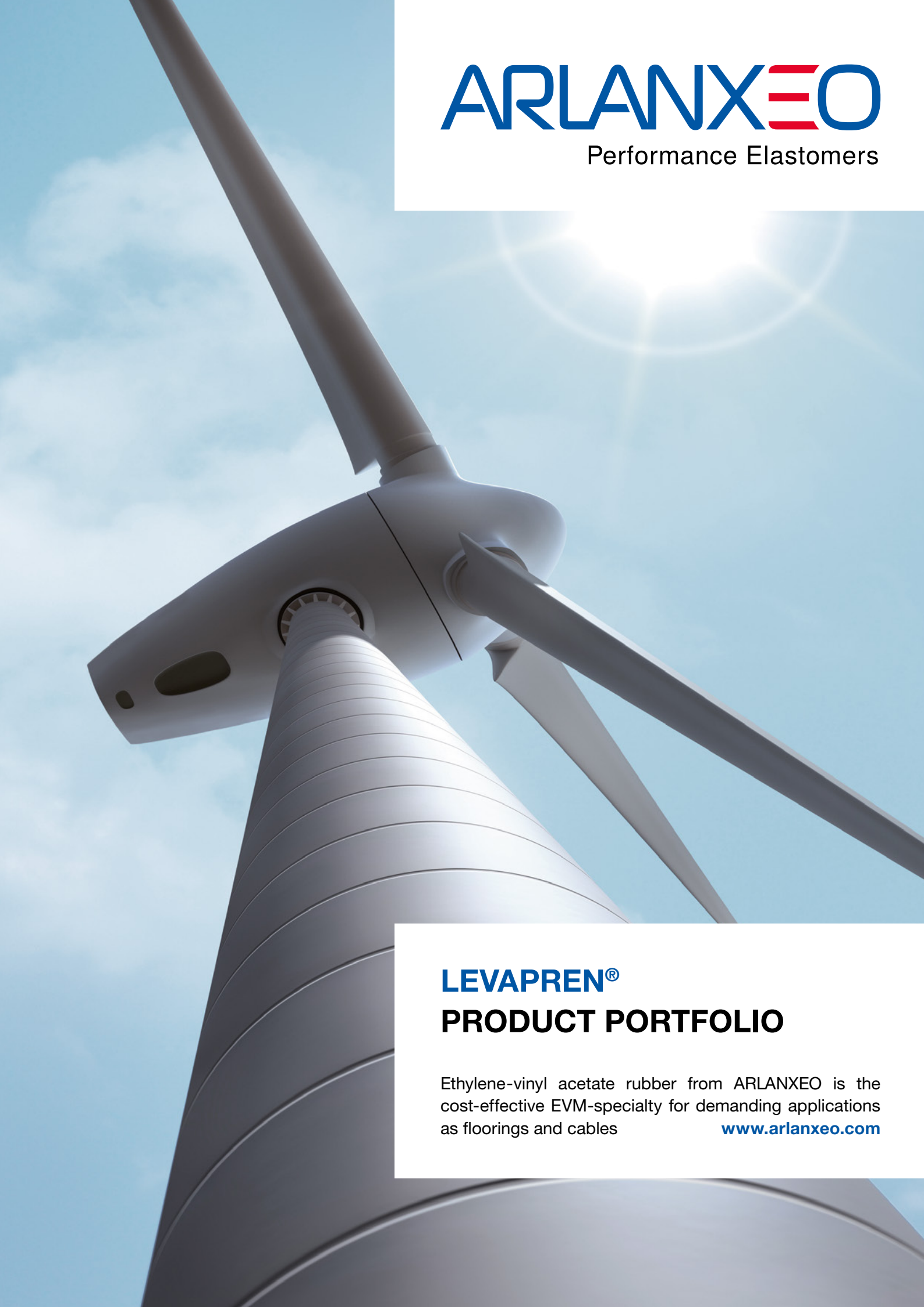


ARLANXEO

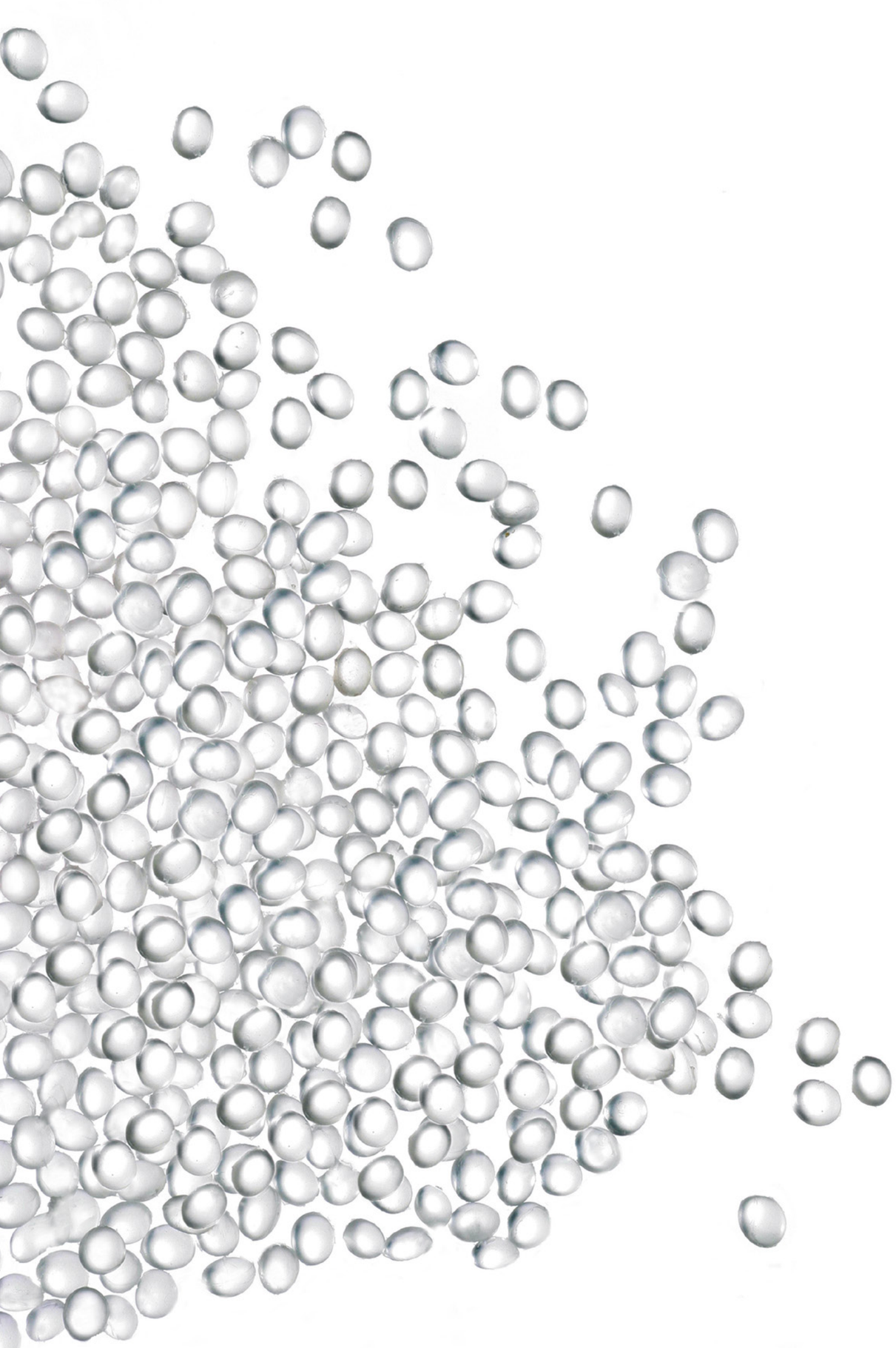
Performance Elastomers

LEVAPREN®

PRODUCT PORTFOLIO

Ethylene-vinyl acetate rubber from ARLANXEO is the cost-effective EVM-specialty for demanding applications as floorings and cables

