



AUTOMOTIVE SOLUTIONS

FREUDENBERG
PERFORMANCE MATERIALS

 **FREUDENBERG**
INNOVATING TOGETHER



AUTOMOTIVE MARKET TRENDS	Page 4
TUFTED CARPET BACKINGS	Page 6
HEADLINER FACINGS	Page 8
ACOUSTIC COMPOSITES	Page 10
CARPET MATERIALS	Page 12
AUTOMOTIVE INNOVATIONS	Page 14
FREUDENBERG	Page 16

MORE RIDE COMFORT AND LOWER FUEL CONSUMPTION

TECHNICAL TEXTILES FROM THE MARKET LEADER IN AUTOMOTIVE NONWOVENS

The future of mobility presents new challenges for safety and comfort in automotive. With our unique competence and knowledge as a market leader in high-tech nonwoven fabrics, we provide the automotive industry with intelligent solutions – meeting market trends and end-customers' needs.

Freudenberg improves your driving experience. Our nonwovens make cars lighter, more comfortable, and more enjoyable. Experience the good feeling of quality and the advantages of state-of-the-art technology. We also help to save fuel and reduce CO₂ emissions. This is part of our strong commitment to environmental protection and tomorrow's living standards.

Thus, our high-quality nonwovens are not only cost-efficient, but also a sustainable response to future challenges. Distinguished by its highly sophisticated design, the application range of our materials includes primary backings for molded automotive carpets, flexible designs of headliner facings, needle-punched nonwovens for package trays and seat back linings, backings for throw-in mats, and sound absorption applications. In addition, we are the ideal partner for tiers and OEMs to work on innovative composites, e. g. for underbody shields. Our longstanding relationship with tiers and OEMs gives proof of our leading position.

AUTOMOTIVE MARKET TRENDS

Our market insights are the result of many years of experience in various industries. We care about the efforts of our clients to fulfill their customers' demands. Therefore, we develop innovations based on the major global trends in the automotive sector.

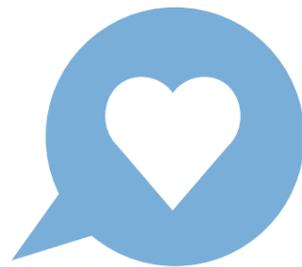


INCREASED FUEL ECONOMY

Fuel economy and efficiency requirements are driven by regulations dealing with issues such as CO₂ reduction in the European Union, Corporate Average Fuel Economy standards (CAFE) in the United States, or various fuel economy regulations in Asia.

How our nonwovens help to address this trend:

- Reducing weight
- Improving aerodynamics
- Facilitating the use of lithium-ion batteries
- Facilitating the use of fuel cells with our gas diffusion layer



IMPROVED DRIVING EXPERIENCE FOR END-CUSTOMERS

Feeling comfortable in a car does not only depend on sophisticated features, but also on the unconscious perception of sensory impressions.

- Wish for creative and individualized car interiors
- Need to downsize, but increase driving comfort and space at the same time
- Use of the car as a mobile office

How our nonwovens help to address this trend:

Improving

- the acoustic performance for a low-noise driving experience
- the haptic sensation to generate a softer and smoother feel of touch
- the optical appearance for a better look & feel

Increasing

- abrasion resistance to ensure the durability of products
- interior dimension and thus driving comfort while keeping the downsizing trend in mind



TRUSTED SUSTAINABLE SOLUTIONS

The growing awareness of environmental issues fosters a sustainable use of resources.

How our nonwovens help to address this trend:

- Reducing weight and thus improving fuel economy of cars
- Fostering environmentally friendly production processes by enabling customers to recycle waste
- Use of latex and binder-free chemical products
- Increasing the share of post-consumer recycling



REMARKABLE COST-EFFECTIVENESS AND EFFICIENCY

Staying competitive in the global market depends on an effective and efficient cost management that still allows a sophisticated interior design.

How our nonwovens help to address this trend:

- Offering solutions based on cost-efficient quality products and manufacturing processes
- Customizing products
- Simplifying processes
- Reducing weight
- Increasing recyclability



GLOBAL PRODUCTION FOOTPRINT

There is an increasing demand from OEMs for products of consistent quality worldwide.

How our nonwovens help to address this trend:

- Being a truly global player with production and R&D facilities in 25 locations across 14 countries
- Maintaining a comprehensive sales network attending to customers all over the world

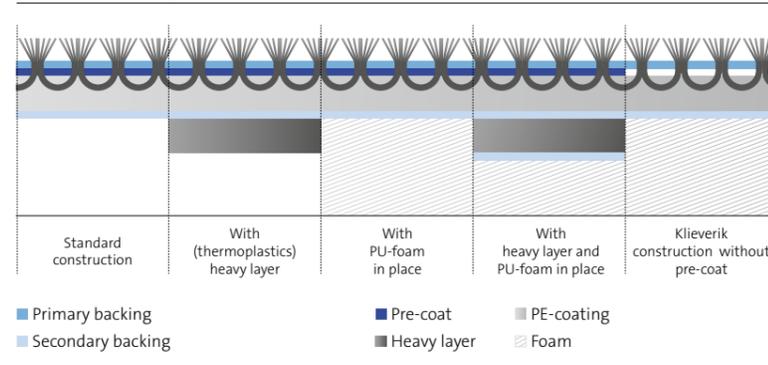
EASY TO MOLD AND DIMENSIONALLY STABLE

Primary and secondary backings for automotive carpets

Freudenberg primary and secondary backings form the invisible and essential supportive inner layer of tufted automotive carpets. Our polyester spunlaid tuft backings have been successfully used in molded automotive carpets since the mid-1970s. Today they are the most widely used backings in the world.

