



create silence



Gesellschaft für Akustikforschung Dresden mbH
Acoustic Engineering Dresden – AED
Acoustic Measuring Instruments & Analysis Software

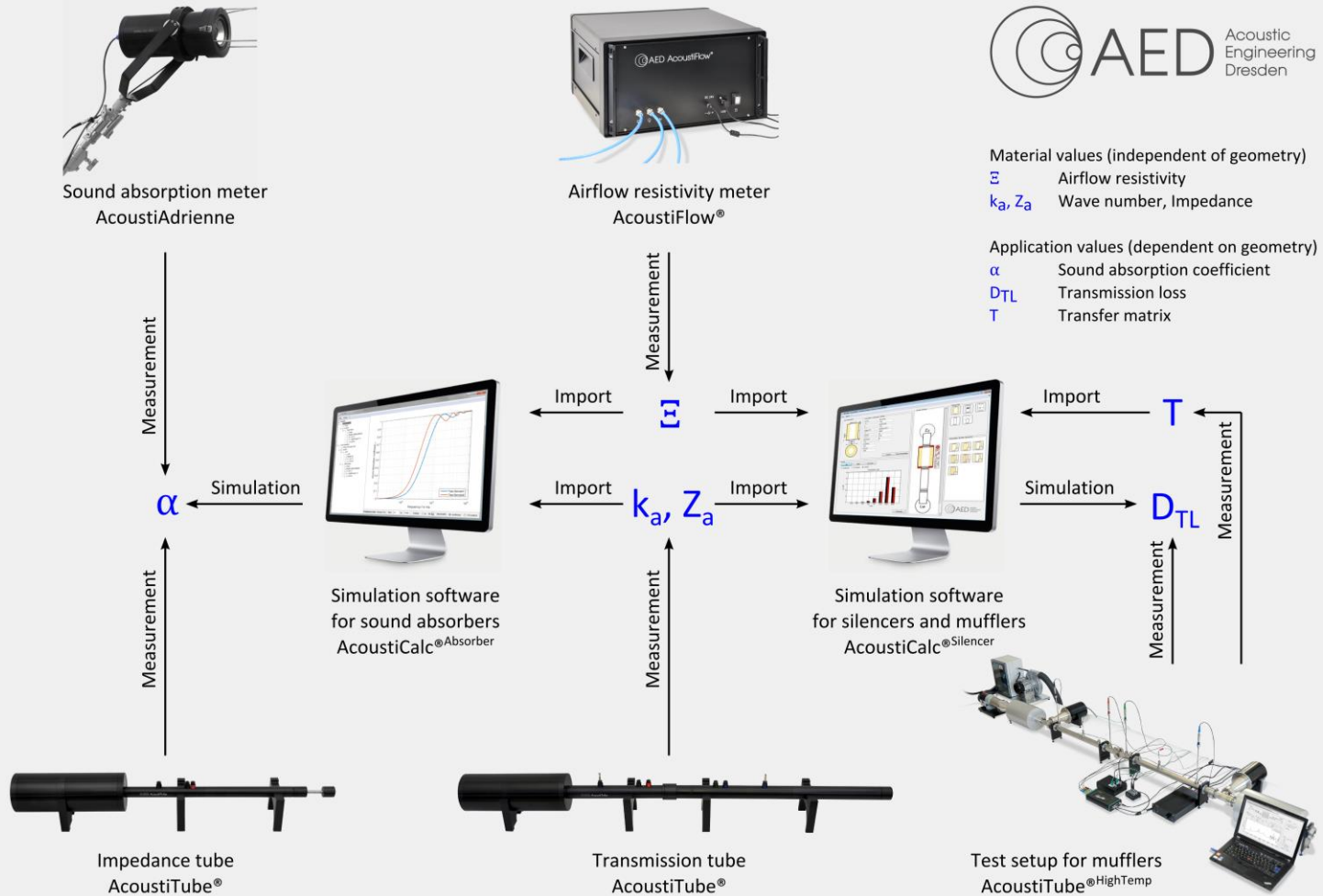
Overview

