

ENERGY-EFFICIENT LIGHTWEIGHT SOLUTIONS

Railway Technology

Improving energy efficiency is a key challenge for today's railway industry. Armacell's flexible equipment insulation and sustainable foam cores for lightweight constructions can help to increase energy efficiency and passenger safety and comfort. Our solutions are used in rail vehicles all over the world, where they ensure safe and smooth operation.

Get on track to a greener tomorrow.

www.armacell.com



MEETING THE
HIGHEST
REQUIREMENTS



 **armacell**[®]
MAKING A DIFFERENCE AROUND THE WORLD

ABOUT ARMACELL

We are the inventors of flexible foams for equipment insulation and a leading provider of engineered foams. Our lightweight thermal, acoustic and mechanical solutions create sustainable value for our customers. Day in day out, our products significantly contribute to global energy efficiency and make a difference around the world. In meeting the challenges of megatrends, such as energy efficiency, lightweighting, the globalisation of food supplies and acoustic comfort, our product solutions stand out in terms of functionality and ease of installation.

3,100

employees worldwide
representing 70 different
nationalities

24

production facilities
in 16 countries on
4 continents

500

active patents



// Passionate

Dedicated and professionally-minded employees with an entrepreneurial spirit are our greatest asset. They share a common set of core values: customer experience, commitment, empowerment and accountability, integrity and sustainability.

Armacell.

Making a difference around the world.

SOLUTIONS ENABLING ENERGY SAVINGS.

// Innovative

We innovate in new technologies and focus on products that deliver superior technical performance. With our ArmaFlex® Rail products we presented the first closed-cell insulation materials to meet the highest requirements of EN 45545-2. Our most recent product launches include ArmaShape, the first PET-based particle foam and ArmaGel, the next-generation aerogel technology offering up to five times superior thermal performance than conventional insulation materials.



// Customer-centric

We create genuine value for our customers, value them as partners, and are committed to developing solutions tailored to their requirements. The outcome is added value for our business partners and, most significantly, energy savings and a longer working life for their critical equipment.

5
MILLION m³
OF INSULATION
PRODUCED PER
YEAR



// Sustainable

We dedicate our business activities to advancing and optimising energy efficiency for equipment and to closing the loop to achieve a more sustainable use of resources. Our ArmaFlex insulation saves 140 times more energy than is required for its production and prevents the emission of several million tonnes of CO₂ per year. Our ArmaForm® product portfolio is made entirely of recycled PET bottles and is 100 percent recyclable.