www.arlanxeo.com



LEVAPREN®
PRODUCT PROPERTIES

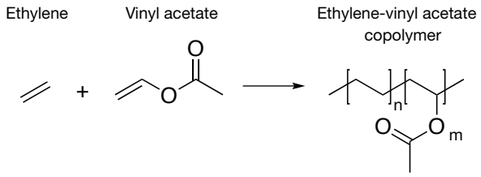
Levapren®

Polymer properties

ARLANXEO offers its customers a comprehensive range of synthetic rubber products, with specialties such as Levapren®. Whereever conventional polymers reach their limits, Levapren®, a polymer with very good heat and weathering resistance, is a suitable alternative.

Levapren® is produced by copolymerization of ethylene and vinyl acetate. In principle Levapren® consists of methylene units forming a saturated polymer backbone with pendant acetate groups. These rubber-like copolymers are designated ethylene-vinyl acetate copolymer (EVM)[1] according to ISO 1629:2015 (E) nomenclature. The presence of a fully saturated main chain already indicates that Levapren® is a particularly stable polymer. Degradation generally only occurs at very high temperatures and even then very slowly.

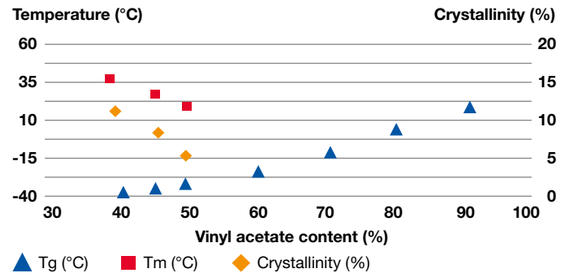
Chemical structure of Levapren®



Our ethylene-vinyl acetate copolymers are used as synthetic rubbers, or as modifiers in thermoplastics, specifically PVC. The adhesive raw materials are sold under the brand name Levamelt®. The main differences between the grades are the vinyl acetate content and the copolymer viscosity.

The general property profile of the copolymers produced from ethylene and vinyl acetate is determined in the first instance by the ratio of the two components. The reactivity of the two monomers is almost similar so that they are statistically distributed throughout the copolymer chain, which is perfect for rubber applications.

Influence of the VA-content on morphology



Tg = Glass transition temp Tm = Melting temp

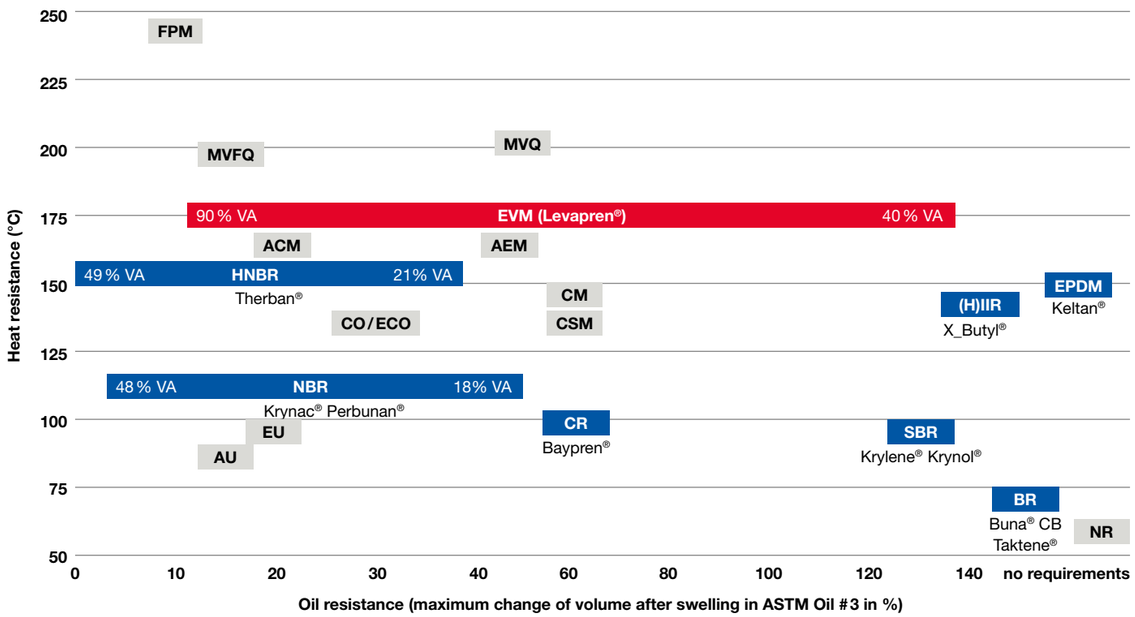
The higher the vinyl acetate content in the copolymer, the stronger the regularity of the ethylene chain is interrupted. Crystallization is reduced and becoming entirely absent at a vinyl acetate content of approx. 60 wt.%. Hence copolymers with a high vinyl acetate content are amorphous.

