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Ingenuity for life



Determining the acoustic properties of materials

Solution brief

Siemens PLM Software

The Simcenter™ portfolio for acoustic material and component testing is a comprehensive solution based on Simcenter Testlab™ software and Simcenter SCADAS™ hardware. This portfolio enables you to fully identify the acoustic properties of materials as well as elements such as doors, panels and mufflers. It supports sound absorption and sound transmission loss (STL) testing in accordance with international standards, but makes it easy to adjust to in-house procedures and can be combined with Simcenter acoustic simulation software for enhanced numerical analysis.

Riding the innovation wave

New materials are very much in vogue. Composites and materials used in additive manufacturing are a few of the elements that will likely constitute the car or machine of tomorrow. These materials need to be lightweight, robust and energy efficient, both in production and use, but modifications typically deteriorate acoustic properties. To ensure they comply with product

manufacturer requirements for sound absorption and transmission, innovators will seek to determine the acoustic properties of materials and designs under development using a combination of testing and simulation.

Knowing that prototypes are scarce and requirements and expectations are high for acoustically optimized products, teams need to efficiently develop and verify designs, making the most of decreasing testing time.

There are a number of reasons why manufacturers should seek in-depth knowledge of material and component acoustic properties, including: developing and certifying noise control products, benchmarking competitive solutions, qualitatively validating manufactured goods and verifying compliance with specifications. The outcome of a successful test provides a set of extensive, high-quality data that can also be used to greatly enhance further numerical analysis using the finite element method (FEM) and boundary element method (BEM).

Challenges

- Speed time-to-market of materials with excellent acoustic properties
- Test efficiently according to requirements
- Feed complex simulation models with reliable input data

Solutions

- Simcenter Testlab Acoustic Material and Component Testing
- Simcenter SCADAS hardware
- Impedance tube and impedance tube extension for sound transmission loss

Results

- Efficiently measure material acoustic properties according to standards
- Correlate and validate simulation results
- Use simulation to validate design variants

Solution focus

An extensive portfolio of solutions

Simcenter Testlab Acoustic Material and Component Testing software supports all industry standard approaches to acoustic testing of parts and materials, as well as newer or company specific testing methods. Two methods commonly used across industries to investigate the acoustic properties of materials are usually described as the tube method and room method.

Simcenter Testlab Acoustic Material and Component Testing supports these methods for both sound absorption and sound transmission loss testing. Combining the strengths of Simcenter Testlab software with the modular Simcenter SCADAS hardware, the solution lets you test according to international standards, but also enables you to adjust to in-house procedures. Further testing methods such as intensity based sound transmission loss are also supported.

Thanks to its flexibility, Simcenter Testlab Acoustic Material and Component Testing provides a complete solution for assessing all types of objects, from small material samples and medium-sized components to large-scale objects such as firewalls, fuselage panels, doors and windows.

For small material samples and components such as mufflers, the solution includes an impedance tube suited for both material absorption and sound transmission loss analysis. Setting up



Step-by-step measurement of sound absorption using Simcenter Testlab.

and executing the measurement in-tube is easy as the dedicated Simcenter Testlab software guides the user through the measurement process, from phase calibration to reporting. Simcenter Testlab supports measurements just as well with any other impedance tube model.

For assessing the acoustics of larger items, Simcenter Testlab supports room methods for sound absorption and sound transmission loss measurements. Sound absorption can be measured either in full-size rooms or in-scale cabins. The in-room sound transmission loss method offers further advantages, such as testing larger samples, characterizing nonhomogeneous objects and providing a more realistic random incident sound field. It can also be used to integrate background noise corrections.

State-of-the-art testing

Simcenter Testlab Acoustic Material and Component Testing efficiently supports testing according to various International Organization for Standardization (ISO), American Society for Testing and Materials (ASTM) and Society of Automotive Engineers (SAE) standards.

Using an impedance tube for sound absorption measurements

When Simcenter Testlab Absorption Testing is used with an impedance tube, it becomes a dedicated approach for verifying the absorption characteristics of small material samples supporting standards like ISO 10534-2 or ASTM E1050-98. The workbook provides a

complete solution for the entire process, including test setup, phase calibration, measurements, validation, analysis and reporting.

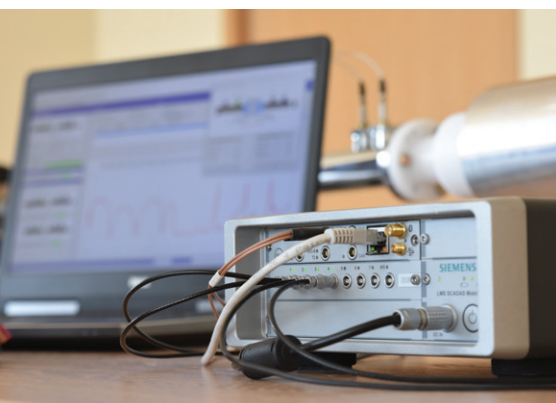
Using an impedance tube for sound transmission loss measurements

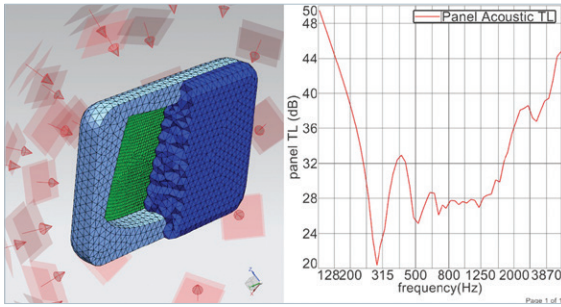
When Simcenter Testlab Sound Transmission Loss is used with an impedance tube, it is ideal for measuring small components based on the four-microphone transfer matrix method that complies with ASTM E2611-09. It is a complete and easy-to-use solution for the entire process, including test setup, measurement, phase calibration, validation and reporting. When measuring mufflers, you can automatically correct the measured results with a conical adaptor correction.