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

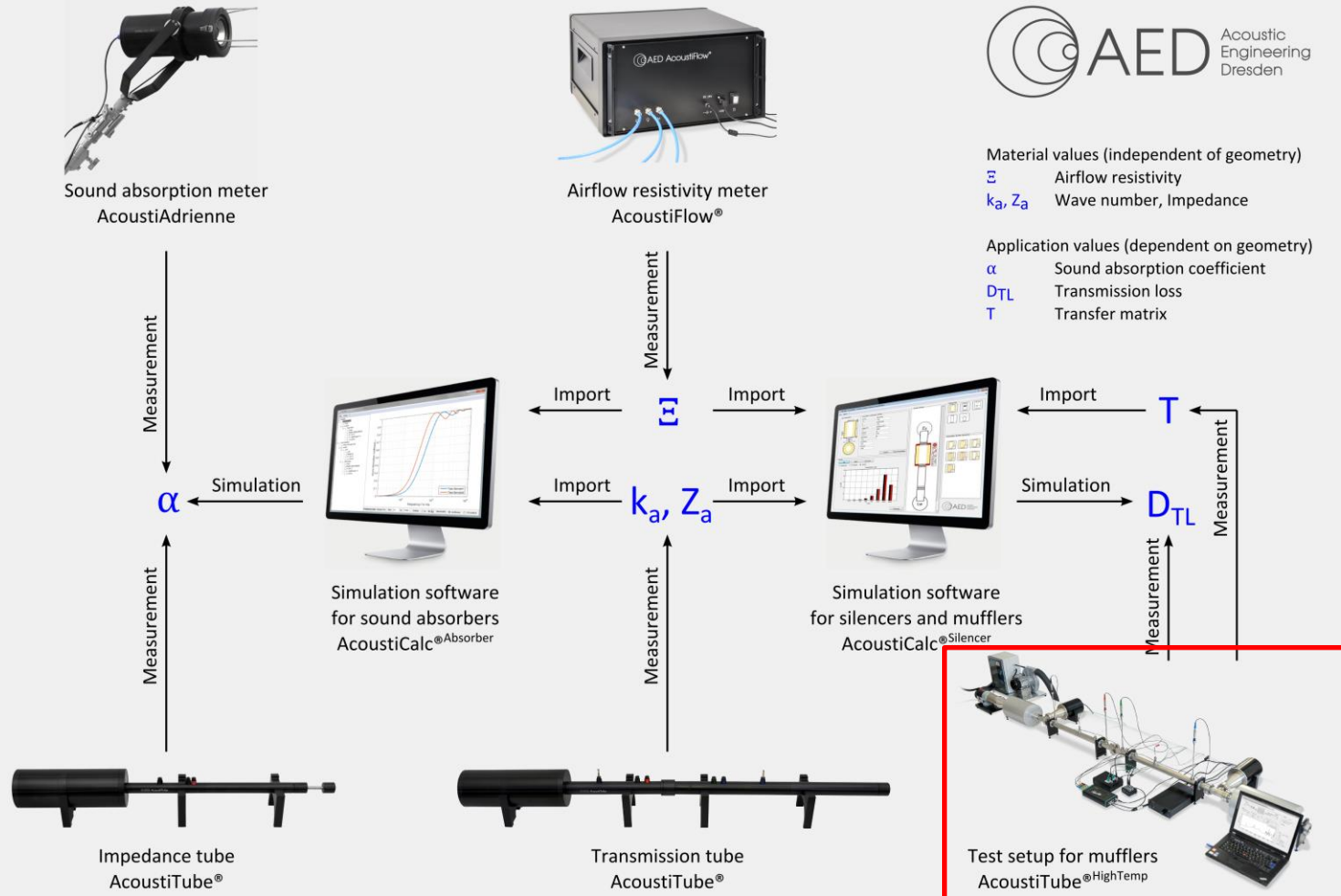
- Application Software
 - AcoustiCalc[®] Absorber – Sound absorber software
 - AcoustiCalc[®] Silencer – Muffler software