[1] In accordance with ISO 1043-1:2016, the abbreviation E/VAC is to be used for thermoplastics. The abbreviation EVA is also frequently used.

LEVAPREN®
VULCANIZATE PROPERTIES

Hot air and oil resistance

Classification of elastomers based on their hot air and oil resistance (in accordance with ASTM D 2000/SAE J 200)



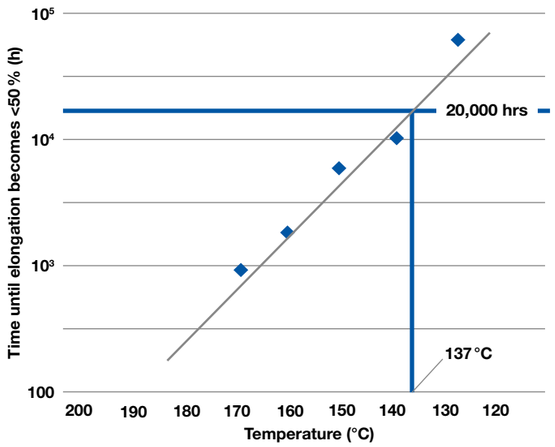
If properly compounded, Levapren® vulcanizates display excellent aging resistance and also continue to function over extended periods of stress at elevated temperatures. The heat resistance of Levapren® vulcanizates is considerably better compared to most other common elastomers.

The very good heat resistance is outperformed only by silicone rubber and fluoroelastomers and is equivalent to that of acrylate rubber.

The above figure shows how Levapren® can be classified in relation to other polymers. At 40 to 90 wt.% vinyl acetate content, Levapren® covers the range from low to very good oil resistance.

Well protected Levapren® vulcanizates can serve up to 1,000 hrs at 175 °C. Even over a period of 20,000 hrs Levapren® can withstand temperatures up to 137 °C.

Determination of heat resistance of Levapren® (in accordance with VDE 0304)



Halogen free and flame retardant non corrosive (FRNC)

Levapren® is the material of choice wherever flame retardancy has to be achieved. It features the advantages of being halogen free and of burning with non-corrosive emissions. Flame retardancy is achieved by adding high amounts of specialized fillers, such as aluminium hydroxide or magnesium hydroxide.

Based on laboratory flame tests, properly compounded Levapren® displays lower smoke evolution than competitive materials. Smoke evolution during an actual fire may impair visibility and obscure escape routes. By proper compounding FRNC materials complying even with DIN 4102/ Fire Class B1 can be produced.(1)

FRNC materials are particularly suitable for use in heavily frequented areas such as:

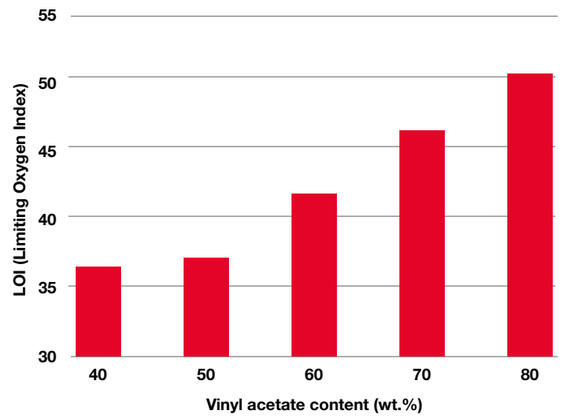
- department stores
- hospitals
- museums
- airports
- railway stations
- buses and trains

Additionally, disposal of old halogen free rubber products has less of an environmental impact.

