VAC Toolbox
Muffler Modeling Module

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VAC Toolbox

• The VAC Toolbox muffler module has been thoroughly updated and is current with the latest MATLAB version. It runs with MATLAB Runtime 9.9 which can be accessed on the MathWorks website.

• The software does not require you to have MATLAB.

• Software is available to VAC members.
Transfer Matrix Method Based

Assumes that all elements are in series with each other.

\[
\begin{align*}
\{p_1\} &= \begin{bmatrix} T_{11}^1 & T_{12}^1 \\ T_{21}^1 & T_{22}^1 \end{bmatrix} \{p_2\} \\
\{Q_1\} &= \begin{bmatrix} T_{11}^1 & T_{12}^1 \\ T_{21}^1 & T_{22}^1 \end{bmatrix} \{Q_2\}
\end{align*}
\]

\[
T_1 = \begin{bmatrix} T_{11}^1 & T_{12}^1 \\ T_{21}^1 & T_{22}^1 \end{bmatrix} \quad T_2 = \begin{bmatrix} T_{11}^2 & T_{12}^2 \\ T_{21}^2 & T_{22}^2 \end{bmatrix} \quad T_3 = \begin{bmatrix} T_{11}^3 & T_{12}^3 \\ T_{21}^3 & T_{22}^3 \end{bmatrix} \quad \ldots \ldots
\]

\[
[T_{Global}] = [T_1][T_2] \ldots [T_{10}]
\]

\[
\begin{align*}
\{p_1\} &= [T_{Global}] \{p_{10}\} \\
\{Q_1\} &= [T_{Global}] \{Q_{10}\}
\end{align*}
\]
User Interface

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Environment Settings

[Image of a software interface for setting environment parameters, including start and end frequencies, fluid speed, and density, with options for source impedance and velocity source settings.]
Muffler Modeling

![Diagram of muffler modeling]

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Define Element Parameters

Temperature for each element may be considered.
Calculation
Muffler Modeling Workflow

1. Environment Setting
2. Muffler Modeling Element Library
3. Muffler Overview
4. Calculate

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Transmission Loss Quarter Wavelength Tube

Uniform Tubes:
D = 1 inch; L = 10 inch

Quarter Wavelength Tubes:
Branch Diameter = 1 inch
Branch Length = 10 inch
Transmission Loss Helmholtz Resonator

Uniform Tubes:
D = 1 inch; L = 10 inch

Helmholtz Resonator:
Neck Diameter = 1 inch
Neck Length = 10 inch
Volume = 10 cubic inch
(neck end correction used)
Transmission Loss Simple Muffler

With quarter wavelength tube

Without quarter wavelength tube

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Compare with SIDLAB

Helmholtz Resonator:
- Neck Diameter = 1 inch
- Neck Length = 10 inch
- Volume = 10 cubic inch
  (neck end correction used)

Quarter Wavelength Tubes:
- Branch Diameter = 1 inch
- Branch Length = 10 inch

VAC Toolbox

SIDLAB
Transmission Loss SEC

\[ d_{\text{duct}} = 5 \text{ cm} \]
\[ d_{\text{exp}} = 22.5 \text{ cm} \]
\[ L = 71 \text{ cm} \]
Insertion Loss SEC

\[ d_{\text{duct}} = 5 \text{ cm} \]

\[ d_{\text{exp}} = 22.5 \text{ cm} \]

\[ L = 71 \text{ cm} \]