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Product portfolio

Interior · Exterior New Mobility · Autoneum Pure. Measurement Systems · Simulation Tools Autoneum is the global market and technology leader in acoustic and thermal management for vehicles and partner for automobile manufacturers around the world.

The Company develops and produces components that enhance a quiet and comfortable driving experience with a low environmental impact at the same time.













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Interior

Tufted and needlepunch carpets, inner dashes, floor insulators, floor mats and inner wheelhouse insulators 4 - 13

Exterior

Engine Bay Engine and gearbox encapsulations, hoodliners, outer dashes and other body-mounted absorbers 16 – 21

Underbody
Underbody systems, wheelhouse outer liners,
battery and spare wheel pans, heatshields
22 - 27



New Mobility

Particularly suitable technologies for electric vehicles **28 – 31**

Autoneum Pure. Best-in-class products and technologies with a superior sustainability performance 32 – 33

Measurement Systems Specialized systems to measure NVH performance of component and material properties 34 – 39



Simulation Tools

Innovative software to optimize NVH performance **40 – 47**



Interior Floor

Autoneum's interior floor products make the vehicle lighter, more comfortable and environmentally-friendly – while providing optimum acoustic performance at the same time. In addition, these multifunctional components also meet the increased requirements for comfortable vehicle interiors thanks to their outstanding cleanability, low odor and high durability.





For further information, please contact: Autoneum | Global Product Management Interior Floor interior-floor@autoneum.com



Di-Light Better durability and perceived quality



Needlepunch carpets have until now been seen as cost effective textile surfaces but prone to flattening and wear over lifetime. With Di-Light, Autoneum now offers a more durable non-woven carpet thanks to its great abrasion resistance and resilience. The technology additionally allows an attractive esthetics even in highly shaped carpet areas due to its uniform surface appearance. The needlepunch carpet absorbs noise entering the passenger compartment from the road or engine bay, thereby contributing to enhanced driving comfort.

The enhanced resistance-to-weight ratio and the homogeneous look and feel of the carpet are based on newly developed fibers. Depending on the product variant, they consist of up to 97% of recycled PET which is reflected in the carpet's excellent environmental performance.

BENEFITS

Homogeneous look and feel

Highly resilient and wear-resistant

97% Made from up to 97% recycled PET Tufted carpets

Relive-1 Excellent sustainability and cleanability



BENEFITS

Easy to clean from dirt

Improved stain resistance

97 % Made from up to 97 % recycled PET With Relive-1, Autoneum offers an innovative tufted carpet for the compact to premium class that meets the highest requirements of sustainable mobility. Relive-1 carpets are particularly eco-friendly: Only recycled PET bottles are used to manufacture the carpet yarns.

At the same time, Relive-1 carpets have a significantly higher abrasion resistance compared to standard carpets in compact to large class vehicles. Thanks to the vertical alignment of the filaments and the water repellency of polyester, they are also easy to clean and particularly stain-resistant. Small particles and liquids can be removed with no residual traces, which is a key benefit for recreational vehicles like SUVs.

Hybrid-Acoustics Unique combination of absorption and insulation



Hybrid-Acoustics provides automobile manufacturers with a versatile acoustic solution for inner dashes, floor insulators and inner wheelhouse insulators. This hybrid technology for vehicle interiors offers a unique performance-to-weight ratio: Hybrid-Acoustics is up to 50 % lighter than conventional solutions, thus the lightest hybrid technology on the market. Furthermore, it consists largely of recycled materials, which reduces CO₂ emissions during the production process.

Thanks to the dynamic stiffness-controlled layer (DSL), the acoustic properties of Hybrid-Acoustics parts can be locally tuned to maximize absorption or insulation performance. As a result, Autoneum's Hybrid-Acoustics parts can be designed to tackle any acoustic challenges in vehicles. Statistical energy analysis (SEA) simulations that take the available packaging space into account, the acoustic loads and the part's environment are used to find the most optimum material configuration before a physical prototype of the car is available.