1,000,000,000
PET BOTTLES
RE-USED

OUR SOLUTIONS

ARMAFLEX RAIL ●

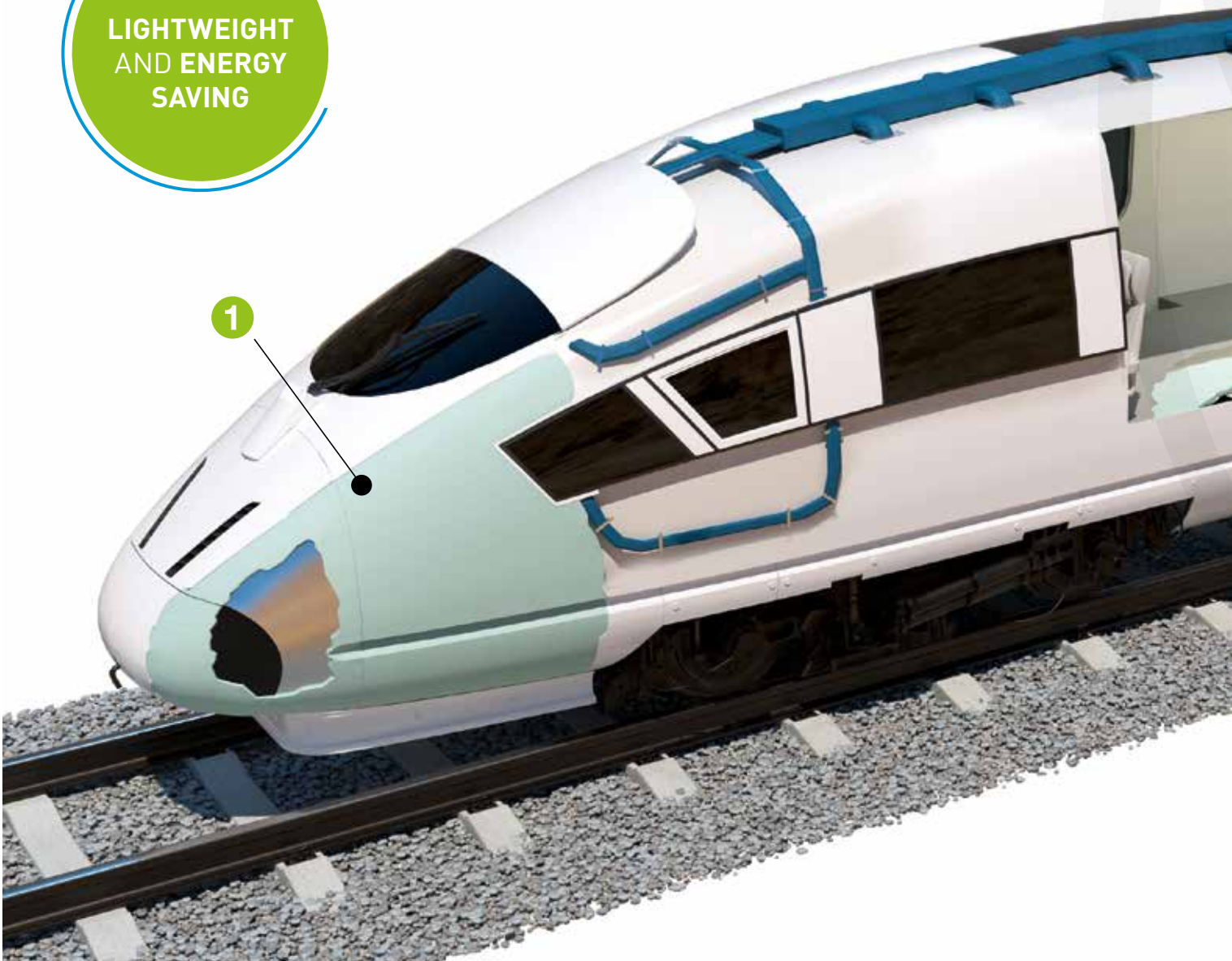
In rolling stock, heating, ventilation and air-conditioning (HVAC) equipment is the second largest energy consumer after the traction. Insulating this mechanical equipment with our **closed-cell and highly flexible ArmaFlex Rail products** is one of the simplest and most efficient measures to save energy in railway vehicles.

ARMAFORM CORES ●

Lightweight constructions offer enormous potential for weight savings in a wide range of rail applications. Innovative composite solutions which are based on our recyclable **ArmaForm core materials** can significantly reduce the weight – from the driver's cab, body shell and floor to doors, lavatory modules, compartment walls and tables.