Overview

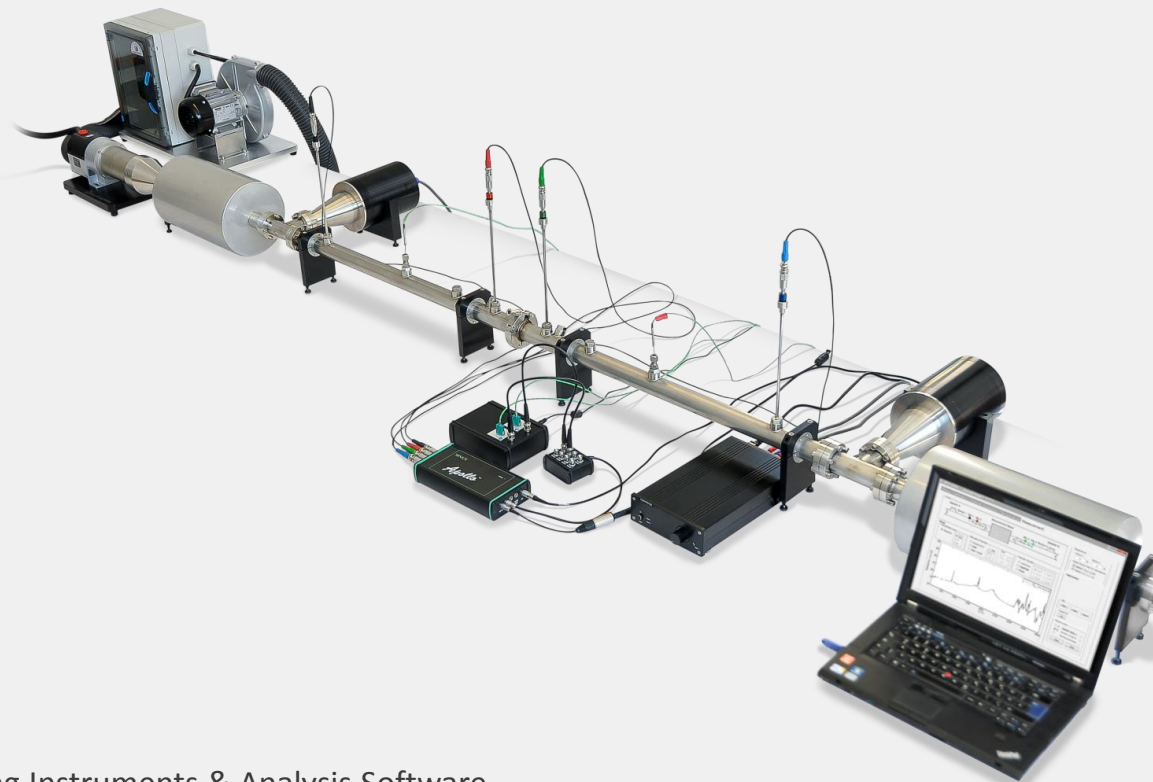


Test setup for mufflers AcoustiTube® HighTemp



Test setup for mufflers AcoustiTube[®] HighTemp – AED 1400

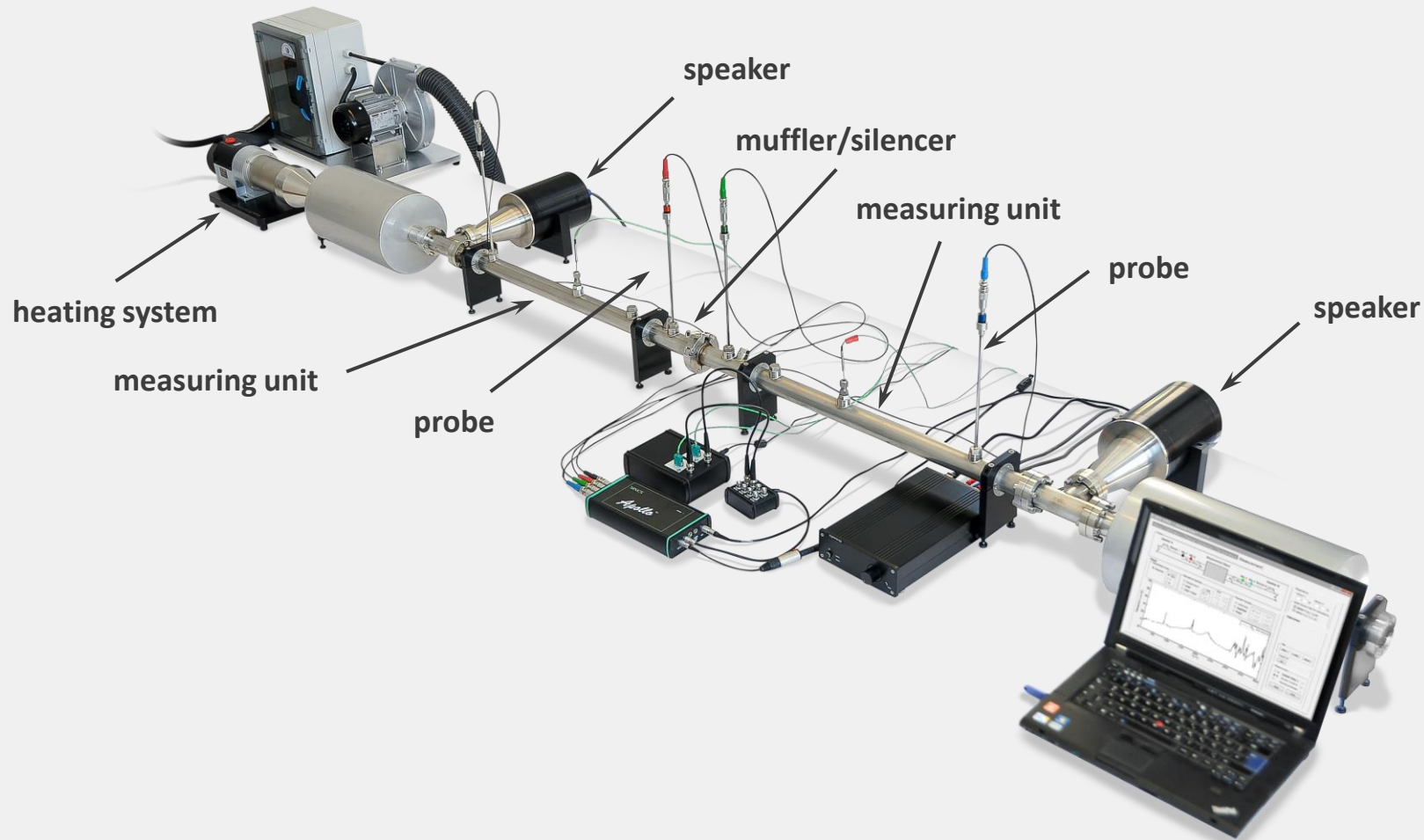
- determination of transmission loss and complex transfer matrix of silencers and mufflers at temperatures up to 600 °C by using the Two-Source Method or the Two-Load Method