BENEFITS

Insulates and absorbs noise simultaneously

Lightweight

Customized

acoustic tuning

Inner dashes and floor insulators

Prime-Light Extremely light and high design freedom



BENEFITS

Lightweight High recycled content





Prime-Light also convinces with low weight while maintaining the same level of acoustic protection. Thanks to a 30 % weight reduction compared with previous models, Prime-Light-based inner dashes and floor insulators save more than two kilos of a vehicle's weight on average. Prime-Light-based components consist of thermoplastic cotton felt blends in which the share of recycled materials is more than 60 % depending on the application-specific composition. oduct portfolio · Interior Floor

Injection Fiber Process (IFP-R2) Technology for optimal acoustic performance



Autoneum is setting new standards in felt technology: The fully-automated IFP-R2 production systems are based on the Rotating Injection Fiber process which is an innovative, patented manufacturing process from Autoneum used for manufacturing tailor-made felt blanks for inner dashes and floor insulators in vehicles. These blanks with locally adjusted area weight are then molded into the shape required for the final product.

The advanced process leads to better acoustics, lower weight and the possibility to locally increase the compressional stiffness of carpet systems for improved quality perception. Autoneum also achieves a higher environmental performance of the production process, as up to 75 % of recycled fibers are possible and fewer fiber scrap is generated, which then can additionally be immediately recycled by the line.

BENEFITS

Optimized part weight and acoustics

Increased compression hardness

Up to

75% recycled fibers



Engine Bay

Engine bay is the vehicle area where most of the noise and heat sources are concentrated. With innovative lightweight and multifunctional components, Autoneum helps automobile manufacturers to address new regulations for pass-by noise and CO_2 emissions.



For further information, please contact: Autoneum | Global Product Management Engine Bay engine-bay@autoneum.com

Hybrid-Acoustics PET Sustainable noise protection in the engine bay

BENEFITS

Outstanding acoustic insulation

Best-in-class sustainability

40%

lighter than alternative powertrainmounted insulators Hybrid-Acoustics PET is used to encapsulate electric motors, thereby reducing noise directly at the source and particularly attenuating high-frequency sounds of the electric drive unit. This key technology accordingly ensures optimum noise protection in the passenger cabin and greater driving comfort.

At the same time, components made of Hybrid-Acoustics PET convince with their low weight. Compared to conventional insulators, they are up to 40 % lighter, thereby contributing to a greater driving range. They are also flameproof and find application as powertrainmounted insulators for combustion engines thanks to their temperature resistance of up to 180°C.

The parts, which consist to a large extent of recycled PET fibers, are produced waste-free and are completely recyclable - an outstanding life cycle assessment compared to equivalent components in the engine bay.

Engine- and body-mounted parts, engine top covers

Theta-FiberCell Key technology for engine encapsulations

Innovative engine encapsulations enhance the efficiency and sustainability of vehicles: The heat storage in the engine bay achieved with the encapsulations reduces fuel consumption at the next cold start, which in turn leads to lower vehicle emissions.

Theta-FiberCell, the key technology for engine encapsulations, combines the benefits of the fiber carrier Theta-Fiber and foam absorber Theta-Cell and is based on Autoneum's long-standing experience. It takes into account customer-specific product requirements such as optimum noise protection and integrated thermal insulation. For instance, Theta-FiberCell is barely flammable and can withstand temperatures of up to 200°C.

As well as the acoustic absorption of interior (by up to 4 decibel) and exterior (by up to 8 decibel) noise, the fiber-foam solution enables heat to be stored for long periods after the vehicle has been parked. After having been switched off for 12 hours, the temperature of an engine with Theta-FiberCell encapsulation is up to six degrees higher than of one without this special insulation.

