AED Acoustic Engineering Dresden

create silence

Acoustic Engineering Dresden

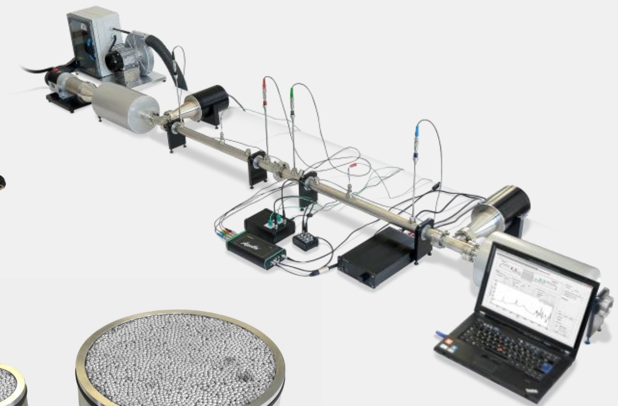
Gesellschaft für Akustikforschung Dresden mbH
Acoustic Engineering Dresden – AED

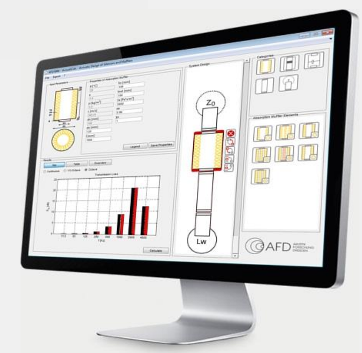
Acoustic Measuring Instruments & Analysis Software

Overview

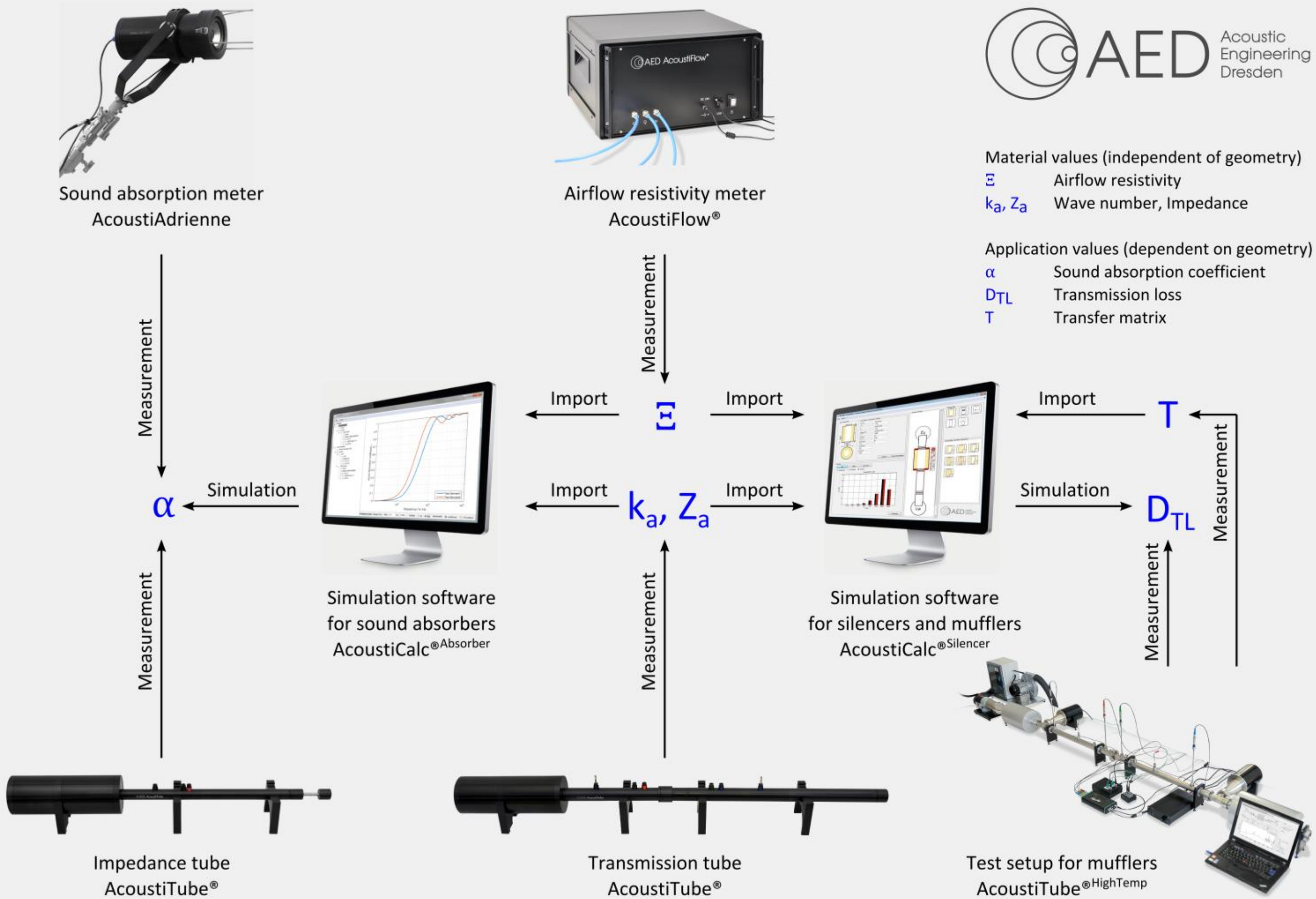
- Measuring Systems
  - AcoustiFlow® – Airflow resistivity meter
  - AcoustiAdrienne – Sound absorption meter
  - AcoustiTube® – Impedance tube
  - AcoustiTube® HighTemp – Test setup for mufflers
  - AcoustiCam® – Acoustic camera

- Application Software
  - AcoustiCalc® Absorber – Sound absorber software
  - AcoustiCalc® Silencer – Muffler software