The flame-retardant properties of Levapren® vulcanizates are not only affected by the amount and kind of filler in the compound, but also by the vinyl acetate content of the EVM grade used.

The higher the content of the vinyl acetate, the higher is the limiting oxygen index (LOI) of the resulting material and therefore the lower the flammability.

Effect of the VA content /aluminium hydroxide (ATH 190 phr) on the LOI



(1) Proper compounding assumed, flammability results are based on small-scale laboratory tests for purposes of relative comparison and are not intended to reflect the hazards presented by this or any other material under actual fire conditions.

LEVAPREN®
VULCANIZATE PROPERTIES

Weathering, UV and ozone resistance

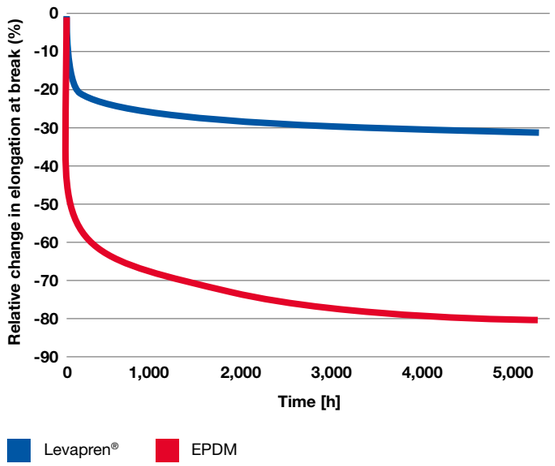
UV radiation, ozone, rain and industrial waste gases can significantly deteriorate the properties of elastomers. The effects are described according to their appearance as ozone cracking, crazing (non-oriented tear cracking), chalking, softening or hardening. Vulcanizates with light-colored fillers in particular are sensitive to these influences.

Levapren® vulcanizates show none of these effects after outdoor weathering tests conducted over a 2-year period. The samples were still useable at the end of the trial.

Similar positive results were obtained in the laboratory after trials involving UV radiation in a xenon tester.

A light-colored Levapren®-based FRNC compound was protected with 10 phr titanium dioxide and 1 phr UV stabilizer. The changes in elongation at break are depicted in the next figure and are compared with the values obtained from a similar compound based on EPDM showing a clear advantage for Levapren®.

Xenon Test DIN 53387:
Relative change of elongation at break (%)



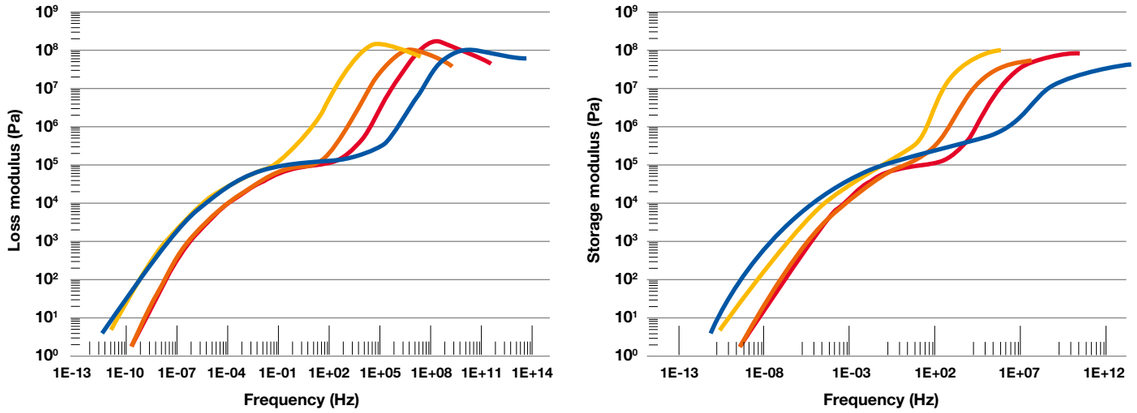
Colored profiles

Mechanical and dynamic mechanical properties

The high VA content Levapren® grades (Levapren® 800 and Levapren® 900) provide high damping at room temperature whereas the low VA content grades (Levapren® 400 and Levapren® 500) show an extremely elastic behavior.