Our tuft backings offer solutions for a large variety of additional automotive carpet applications, such as car mats, door panels, or trunk and seat backs.

Automotive carpet constructions



Our carpet backings offer unique benefits that lead to excellent results:

Precise fit

Fast and cost-efficient installation
No carpet bridgings for more comfort

Excellent moldability

Moldability over the entire carpet surface for an improved haptic sensation

High dimensional stability

Low-temperature molding

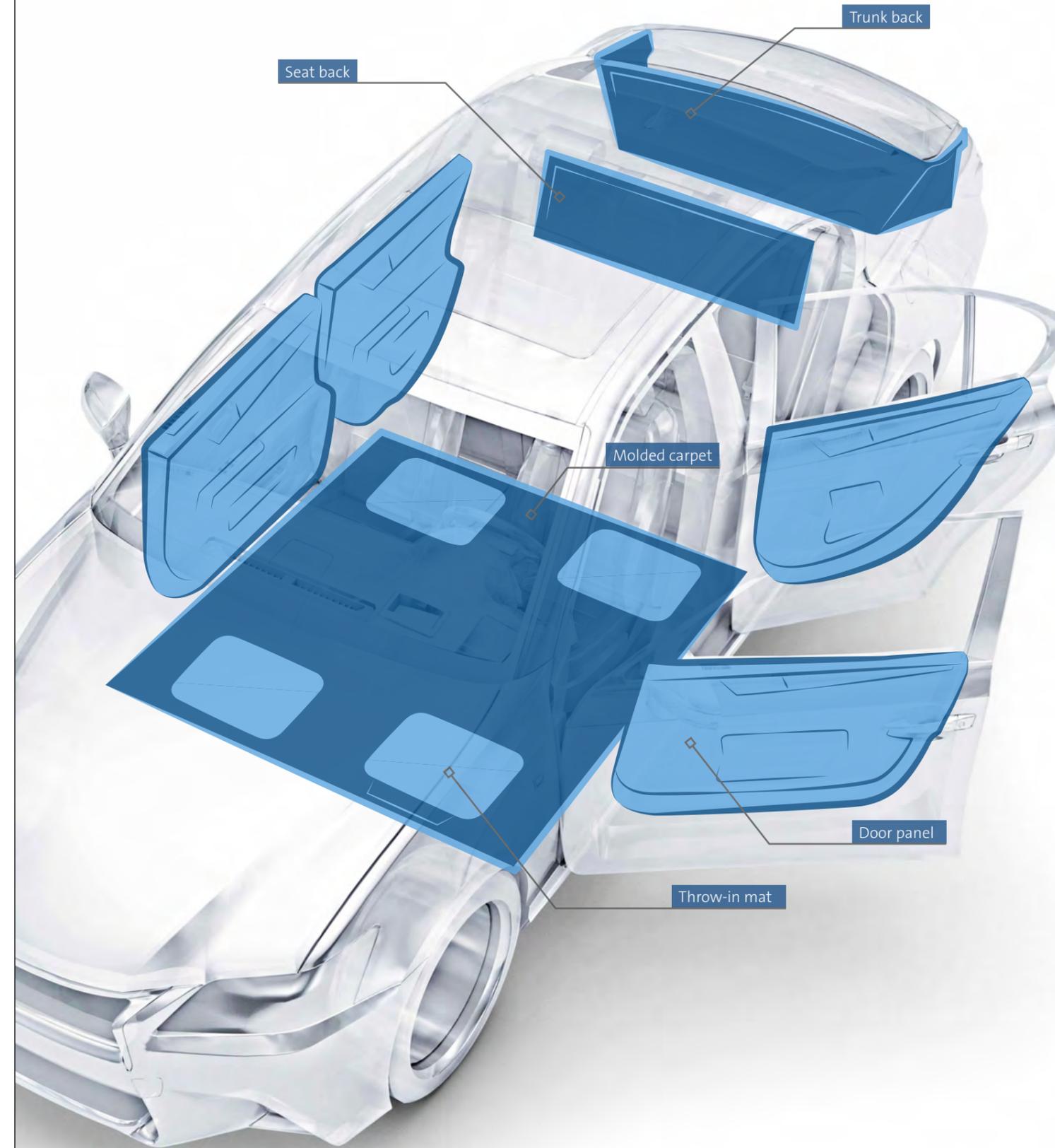
Low processing temperature for reduced energy costs and CO₂ emissions

Flame retardancy of finished products

Improved safety without compromising on driving comfort

Improved color matching ability and customizable widths

Sustainable and recyclable backings



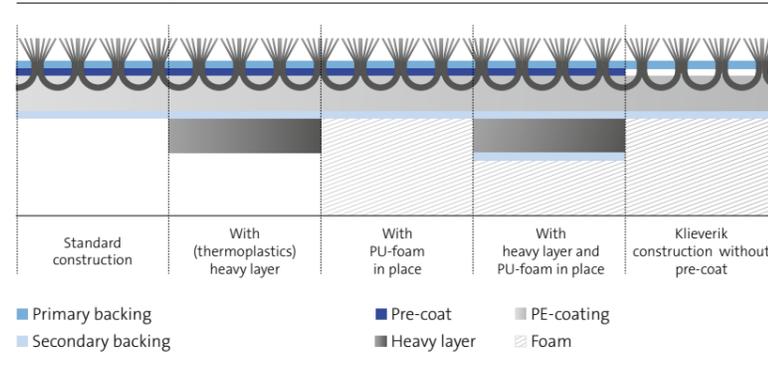
EASY TO MOLD AND DIMENSIONALLY STABLE

Primary and secondary backings for automotive carpets

Freudenberg primary and secondary backings form the invisible and essential supportive inner layer of tufted automotive carpets. Our polyester spunlaid tuft backings have been successfully used in molded automotive carpets since the mid-1970s. Today they are the most widely used backings in the world.