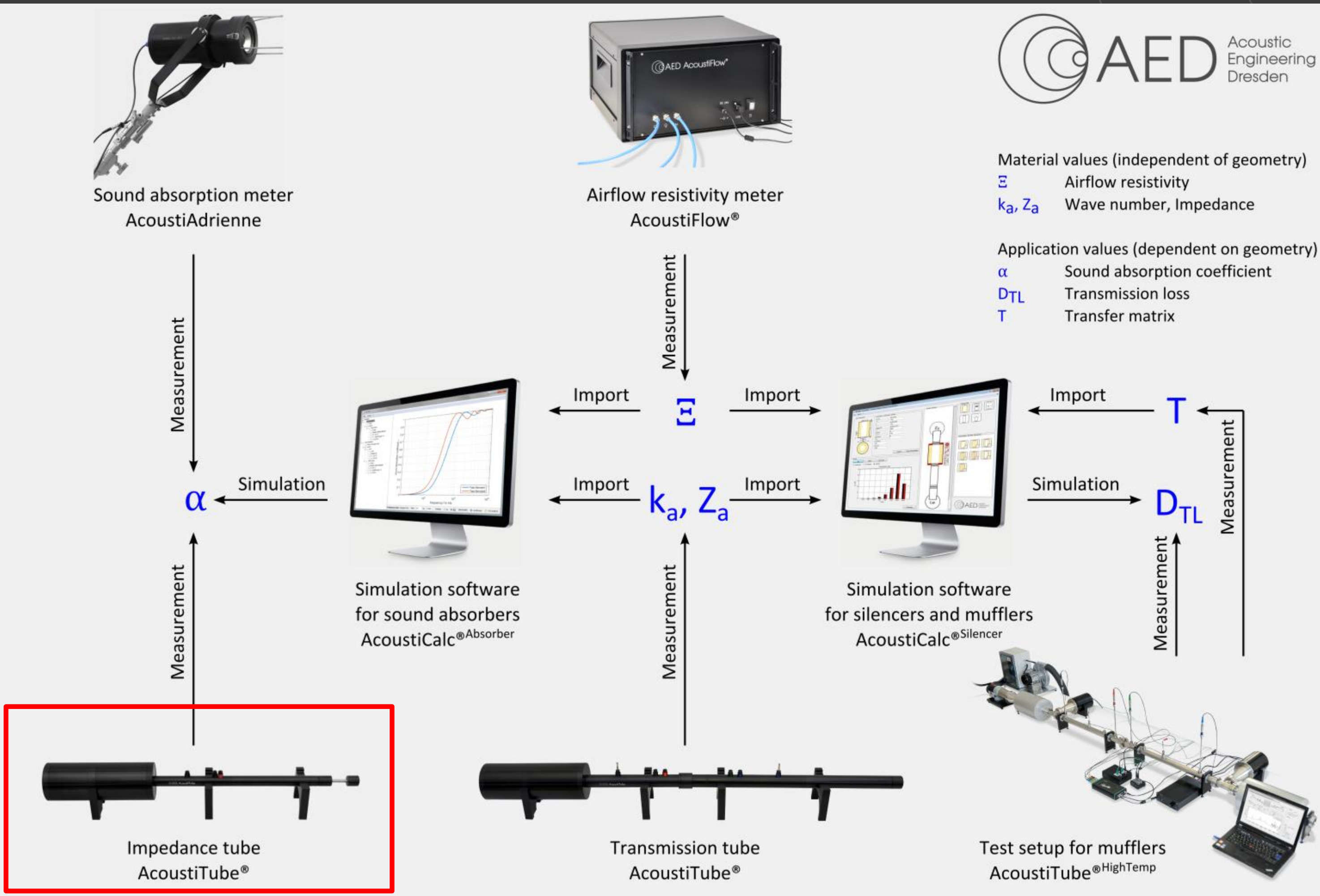


Overview



Sound absorption meter
AcoustiAdrienne
Airflow resistivity meter
AcoustiFlow®
AED Acoustic Engineering Dresden
Material values (independent of geometry)
Ξ Airflow resistivity
k_a, Z_a Wave number, Impedance
Application values (dependent on geometry)
α Sound absorption coefficient
D_{TL} Transmission loss
T Transfer matrix
Measurement
Measurement
Import
Ξ
Import
Import
T
Simulation
α
Import
k_a, Z_a
Import
Simulation
D_{TL}
Measurement
Measurement
Measurement
Measurement
Simulation software
for sound absorbers
AcoustiCalc®Absorber
Simulation software
for silencers and mufflers
AcoustiCalc®Silencer
Impedance tube
AcoustiTube®
Transmission tube
AcoustiTube®
Test setup for mufflers
AcoustiTube®HighTemp

Impedance Tube AcoustiTube®



Impedance Tube AcoustiTube® – AED 1000

- determination of sound absorption coefficient, sound reflection factor and impedance ratio of materials with open porosity acc. to DIN EN ISO 10534-2 and DIN EN ISO 13472-2

Fields of Application

- quality control during manufacturing process
  - cylindrical specimens in the laboratory
- optimization in research and development of sound absorbers
  - of materials with open porosity
  - of structures and components, e.g. dense road surfaces

Physical Definition

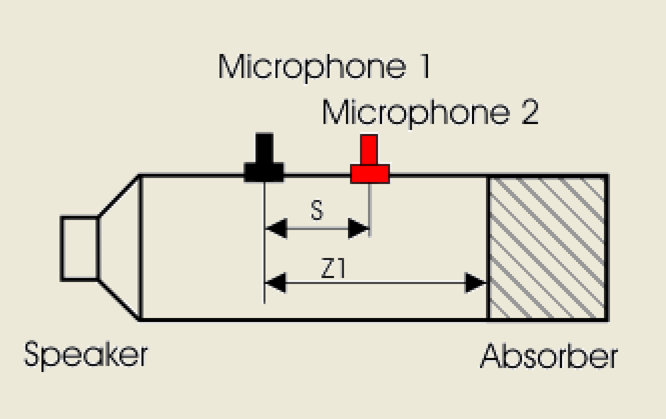
sound reflection factor: $\underline{r} = \frac{H_{12} - H_I}{H_R - H_{12}} e^{2jk_0 z_1}$