Different Levapren® grades can be blended, thus delivering an elegant way to produce materials with tailor-made dynamic mechanical properties.

Frequency dependance of the complex shear moduli at 20 °C of raw polymers (Mettler DMA/STDA861e and Rheometer Physica MCR300)



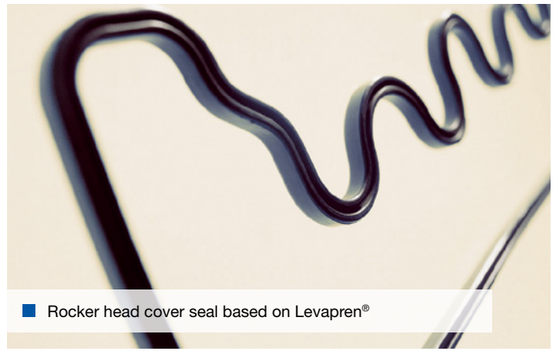
LEVAPREN®
APPLICATIONS

The Levapren® product range consists of rubbers that can cope with the continuously more demanding requirements for:

- automotive
- machinery
- building / construction
- wire and cable
- sporting goods

Seals

Due to its long-term heat stability and its good resistance to automotive fluids, Levapren® is used in seals, e. g., for rocker head covers.



Rocker head cover seal based on Levapren®

Hoses

Levapren® is used as base material for flame-retardant and chlorine-free hose covers like in the fuel hoses for AUDI produced by Veritas.

At home under the hood: fuel hose cover made of high performance EVM Levapren®

Cables

The high flame resistance of Levapren®-sheeted cables is one of the reasons for the great success of this EVM brand of ARLANXEO.

Whereever flame retardance has to be achieved: Levapren®

Floorings

Floorings based on Levapren® can not only fulfill FRNC requirements(1), they also give benefits like good resistance to wear, abrasion, ozone, weathering and they offer outstanding color stability.

Floor coverings made of Levapren®

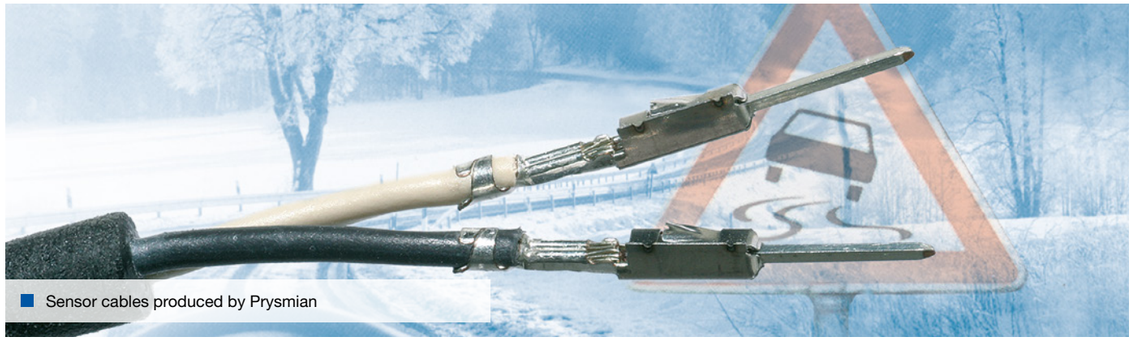
(1) Proper compounding assumed, flammability results are based on smallscale laboratory tests for purposes of relative comparison and are not intended to reflect the hazards presented by this or any other material under actual fire conditions.

(2) Vitroflex® is a registered trademark of ContiTech AG

Sensor cables

Due to its unique polymerization process, the molecular weight distribution of Levapren® is in particular wide. The gel-free product has a positive effect on the processability of the material and the quality of the end product such as the sensor cables produced by Prysmian. Gel particles would impact the function of the cables and therefore cause safety problems.

