviour of rear mufflers to be used at early stages of exhaust system design are described. First, the interest and potential application of the work is discussed. Then, a first approach is considered, in which a modified ideal cavity is used, together with suitable resistances in order to account both for given attenuation requirements and for dissipation constraints. The model is compared with a typical rear muffler, indicating the necessity to include some resonance effect in the acoustic behaviour. This issue is addressed next, with several possibilities being discussed, and the outcome indicates that in order to keep a relative simplicity in the model the best choice is to add a resonating device, while keeping the same total volume. Two different resonant devices (Helmholtz and quarter-wave resonator) are considered, and comparison is given with the same muffler as before, showing the potential of the proposed approach.