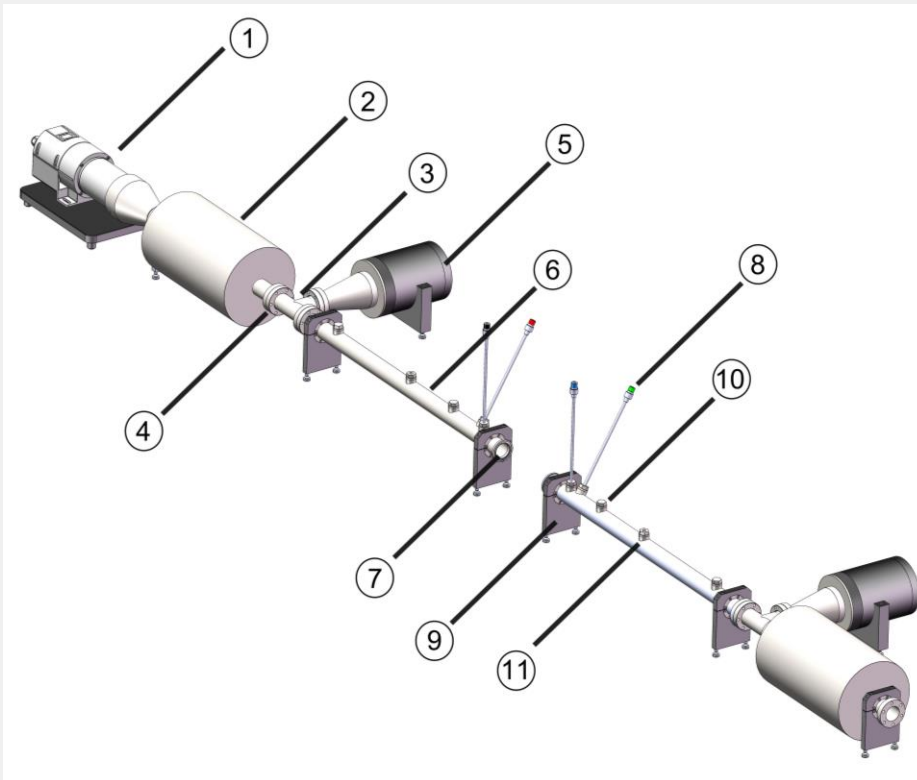
Fields of Application

- test setup for mufflers (suitable for application in the laboratory as well)
 - measurement of the spectral transmission loss and the complex transfer matrix of silencers and mufflers at near-service conditions
- application of measurement data as input parameters for calculating the spectral transmission loss and the spectral insertion loss of complete systems of silencers and mufflers by means of the analysis software AED 8001 – AcoustiCalc® Silencer
 - consideration of peripheral components
 - e. g. installation of a measured muffler within a complete exhaust system
- application of measuring device as impedance tube

Components



Components



- ① heating system with connection to ventilation system
- ② system muffler
- ③ T-piece
- ④ CF-flange with 6 screws (M6x35mm)
- ⑤ speaker with transition
- ⑥ measurement tube with 5 measuring probe positions
- ⑦ QC-flange (assembly of test object)
- ⑧ microphone probe
- ⑨ support foot
- ⑩ top sealing screw
- ⑪ thread adaptor for connection of temperature probe

System Diameters/ Frequency Range/ Temperature Range

- tube system = measuring units + speakers + muffler
 - robust construction, durability against temperature of all components up to 600 °C
 - 66 mm (type 1)
 - 30 Hz – 3000 Hz (Fluidtemperatur 20 °C)
 - 50 Hz – 5200 Hz (Fluidtemperatur 600 °C)
 - 38 mm (type 2)
 - 30 Hz – 5300 Hz (Fluidtemperatur 20 °C)
 - 50 Hz – 9100 Hz (Fluidtemperatur 600 °C)
- heating system (configurable): heating source + ventilator
 - max. temperature: 650 °C (output of heating source)
 - max. volume airflow: 6000 l/min (ventilator at 3600 U/min)
- sensors
 - 4 microphone probes
 - 2 temperature probes

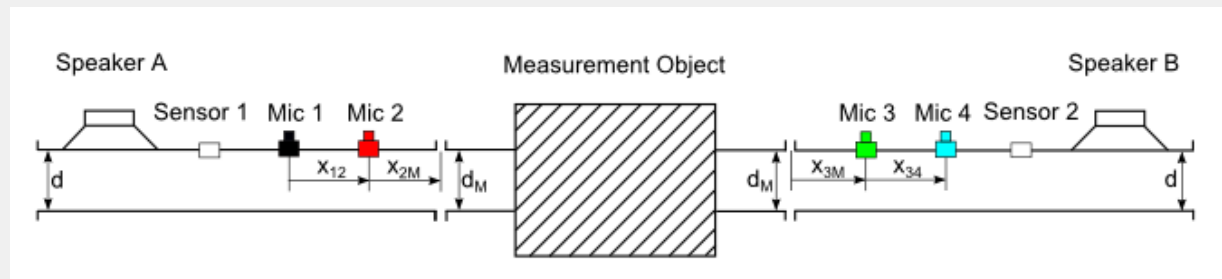
Physical Definition

- description of muffler by four-pole parameters (transfer matrix)