For instance, Levapren® vulcanizates satisfy the stringent requirements of such applications in terms of thermal stability, flame retardancy, and good resistance to ozone, UV light and industrial waste gases.



Sensor cables produced by Prysmian

Cables

Due to the high flame retardancy and the heat and chemical resistance of FRNC Levapren® vulcanizates, cables are one of the key applications of Levapren®. Many cables in buildings, ships and mass transit or rolling stock are made of FRNC Levapren® compounds.

FRNC Levapren® vulcanizates are used in high-speed trains

Translucent articles

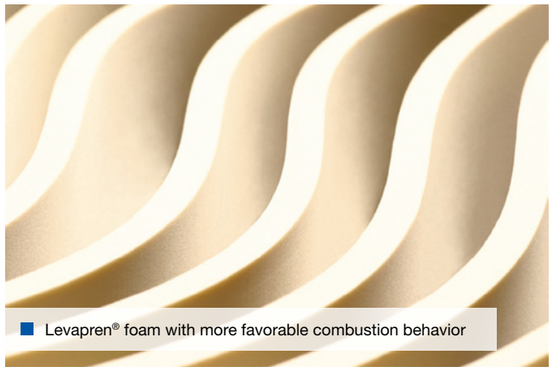
Flexibility in design without compromising in properties is one of the common challenges in the industry. Levapren® enables designers to create translucent articles with very good weather and UV resistance which in most cases can only be achieved with carbon-black-filled rubber articles. Reinforced with glass fibers, this material, called Vitroflex®, is used, for example, for the flex bellows in buses, allowing more light to pass inside.

Vitroflex®(2) made of Levapren® (© ContiTech AG)

LEVAPREN®
APPLICATIONS

Foams

Interep produces foams out of Levapren® which are formulated for more favorable combustion behavior than competitive materials. These foams are used in many applications where human safety has highest priority or where significant material assets exist. Typical applications are in ships, railways and buses.



Levapren® foam with more favorable combustion behavior

LEVAPREN®
SUPPLY FORM

The numbers of the Levapren® nomenclature are used to differentiate the grades. The first two digits indicate the vinyl acetate content. Trial products are designated VP (VP = Versuchsprodukt in German). Some products are precrosslinked in a controlled manner in an additional process stage (XL and PXL grades).

Levapren® is dispatched as almost colorless granules in 25 kg bags or big bags on pellets. The polyethylene (PE) based bags should always be removed.

Storage conditions:
Store under moderate temperatures and dry conditions in original packaging. Avoid exposure to the light. Do not stack pallets/boxes at storage. The temperature for storage shall not exceed +40°C and only if flowability of the granules is no keyfactor. Keep storage to a minimum. Granules tends to block at temperatures above +25 °C if stored improperly. For this reason, the flowability of this product is explicitly not warranted. If flowability is an important keyfactor for your process, ask your ARLANXEO customer contact for other product solutions.

Shelf life:
36 month from date of production warranted under the above mentioned storage conditions.