Our tuft backings offer solutions for a large variety of additional automotive carpet applications, such as car mats, door panels, or trunk and seat backs.

Automotive carpet constructions



Our carpet backings offer unique benefits that lead to excellent results:

Precise fit

Fast and cost-efficient installation
No carpet bridgings for more comfort

Excellent moldability

Moldability over the entire carpet surface for an improved haptic sensation

High dimensional stability

Low-temperature molding

Low processing temperature for reduced energy costs and CO₂ emissions

Flame retardancy of finished products

Improved safety without compromising on driving comfort

Improved color matching ability and customizable widths

Sustainable and recyclable backings



AN ATTRACTIVE ROUTE TO YOUR DESTINATION

Headliner facings from Freudenberg Performance Materials and our partner Japan Vilene Company

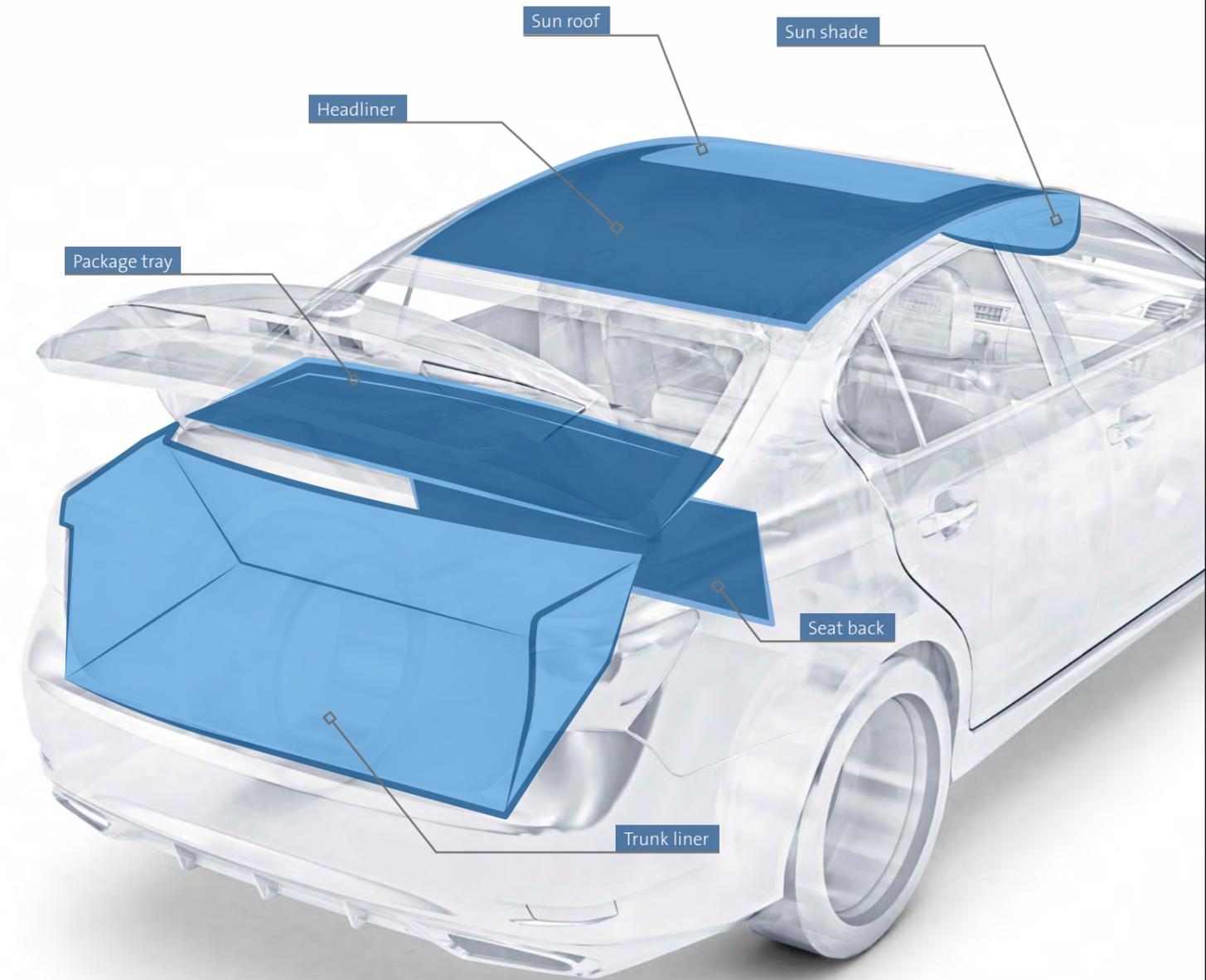
As a manufacturer of nonwoven headliner facing materials, Freudenberg Performance Materials and its partner Japan Vilene Company are unchallenged market leaders. Our visually appealing and versatile facings are mechanically bonded and offer an attractive 3D engineered surface with an excellent abrasion resistance. Compared to composite knitted or foam fabrics, Freudenberg facings offer a significant weight reduction potential with remarkable cost benefits. Our products are found in a wide range of applications, such as headliners, sun roofs, sun shades, trunk liners, package trays and seat backs.