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

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

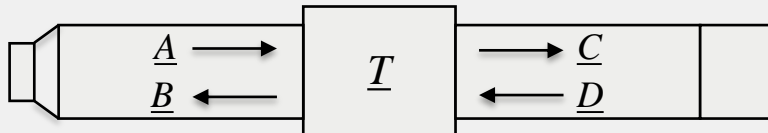
transmission loss:
$$D_{TL} = -10 \cdot \lg(\tau) \text{ dB}$$



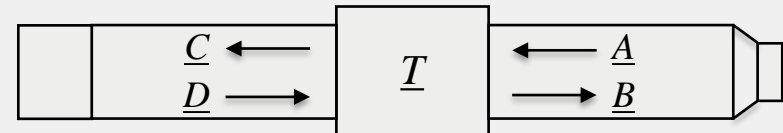
Measurement Method

- Two-Source Method

sound source 1 object under test termination

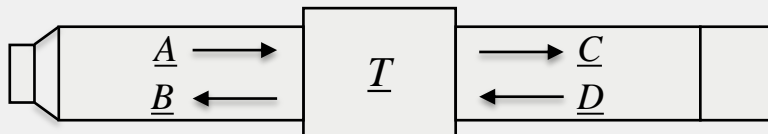


termination object under test sound source 2

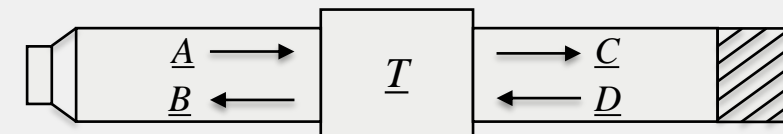


- Two-Load Method

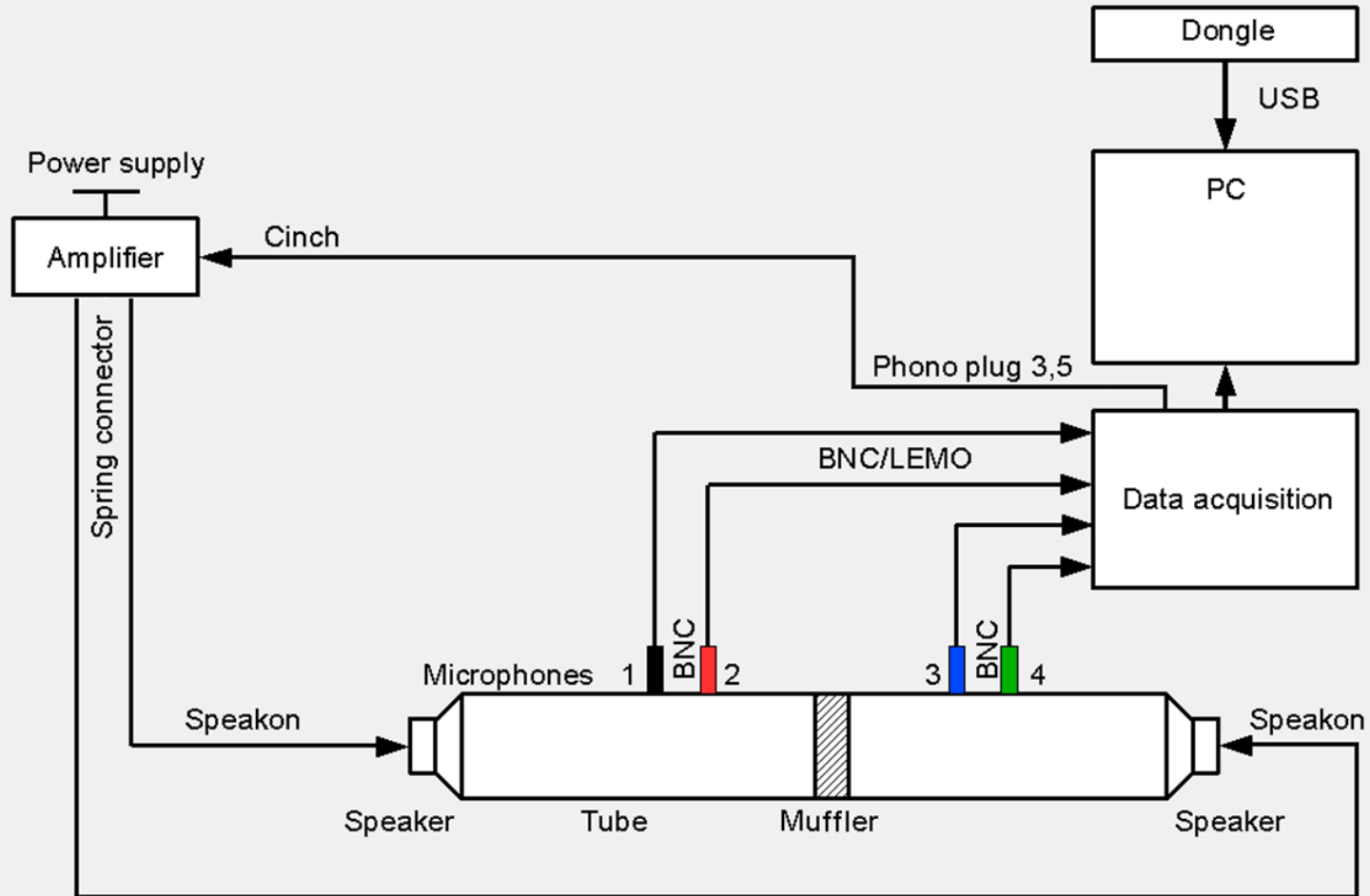
sound source object under test termination 1



