




VULKOLLAN®

Vulkollan®

The Ultimate Elastomer





Covestro – a leader in material solutions

With sales of EUR 12.1 billion in fiscal 2017, a global workforce of around 16,200 (calculated as full-time equivalents) and 30 production sites worldwide, Covestro is among the world's largest polymer companies. Covestro's business activities are focused on manufacturing high-tech polymer materials and the development of innovative solutions for products used in many areas of daily life, e.g., in the automotive, construction, wood processing and furniture, electrical and electronics, sports and leisure, cosmetics and health industries.

In the Coatings, Adhesives, Specialties (CAS) segment, Covestro systematically develops and supplies aliphatic and aromatic isocyanates and their derivatives as well as polyurethane dispersions for coatings, adhesives, sealants and specialty products. The main application areas are in the automotive, transportation, infrastructure, construction, wood processing and furniture industries. New applications are also being developed in fields such as cosmetics, medical equipment, textiles, specialty films, elastomers and 3D printing products. Innovations are focused on enhancing efficiency, improving quality, boosting sustainability and environmental aspects such as reducing solvent content.

In the Polyurethanes (PUR) segment, Covestro offers a comprehensive range of raw materials for manufacturing rigid polyurethane foam for insulation purposes, soft polyurethane foam for applications such as upholstered furniture, mattresses and car seats, and high-strength, lightweight composites. Covestro has also developed a new polyurethane infusion resin for wind turbine blades with superior qualities to the widely used epoxy resins.

In the Polycarbonates (PCR) segment, Covestro develops and supplies products that set new standards in energy efficiency and safety, support the lightweighting trend, and allow greater design freedom. Important application areas include weight-saving solutions for the automotive industry, energy-efficient LED lighting, solid and multi-skin polycarbonate sheets for the construction industry, and medical equipment.

Performance where it's needed

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Polyester

Vulkollan® engineering material – premium performance that benefits you

Vulkollan® is a high-grade polyurethane elastomer based on raw materials from Covestro: Desmodur® 15 and special polyester polyols.

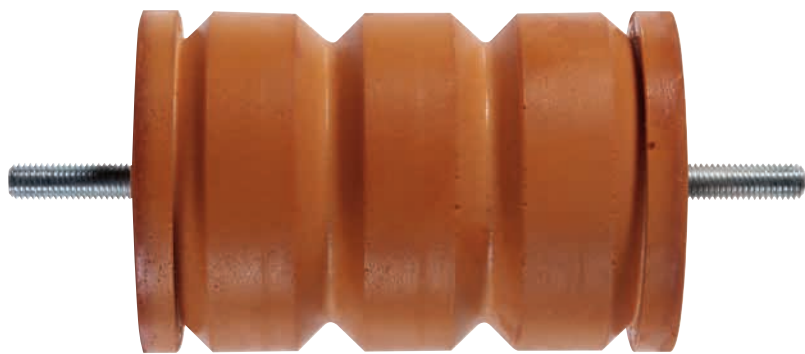
The rubber-elastic material boasts an highest mechanical and dynamic load-bearing capacity.

On the one hand, it's a classic, but on the other, it's one of the world's most modern plastics. First developed in the 1950s as an advancement of polyurethane (PU), invented by Otto Bayer in 1937, Vulkollan® quickly won over the industry. Users today can benefit from a wealth of experience with the hot-cast elastomer and take full advantage of its unique set of properties. Most worthy of mention in this connection are its extremely high mechanical strength and dynamic load-bearing capacity.

The right combination of critical properties makes solid and cellular Vulkollan® the materials of choice wherever numerous other candidates fail to make the grade. Even steel and rubber are increasingly being replaced by the elastomer.

Vulkollan® is produced on the processor's premises: certified manufacturers make molded parts from the raw materials. The formulations and manufacturing process parameters are determined by precise specifications defined in close cooperation with Covestro. This is an important prerequisite for maintaining the uniformly high level of quality of the engineering material, formulated in part on the basis of the isocyanate Desmodur® 15.