transfer functions: H_{12}

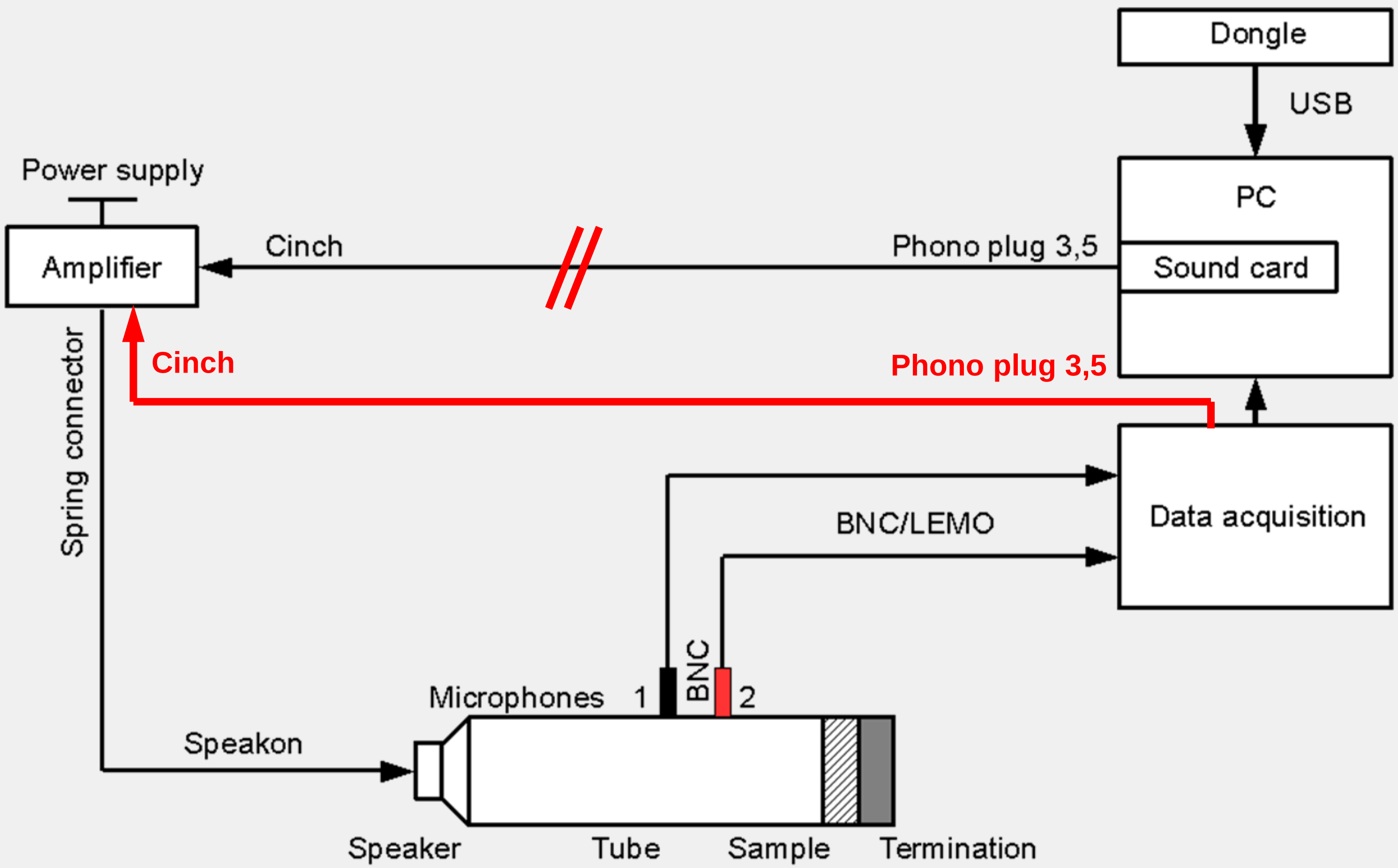
$H_I, H_R = f(s)$

sound absorption coefficient: $\alpha = 1 - |\underline{r}|^2$

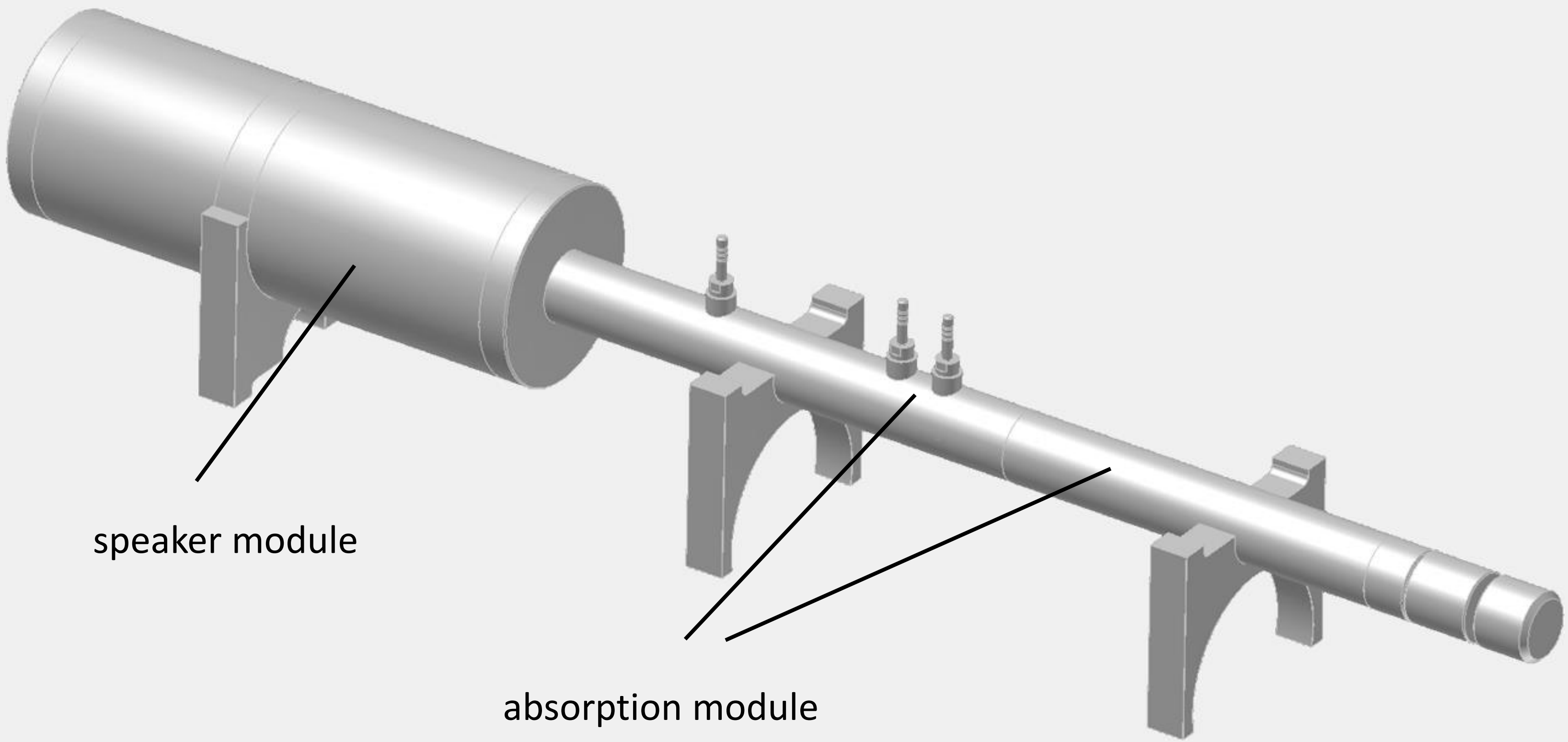
$$\alpha = \frac{P_a}{P_e} = \frac{\text{absorbed sound power}}{\text{incident sound power}}$$



Measuring Setup



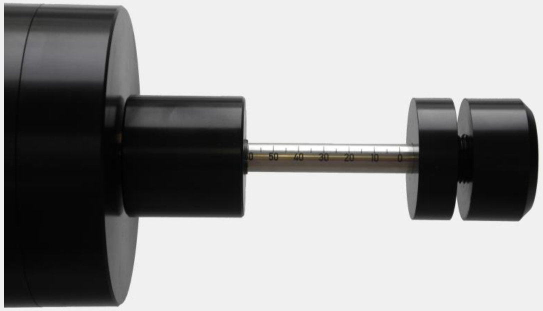
Components



Specimen Holders

- depending on the application, there are different specimen holders available

type I, diameter 30 mm for laboratory testing



type I, diameter 100 mm for laboratory testing

type II, diameter 100 mm
for in situ testing of dense asphalts

Specimen Holders

- depending on the application, there are different specimen holders available

type I + compression unit,
diameter 100 mm for laboratory testing

capsular for compression unit for reproducible installation of specimen with defined compression, diameter 30 mm

Hard-shell cases for compression units

hard-shell case for compression unit, diameter 100 mm

hard-shell case for compression unit, diameter 30 mm

Reference Specimens

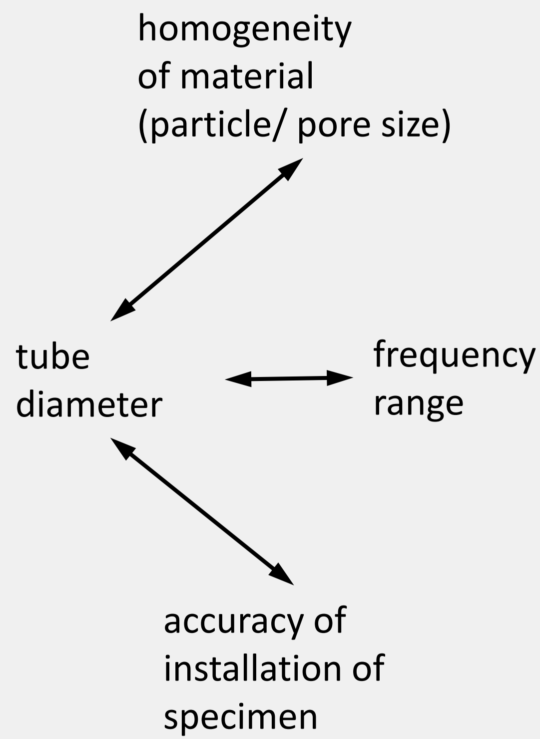
- metal sound absorbers with enduring constant properties

diameter 100 mm, 40 mm and 30 mm,
plug element

diameter 100 mm and 30 mm,
tube element

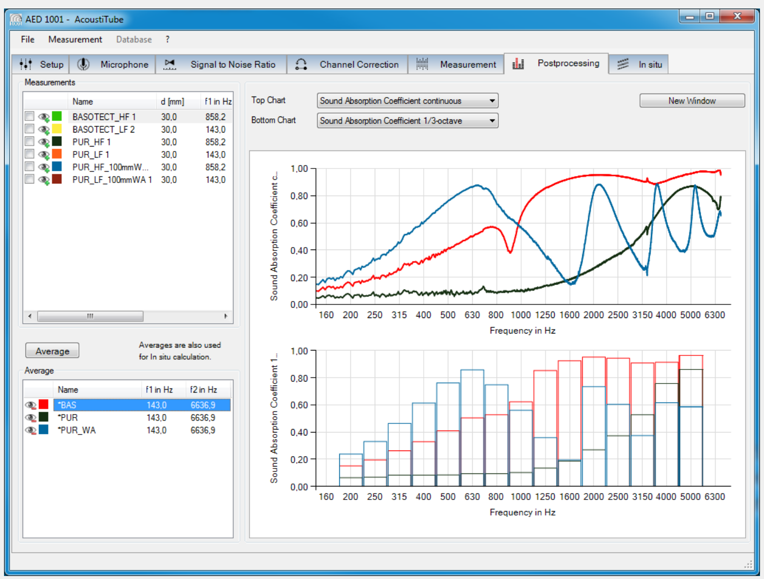
System Diameter / Frequency Range

- type I
  - suitable for investigation of cylindrical specimens acc. to DIN EN ISO 10534-2
  - 40 mm (type 1, Standard): 100 Hz – 4400 Hz
  - 100 mm (type 2): 50 Hz – 2000 Hz
  - 30 mm (type 3): 150 Hz – 6600 Hz
  - 15 mm (type 4): 150 Hz – 10200 Hz
- type II
  - suitable for investigation of road surfaces in situ or plates of closed porous asphalts acc. to DIN EN ISO 13472-2
  - 100 mm (type 2): 50 Hz – 2000 Hz



Analysis software AED 1001

- determination of sound absorption coefficient, sound reflection factor and impedance ratio as a function of frequency
- averaging of results of various material samples
- simple management and comparability of results by application of database



Analysis software AED 1001 – New Release: Version 2

- **new version 2** comes with **new front end** and **back end features** to make measurements **faster** and **easier**