Illustrative material examples:



Freudenberg facings can be tailor-made in order to satisfy individual needs:

- Many design options for an improved appearance using our unique and leading-edge printing process technology
- Improved cleanability and odor protection for an optimal driving experience
- Use of sustainable materials such as recycled fibers



AN ATTRACTIVE ROUTE TO YOUR DESTINATION

Headliner facings from Freudenberg Performance Materials and our partner Japan Vilene Company

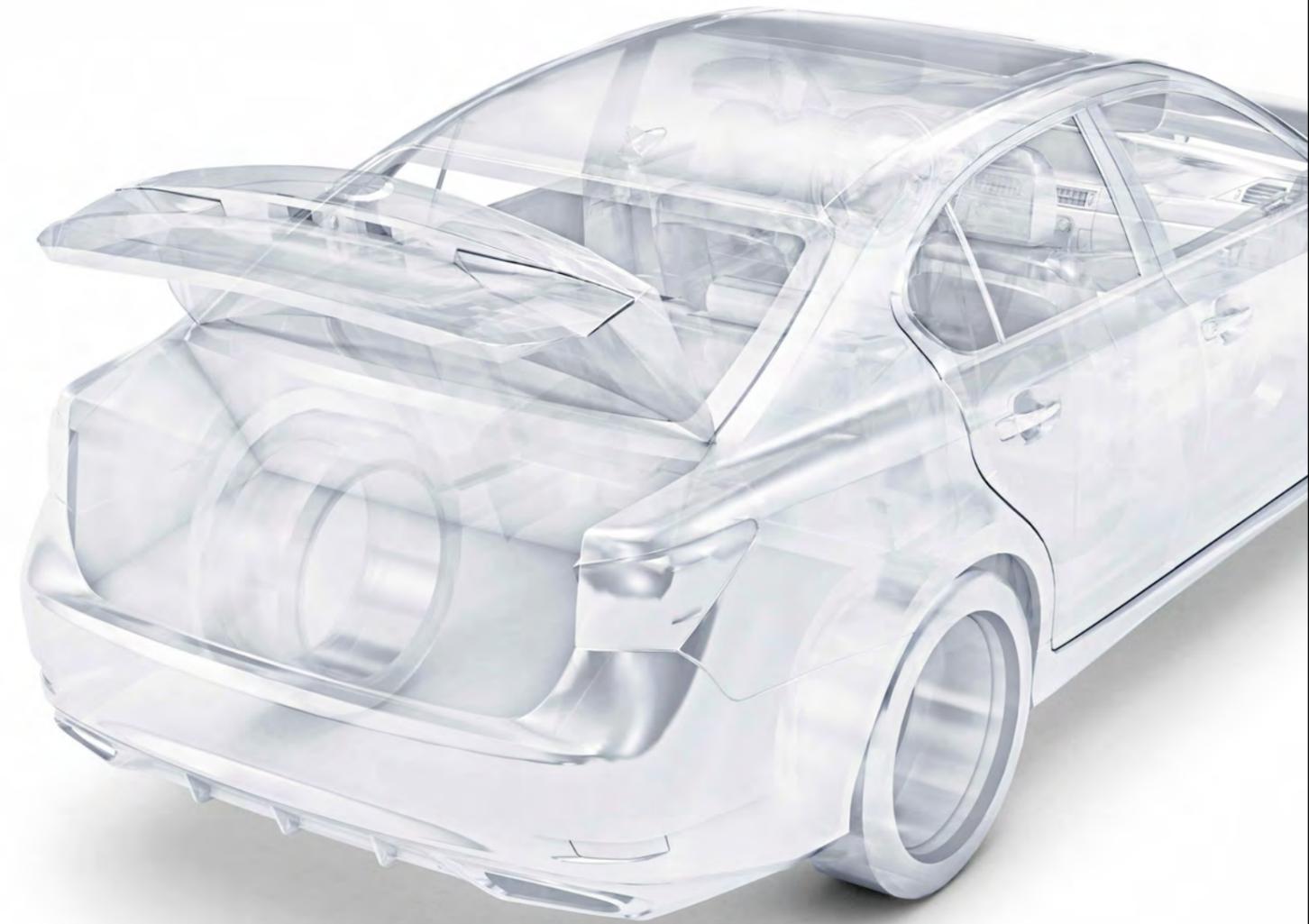
As a manufacturer of nonwoven headliner facing materials, Freudenberg Performance Materials and its partner Japan Vilene Company are unchallenged market leaders. Our visually appealing and versatile facings are mechanically bonded and offer an attractive 3D engineered surface with an excellent abrasion resistance. Compared to composite knitted or foam fabrics, Freudenberg facings offer a significant weight reduction potential with remarkable cost benefits. Our products are found in a wide range of applications, such as headliners, sun roofs, sun shades, trunk liners, package trays and seat backs.