A success in many fields of application, Vulkollan® is often the best solution.



Vulkollan® – the ultimate elastomer

- Highest mechanical load-bearing characteristics
- Highest dynamic load-bearing capacity
- Made from Desmodur® 15

Solid Vulkollan® – pure resistance

Solid Vulkollan® really shows its strengths when it comes to heavy-duty tasks with peak loads. It is the engineering material of choice for many users whenever they need exceptionally high wear resistance and high mechanical strength.

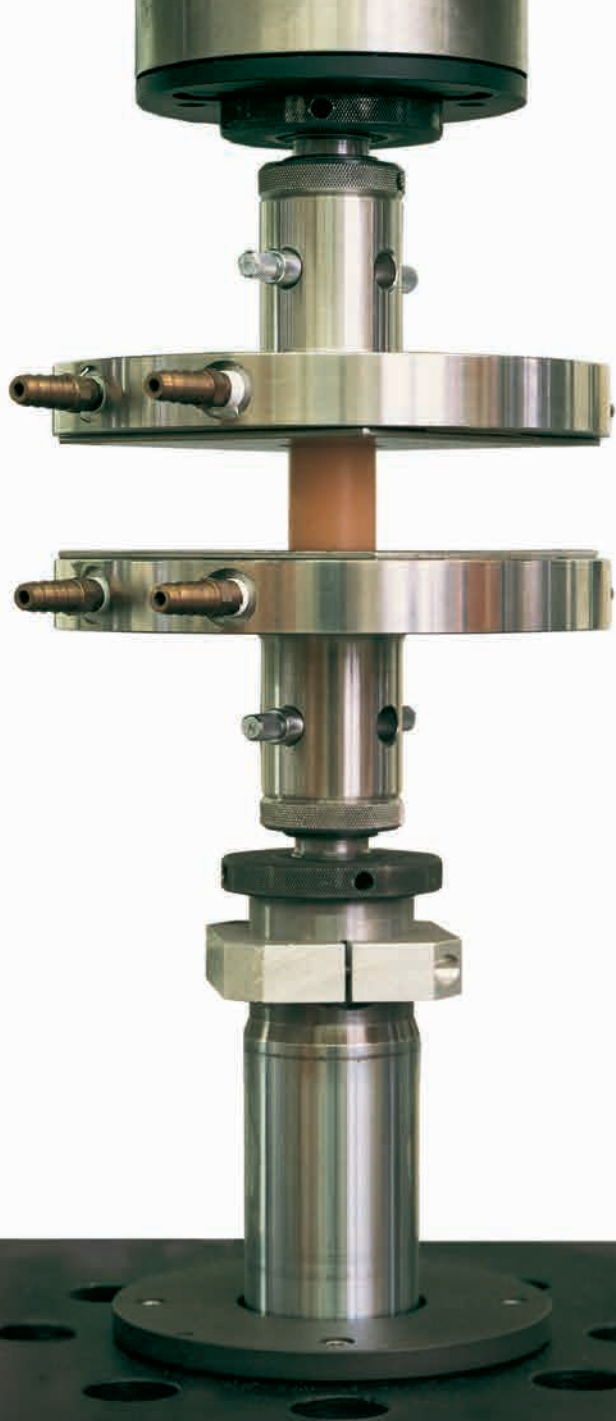


From the 2nd subbasement to the 78th floor at the press of a button
... and back down again. Elevators are on the move day and night, some of them running almost constantly. Guide rollers made of solid Vulkollan® guarantee passengers a high level of safety and a comfortable ride. Elevator manufacturers and building owners benefit from lower maintenance costs thanks to the high wear resistance of the rollers.

Heavy loads on quiet wheels
Cutting-edge goods supply systems call for increasingly efficient logistics centers, which in turn depend on forklifts and order-picking vehicles that can move heavy items quickly and reliably. Solid Vulkollan® wheel coverings enable such vehicles to achieve high travel speeds, offer a long service life and display outstanding elastic recovery.