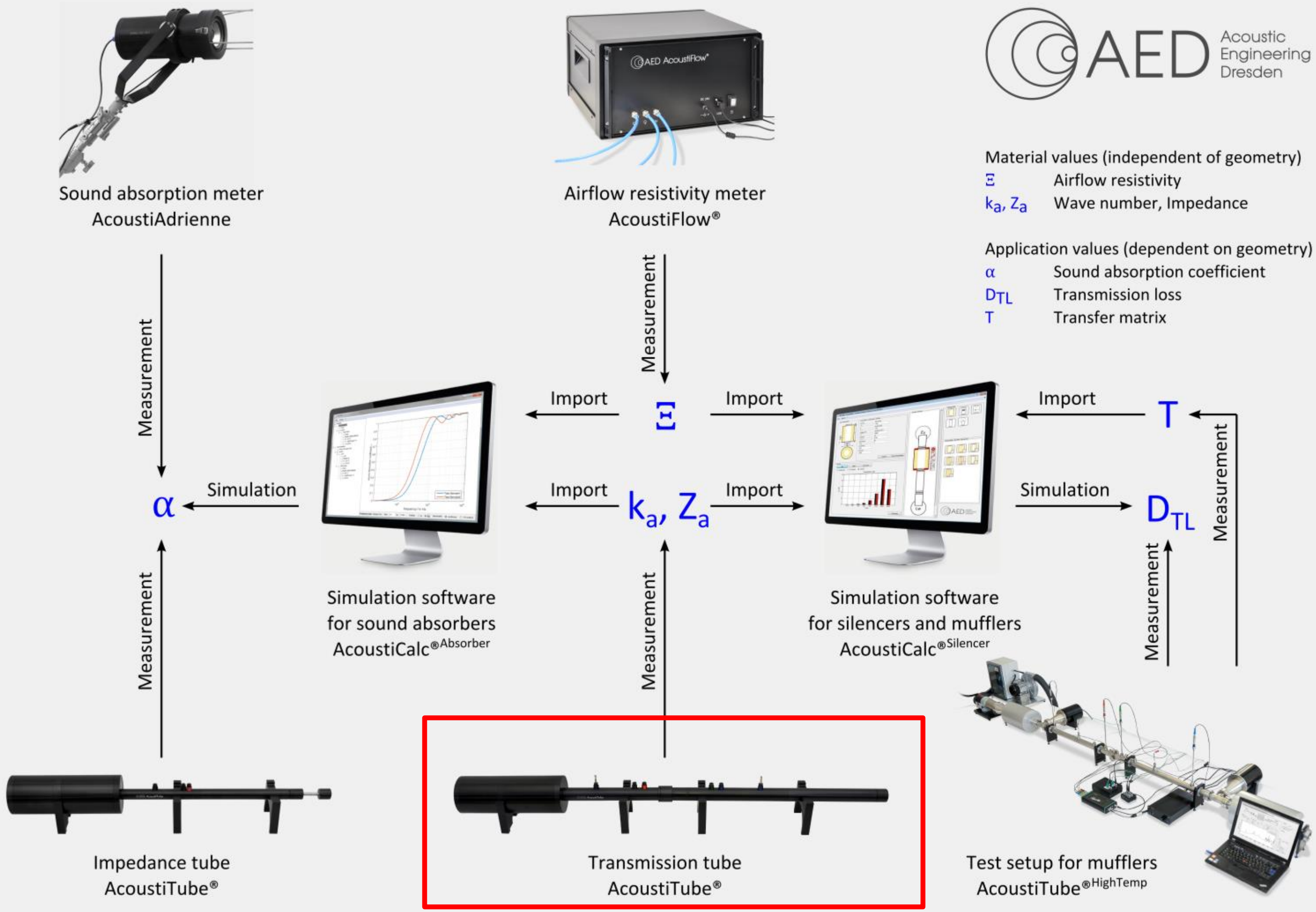
- new **front end features** include:
  - brand-new **Graphical User Interface** (GUI)
  - more **advanced handling** of configuration settings and channel corrections for different impedance tubes and microphone positions
  - very **intuitive** and **ergonomic** user experience

Analysis software AED 1001 – New Release: Version 2

- **new version 2** comes with **new front end** and **back end features** to make measurements **faster** and **easier**

- new **back end features** include:
  - **flexible** sound output by data acquisition hardware **or** by sound card of PC
  - considerably **improved** signal processing algorithms for increased signal-to-noise ratio in shorter measurement time (**speed-up of factor 10** for each measurement)
  - additional **increase** of signal-to-noise ratio due to software equalizer
  - **enhanced** and **reliable** database structure and functionality

Impedance Tube AcoustiTube® – Extension to Transmission Tube



Impedance Tube AcoustiTube® – Extension to AED 1200

- determination of characteristic absorber values, transmission coefficient and sound insulation of open porous materials by using the Two-Load Method or the Two-Source Method

Fields of Application

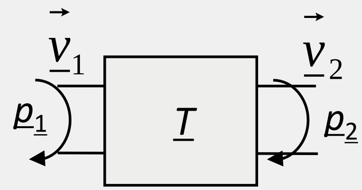
- quality control during manufacturing process
  - cylindrical specimens in the laboratory
- input parameters for acoustic modeling
  - numerical software solutions such as Comsol Multiphysics*
  - calculation of insertion loss of mufflers (see software AED 8001 – AcoustiCalc® Silencer)
- optimization in research and development of sound absorbers
  - of materials with open porosity
  - of structures and components, e.g. silencers and mufflers

Physical Definition

- description of porous material by four-pole parameters (transfer matrix)

transfer matrix:

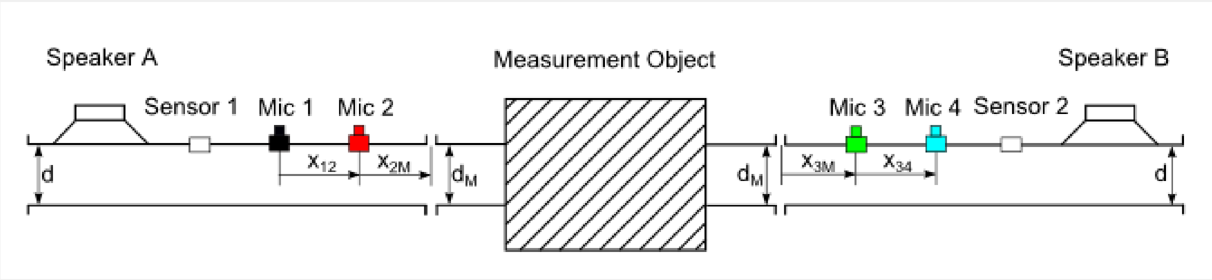
$$\begin{pmatrix} p_1 \\ u_1 \end{pmatrix} = T \begin{pmatrix} p_2 \\ u_2 \end{pmatrix}$$



$$T = \begin{pmatrix} \cos(\underline{k}_a d_a) & j\,\underline{Z}_a \sin(\underline{k}_a d_a) \\ \dfrac{j}{\underline{Z}_a} \sin(\underline{k}_a d_a) & \cos(\underline{k}_a d_a) \end{pmatrix}$$

wave number: $\underline{k}_a$

characteristic impedance: $\underline{Z}_a$



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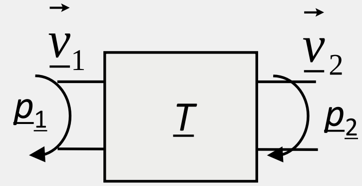
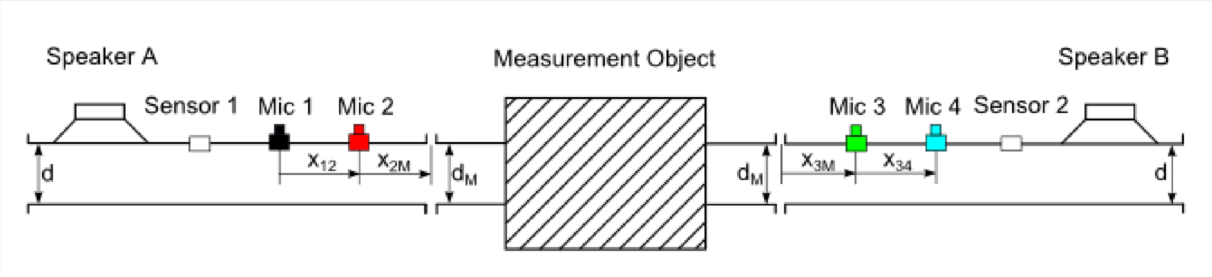


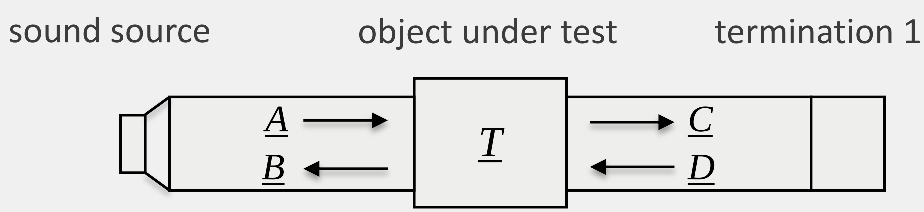
transmission coefficient: $$\tau = \frac{P_t}{P_e} = \frac{\text{transmitted sound power}}{\text{incident sound power}}$$