Illustrative material examples:



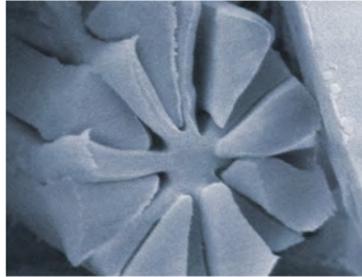
Freudenberg facings can be tailor-made in order to satisfy individual needs:

- Many design options for an improved appearance using our unique and leading-edge printing process technology
- Improved cleanability and odor protection for an optimal driving experience
- Use of sustainable materials such as recycled fibers



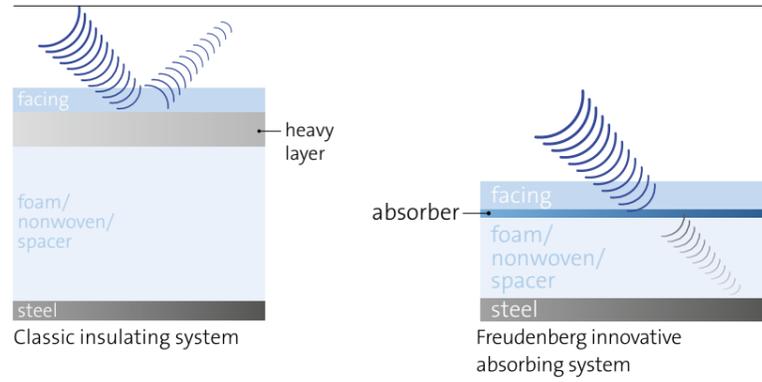
SOUND ABSORPTION AT THE HIGHEST LEVEL

Reduced noise for a more comfortable driving experience



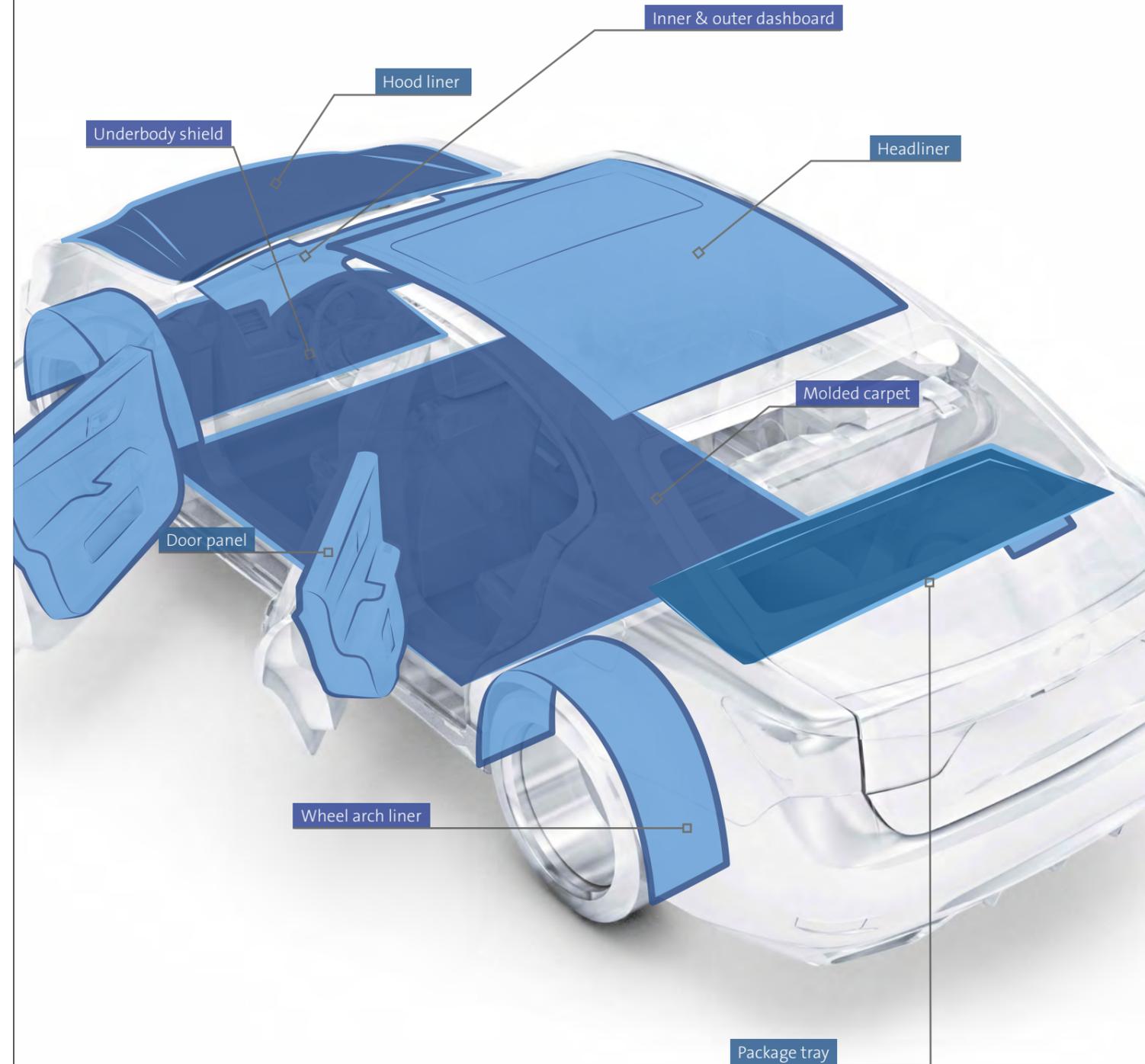
Effective noise reduction is required for optimal acoustics in state-of-the-art automobiles. For tiers and OEMs we offer solutions based on our innovative proprietary Evolon technology. This enables us to produce filaments up to 100 times thinner than human hair which are ideally suited to absorb noise.