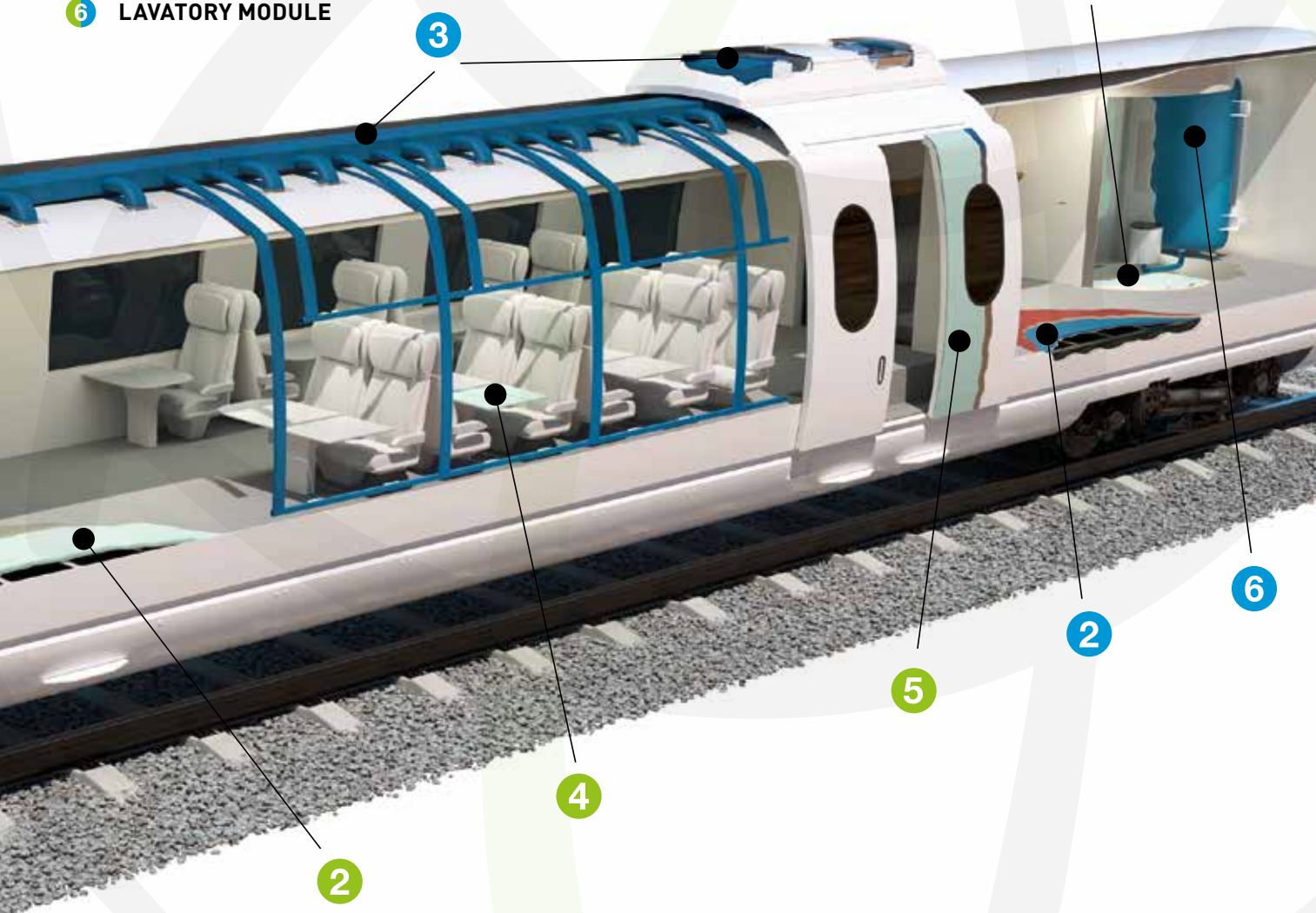
LIGHTWEIGHT
AND ENERGY
SAVING

1





- 1 FRONT END
- 2 FLOOR
- 3 HVAC
- 4 TABLES
- 5 DOORS
- 6 LAVATORY MODULE

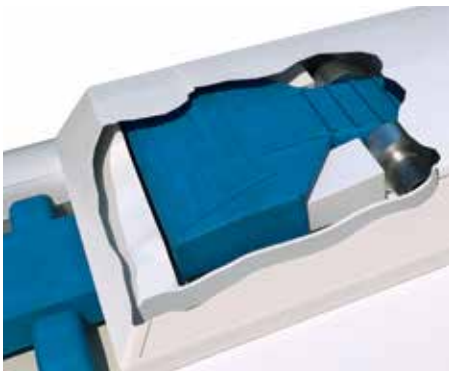


Rail is the most environmentally friendly mode of transportation. But increased comfort requirements, such as air conditioning, comfortable seats and tables, easily accessible lavatories and CET tanks have made trains heavier and more expensive to operate. To maintain its environmental advantage, energy efficiency has to be improved – without compromising passenger safety and comfort.



HVAC

Wherever energy is transported, part of the valuable resource gets lost when the equipment is not, or poorly, insulated. With HVAC equipment being the second largest energy consumer, insulation with our dedicated ArmaFlex Rail products offers enormous energy-saving potential. Our closed-cell material protects mechanical equipment against heat loss and condensation, and supports its long-term function.

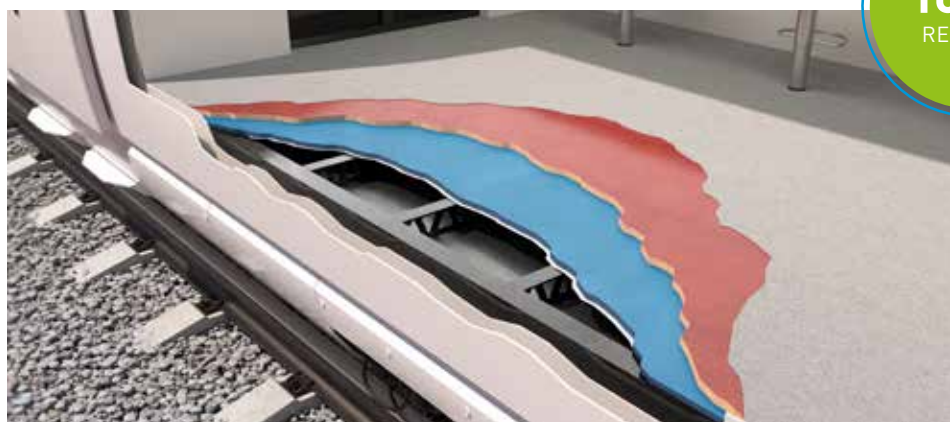


Our ArmaFlex Rail range includes halogen-free, Microban-protected and coated solutions and meets the requirements of EN 45545-2.