BENEFITS

Lightweight fiber-foam solution

High acoustic absorption

Resistant to engine vibration

Heat insulation and temperature stability up to

200°C

Hoodliners, outer dashes, battery insulators

Theta-Cell Durable and lightweight foam absorber

BENEFITS

Low weight

Premium acoustic absorption

Theta-Cell is an innovative polyurethane foam material developed by Autoneum. It is used for different applications such as lightweight and multifunctional hoodliners, outer dashes, tunnel insulators and battery covers. Compared with conventional acoustic absorbers, Theta-Cell components can be used to achieve weight reductions of up to 60% as well as high thermal insulation.

Products based on Theta-Cell are able to withstand temperatures of up to 180°C at peak; they meet customer requirements and legal provisions with regard to the non-flammability of components for the engine bay. They are also oil- and water-repellent and help to reduce the interior and exterior noise of vehicles. Engine-mounted parts, engine top covers

Theta-Fiber Multifunctional non-woven technology

The engine bay compartment is a major source of heat and noise in any vehicle. Therefore, it has to be acoustically and thermally isolated in order to increase passengers' comfort. For that, Autoneum offers Theta-Fiber, a robust and multifunctional non-woven material.

Theta-Fiber stands out against conventional non-woven components, above all thanks to its high temperature resistance: While traditional thermoplastic materials are able to withstand temperatures of up to 150°C, noise and thermal insulation parts based on Theta-Fiber can also be applied at temperatures of up to 200°C.

Compared to traditional heavy engine covers made of solid plastic, Theta-Fiber engine covers achieve weight savings of up to 60%, reduce the interior and exterior noise of vehicles and insulate heat generated by the engine.

BENEFITS

Robust and multifunctional

High temperature stability

Underbody

Textile-based and correspondingly lightweight underbody systems of Autoneum absorb noise and therefore simultaneously reduce the interior and exterior noise of cars. They also enhance the aerodynamics of a vehicle. This leads to lower fuel consumption and reduced vehicle emissions.

For further information, please contact: Autoneum | Global Product Management Underbody underbody@autoneum.com

Ultra-Silent The lightest textile underbody system

With underbody systems made of Ultra-Silent, Autoneum offers the most lightweight textile under floor systems for vehicles: They are up to 50 % lighter compared with equivalent plastic components. Underbody systems made of Ultra-Silent also convince with a high degree of impact resistance and optimum stone chip protection. The PET-based, glass-free mono-material is resistant against water and heat and fully recyclable.

At the same time, Ultra-Silent absorbs sound and in doing so reduces the vehicle noise by up to 2 decibels. In addition, under floor systems made of Ultra-Silent enhance the aerodynamics of vehicles by reducing their air resistance. This contributes to lower fuel consumption and thereby reduces CO₂ emissions. The sophisticated engineering behind Ultra-Silent helps reduce mass, the number of fixation points, part numbers, overall complexity and costs. This makes Ultra-Silent a convincing value offer for car makers.

In electric cars, undercovers made of Ultra-Silent are installed underneath the battery casing, providing the battery cells with the best possible protection against extreme ambient conditions.

BENEFITS

Lightest textile underbody technology

Absorbs sound, thereby reducing vehicle noise

Optimum stone chip protection

100% PET and completely recyclable - Wheelhouse outer liners

Mono-Liner Meets highest sustainability standards

Mono-Liner is Autoneum's latest technology for wheelhouse outer liners. Mono-Liner-based components convince thanks to their lightweight construction, thereby contributing to lower vehicle weight with correspondingly less fuel consumption and CO₂ emissions. They also ensure a greater driving range for electric vehicles.

Mono-Liner-based wheelhouse outer liners are made completely out of PET, of which up to 70% are recycled fibers. All in all, more than 70 PET bottles are reused in one set of these sustainable components. The excellent life cycle assessment is also based on their particularly resource-saving manufacturing: Production cut-offs of Mono-Liner can be processed into pellets and completely returned to the manufacturing process as fibers.