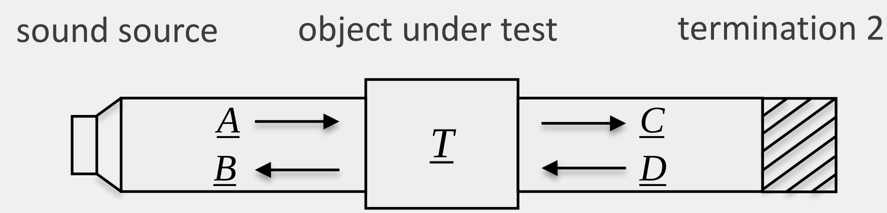
sound insulation: $$R = -10 \cdot \lg(\tau)\ \mathrm{dB}$$



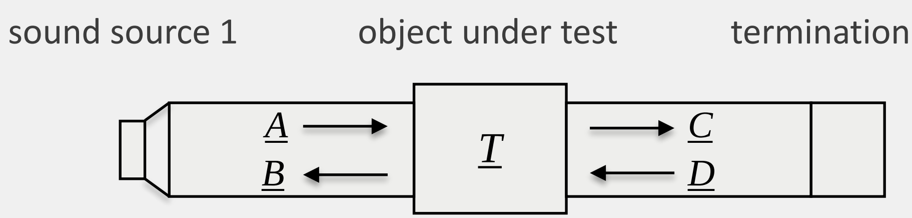
Measurement Method

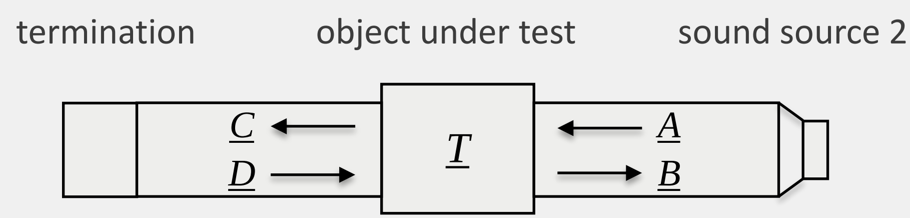
- Two-Load Method



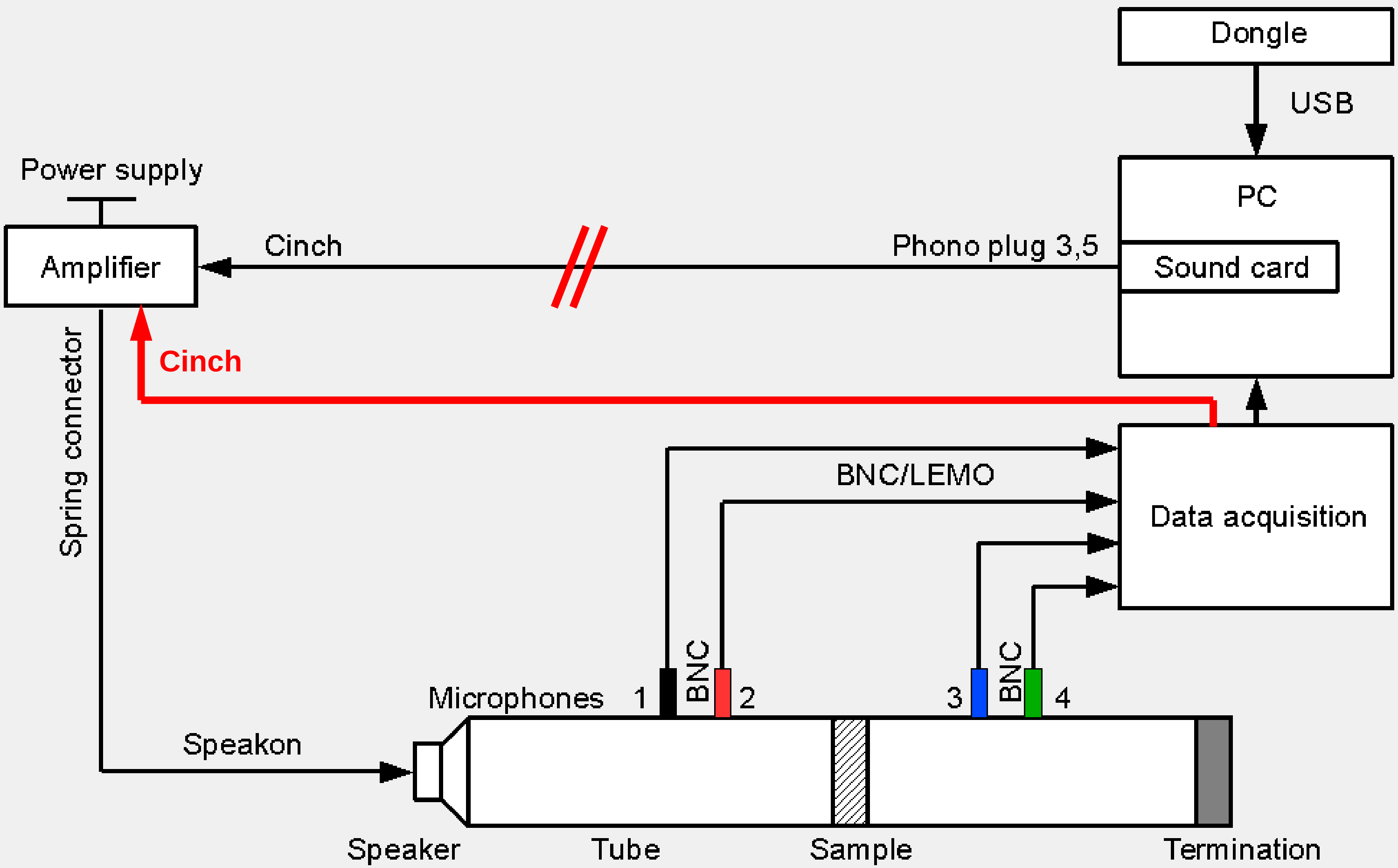


- Two-Source Method

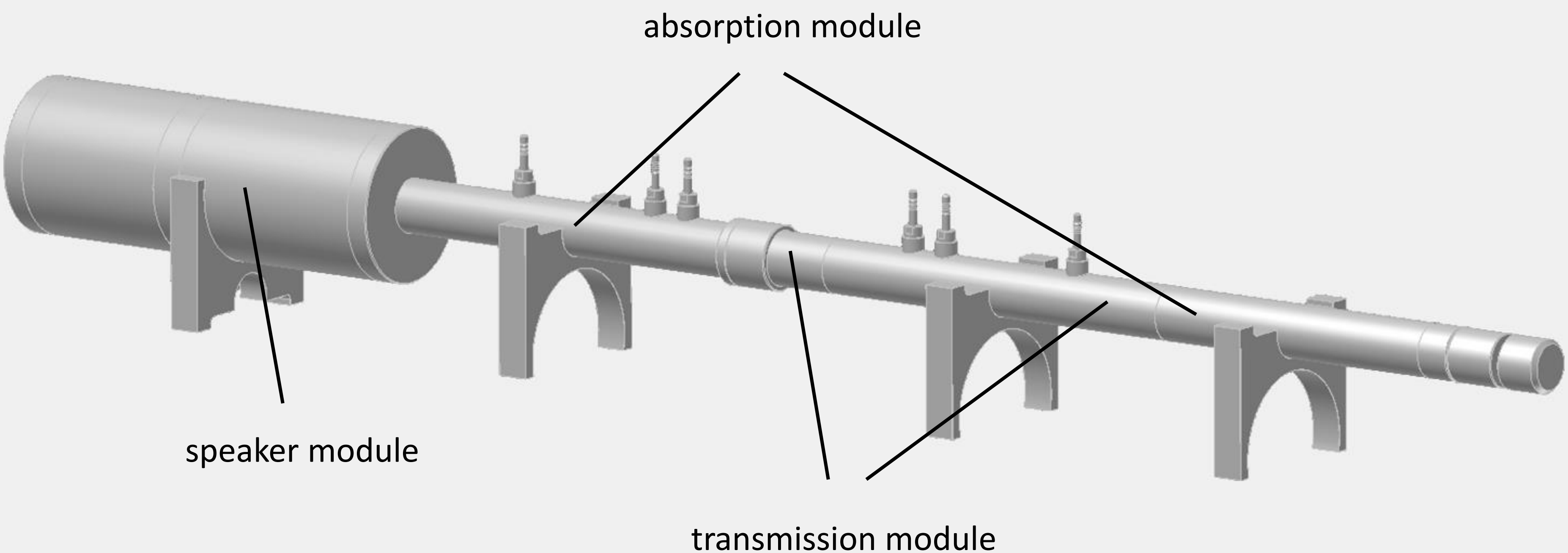




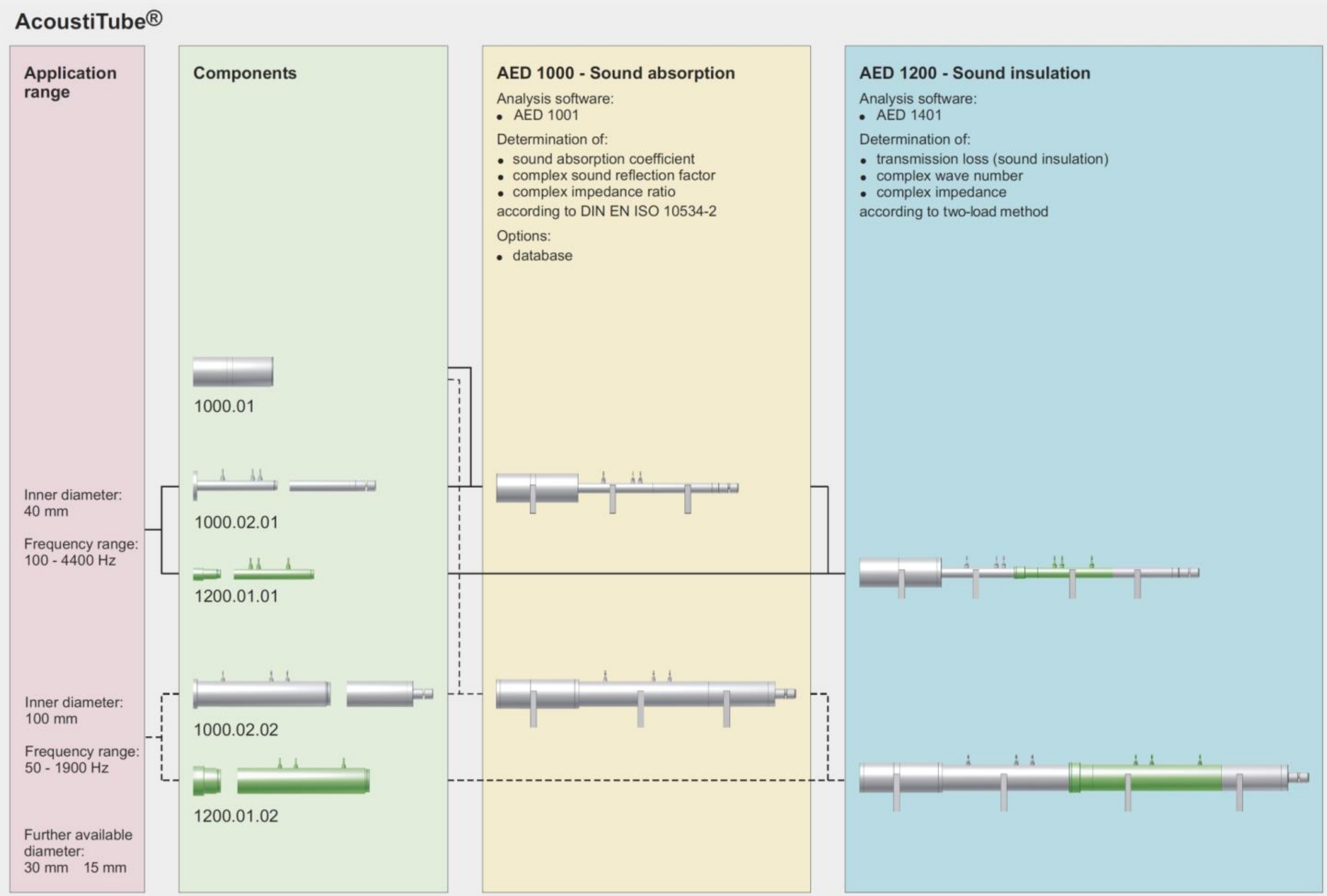
Measuring Setup – Two-Load Method



Components



Components – Extension to AED 1200



Specimen Holders

- depending on the application, there are different specimen holders available

diameter 40 mm for laboratory testing

standard set for testing of cylindrical specimens