Loop-the-loops at maximum G-force
The wheels on roller coasters are subjected to tremendous loads. Very strong forces act on them, some reaching several times gravity in the curves. Vulkollan® wheel coverings ensure long-lasting functional reliability. What's more, the high-tech material's elasticity promotes the quiet, smooth running of the wheels.





Optimal mechanical properties – top rankings in all disciplines

Vulkollan® has outstanding mechanical properties, including low abrasion loss, high tensile strength, excellent tear propagation resistance, as well as outstanding compressive deformation and rebound resilience.

Vulkollan® properties as a function of hardness

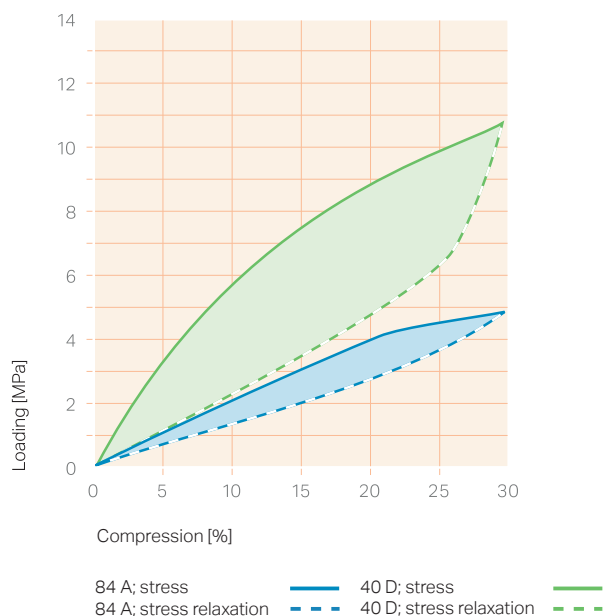
Mechanical properties	ISO test standard	Unit	Shore A/D hardness			
Shore A/D hardness	868		83/29	83/35	92/36	95/40
Density	1183	g/cm ³	1.26	1.26	1.26	1.2
Stress at 100% elongation	37	MPa	4.3	5.9	8.0	10.6
Stress at 300% elongation	37	MPa	7.8	10.4	12.8	15.8
Tensile strength	37	MPa	50	54	53	42
Elongation at break	37	%	660	700	740	692
Tear propagation resistance	34	kN/m	31	38	54	67
Rebound resilience	4662	%	65	64	62	61
Abrasion	4649	mm ³	37	32	28	26
Taber abrasion (S42/4.9 N)	9352	mg	3.5	4.0	6.1	7.5
Compression set	815					
70 h/23°C		%	8	9	10	14
24 h/70°C		%	18	19	19	20

High performance – low energy loss during deformation and high thermal stability

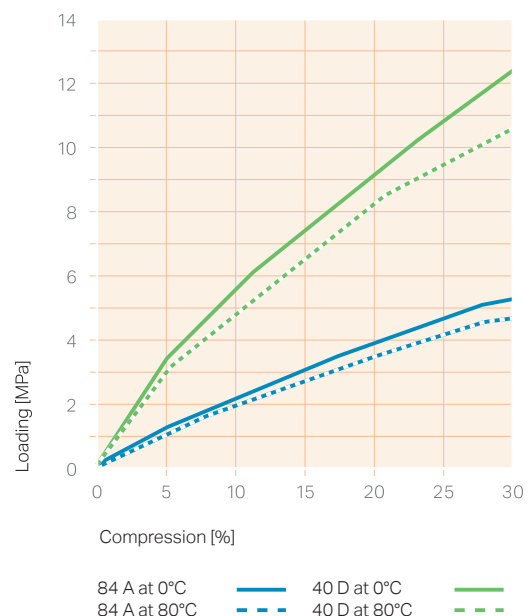
Compressive deformation at various temperatures

In compression testing, the stress application and removal curves for solid Vulkollan® are very close together, indicating very low energy losses. This is particularly advantageous in the case of repetitive and sustained dynamic loading.