LEVAPREN®
PRODUCT RANGE

Levapren®

Product range and typical properties

Product	Vinyl acetate content (weight in %)	Mooney Viscosity ML (1+4) 100 °C	Density (g/cm³)	Packaging
Levapren® 400	40 ± 1.5	20 ± 4	approx. 0.98	25 kg bags(1) on pallet, 1000 kg net
Levapren® 450	45 ± 1.5	20 ± 4	approx. 0.99	
Levapren® 500	50 ± 1.5	27 ± 4	approx. 1.00	
Levapren® 600	60 ± 1.5	27 ± 4	approx. 1.04	25 kg bags(1) in cardboard boxes on pallet, 1000 kg net
Levapren® 650 VP(2)	65 ± 2.0	27 ± 4	approx. 1.05	
Levapren® 700	70 ± 1.5	27 ± 4	approx. 1.07	
Levapren® 800	80 ± 2.0	28 ± 6	approx. 1.11	
Levapren® 900	90 ± 2.0	38 ± 6	approx. 1.15	
Trial products, precrosslinked				
Levapren® 500 XL VP(2)	50 ± 1.5	55 ± 10	approx. 1.00	25 kg polyethylene bags, in cardboard boxes on pallet, 750 kg net
Levapren® 600 XL VP(2)	60 ± 1.5	55 ± 10	approx. 1.04	
Levapren® 700 XL VP(2)	70 ± 1.5	60 ± 10	approx. 1.07	
Levapren® 800 XL VP(2)	80 ± 2.0	55 ± 10	approx. 1.11	
Levapren® 500 PXL VP(2)	50 ± 1.5	60 ± 5	approx. 1.00	25 kg polyethylene bags, in cardboard boxes on pallet, 1000 kg net
Levapren® 600 PXL VP(2)	60 ± 1.5	60 ± 5	approx. 1.04	
Levapren® 700 PXL VP(2)	70 ± 1.5	60 ± 5	approx. 1.07	
Levapren® 800 PXL VP(2)	80 ± 2.0	60 ± 5	approx. 1.11	

(1) film based on EVA-Copolymer resin, melting point 93 °C, film thickness 0.13 mm
(2) VP = Versuchsprodukt = trial product

FOR MORE INFORMATION
PLEASE CONTACT US

Make use of our experience

Inventing the future together
Research and development plays a key role at ARLANXEO. The High Performance Elastomers (HPE) business unit has research and technical centers with testing facilities on almost every continent. Whether you are looking for better compounding ideas or are thinking about developing a new product, our experts will be happy to support you.

For direct information, please contact our technical support service. Our Levapren® experts are looking forward to answering your questions.

Your contact to Levapren® experts

levapren@arlanxeo.com

Trial product:
(VP = Versuchsprodukt = trial product). The information contained herein is merely preliminary. Testing as to properties and applications is not final. Further information, including data which could change or add hazards with use, may be developed by the manufacturer, the user or a third-party institute. Such information may be needed to properly evaluate or use this product. Use is undertaken at the sole risk of the user.

Quality & Environmental Management:
Levapren® is produced under strict control regarding safety, environmental protection and quality. The whole supply chain, from production to customer service, is covered by ISO 9001 and ISO 14001 certification.

Product Safety:
Relevant safety data and references as well as the possibly necessary warning labels are to be found in the corresponding safety data sheets.

Food contact:
Information concerning FDA and BfR compliance can be obtained on request from the Health, Safety, Environment and Quality department (HSEQ) of ARLANXEO.

Health and Safety Information:
Appropriate literature has been assembled which provides information concerning the health and safety precautions that must be observed when handling the ARLANXEO products mentioned in this publication. For materials mentioned which are not ARLANXEO products, appropriate industrial hygiene and other safety precautions recommended by their manufacturers should be followed. Before working with any of these products, you must read and become familiar with the available information on their hazards, proper use and handling. This cannot be overemphasized. Information is available in several forms, e.g., material safety data sheets and product labels. Consult us through your ARLANXEO representative or the Health, Safety, Environment and Quality Department (HSEQ) of ARLANXEO.

Regulatory Compliance Information:
Some of the end uses of the products described in this publication must comply with applicable regulations, such as the FDA, BfR, NSF, USDA and CPSC. If you have any questions on the regulatory status of these products, contact your ARLANXEO representative.
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Therefore, it is imperative that you test our products, technical assistance and information to determine to your own satisfaction whether they are suitable for your intended uses and applications. This application-specific analysis must at least include testing to determine suitability from a technical as well as health, safety, and environmental standpoint. Such testing has not necessarily been done by us. Unless we otherwise agree in writing, all products are sold strictly pursuant to the terms of our standard conditions of sale, which can be found at the ARLANXEO homepage. All information and technical assistance is given without warranty or guarantee and is subject to change without notice. It is expressly understood and agreed that you assume and hereby expressly release us from all liability, in tort, contract or otherwise, incurred in connection with the use of our products, technical assistance and information.
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ARLANXEO
Performance Elastomers

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