special termination for application of transmission method with three microphones

System Diameter / Frequency Range

- standard set
  - suitable for investigation of both cylindrical specimens and silencers and mufflers
  - 40 mm (type 1, Standard): 100 Hz – 4400 Hz
  - 100 mm (type 2): 50 Hz – 2000 Hz
  - 30 mm (type 3): 150 Hz – 6600 Hz
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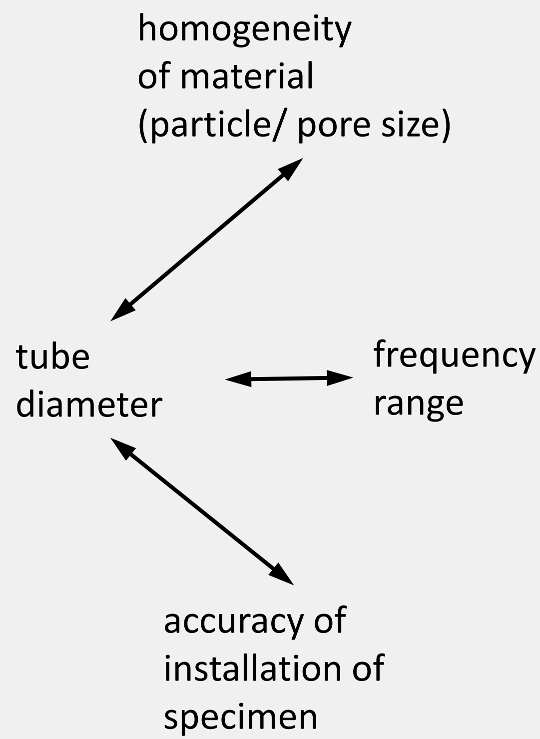
- special termination
  - suitable for investigation of cylindrical specimens by application of transmission method with three microphones
  - 40 mm (type 1, Standard): 100 Hz – 4400 Hz