Test conditions: Test specimen 29 mm Ø x 12.5 mm high
Deformation rate 10 mm/min
Temperature 23°C, measured after 3rd deformation



Test conditions: Test specimen 29 mm Ø x 12.5 mm high
Deformation rate 10 mm/min

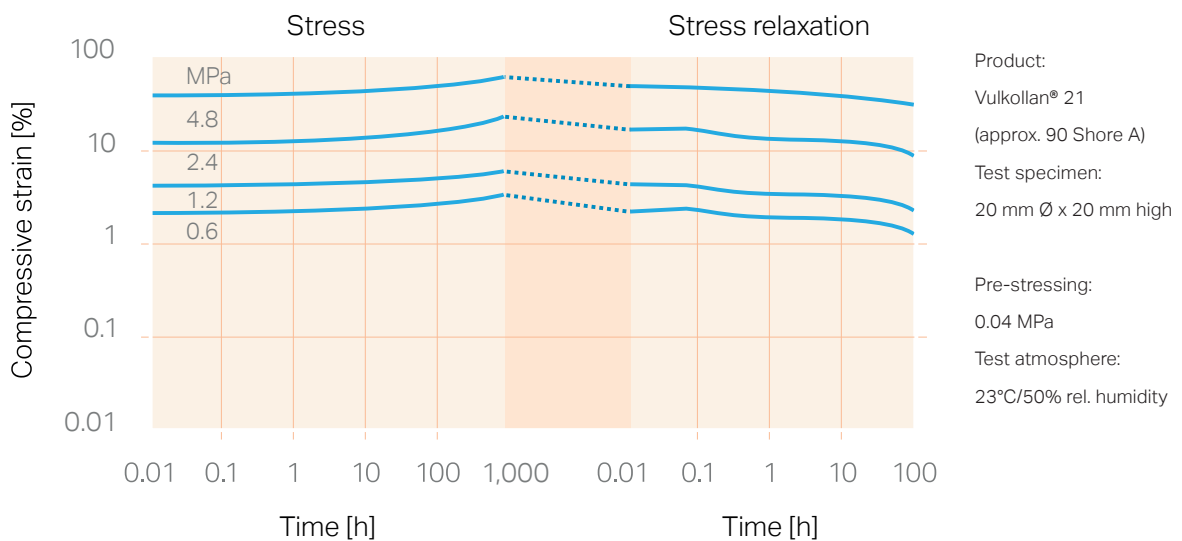


Long-lasting dimensional stability – good for wheels, rollers and seals

At higher deformation levels in elastomers, it is important to look at the material's set behavior as well as its spring characteristics. The compressive deformation performance of solid Vulkollan® exposed to sustained loading can be demonstrated by the compression creep test to DIN 53444.

At constant load, only slight permanent deformation occurs over time.

Therefore rollers and wheels made of Vulkollan® do not go flat even after long periods of inactivity, meaning the associated vehicles function without interruption. Seals made of the elastomer can do their job continuously because their elasticity remains constant over long periods of time.