BENEFITS

50% lighter than equivalent parts made of plastic

Reduces interior and exterior noise

Excellent flammability resistance

Consists of up to **70%** recycled PET fibers

- O- Wheelhouse outer liners

Alpha-Liner Optimum tire noise reduction

BENEFITS

Enhanced acoustic absorption

Anti-icing

Stone impact protection

100% acoustically tunable Alpha-Liner is a lightweight textile wheelhouse outer liner featuring a thin coated surface on the tire side. Thanks to this innovative technology, the porosity of the textile material is tuned to maximize the sound absorption, which contributes to the reduction of tire noise and accordingly improves the pass-by noise level as well as passenger comfort. This advantage is key for car manufacturers, especially in light of increasingly stringent exterior noise regulations worldwide. Sound-reducing components are also essential for electric vehicles because tires have to be insulated even more: Due to the lack of the engine noise, other noises are more audible for passengers. The coating can be adapted to the specific requirements of every vehicle, thereby protecting the textile carrier in areas strongly impacted by water and stone chipping for instance. The plasticized surface is also easier to clean than standard textile wheelhouse outer liners with less ice accumulation on the component. The manufacturing process of Alpha-Liner is solvent-free and eco-friendly. Applied only where it is most effective, the coating allows for the production trim waste to be recycled.

-@- Heatshields

RIMIC Heat protection and noise absorption

Heatshields are used in vehicles primarily to provide protection against the heat that arises in the engine bay and the exhaust system. In order to shelter this radiant warmth, these shields resist heat up to 500°C. Acoustic heatshields based on Autoneum's RIMIC technology additionally reduce the noise emission of the vehicle thanks to their integrated acoustic function. The noise re-duction is achieved by means of a special perforation developed by Autoneum. It converts the airborne sound into thermal energy and absorbs it. Using in-house production processes, these perforations are applied specifically only in predefined areas to ensure optimal heat protection and durability. The acoustic performance of heatshields is controlled by the number and density of openings per shield. RIMIC can be used as a single layer, with glass fiber mats or in combination with the Theta-Cell acoustic absorption technology in order to facilitate the absorp-tion of high-frequency sounds of between 2 – 6 kHz.

BENEFITS

Maximized tunable acoustic performance

High durability thanks to optimized design of perforation area

Battery shields

Outer floor insulators

New Mobility

Innovative and future-oriented portfolio

Major industry trends such as electromobility are raising the requirements on future vehicles. There is a growing demand for components designed to make vehicles significantly lighter, quieter and environmentally-friendly while enhancing driving comfort. As innovation leader in acoustic and thermal management, Autoneum is manufacturing products and technologies that meet the requirements of modern mobility.

Under battery shields

Heated floor

..... E-motor encapsulations

. Frunk

mats

Inner wheelhouse insulators

electromagnetic

Mobility [>]roduct portfolio ·

trunk floor insulators

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New N

Optimized product portfolio for e-mobility

| Missing heat sources | Road noise | Interior and trunk aesthetics |
|--|---|-----------------------------------|
| Reducing vehicle weight | Sustainable technologies | Comfort in autonomous vehicles |
| Aerodynamics | Powertrain noise | Shared use |
| Acoustic components with thermal properties | Textile exterior treatment | Material innovations |
| Lightweight construction expertise and product portfolio | Recycled fibers | New noise insulation requirements |
| Expanding underbody business | Tailored acoustic solutions, diagnostics and simulations | Cleanability and durability |

Carpet systems

Inner dashes

Wheelhouse outer liners

Underbody systems

IN THE SPOTLIGHT

Frunk based on Ultra-Silent Higher driving range for electric vehicles

With its innovative front trunk for electric vehicles, Autoneum offers the optimal solution for more storage space and longer driving pleasure. Thanks to its textile fibers, the multifunctional frunk made of Ultra-Silent is particularly light and replaces heavier plastic solutions common in electric vehicles today, thereby contributing to less electric energy consumption and a higher driving range.