MORE
SAFETY
AND COMFORT
ON THE
TRACKS

Microban® technology provides protection against the development of harmful microbes such as bacteria, mould and mildew. The antimicrobial additives are integrated into the products during the manufacturing process and contribute to improved indoor air quality.



To prevent condensation in floor constructions our closed-cell ArmaFlex Rail forms a reliable vapour barrier and mitigates the risk of corrosion.

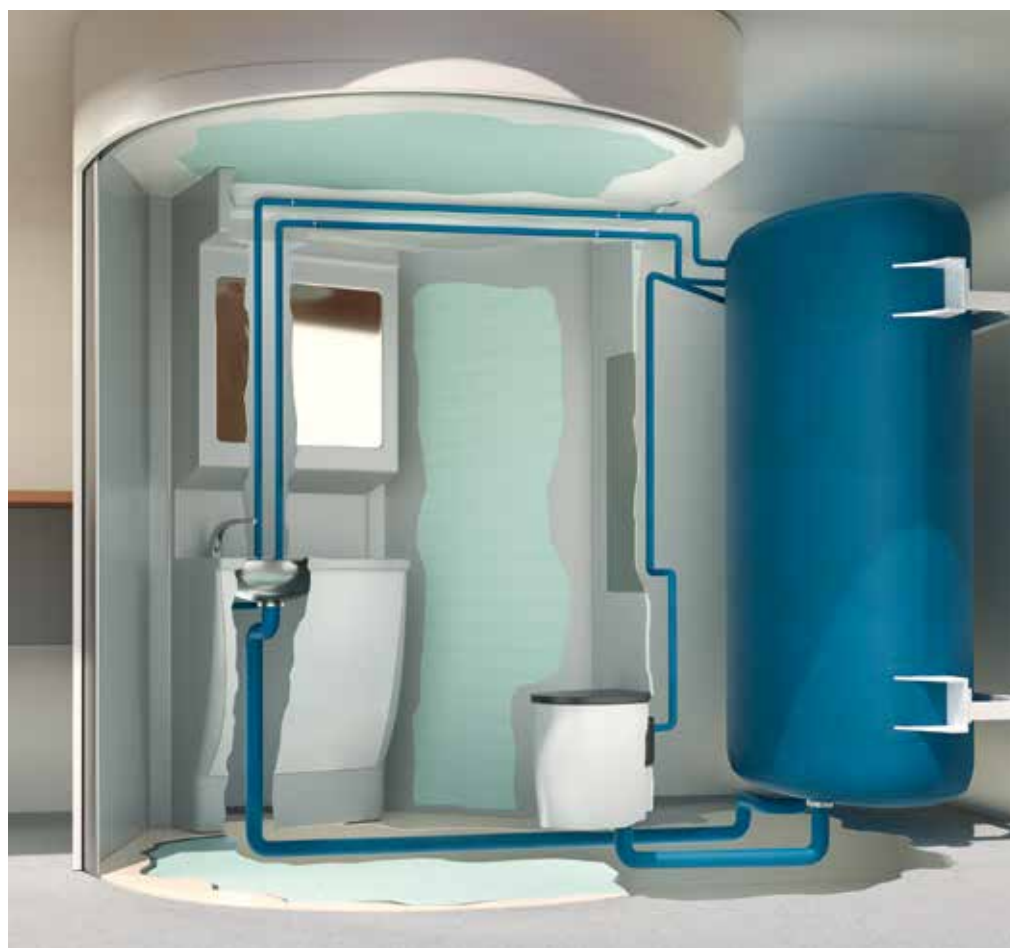


FLOOR

High strength, low weight, excellent fatigue, durability and insulation properties makes ArmaForm today's benchmark for a sustainable, 100 percent recyclable alternative to conventional materials in rail vehicle construction.

LAVATORY MODULE

Fresh water supply for washrooms, the on-board restaurant and the hygienic disposal of wastewater are taken for granted in modern trains. Our ArmaFlex Rail insulation protects hot and cold water pipes against unacceptable temperature fluctuations which can lead to a contamination with legionella bacteria. The dust- and fibre-free material prevents condensation and thermal losses and the Microban technology offers protection against the development of bacteria and mould. Sandwich constructions based on ArmaForm ensure low life-cycle costs and greater passenger comfort. The lavatory module is only one of many possible interior applications.



The lighter the train, the more energy-efficiently and cost-effectively it can be operated. Its unique properties our sustainable ArmaForm cores are the ideal material for designing structural and interior train parts.



DOORS

ArmaForm can be combined with metal, plastic, GRP or almost any kind of skins. Armacell's foam cores are fatigue-resistant, thermoformable and allow an unmatched versatility of manufacturing methods.