sound source object under test termination 2

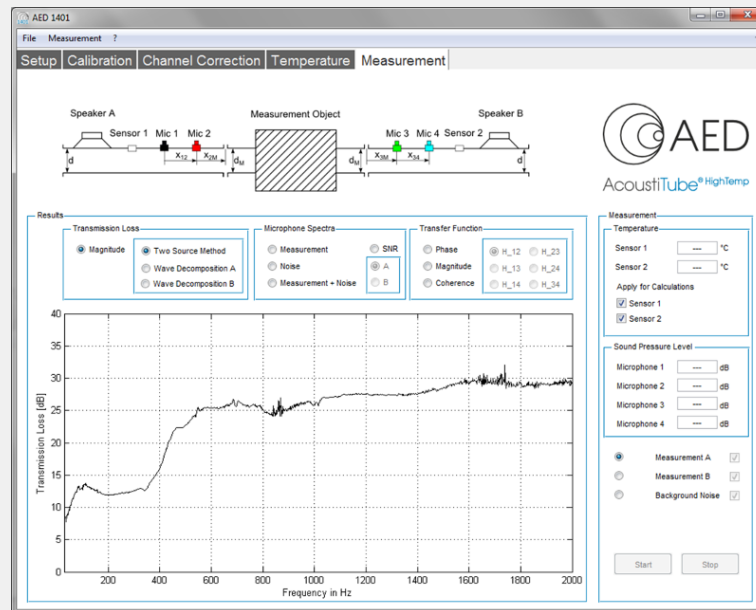


Measuring Setup



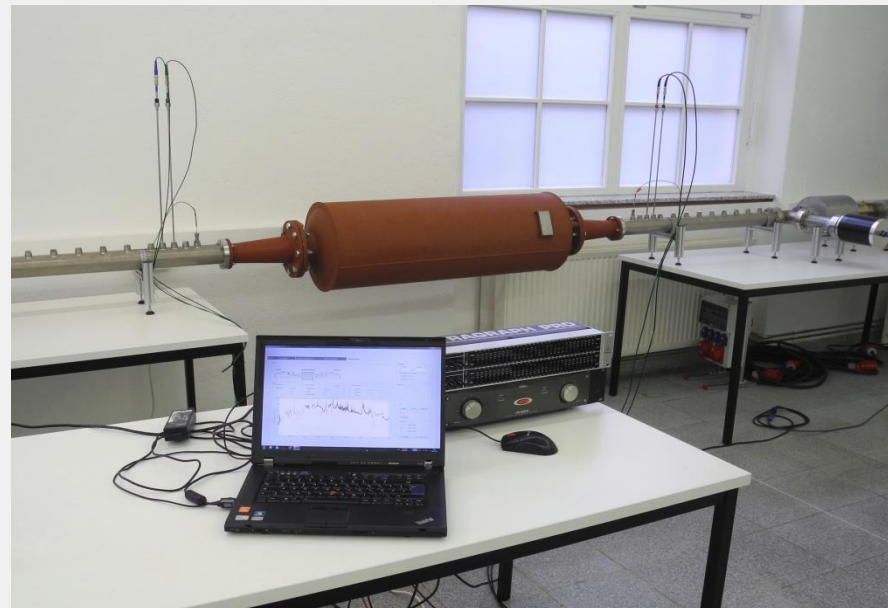
Analysis software AED 1401

- determination of transmission loss and complex transfer matrix as a function of frequency
- intuitive measurement process
- comfortable storage and management of measurement data
- easy link to analysis software AED 8001 – AcoustiCalc® Silencer and AED Data Viewer