At the same time, the component improves vehicle acoustics by reducing annoying noises at the source due to its sound-absorbing material composition. The Ultra-Silent-based frunk is highly sustainable as well: It is made entirely of PET and contains up to 70% recycled material.

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BENEFITS

Made from up to 70 % recycled material

Excellent sound absorption

50% lighter than alternative solutions

Autoneum Pure.

Technologies with an excellent environmental performance throughout the entire product life cycle – that is what "Autoneum Pure." stands for. Components carrying this label are made partially or entirely of recycled materials, which have a significantly low environmental footprint. Moreover, the production waste can be reclaimed during the manufacturing process and reused again. Being lightweight, "Autoneum Pure." technologies also reduce vehicle weight, thereby lowering both fuel consumption and CO_2 emissions.

Hybrid-Acoustics PET

Mono-Liner

Relive-1

Measurement Systems

Autoneum has been the leading supplier of specialized measurement tools in automotive acoustics for 50 years. The innovative systems can be used to assess and compare noise-reducing components in next to no time. This facilitates the compilation of sound packages for vehicle manufacturers, while at the same time ensuring that customers receive a product that is optimally tailored to their needs. Autoneum's measurement systems have become globally recognized industry standards that are successfully used by vehicle manufacturers, suppliers and research institutes alike.

For further information, please contact: Autoneum | Measurement Systems ms-sales@autoneum.com

AFR

The AFR (Airflow Resistance Measurement) system was designed to measure the airflow resistance of porous materials in an easy way without compromising measurement quality. The results comply with ISO standard 9053-1:2018.

Dim

BENEFITS

- Extremely robust, stable and durable construction
- Easy and intuitive operation
- Measurement of thin materials (fabrics or non-wovens)

Alpha Cabin

Alpha Cabin is the leading system to measure acoustic absorption properties of materials and components that contribute to noise reduction in vehicles. The system is particularly suitable for validation and quality assurance of the measured data. A recognized standard by car makers, the system is used in over 20 countries worldwide.

- Results enable specifications for the absorption properties of NVH products
- Fast and repeatable measurement processes
- Significantly smaller than normal reverberation rooms

APAMAT II

APAMAT II compares and classifies the complex range of soundproofing solutions currently used in the automotive industry. For instance, the system evaluates the effectiveness of NVH materials in terms of noise control, noise damping and noise insulation in just one system. Optionally, the system is compatible with the airborne excitation only, allowing the installation of loudspeakers in the excitation chamber.

BENEFITS

- Measurement of acoustic efficiency by reproducing material performance in the car
- Combination of structure-borne and airborne excitation
- · Quick and easy measurement

| Dimensions | 600 x 600 x 1 240 mm (L x W x H) |
|-----------------|---|
| Sample diameter | 100 mm |
| Airflow Source | Vacuum pump or compressed air |
| Standards | ISO standard 9053-1:2018 |
| Output | Airflow resistance, airflow resistivity |
| | • |

| Dimensions | 3 220 x 2 370 x 2 030 mm (L x W x H) |
|---------------------|--|
| Volume | 6.44 m ³ |
| Sample surface area | 1.2 m² (standard sample), 0.6 – 2.4 m² |
| Frequency range | 400 – 10 000 Hz |
| Standards | Based on ISO 354:2003 |
| Output | Absorption coefficient, equivalent absorption area |

| Dimensions | 1740 x 1180 x 1865 mm (L x W x H) |
|-----------------|-----------------------------------|
| Sample size | 840 x 840 mm |
| Frequency range | 100 - 10 000 Hz |
| Output | Overall acoustic efficiency |

| Dimensions | 920 x 920 x 1490 mm (L x W x H) |
|-----------------|---------------------------------|
| Frequency range | 100 – 800 Hz |
| Sample size | 643 x 544 mm |
| Output | Structure-borne insertion loss |

| Dimensions | 440 x 180 x 305 mm (L x W x H) |
|---------------------------------|--------------------------------|
| Bell overall dimensions | 145 mm |
| Range of airflow resistances | 200 – 4 000 Ns/m³ |
| Recommended sample thickness | less than 20 mm |
| Output | Airflow resistance |

| Dimensions | 1500 x 950 x 1800 mm (L x W x H) |
|----------------------------------|---|
| Dimensions of standard sample | 180 x 620 mm |
| Suction head speed | 7 m/min |
| Output | Cleanability index, dirt repellency index |