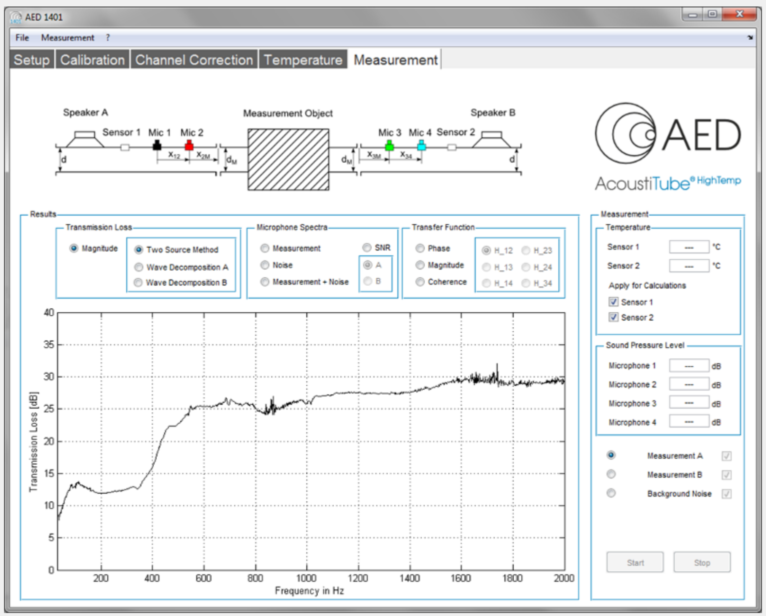
Hard-shell cases for tube components

100 mm (type 2), AED 1000

100 mm (type 2), Extension to AED 1000

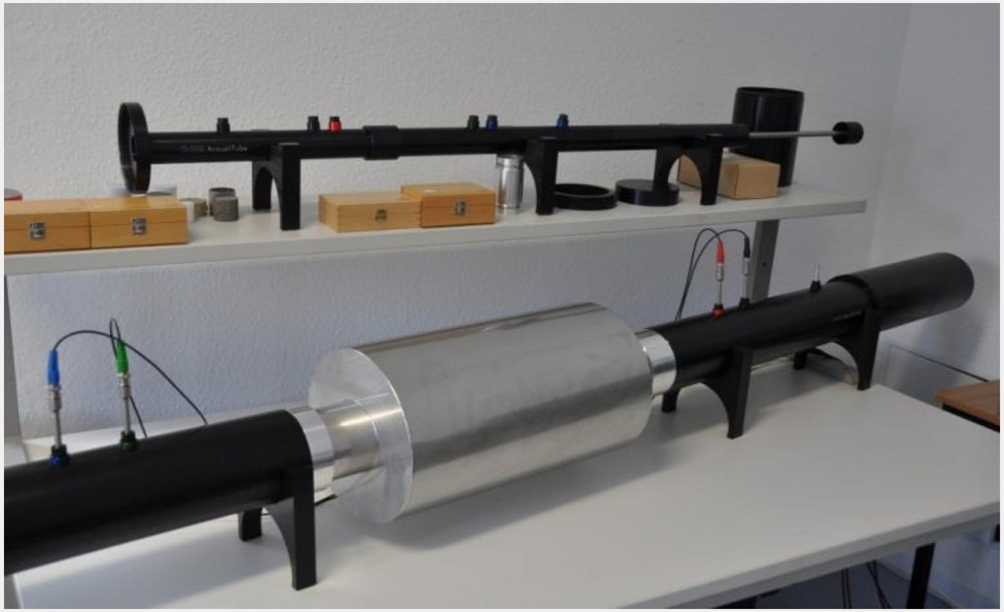
Analysis software AED 1401

- determination of characteristic absorber values (wave number, characteristic impedance), transmission coefficient and sound insulation as a function of frequency
- intuitive measurement process, comfortable storage and management of measured data
- easy link to AED Data Viewer



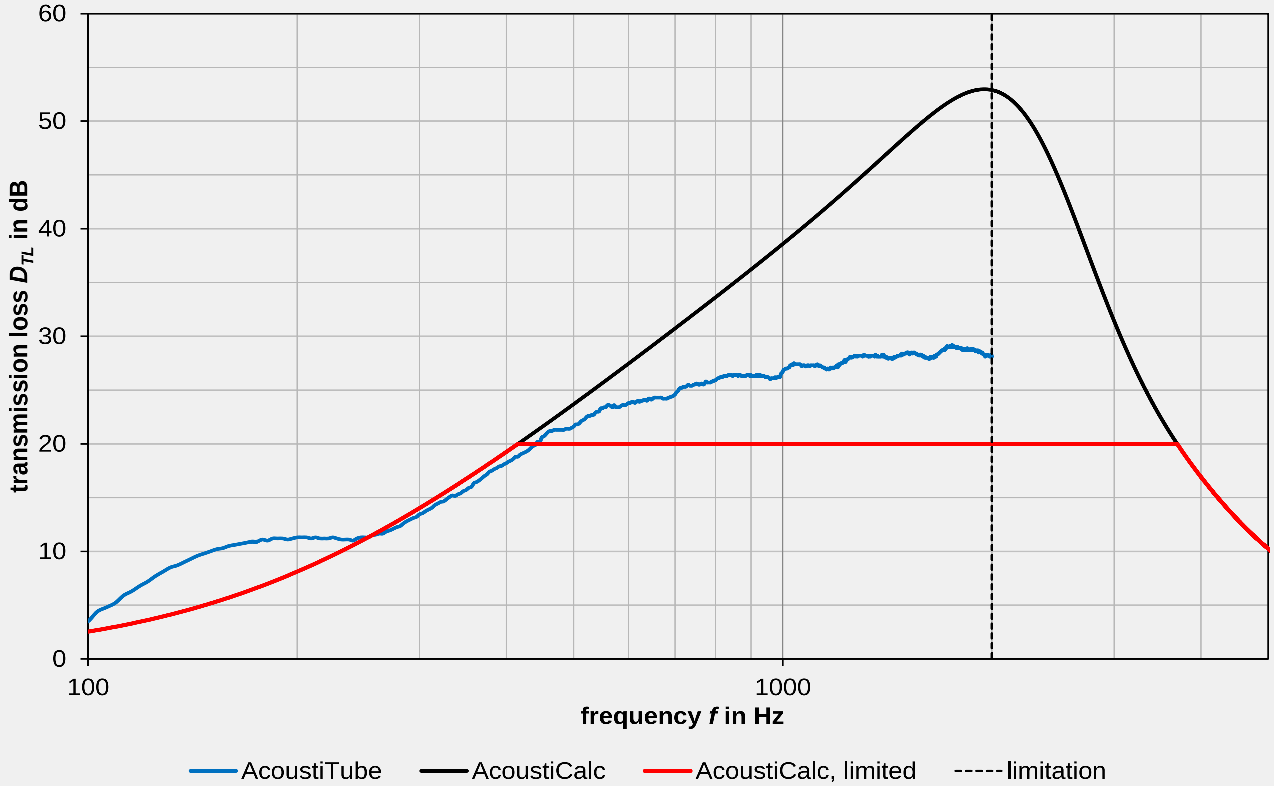
Measurement Results – Absorption Muffler

- acoustic evaluation of absorption muffler at room temperature
  - measurement with transmission tube AED 1200 – AcoustiTube®
  - analytical calculation by means of muffler software AED 8001 – AcoustiCalc® Silencer



Measurement Results – Absorption Muffler

- comparison of transmission loss of measurement and analytical calculation



Measurement Results – Absorption Muffler

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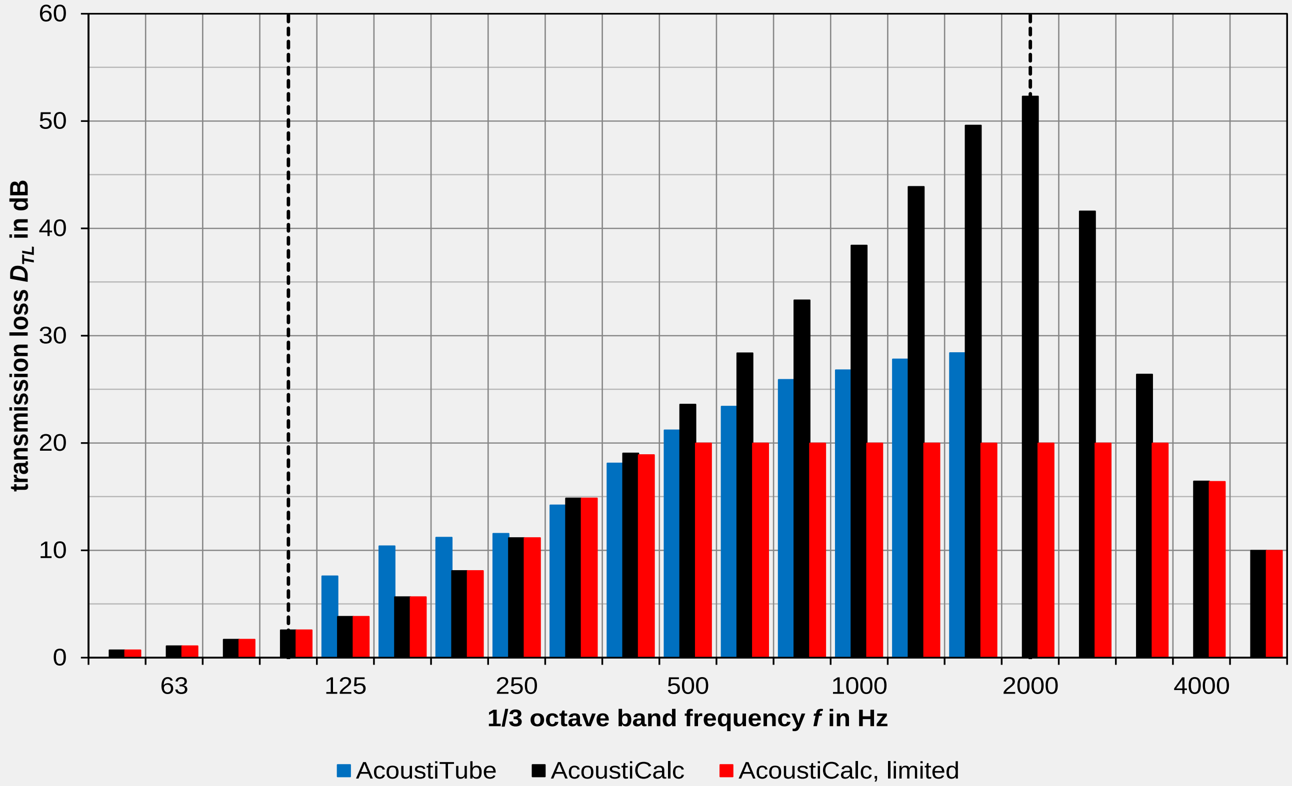
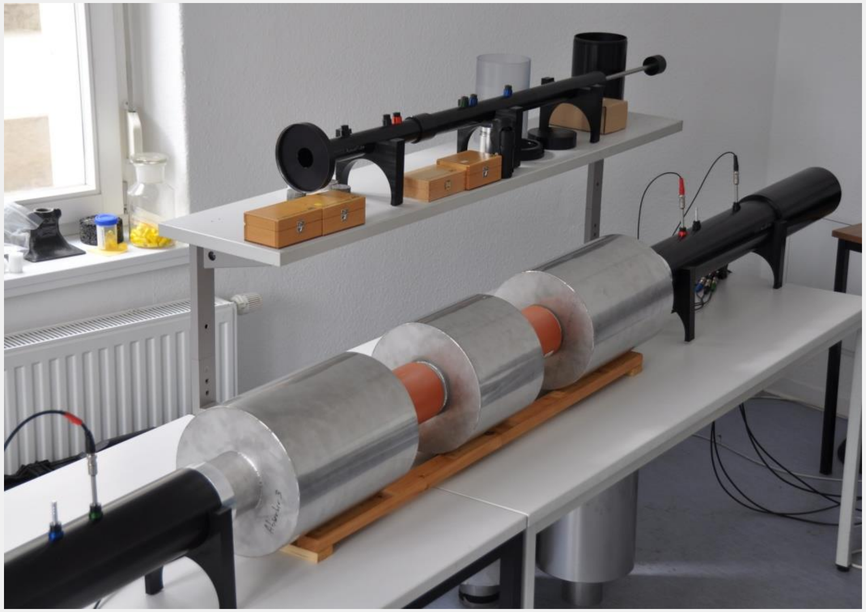