TABLES

In sandwich constructions our lightweight foam cores add stiffness and durability to the panel. They can be coated with a wide variety of materials, e.g. easy-to-clean skins. A solvent-resistant surface allows cleaning in line with the rail industry's high hygiene standards.



Thanks to its unique combination of weight-saving potential, environmental benefits and excellent mechanical and fire properties, ArmaForm is ideal for use in railway composite structures.



FRONT END

To reduce weight without compromising passenger safety composite materials must meet the stringent fire, smoke and toxicity requirements of the rail standard EN 45545-2. In combination with appropriate laminates, ArmaForm cored sandwich structures achieve the highest classification, HL3, R1 – which qualifies the material for use in all types of trains including metro, sleeper and couchette cars.

A high-speed train, primarily red and white, is shown in motion on a track. The background is a blurred city skyline with tall buildings under a clear blue sky. Overhead power lines and support structures are visible above the train. The overall scene conveys speed and modern transportation.

OUR INCREASINGLY CONNECTED,
BUSIER WORLD NEEDS
TRANSPORT THAT IS LIGHTER,
SAFER AND MORE RELIABLE
THAN EVER BEFORE.

By combining conventional engineering, new technologies and creative thinking, Armacell can deliver solutions that allow great ideas to come to life.



INDUSTRY-LEADING INSULATION SOLUTIONS FOR ROLLING STOCK

MOST
COST-EFFECTIVE
WAY TO SAVE
ENERGY



With our ArmaFlex Rail range we offer the first flexible closed-cell insulation with integrated fire protection for the international railway industry. All ArmaFlex Rail products meet the high requirements of the European fire protection standard EN 45545-2 and are the first to achieve the hazard levels HL2 and 3, R1. Our innovative system solutions for insulating refrigeration, heating, ventilation, air-conditioning and plumbing ensure more safety and comfort on the tracks. Our ArmaFlex Rail products have also been successfully installed to insulate body shell parts and doors and proven themselves as a reliable solution for rattle protection and vibration dampening in various application areas.

ARMAFLEX RAIL PRODUCTS AT A GLANCE



// ArmaFlex Rail SD

The first closed-cell insulation to achieve the **HL2**, R1 level. It is also classified under the national fire protection standards NFPA 130, GOST 12.1.044-89 and DIN 5510-2. Microban technology provides protection against harmful microbes and prevents the growth of mould and mildew.



// ArmaFlex Rail SD-C

Achieves **HL3**, R1, the most stringent hazard level. The product is equipped with a shiny, silver covering. The attractive surface is UV-resistant, protects the insulation against mechanical impact and is very easy to clean.

» Maximum reliability ensures cost-efficient continuous operation and long-term performance.«



Condensation control and improved indoor air quality

Our closed-cell insulation with low thermal conductivity and high resistance to water vapour transmission provides installations with reliable, long-term protection against energy loss and condensation. ArmaFlex Rail products have a 'built-in water vapour barrier'. Unlike conventional insulation materials which have to be protected against moisture penetration with a separate vapour barrier, in ArmaFlex the resistance to water vapour transmission is built up throughout the entire insulation thickness. Microban technology provides protection against the development of harmful microbes, such as bacteria and contributes to improved indoor air quality.

Neat and simple installation

No other insulation material can be installed as reliably, neatly, simply and as fast as ArmaFlex. Our great advantage in tight-fitting conditions is the high flexibility of our material. The homogenous, three-dimensionally linked structure allows the insulation to be cut neatly without the release of dust or fibres which could pose a health threat if breathed in. ArmaFlex Rail can be fitted simply even on complex equipment. Application times can be further reduced by using self-adhesive sheets. We offer a complete range of accessories, such as adhesives and cleaners, which have been developed especially for our products and tested as a system.

EASY TO
INSTALL



EXCELLENT FIRE
BEHAVIOUR



SPACE
SAVING



CONDENSATION
CONTROL



ENERGY
EFFICIENT



// ArmaFlex Rail ZH

The first halogen-free, closed-cell insulation to achieve the classification **HL2**, R1. Besides very good flame-retardant properties and low smoke density, it also minimises the risk of secondary damage. For example, halogen-free materials do not develop corrosive gases which can damage (electronic) equipment in a fire.



// ArmaFlex Rail ZH-C

Achieves the most stringent hazard level **HL3**, R1 and can be used in operating category 4 in underground track sections or tunnels.

Our ArmaFlex Rail range includes halogen-free, Microban-protected and coated solutions and meets the requirements of EN 45545-2.

DESIGNED FOR A CLEANER TOMORROW

SUSTAINABLE FOAM CORES FOR COMPOSITES

Made entirely of recycled PET bottles, ArmaForm is the benchmark for a sustainable, 100 percent recyclable alternative to legacy materials in rail vehicle construction. Thanks to its unique combination of weight-saving potential, environmental benefits and excellent mechanical and fire properties, it is predestined for the use in railway composite structures.