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ARTIS3

The innovative ARTIS3 system features an optimized experimental set-up for the performance assessment of structure-borne noise of acoustic packages. The dedicated software for testing, archiving and analysis makes it easy for the user to find the best solution in terms of performance, weight or cost.

- Robust evaluation of the acoustic effectiveness of a passive treatment versus structure-borne noise
- Immediate and easy measurement process
- Easy to transport thanks to comparatively small size

CARE+

The control of airflow resistance in the production of materials and components is a growing requirement in the automotive industry. CARE+ (Concentric Airflow Resistance Evaluator) is an apparatus designed to measure the airflow resistance of materials and parts.

BENEFITS

- Non-destructive air flow resistance measurements
- Quality control adequate to manufacturing environment
- Easy to transport

Carpet Cleanability Analyzer

Autoneum developed the Carpet Cleanability Analyzer measuring system to conceptualize carpet systems during predevelopment of new vehicle models. The underlying process enables the cleanability and dirt resistance of different carpet surfaces to be analyzed and compared. It can be supplied together with standardized soiling particles and tools for sample soiling preparation.

- Works with all carpet surfaces (tufted and non-woven)
- Repeatability of the results ensured
- Quantitative assessment of carpet cleanability

IN THE SPOTLIGHT

ELWIS

ELWIS (Evaluation of Light Weight Impedance System) offers a full, reliable and rapid characterization of the physical parameters of the porous materials (Biot-Allard parameters). The system consists of the ELWIS-A and ELWIS-S devices, which can be used independently from each other, although both applications are needed for a complete material modeling.

| Dimensions | 850 x 2210 x 1240 mm (L x W x H) |
|-----------------|--|
| Sample size | ELWIS-A: 60 mm diameter additional option: 29 mm diameter ELWIS-S: 100 mm diameter |
| Frequency range | ELWIS-A: 200 – 3 400 Hz additional option: 1000 – 6 300 Hz ELWIS-S: 50 – 800 Hz |
| Standards | Fulfills ASTM (E-1050) and ISO (10534-1/2) For impedance tube measurements (measure- ments between 200 and 3 400 Hz or up to 6 300 Hz with the additional option) |
| Output | Acoustical and structural Biot-Allard parameters |

BENEFIT

- Rapid, easy and reliable data evaluation
- Adaptable to a wide range of materials and parts
- Easy-to-operate

Isokell

Isokell offers a flexible method geared specifically to the needs of the automotive industry for measuring airborne noise insulation and the transmission loss of vehicle components. The system is easier to use and less costly than traditional transmission loss suites.

Sample apertures

Frequency range

Output

1.0 x 1.2 m (standard flat samples)

Transmission loss, insertion loss

125 - 6 300 Hz (extendable up to 10 kHz)

1.0 x 1.8 m (dashboards)

1.5 x 2.0 m (larger parts)

BENEFITS

- Measurement of flat samples or components
- Fast and easy measurement procedure
- Used in combination with Alpha Cabin, it can also measure absorption

PORPOS

PORPOS measures the porosity (ratio of air to overall volume) of felts and foams on the basis of the so-called air-based method. Via a process of alternately compressing and decompressing air, the porosity of the sample under analysis can be derived from the resulting pressure changes.