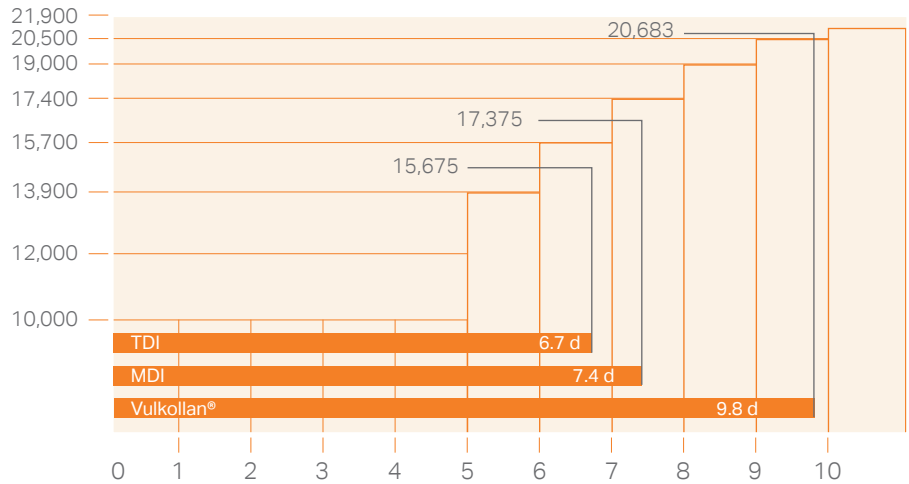


Impressive dynamics – top bench test results

In elastomer components subject to dynamic load, internal friction processes generate heat. This effect is particularly pronounced in the case of loads associated with high deformation or high frequency. Many elastomer materials sustain thermal damage as a result. In contrast, solid Vulkollan® can withstand extraordinarily high dynamic loads. This is the main reason why it is used to manufacture wheel coverings and suspension elements.

Test result (TÜV Munich) as mean failure load/failure time with gradually increasing load; 6 km/h test speed; wheel dimensions 250 x 130 mm

Contact force [N]

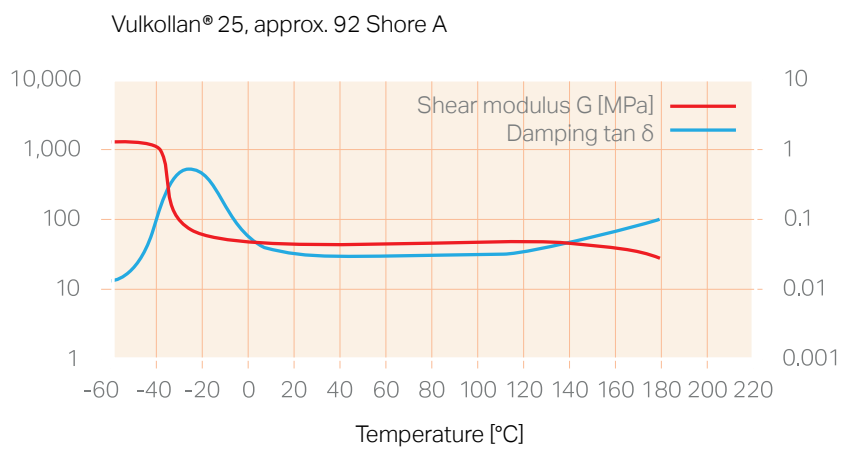


Time [d]

Roller test bench experiments support the quality testing of heavy-duty rollers and provide a wealth of other important data.

The quality of the elastomer itself, and the strength of the bond between the material and the metal, are carefully assessed.

Additionally, possible line loads can be evaluated at different speeds and cross-sectional geometries.



Solid Vulkollan® stiffens as the temperature drops (below -10°C). The glass transition temperature is approximately -40°C , but embrittlement only sets in at much lower temperatures.

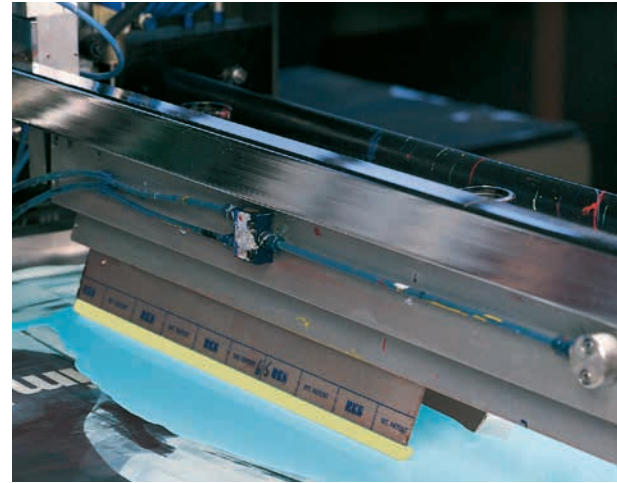
The shear modulus is virtually constant over a temperature range from approx. -10°C to $+120^{\circ}\text{C}$. In other words, consistent deformation behavior is seen across a very wide temperature range.