Measurement Results – Absorption + Resonance Mufflers

- acoustic evaluation of absorption muffler + two resonance mufflers at room temperature
  - measurement with transmission tube AED 1200 – AcoustiTube®
  - analytical calculation by means of muffler software AED 8001 – AcoustiCalc® Silencer



Measurement Results – Absorption + Resonance Mufflers

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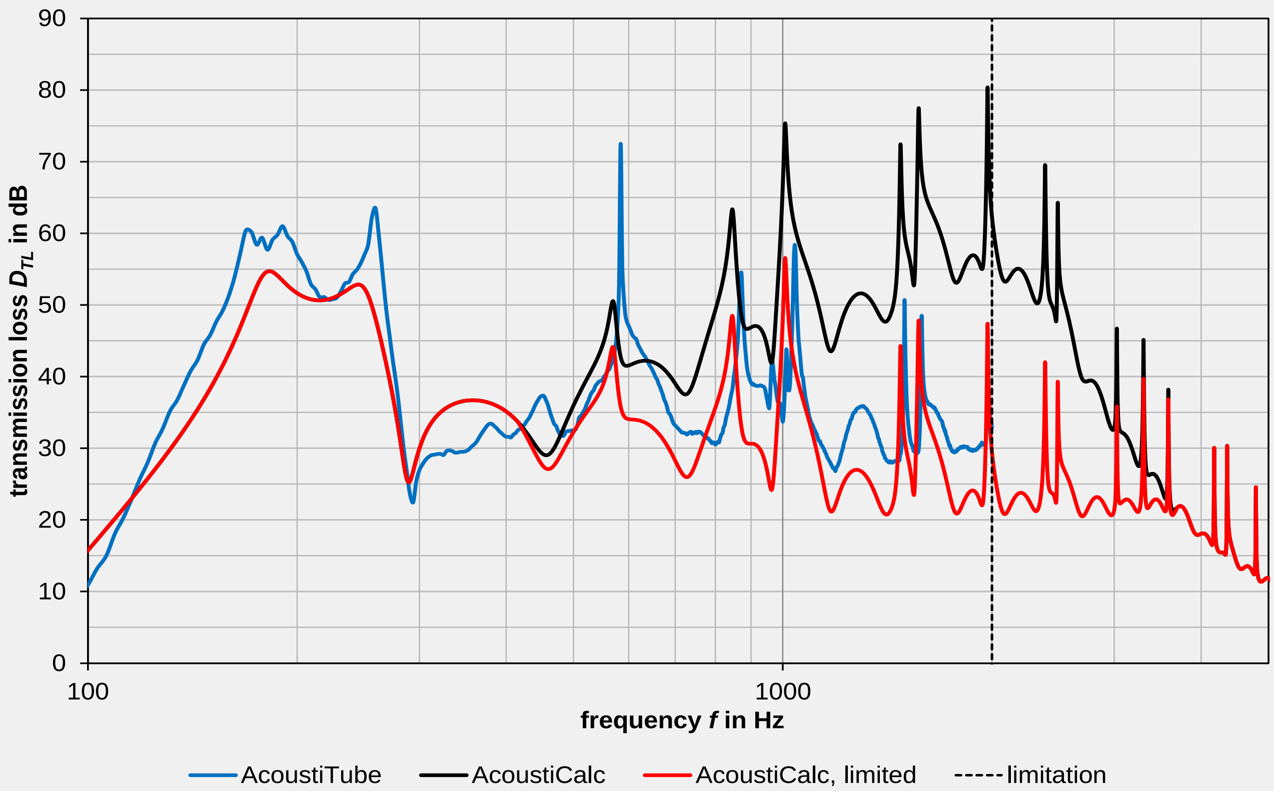

Measurement Results – Absorption + Resonance Mufflers

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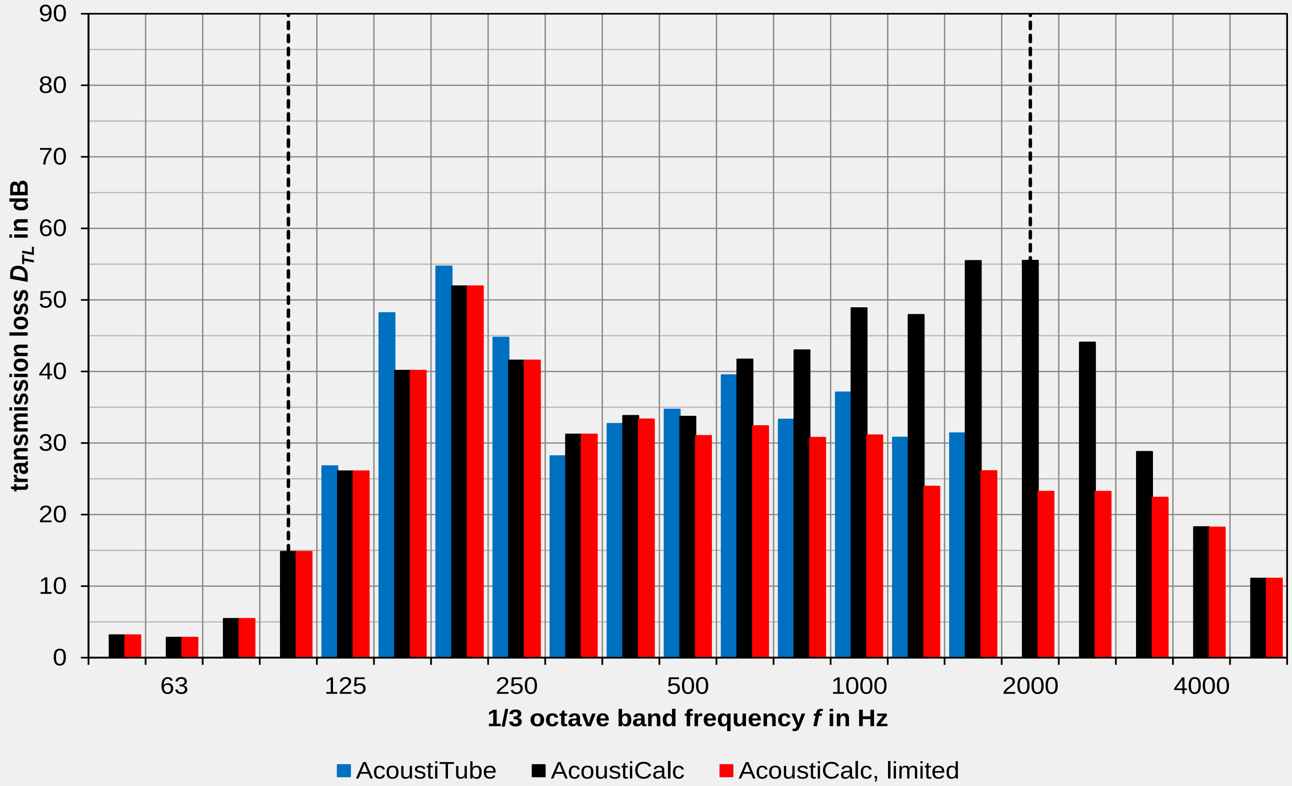

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