BENEFITS

- Fast and easy measurement procedure
- Automatic evaluation of the measurement results
- Suitable for a wide range of porous materials such as felts and foams

| 1 | |
|---|--|

| Dimensions | 600 x 600 x 1240 mm (L x W x H) |
|----------------------|---------------------------------|
| Sample holder length | 50 mm |
| Sample diameter | 40 mm |
| Output | Porosity |

ATLAS New testing standard for measurement of acoustic insulation

ATLAS - short for "Airborne Transmission Loss Analysis System" - measures the acoustic insulation and transmission loss of interior components such as carpets, inner dashes and floor insulators. While developers previously had to analyze the NVH behavior of interior parts using material samples of around one square meter in size, ATLAS makes this process faster, cheaper and more environmentally-friendly. It enables measurements of small samples with a diameter of no more than ten centimeters, which substantially decreases the amount of material used. Thanks to four highly sensitive microphones, only two trials are required to collect precise and valid test data, making the system especially suitable for quality assurance and repeatability of the results obtained. Users also benefit from time savings of up to 50 % compared to the previous testing standard.

| Dimensions | 850 x 1210 x 1240 mm (L x W x H) |
|-----------------|------------------------------------|
| Frequency range | 100 to 3000 Hz |
| Sample size | 100 mm diameter |
| Output | Normal incidence transmission loss |
| | |

BENEFITS

Overcomes limitations of current methods

Measures insertion loss of single layers and multilayers on small samples

Rapid, easy and reliable data evaluation

Simulation Tools

Autoneum provides a full range of simulation tools based on our long-standing expertise in vehicle acoustics and thermal management. These tools predict and optimize NVH in the concept phase in order to provide our customers with cost-effective solutions and reduced lead times. Thanks to our broad range of measurement systems, the data for this process can be evaluated thoroughly.

For further information, please contact: Autoneum Products and Systems Simulation simulation@autoneum.com

Optimizing the vehicle body structure and acoustic trim

Autoneum has developed a complete tool portfolio for state-of-the-art computer-aided engineering (CAE) for vibroacoustics, focusing on body vibration and acoustic trim performance. Our tools predict and optimize NVH in the concept phase in order to provide our customers with cost effective solutions and reduced lead times.

GOLD

GOLD is a unique simulation tool for the simultaneous improvement of a damping package and vehicle body panel shape. It exploits the Finite Elements (FE) analysis performed with NASTRAN (Superelement Technique for full body optimization) and uses an Autoneum modeling technique to simulate the application of damping material on vehicle body panels. GOLD automatically updates the FE model with possible shape modifications as set by the user: beadings, ribs and soapfilms.

BENEFITS

· Handles high number of design variables

Customized shape modification

11 design variables for the position and the thickness of damping patches.

27 design variables for the shape modificati-

ons on the panels: 20 beadings, 7 soap films.

Full vehicle simulation: 7 uncorrelated

loading conditions.

Example

Reduction of damping package weight by 20% in floor area. Same or better performance as original (same panel vibration).

SILVER

SILVER is a simulation tool which predicts the shape and ideal location of dampers based on a single vibration Finite Elements (FE) simulation performed with NASTRAN. SILVER rationalizes and simplifies the design process of a damping package by optimizing the overall weight and the distribution of pads among the different areas of the vehicle, making it possible to efficiently evaluate a particular damping solution (e.g. reference damping configuration versus a proposed modification). It is applied directly on the same FE models used by automobile manufacturers for NVH optimization.

Example

Refinement of baseline damping package with 15% weight reduction

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BENEFITS

- Rationalized and simplified design process
- Provides ranking of damping package parts

Enhancing the acoustic performance of vehicle parts

High-performance software programs are used for the analysis, optimization and validation of the isolation and insulation properties of components for the vehicle interior floor, including carpet systems, inner dashes and floor insulators. The aim is to achieve the perfect balance between acoustic performance and product weight.

VisualSISAB

VisualSISAB calculates the absorption and insulation of sound package components with complex geometries and a wide range of different materials. It exploits the transfer matrix technique to represent the wave propagation through layers of porous materials, hard layers, foils or spacers. VisualSISAB enables material compositions and thicknesses of press-molded components already to be reviewed with respect to NVH requirements and adjusted if necessary during the CAD stage by means of computer-controlled simulations. This is a prerequisite for the development and manufacture of effective, lightweight and cost-efficient noise protection components.