Using rooms for sound absorption measurements

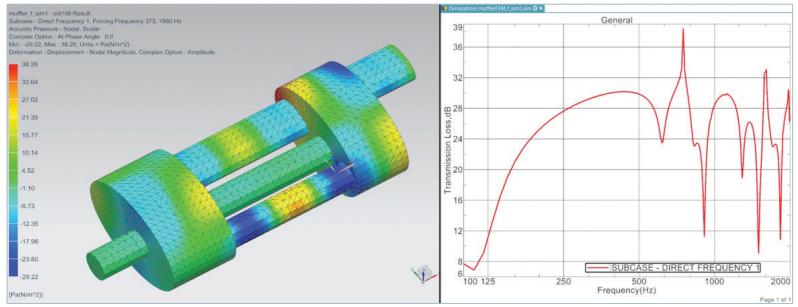
The Simcenter Testlab Absorption in room has been specifically designed to proof the absorption characteristics of material panels in full-size reverberant rooms or in scale rooms (also called alpha cabins). With a fully automated measurement process, it supports standards such as ISO 354-2003 (Acoustics - Measurements of sound absorption in a reverberation room), or ASTM C423 (Sound absorption and sound absorption coefficients by the reverberation room method).

The absorption properties of the material are calculated by comparing the reverberation in an empty test room with the reverberation in a room where the material sample is being analyzed.





Simulating the sound transmission loss for panels.



Simulating the sound transmission loss for mufflers.

Using rooms to measure sound transmission loss

The Simcenter Testlab Sound Transmission Loss uses rooms to address the measurement of large samples and complete objects like doors, windows and vehicle components. This solution supports field and laboratory measurements by following industry standards, as well as providing free setup measurements.

Using intensity based sound transmission loss

Using a sound intensity based method according to ISO 15186-1 (Acoustics – Measurement of sound insulation in buildings and of building elements using sound intensity – Part 1: Laboratory measurements) or ASTM-E2249-02 (Standard test method for laboratory measurement of airborne transmission loss of building partitions and elements using sound intensity) provides an alternative for obtaining the sound reduction index in a room. The sound reduction index is measured by calculating the difference between the

averaged sound pressure level in the reverberant room and the averaged sound intensity measured on the surface of the tested component. This method makes it possible to plot sound intensity maps using Simcenter Testlab Sound Intensity Testing and Analysis. It delivers additional valuable information such as precise sound source localization.

Enhancing numerical investigations

Simcenter acoustic simulation software complements the Simcenter material and component testing portfolio to carry out equivalent acoustic tests in the virtual world. It can be used to simulate duct acoustics for evaluating transmission loss, for example, due to automotive intake or exhaust systems.

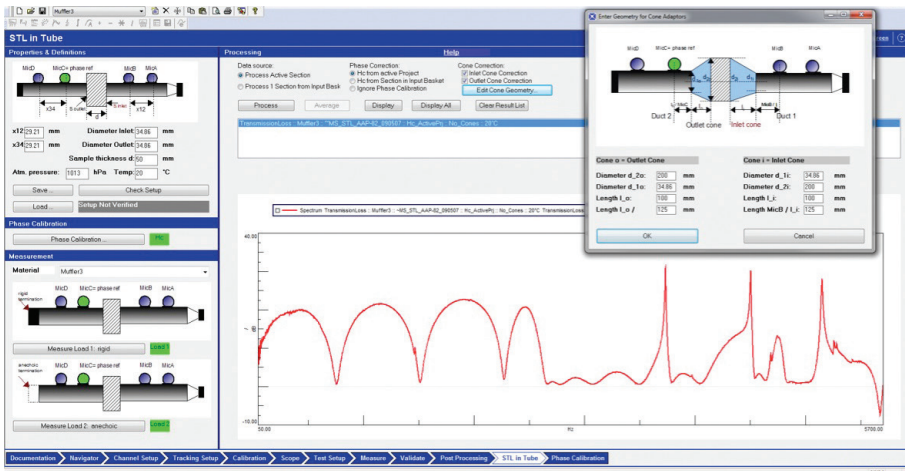
Additionally, using the software also supports panel transmission loss simulation, a dedicated solution for evaluating acoustic transmission loss through structures such as aircraft fuselage panels and car door panels. The 3D model of the panel can be simulated in

a FEM framework and the transmission loss can be computed. The software’s FEM panel transmission loss solutions support multiple approaches, such as direct and modal response.

The Simcenter portfolio helps you go beyond simple verification to performance prediction by combining simulation and testing. It provides a comprehensive solution for testing materials for acoustics and components in all situations, from the standard certification procedure of a noise control solution to detailed investigations on a simulated component model.

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Typical sound transmission loss results for a muffler.

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