Noise reduction concepts – our innovative absorption systems help to cater for market requirements



How our products help our customers:

- Reducing weight significantly and thus reducing fuel consumption
- Improving acoustic performance
- Improving processing efficiency due to excellent molding, cutting, and bonding characteristics
- Available in a wide range of variants:
 - From 150 to 3,500 rayl (porosity and density properties)
 - In widths of up to 2 m
 - With optional treatments such as PE adhesive, flame retardant, oleophobic and hydrophobic



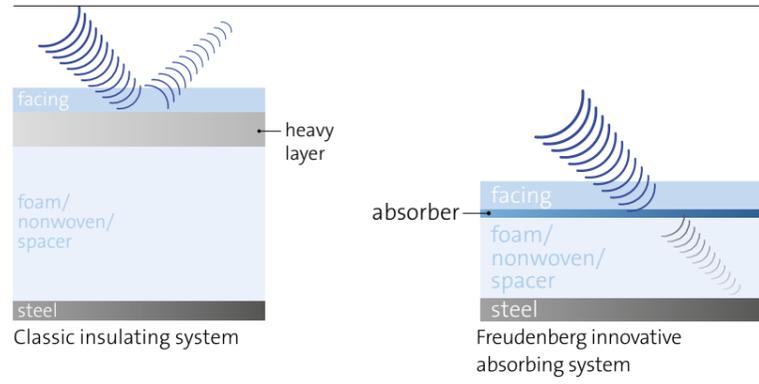
SOUND ABSORPTION AT THE HIGHEST LEVEL

Reduced noise for a more comfortable driving experience



Effective noise reduction is required for optimal acoustics in state-of-the-art automobiles. For tiers and OEMs we offer solutions based on our innovative proprietary Evolon technology. This enables us to produce filaments up to 100 times thinner than human hair which are ideally suited to absorb noise.

Noise reduction concepts – our innovative absorption systems help to cater for market requirements



How our products help our customers:

- Reducing weight significantly and thus reducing fuel consumption
- Improving acoustic performance
- Improving processing efficiency due to excellent molding, cutting, and bonding characteristics
- Available in a wide range of variants:
 - From 150 to 3,500 rayl (porosity and density properties)
 - In widths of up to 2 m
 - With optional treatments such as PE adhesive, flame retardant, oleophobic and hydrophobic



THE LIGHTWEIGHT SOLUTION FOR MOLDED CARPETS

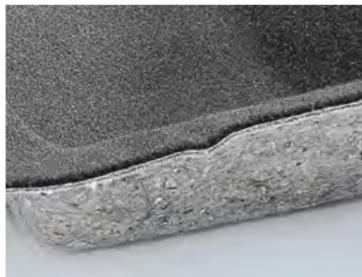
The proprietary nonwoven carpet material based on our Lutraflor technology

With nonwovens based on our Lutraflor technology we offer the perfect solution for automotive carpets, as well as other interior and trunk trims such as seat backs and back floors.

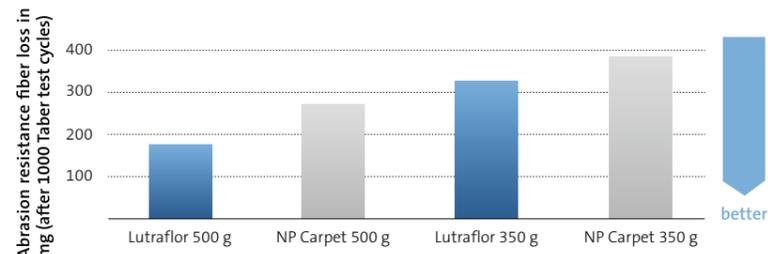
Freudenberg Performance Materials utilizes recycled materials and a state-of-the-art velour needling process for a luxurious appearance and excellent wear characteristics. Materials based on the Lutraflor technology are the preferred choice when it comes to modern automotive flooring applications. With balanced costs, reduced weight, improved performance and sustainability, our product is an advanced 100 % PET sandwich construction with a velourized staple fiber surface and a spunlaid fabric base with a luxurious appearance.

How customers benefit from our products:

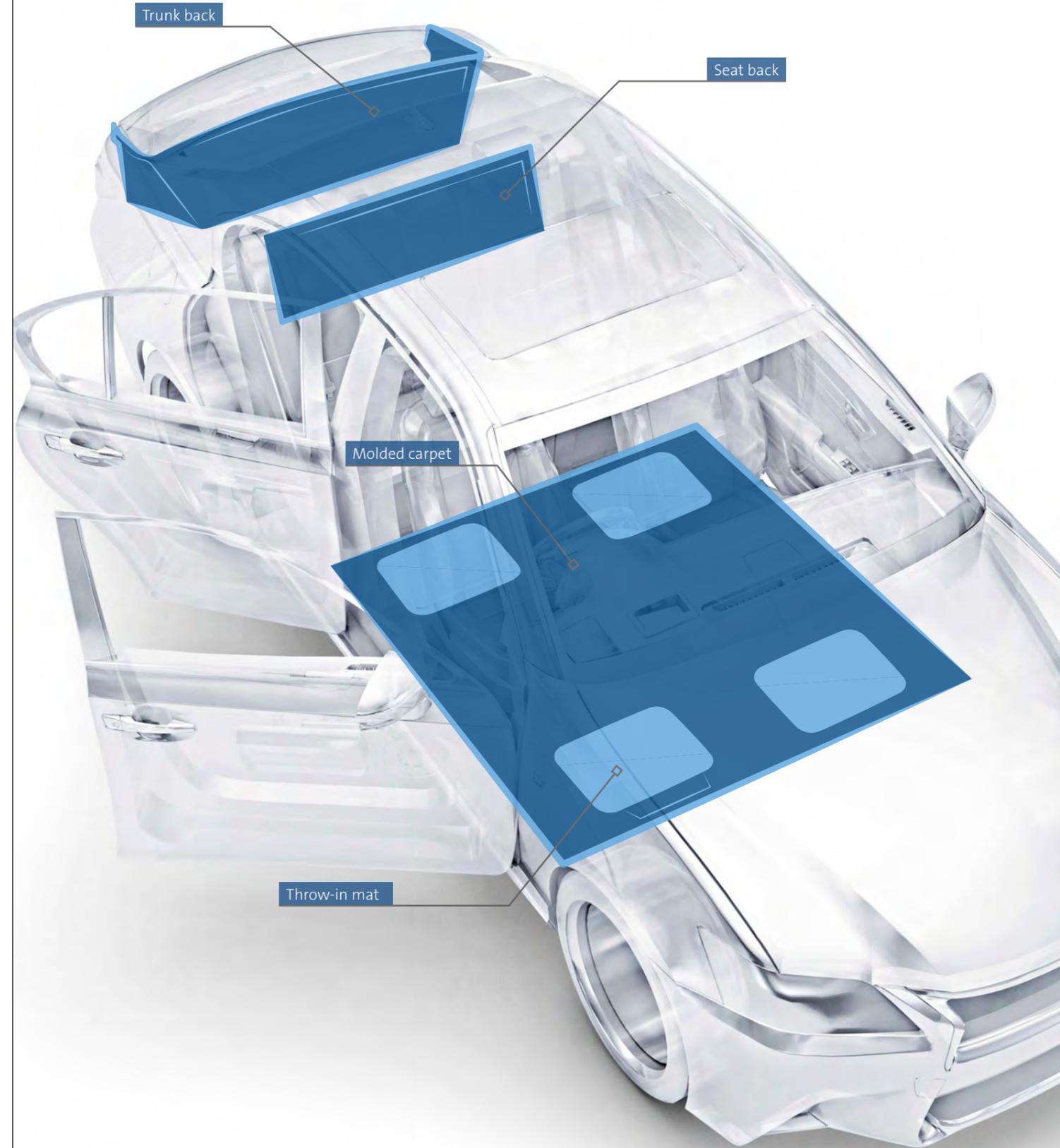
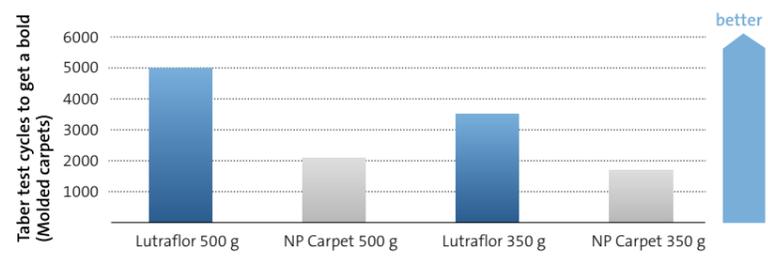
- Lightweight solution contributing to compliance with regulatory requirements
- Superior abrasion resistance
- Excellent molding characteristics
- Excellent mechanical properties
- Green product with improved sustainability (can be manufactured from recycled polyester and does not need latex and/or any chemical binders)
- Global support and service



Lutraflor technology – Abrasion resistance test



Taber test



THE LIGHTWEIGHT SOLUTION FOR MOLDED CARPETS

The proprietary nonwoven carpet material based on our Lutraflor technology



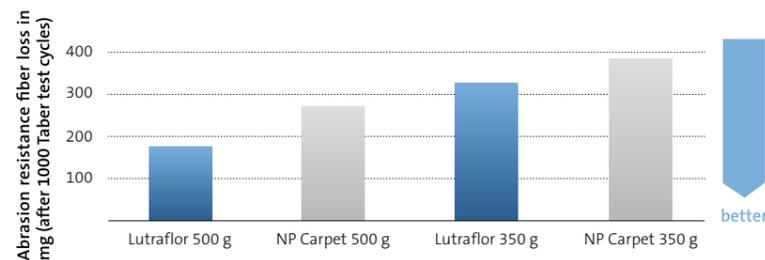
With nonwovens based on our Lutraflor technology we offer the perfect solution for automotive carpets, as well as other interior and trunk trims such as seat backs and back floors.

Freudenberg Performance Materials utilizes recycled materials and a state-of-the-art velour needling process for a luxurious appearance and excellent wear characteristics. Materials based on the Lutraflor technology are the preferred choice when it comes to modern automotive flooring applications. With balanced costs, reduced weight, improved performance and sustainability, our product is an advanced 100 % PET sandwich construction with a velourized staple fiber surface and a spunlaid fabric base with a luxurious appearance.