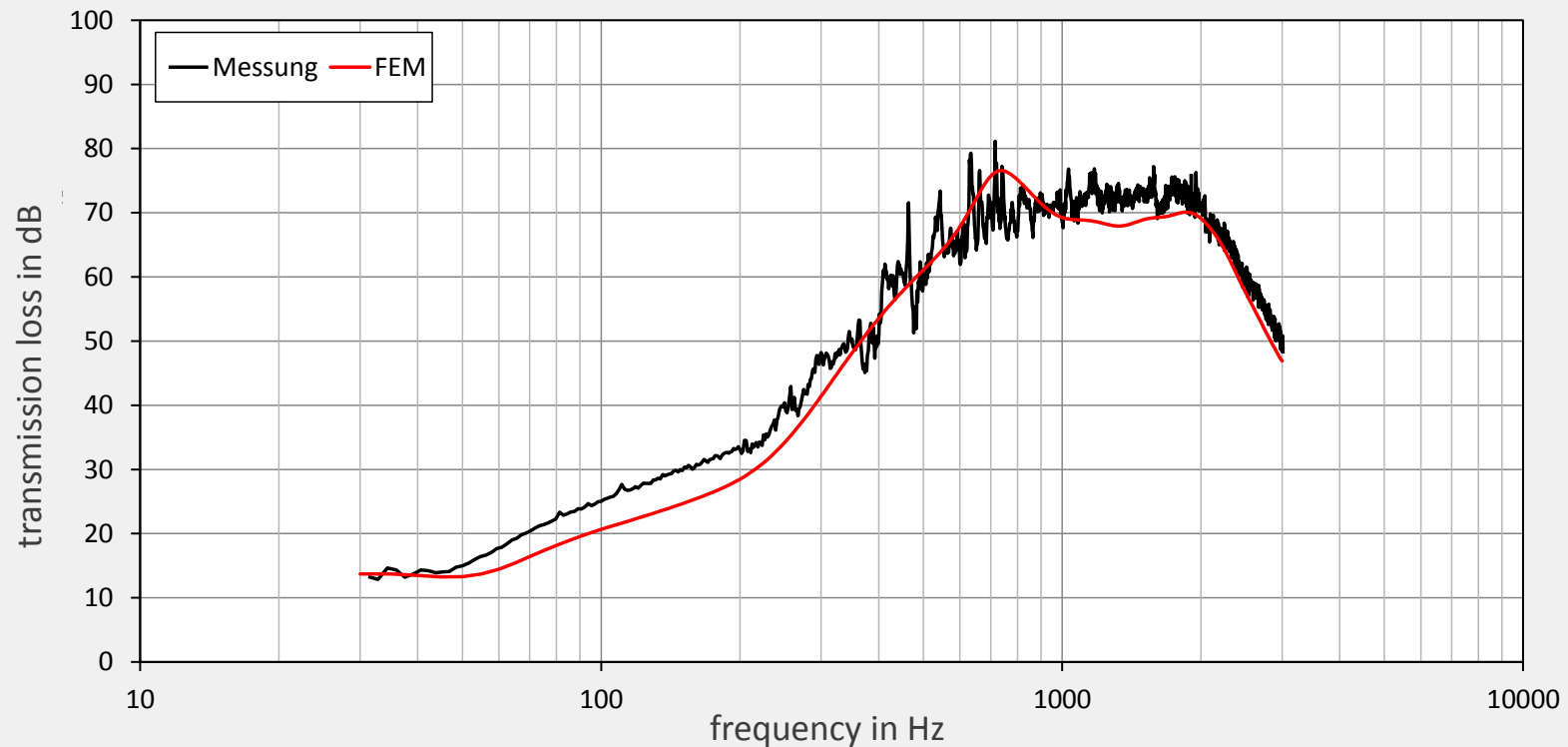
Measurement Results – Absorption Muffler

- acoustic evaluation of absorption muffler
 - measurement with test setup AED 1400 – AcoustiTube® HighTemp
 - numerical calculation by means of FEM software



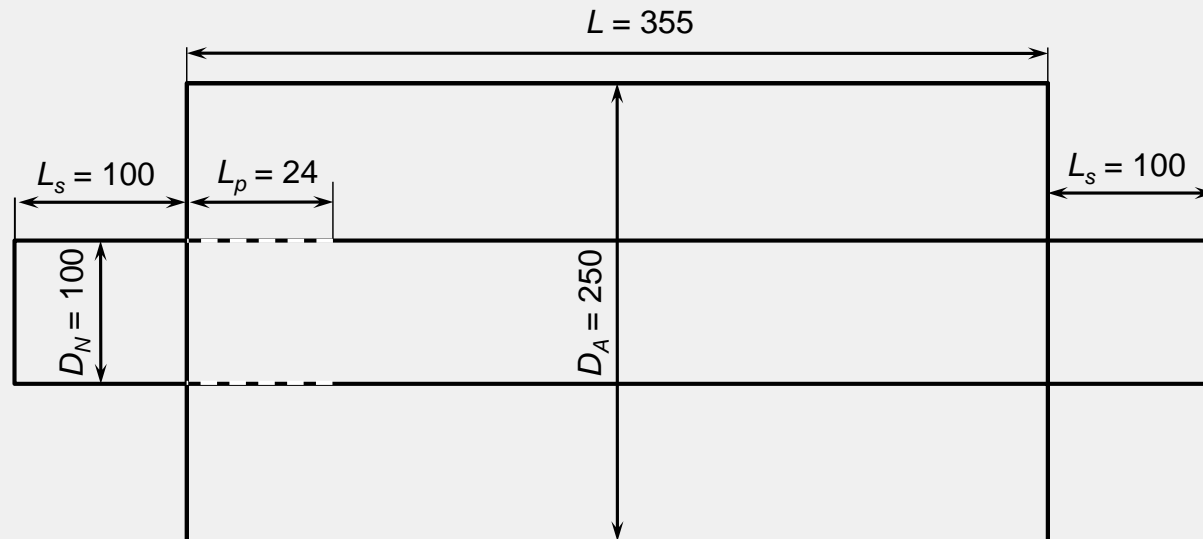
Measurement Results – Absorption Muffler