Example

Area split to simulate transmission loss of dashes

BENEFITS

- Used for components in the vehicle interior, engine bay and body-in-white
- Fast design modifications and analysis on parts
- Performance result comparison with target curves
- Fast multilayer 3D constructions from CAD data

REVAMP

REVAMP can predict the impact of trim parts inside the passenger compartment. It is based on the existing Statistical Energy Analysis (SEA) theory. REVAMP is based on over 20 years' experience in SEA modeling and is specifically designed to carry out typical sound package development and optimization tasks in the mid- and high-frequency range.

VisualSISAB

Trim component

Trim simulation

Example

Workflow to link parts performance to vehicle targets

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BENEFITS

- Supports the building and analysis of SEA models of vehicles
- Allows determination of dominating acoustic transfer paths
- Cascades vehicle noise level targets down to acoustic component TL and ABS targets
- Compatible with other commercial SEA tools

Thermal management for the next vehicle generation

At global research and development centers, Autoneum carries out material testing on components as well as in vehicles and uses unique simulation software to design innovative packages that are tailored to customer needs.

Autoneum provides full engineering services for thermal performance, safety and storage from concept selection and material choice to part design and optimization by using computer aided engineering (CAE) software. Thanks to these solutions, the Company's experts can analyze better design options faster and earlier in the vehicle development process.

Case study: E-motor and engine encapsulation pre-development workflow

Based on a smart and accelerated combination of Star-CCM+ and TAITherm, the cooldown duration and efficiency of engine encapsulations is evaluated in shorter time.

Case study: Improving battery performance and protection

With its specialized CAE software developed in-house, Autoneum supports customers in optimizing the thermal management of the battery. This includes the design of the battery structure with coolant circuits among others to calibrate temperature resistance. These simulations thereby help to improve battery performance and correspondingly result in lower energy consumption.

Assessment of interior parts for greater thermal comfort

In order to develop carpet systems, inner dashes and floor insulators that not only provide noise protection, but also optimal thermal comfort inside the passenger cabin, Autoneum offers state-of-the-art simulation tools. These programs factor parameters such as external and internal convection, surface and solar radiation, cabin conduction, heat storage or varying part insulation

Case study: Carpet part simulation and mechanical testing

Combining virtual calculations with the Company's mechanical testing expertise in the predevelopment of carpet systems also enables Autoneum to evaluate the compression performance of the floor system. This is crucial for enhancing part quality.

properties to simulate components that meet the special requirements for thermal management of vehicles. This is also key for electric cars as such components are needed to shield the passenger cabin from cooling or heating, thereby reducing the energy required for temperature regulation. Applying Autoneum's simulation tools in predevelopment thus supports a higher driving range.

Autoneum Locations with minority shareholders Associated companies and investments Licensees

Europe

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Hnátnice

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• Ryazan

Spain Gundernhausen • A Rúa • Sindelfingen

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France

• Blainville

Moissac

Germany

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· Aiken, South Carolina

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· Durban Turkey · Bursa

South Africa

· Rosslyn

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- Pinghu
- Shanghai
- Taicang
- Tiexi • Yantai
- · Guangzhou
- Tianjin
- Wuhan
- Fuzhou

Switzerland

- \cdot Sevelen
- · Winterthur (HQ)

United Kingdom

- Halesowen
- · Heckmondwike
- · Stoke-on-Trent

India

- Behror
- · Chennai

Indonesia

· Jakarta

Japan

- Oguchi
- · Tokyo

Malaysia \cdot Shah Alam

South Korea \cdot Seoul

Thailand · Laem Chabang · Chonburi

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Concept Büro Varieté – Marcel Landolt, Lucerne

Realization evolve advertising ag, Zurich

Print Druckmanufaktur, Urdorf

Autoneum. Mastering sound and heat.