Solid Vulkollan® – peak performance in every application

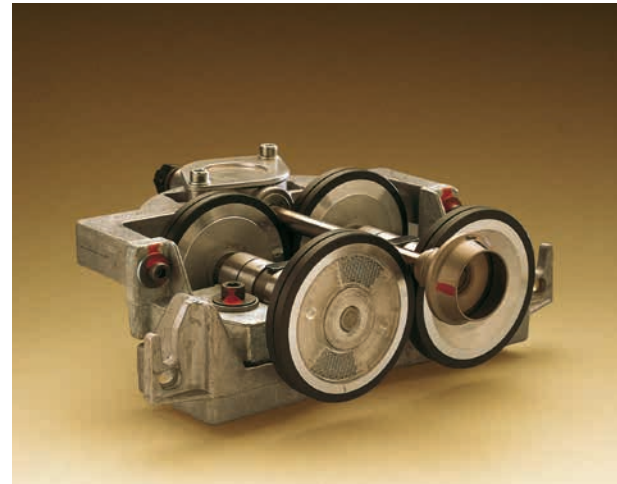
High dimensional stability

A screen printing doctor blade has to withstand quite a lot. It must demonstrate high resistance to solvent-induced swelling and outstanding dimensional stability for consistently superior printing results, even when handling long print runs. Furthermore, it must offer a long service life, so as to reduce blade changes and retouching to a minimum. Solid Vulkollan® is the material of choice for screen printing doctor blades: it contains no fillers or plasticizers, has a high shear modulus and displays only minimal permanent deformation.



High modulus of elasticity

Couplings are required to reliably transfer engine power. To do so, they must withstand high torques and acceleration, and be capable of balancing out axle angles and displacement. Solid Vulkollan® has just the right properties to act as a cushioning element or coupling disc in such applications: a high modulus of elasticity for optimal power transmission, the right degree of damping, high abrasion resistance and good resistance to grease and lubricants.



Handles heavy loads

When forklifts carry heavy loads, all the weight is transferred to the tires, so their coverings must be capable of withstanding high surface pressures over long periods. Solid Vulkollan® can easily handle these extreme conditions. It is characterized by outstanding mechanical load-bearing properties and dynamic load resistance, combined with impressive wear resistance and high tear resistance. Its low compression set prevents tires from flattening out, even after long periods of inactivity.





Cellular Vulkollan® – lasting dynamic properties for effective damping and shock absorption

For greater comfort and safety

The vehicle manufacturing industry faces rising comfort and safety requirements. From bicycles to cars and agricultural machinery, all demand innovative engineering solutions. In these applications, excellent quality and high cost-efficiency need not be contradictory. Cellular Vulkollan® meets all these requirements.

For greater cost-efficiency and a longer service life

Cellular Vulkollan® boasts outstanding dynamic properties and an impressive combination of high-quality and very consistent characteristics. It shows hardly any signs of fatigue under load, meaning that components made of the high-performance elastomer have a long service life and maintain their value. As a result, the consumption of raw materials in their manufacture is at very sustainable levels.

For space-saving designs

Cellular Vulkollan®, with its good mix of high-level material properties, offers an opportunity to design components of significantly smaller dimensions than is possible with other materials. With its good deformation behavior and thermal stability, this material is predestined for use in components that have to remain functional in the long term even in small spaces.

Vulkollan® – the ultimate elastomer

- Highest mechanical load-bearing characteristics
- Highest dynamic load-bearing capacity
- Made from Desmodur® 15

Cellular Vulkollan® – dimensional stability in all terrains

Cellular Vulkollan® is preferred over the solid version in applications requiring higher levels of deformability and lower compression hardness. In day-to-day operations, it is the compressive deformation properties that are of relevance.

The advantages of cellular Vulkollan® make it particularly well-suited to use in motor vehicles. For example, it is used to make auxiliary springs for low-cost linear steel springs, which are an economical alternative to expensive progressive steel springs. As well as being a solution to purely suspension-related problems, our elastomer is increasingly popular in many other fields of application, such as sound insulation, where Vulkollan® is proving to be very effective in decoupling vibrating components while vastly improving vibration damping.

