WOLFRAM Demonstrations Project

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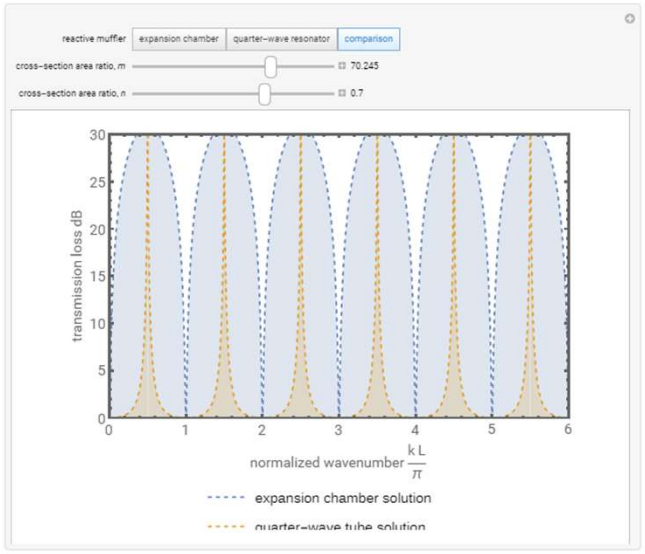
Performance of Reactive Acoustic Mufflers

BETA



DETAILS

Transmission loss represents the reduction of sound power level. For our models, the pipe cross-sectional area is assumed to be constant and equal at both ends.

After applying various boundary conditions based on the continuity of acoustic pressure and volume velocity for each change in cross-sectional area (i.e., where the pipe interfaces with the muffling device), the closed-form solution for a expansion chamber is given (in dB) by

$$\mathrm{TL} = 10 \log_{10}\left(\frac{1}{4}\left(m - \frac{1}{m}\right)^2 \sin^2(k\,L) + 1\right),$$

and the analytical closed-form solution for a quarter-wave resonator is

$$\mathrm{TL} = 10 \log_{10}\left(\frac{1}{4} n^2 \tan^2(k\,L) + 1\right),$$

where

TL: transmission loss ($\mathrm{dB\ ref\ } 10^{-12}\ \mathrm{W}$)

m: the ratio of expansion chamber cross-sectional area to pipe cross-sectional area

n: the ratio of quarter-wave resonator cross-sectional area to pipe cross-sectional area

k: wavenumber dependent on the speed of sound of the medium and frequency

L: length of expansion chamber or quarter-wave resonator

Reference

[1] D. A. Bies and C. H. Hansen, *Engineering Noise Control: Theory and Practice*, 4th ed., New York: CRC Press, 2009 pp. 456–464.