Today's train operators and manufacturers are challenged by the need for even lighter, more energy-efficient and environmentally friendly trains without compromising safety and durability. Composite sandwich constructions are increasingly used in the railway industry owing to their combination of low weight, high mechanical strength and long service life.

With outstanding product quality, a tremendous diversity of uses and truly sustainable production, ArmaForm offers you new perspectives for your business. It is the change in the core that changes your options.

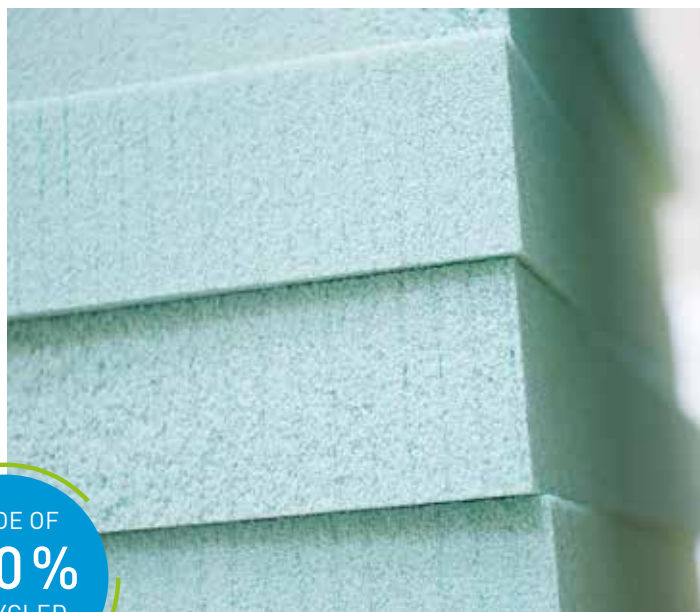


Truly green

ArmaForm is 100% made of recycled PET and can be 100% recycled after use. It requires less energy for its production than conventional foam core materials. Compared to PVC, our foam cores made of recycled PET deliver 52% savings on CO₂ emissions, and compared to polyurethane even 62%.

ArmaForm
Structural PET-based foam
core for railway composite
sandwich applications.

» Our lightweight solutions
for a more sustainable and
cost-effective rail industry. «



ARMAFORM PRODUCTS AT A GLANCE

// ArmaForm Core

Our structural foam core materials combine high strength with low weight, excellent fatigue and durability, superior temperature stability and excellent compatibility with most common resins and manufacturing methods. Beyond the mechanical properties of sandwich structures, the fire, smoke and toxicity performance according to EN 45545-2 is a top priority in public transport, even more so when trains operate underground or in tunnels. In combination with appropriate laminates, ArmaForm cored sandwich structures achieve the highest classification, HL3, R1 – which qualifies the material for use in all types of trains including metro, sleeper and couchette cars.

ArmaForm can be tailored to the different needs of various train composite applications. To improve impact and point load resistance while keeping the weight to a minimum, it is possible to combine different densities in one foam core. A combination of decreased weight and increased impact resistance is ideal for a number of train applications, e.g. floor and nose cone. Our low density foam for structural insulation panels combines structural integrity with stable long-term insulation for interior sandwich applications like doors, ceilings or partition walls.

// ArmaForm Foil

ArmaForm is the first fully recyclable and thermoformable thermoplastic foil product designed to provide a sustainable and superior alternative to cross-linked polyethylene (XLPE) and polypropylene (XLPP) products in thermoforming applications. Its improved stiffness and compression properties in combination with thermal and chemical stability differentiate ArmaForm from any other thermoplastic foil product currently available on the market today. Closed and fine cells provide a smooth surface structure for better processing, for example in lamination, die cutting and forming.



ArmaForm Foil
PET-based foil product
for thermoforming
applications.

LIGHTWEIGHT



LOW SMOKE AND
TOXICITY LEVEL



LONG-TERM
PERFORMANCE



LIFE-CYCLE
COST-EFFECTIVE



SUSTAINABLE



360°
SERVICE
SUPPORT

AT YOUR SERVICE

At Armacell, we are committed to creating an exceptional customer experience. We understand the challenges in today's railway industry and are here to help you complete your projects successfully. From planning to handover – our 360 degree service supports you throughout. By sharing know-how based on our extensive experience we strive to help you solve your unique project challenges. At Armacell, we do all we can to make sure your projects stay on track.