Mechanical properties

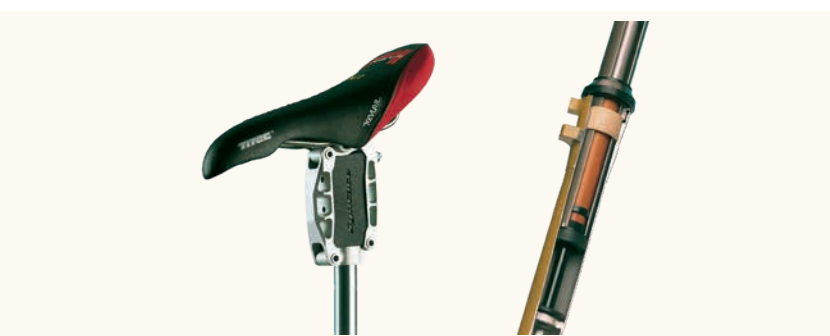
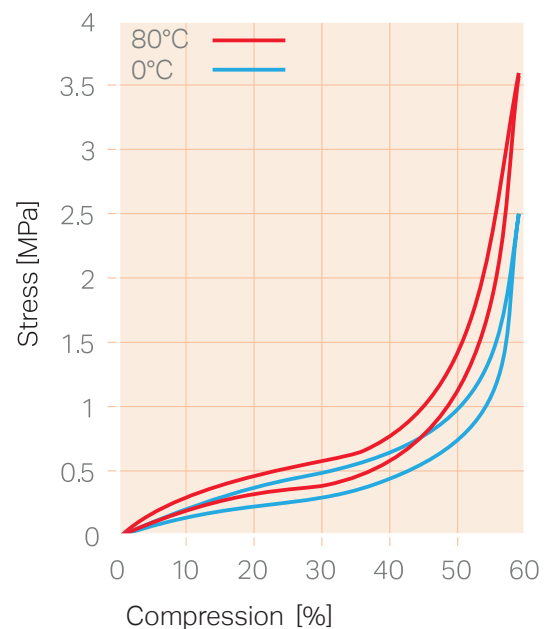
		Test standard				
Density	kg/m ³	ISO 845	350	450	550	650
Tensile strength	MPa	ISO 37	3.0	4.0	5.5	7.7
Elongation at break	%	ISO 37	400	400	400	400
Tear propagation resistance	kN/m	ISO 34	8	12	16	20
Rebound resilience	%	ISO 4662	60	60	60	60
Compression set		ISO 815				
70 h/23°C	%		3.0	3.0	3.0	3.0
24 h/70°C	%		10.0	7.5	8.0	9.0



Cyclists enjoy a particularly comfortable ride when telescopic forks and saddles are dampened with compressible cellular Vulkollan®. The smoothness of the ride is confirmed by the spring characteristics measured in tests of the material's damping behavior at various temperatures.

Determined during the upward and downward deflection phases, the curves describe an area whose size is a measure of the energy loss occurring during deformation. In suspension elements, the heat build-up over repeated load cycles remains very low, be it at 0°C or 80°C, as demonstrated by the low temperature dependence of the damping characteristics of cellular Vulkollan®.

Cellular Vulkollan® hysteresis curves at 0°C and at 80°C, density 505 kg/m³



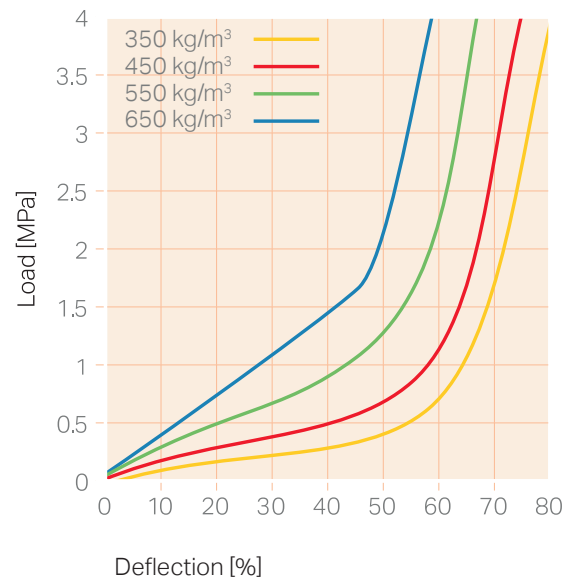
Design benefits – less space, less weight



Progressive spring characteristics:
The compressive deformation curves for cellular Vulkollan® demonstrate its typical progressive spring characteristics. Transverse expansion or “spreading” is very minimal.