- comparison of transmission loss of measurement and numerical calculation
- limit transmission loss of test setup: > 70 dB



Measurement Results – Resonance Muffler

- acoustic evaluation of resonance muffler
 - measurement with test setup AED 1400 – AcoustiTube® HighTemp



Lochblech:

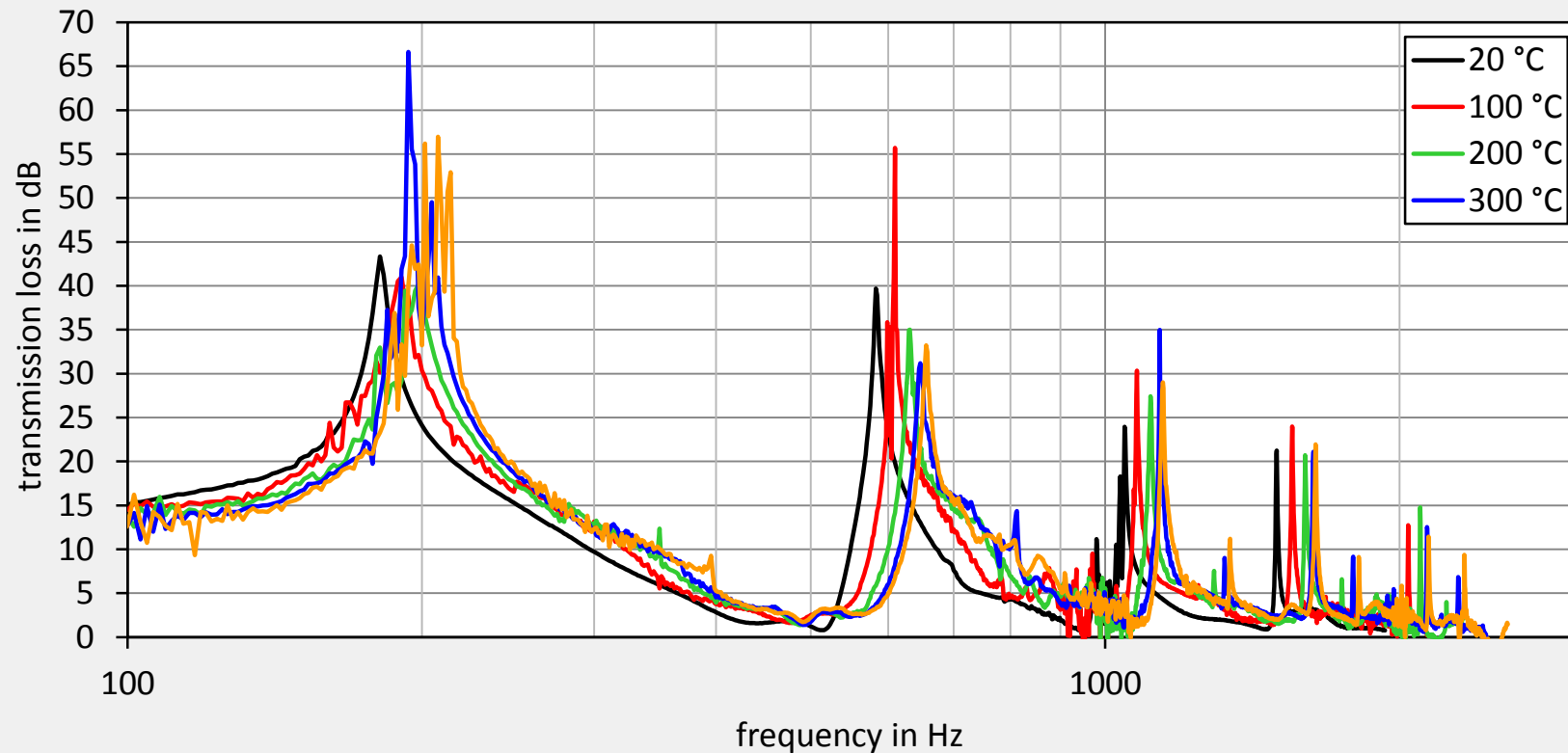
$t_p = 1,0 \text{ mm}$

$d_p = 7,5 \text{ mm}$

$\sigma = 33,4 \%$

Measurement Results – Resonance Muffler

- measured transmission loss of resonance muffler as a function of fluid temperature



Advantages

- measurement of acoustic efficiency of silencers and mufflers in the laboratory
- clearly reduced required space with respect to alternative test setups
- consideration of near-service conditions, especially high temperatures by directly coupled heating source
- determination of spectral transmission loss as well as complex transmission matrix of muffler by specially applied measuring technique
- possible calculation of acoustic efficiency of complete systems on the basis of complex transmission matrix of single components (e. g. integration of measured muffler in complete exhaust system)



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create silence