ARMACELL'S CUSTOMISED SOLUTIONS

Take the fast track and get your ArmaFlex Rail fittings trimmed by our professional waterjet-cutting technology. Just provide us with CAD or DXF files of the shapes you need and we will make prototypes. Our machines cut smooth, precise edges in any two- or three-dimensional shape. We provide full service cutting capabilities and can deliver your order in the amount and sequence you need to install it in the workshop.

Call us to discuss your specifications.



TAILOR-
MADE
INSULATION

ARMAFLEX APPLICATION TRAININGS

To ensure that our insulation materials are installed properly, Armacell has trained thousands of installers around the world. Special training centres have been set up at many locations and we also provide valuable support on site. Several thousand insulators attend courses on installing Armacell products every year and are awarded the ArmaFlex application certificate.

Valuable tips and tricks

Don't miss out on our application trainings. You will learn to install ArmaFlex more reliably and faster than you do today.



ARMWIN – PROFESSIONAL INSULATION CALCULATIONS

With our powerful ArmWin software you can carry out all common technical calculations in HVAC applications – even on the building site, thanks to the app. You can easily determine not only the minimum insulation thickness required for condensation control, but also surface temperature, heat flow, temperature changes in flowing and stationary media, freezing times for water pipes and the most economical insulation thicknesses, i.e. those with the shortest pay-back periods.

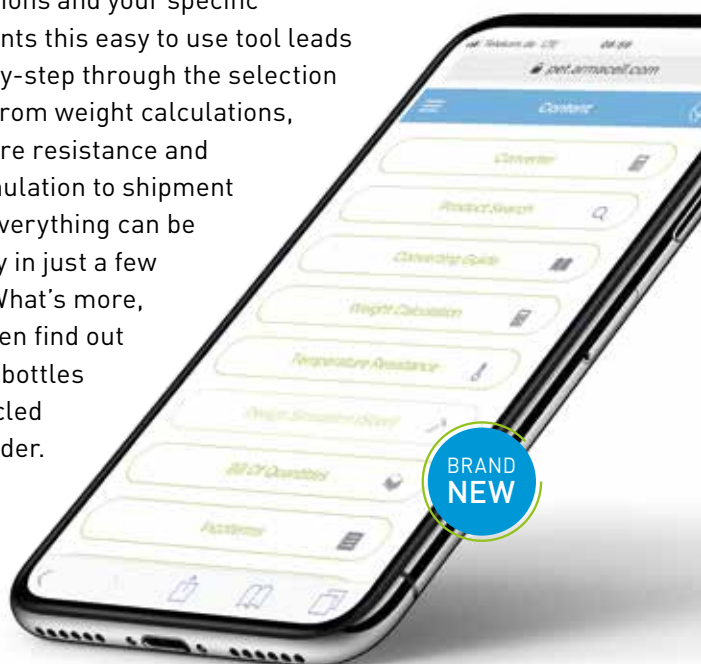


ArmWin

All technical insulation calculations in one tool.

ARMASELECT – COMPOSITE CORE SELECTION

With our new ArmaSelect tool the appropriate product for your sandwich construction is just a few clicks away. Based on mechanical considerations and your specific requirements this easy to use tool leads you step-by-step through the selection process. From weight calculations, temperature resistance and design simulation to shipment details – everything can be done easily in just a few minutes. What's more, you can even find out how many bottles were recycled for your order.



ArmaSelect

Easy specification of the appropriate core material for your project.

LONG-TERM EXPERIENCE IN RAILWAY TECHNOLOGY

With more than 50 years of experience in the railway industry, Armacell supplies technology you can rely on. We are experts in railway applications and our product range has been specifically designed to meet the special requirements of this industry.

At Armacell, safety comes first and maximum reliability is essential. We know the railway requirements and standards and offer global support. The European standard EN 45545-2 which came into force in 2013 and replaced all national standards in 2016 defines tighter requirements for the fire behaviour of materials and components.



The objectives of this standard are to minimise both the risk of a fire starting and spreading within railway vehicles and its effects on passengers and stuff. As a consequence, this provides the best level of protection against the occurrence of a fire on board.

WITH
ARMACELL
YOU'RE ALWAYS ON
THE SAFE SIDE



To achieve the highest possible level of safety in trains, both materials and components must meet strict fire, smoke and toxicity requirements. Depending on where they are used, materials are assigned to the categories R1 to R26 (R = Requirement Set).

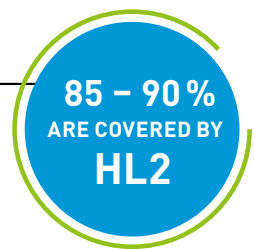
The various operating and design classes provide the basis for the hazard levels (HLs) which in turn define the requirements of the classification system. There are a total of three hazard levels (HL1 to HL3). HL3 is the highest level and thus makes the highest demands of the materials used.