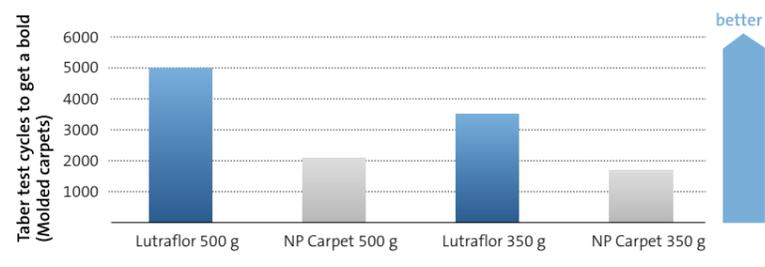
How customers benefit from our products:

- Lightweight solution contributing to compliance with regulatory requirements
- Superior abrasion resistance
- Excellent molding characteristics
- Excellent mechanical properties
- Green product with improved sustainability (can be manufactured from recycled polyester and does not need latex and/or any chemical binders)
- Global support and service

Lutraflor technology – Abrasion resistance test



Taber test



TOGETHER WITH OUR CUSTOMER WE DRIVE INNOVATION TO IMPROVE OUR PRODUCTS



Ecological Tuft Backings

Ecological primary backings from Freudenberg Performance Materials are fabricated from an eco-friendly and innovative spunlaid which contains up to 90 % of recycled polyester. With this sophisticated solution we deliver on our promise to cater for a sustainable market and provide our customers with high-performance products of exceptional quality.



Innovative nonwoven composite for molded underbody panels and wheel liners

Freudenberg Performance Materials has developed a unique multi-layer composite that provides improved performance for the underbody and wheel liner market. This new product offering convinces with improved durability, low-noise acoustical performance, abrasion, temperature and wear resistance, while enabling weight savings of 15 to 40 % compared to conventional products. The construction is 100 % recyclable and can be utilized in closed loop systems.



Ultra-thin nonwovens as battery separators

Lithium-ion batteries used in the automotive industry are particularly technically demanding. In these batteries separators play a key role. Freudenberg Performance Materials offers pioneering solutions for this application. Our separators consist of ultra-thin, ceramic-coated PET nonwovens that can significantly improve safety in battery cells and more.



High-tech nonwovens for fuel cells

Developed specifically for the pioneering fuel cell technology, gas diffusion layers (GDL) from Freudenberg Performance Materials are characterized by excellent quality standards and exceptional functional flexibility. Perfect management of reaction media optimized for all operation modes, high thermal and electric conductivity, optimum protection of the membrane against damage and very good processing properties are just a few of the features that characterize these advanced nonwovens.



ALWAYS A FEW STEPS AHEAD
WITH THE FREUDENBERG GROUP
INNOVATIONS NETWORK

INNOVATING TOGETHER

One of the main elements of the Freudenberg Group's corporate culture is coming up with new solutions and products for your long-term success. The automotive specialist from Freudenberg embodies this highly innovative spirit.

Globally linked Research & Development organization
Worldwide innovation process
More than 2,500 employees in Research & Development
Corporate basic research and development center



**“INNOVATIVE AUTOMOTIVE SOLUTIONS:
A STRONG PILLAR OF FREUDENBERG
PERFORMANCE MATERIALS.”**

FREUDENBERG PERFORMANCE MATERIALS

Our aim is to be a pioneer in the technological development of innovative materials and new production processes. With more than 3,800 employees in 14 countries, we rely on the experience of our global experts in providing our international customers with tailored solutions that add real value.

Our commitment to innovation and quality has made us a leading global manufacturer of technical textiles for a wide range of applications.

When it comes to high-end materials, we are the number one choice not only in the automotive industries. Freudenberg Performance Materials also provides innovative solutions for the apparel, hygiene, and medical sectors as well as for shoe components, filtration, and the field of technical applications.



FREUDENBERG

As a global technology group Freudenberg strives for pioneering solutions that support our customers and our society in a sustainable way. We use the knowledge of experts in some 60 countries to develop leading-edge solutions for over 30 different market segments. More than that, we are inspired by technology and innovation. Thanks to our technological materials and process expertise, we deliver lead-

ing-edge innovations that help ensure the ongoing success of our customers. We are leaders in our business segments. We provide products, solutions and services for mobility & transport, industry & manufacturing, energy & resources, household & textiles, healthcare & the food industry, and services.

Editorial Information

Freudenberg Performance Materials Holding SE & Co. KG
Höhnerweg 2–4
69469 Weinheim, Germany
Phone: +49 6201 80 0
automotive@freudenberg-pm.com
www.freudenberg-pm.com

Freudenberg Performance Materials LP
3500 Industrial Drive
27704 Durham, USA

Freudenberg Vliesstoffe SE & Co. KG
Liebigstraße 2-8
67661 Kaiserslautern, Germany

Freudenberg & Vilene Nonwovens Co. Ltd.
1588 Binhe Road Suzhou SND
215011 Suzhou, China

Korea Vilene Co. Ltd.
367-61 Cheongo-ro, Oseong-myeon,
Pyeongtaek-si, Gyeonggi-do, South Korea

Freudenberg Far Eastern Spunweb Co. Ltd.
38 Lun Din , Shi Hai Village 33751 Tayuan
Tao-Yuan, Taiwan

Freudenberg Nao-Tecidos Ltda. & Cia
Avenida Ademar Pereira de Barros,
1021 - Jardim Santa Maria
12328-300 Jacarei, Brazil

Item No. FPM AUTO 0616 0001EN