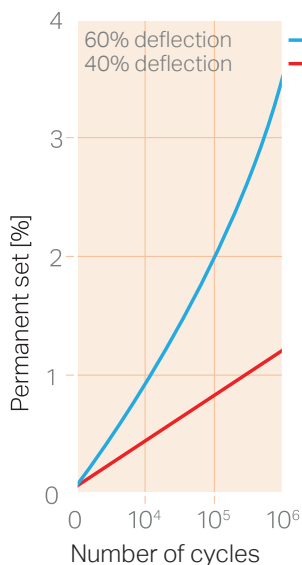
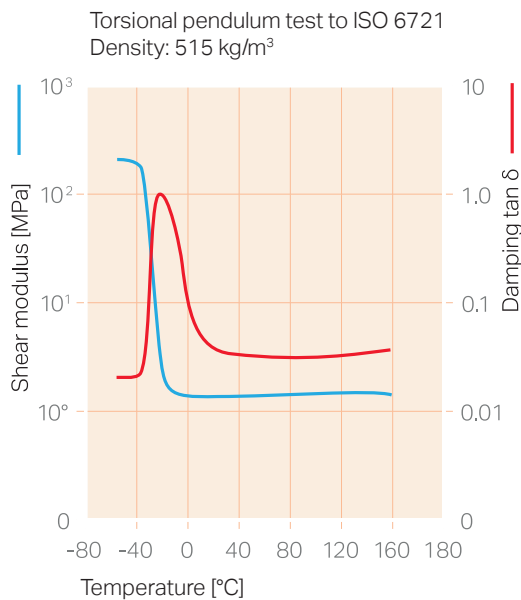
The engineering material therefore combines the high mechanical strength of solid elastomers with the compressibility of foamed plastics.

Load deflection as a function of density



The superior advantages of cellular Vulkollan® prove their worth in innumerable motor vehicles of virtually all makes around the world. One primary application is spring struts. Auxiliary springs made of cellular Vulkollan®, together with the shock absorbers and steel springs, are the main components responsible for ensuring that the struts can do their job continuously even in limited spaces and at such a low weight. The spring characteristics can be altered by varying the density of the auxiliary spring and its geometry.

Demands on vehicle comfort and noise damping likewise are on the rise. One highly effective way of tackling this challenge is to adopt designs that decouple the suspension from the body using damper bearings made of cellular Vulkollan®. The result is well-damped elastic resonance and a reduction in the transmission of structure-borne noise into the body and the vehicle interior.



The shear modulus of cellular Vulkollan® is virtually constant from -10°C to +120°C, meaning its deformation behavior is consistent over a wide range of temperatures, and that is a decisive criterion when it comes to material selection. Another benefit is the extraordinarily good low-temperature flexibility. Hardening does not set in until the temperature drops below -40°C. The maximum permissible working temperature is +80°C.

Brief and temporary exposure to +120°C is also permissible. The properties of cellular Vulkollan® change only gradually under sustained dynamic load. Whether at room temperature or at 80°C, the spring characteristics are always of the same order of magnitude. Even after 1 million compressions by 60%, permanent deformation is still only 3.5%!

Know-how is part of our service

With Vulkollan®, you are also putting our expertise to use. The Covestro Marketing team of highly qualified chemists, business professionals and technical specialists is happy to share their expertise and provide you with any advice or practical information you need. You can contact us at our headquarters in Leverkusen, Germany, and in many countries on all continents.

We look forward to partnering with you!

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For your notes

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