- // As of April 2016 all national standards were replaced by EN 45545-2
- // All trains are now built according to new European law
- // Armacell's solutions for the railway industry can now be specified and installed throughout Europe

NATIONAL STANDARDS REPLACED BY EN 45545-2

Country	Standard	European Standard	Testing standard
Great Britain	BS 476-6/7	EN 45545-2	Spread of flame ISO 5658-2
France	NF 16 101 NF 16 102	Railway application	Heat release, smoke production and mass loss rate ISO 5660
Germany	DIN 5510	Fire protection on railway vehicles	Smoke optical density and toxicity EN ISO 5659-2
Italy	UNI CEI 11170		
Poland	PN-K-02511	Requirements for fire behaviour of materials and components	

TYPE OF VEHICLE AND OPERATION DETERMINE THE REQUIRED HAZARD LEVEL



	N: Standard vehicles	A: Vehicles of automatic train, no emergency trained staff on board	D: Double decked vehicles	S: Sleeping / couchette vehicles
1: No underground lines.	HL1	HL1	HL1	HL2
2: Regular use of underground sections and tunnels. Fast evacuation possible.	HL2	HL2	HL2	HL2
3: Regular use of underground sections and tunnels. Slow evacuation possible.	HL2	HL2	HL2	HL3
4: Regular use of underground sections and tunnels (incl. Euro-Tunnel). No evacuation possible.	HL3	HL3	HL3	HL3

HL1
e.g. tramway

HL2
e.g. TGV, TER,
RER, subway

HL3
e.g. subway,
metro, couchette
wagon

FIRE STANDARD
EN 45545 TAKES THE
FIRST PRINCIPLES INTO
CONSIDERATION

- Flame spread
- Ignitability
- Rate of heat release
- Smoke emissions
- Toxic gas emissions



CRH3A BULLET TRAIN

The CRH3A bullet train connects the cities of Chengdu and Xi'an in Western China, travelling the 700 km in less than four hours and transporting passengers at speeds of up to 250 km/h. ArmaForm was selected as a lightweight structural core material for the train's nose as a result of its thermoformability, fatigue resistance and process versatility. The success of the CRH3A has put an end to flights between the two cities, reducing the carbon footprint on this route.


 TRACK
RECORD

TRAINS ALREADY RELYING ON OUR SOLUTIONS

TO NAME JUST A FEW OF THE
SUCCESSFUL PROJECTS REALISED:

// **Bombardier**

Talent
Itino
Twindexx

// **Siemens**

Viaggio
Velaro
ICE

// **Stadler**

Flirt
Kiss
Smile

// **Alstom**

Coradia

// **Hitachi**

AT300
Caravaggio

// **CRRC**

Melbourne Metro
Switzerland Metro
Shanghai Metro
CRH3A bullet train

// **Kawasaki**

Taipei Metro

// **Taiwan Rolling Stock Co.,Ltd**

Taiwan Metro Danhai Line
Taiwan Railway

// **Hosue (Wabtec Group)**

Faiveley Transport

// **Integrated Coach Factory, Chennai**

Indian Railways

SMART SOLUTIONS FOR YOUR BUSINESS

Enjoy the benefits of our excellent customer service

All over the world, our customers rely on sales representatives, technical consultants and applications engineers.

Your project demands more. You deserve the best solution.

Get the original closed-cell insulation and lightweight foam cores from Armacell.

All data and technical information are based on results achieved under the specific conditions defined according to the testing standards referenced. It is the customer's responsibility to verify if the product is suitable for the intended application. The responsibility for professional and correct installation and compliance with relevant building regulations lies with the customer. Armacell takes every precaution to ensure the accuracy of the data provided in this document and all statements, technical information and recommendations contained within are believed to be correct at the time of publication. By ordering/receiving product you accept the **Armacell General Terms and Conditions of Sale** applicable in the region. Please request a copy if you have not received these. Microban® is a registered trademark of Microban Products Company.

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ABOUT ARMACELL

As the inventors of flexible foam for equipment insulation and a leading provider of engineered foams, Armacell develops innovative and safe thermal, acoustic and mechanical solutions that create sustainable value for its customers. Armacell's products significantly contribute to global energy efficiency making a difference around the world every day. With 3,100 employees and 24 production plants in 16 countries, the company operates two main businesses, Advanced Insulation and Engineered Foams. Armacell focuses on insulation materials for technical equipment, high-performance foams for high-tech and lightweight applications and next generation aerogel blanket technology. For more information, please visit: www.armacell.com.

For product information, please visit:
www.armacell.eu | www.armacell-core-foams.com

 **armacell**[®]
MAKING A DIFFERENCE AROUND THE WORLD