ELWIS

Porous material analyser system for Acoustical and Structural parameters.

The ELWIS porous material analyser

The ELWIS (Evaluation of Light Weight Impedance System) measurement system comprises an ELWIS-A system for the evaluation of the Acoustic parameters and an ELWIS-S system for the evaluation of the Structural parameters together with an acquisition unit including the acquisition cards and a PC.
The system permits the physical parameters of porous materials to be determined in a rapid, reliable and convenient way.

ELWIS-A also fulfils the ASTM (E-1050) and ISO (10534-1/2) standards for impedance tube measurements (measurement between 200 and 3400 Hz).

The ELWIS-A and ELWIS-S systems are described in more detail in separate brochures.

Porous material parameter measurements

As it is well known, the simulation of the physical behaviour of porous materials by means of the Biot-Allard model requires the knowledge of a set of material parameters. These parameters are essentially needed both for the characterisation of the material structural frame of foam and felt, and of the air that saturates it and also for the characterisation of the inertial and dynamic coupling between them.

These parameters are required in the following situations:

Acoustic performance evaluation:

The Biot-Allard model is used when evaluating the macroscopic acoustic performances of sound insulating and sound absorbing multi-layer treatments using software tools (e.g. SISAB, developed by Rieter).

- Can be used to compare quickly the performances of different sound package solutions or materials
- Widely used in vehicle airborne noise SEA models.

Finite Element simulations

The Biot-Allard model is used when simulating the dynamical and acoustical behaviour of real finite-size sound package parts in the medium to low frequency range

- FE simulations with software such as Actran, Nastran, Rayon, …

The Biot parameters to be measured

The acoustical Biot-Allard parameters:

Parameter	Symbol	Unit S.I.
Composite porosity	ϕ	[-]
Air flow resistivity (AFR)	σ	[Pa s m^{-2}]
Composite tortuosity	τ	[-]
Composite pore shape factor	c	[-]
Viscous characteristic length	Λ	[m]
Thermal characteristic length	Λ'	[m]

The structural Biot-Allard parameters:

Parameter	Symbol	Unit S.I.
Young's Modulus	E	[Pa]
Damping Loss Factor (DLF)	η	[-]
Poisson's ratio (for foam materials) (Range: 0.15-0.48)	ν	[-]

It is necessary to measure these parameters in a rapid and robust way

- Since the results of the simulations based on the Biot-Allard model can be rather sensitive to variations in one or more of these parameters;
- During the development or the analysis of a sound package part, it is generally necessary to compare several different solutions quickly and this requires, in principle, the availability of large material parameter databases. The construction of such databases by means of classical and direct techniques is a rather long and delicate process

The ELWIS-A methodology requires only the separate measurement or calculation of the porosity.

Parameter		Without ELWIS	With ELWIS system
Porosity	ϕ	**RIETER PORPOS**	**RIETER PORPOS**
AFR	σ	**RIETER AFR**	**ELWIS-A** ✓
Tortuosity	τ	Estimated/ or - Ultrasonic methods - Identification methods	**ELWIS-A** ✓
Viscous Length	Λ		**ELWIS-A** ✓
Thermal Length	Λ'		**ELWIS-A** ✓
Pore shape factor	c		**ELWIS-A** ✓
Normal absorption	α	Impedance tube	**ELWIS-A** ✓
Surface impedance	z	Impedance Tube	**ELWIS-A** ✓
Young's modulus	E	Resonant Method	**ELWIS-S** ✓
Loss factor	η	Resonant Method	**ELWIS-S** ✓
Poisson ration	ν	Estimated	**ELWIS-S** ✓

System Specifications available on request

Select the "contacts" link on our website (www.rieter.com) for further information