# Vulkollan® –
# Always a step ahead

Bayer MaterialScience

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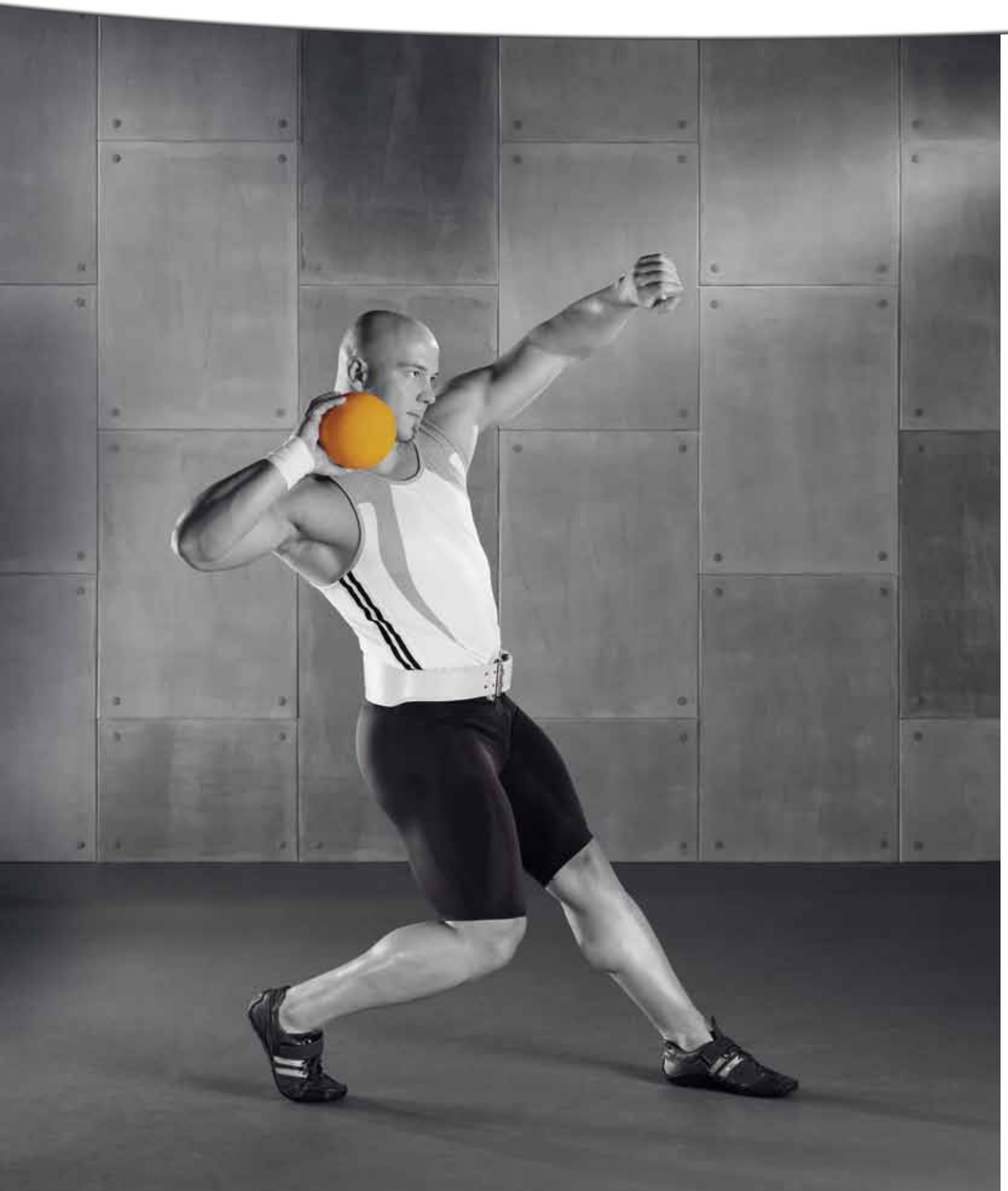
VULKOLLAN®

# Mit Vulkollan®
## Puts you in new territory



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# Vulkollan® – Benefit from one of the top-performing engineering materials

Vulkollan® is a high-grade polyurethane elastomer based on raw materials from Bayer MaterialScience: Desmodur® 15 and special polyester polyols. The rubber-elastic material boasts outstanding mechanical load-bearing properties and dynamic load resistance.

Vulkollan® is both a true classic and one of the most innovative plastics in the world. First developed in the 1950s from 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 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 Vulkollan®.

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 Bayer MaterialScience. This is an important prerequisite for maintaining a uniformly high level of quality in the engineering material, formulated in part on the basis of the isocyanate Desmodur® 15.

A success in many areas, Vulkollan® is often the best solution.

## Vulkollan® – The ultimate performance of an elastomer

- highest mechanical load-bearing properties
- optimum dynamic load-bearing capacity
- Made from Desmodur® 15

# Solid Vulkollan® –
## Make light work of heavy-duty tasks

**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 a multiple of the 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.

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

**From the 2nd to the 78th floor**
and 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.

Solid Vulkollan® really shows its strengths when it comes to heavy-duty tasks with peak loads. Whenever exceptionally high wear resistance and excellent mechanical strength are the order of the day, it is the engineering material of choice for many users.

# Optimal mechanical properties –
## Top scores in all disciplines

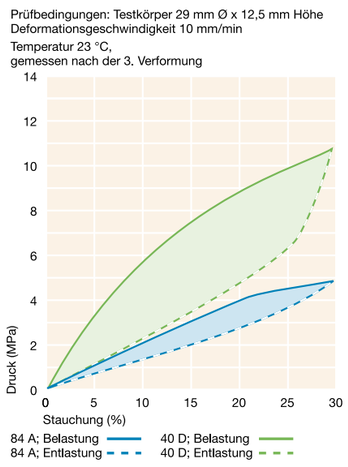
Vulkollan® has outstanding mechanical properties, including low abrasion loss, high tear resistance, excellent tear propagation resistance, as well as outstanding compressive deformation and rebound resilience.

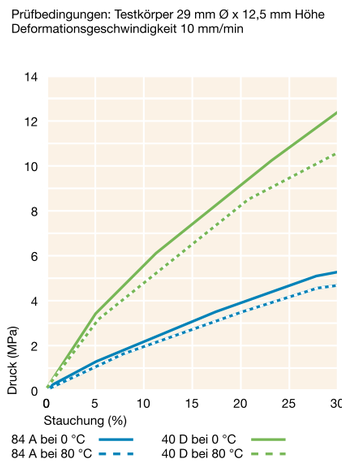
| Vulkollan® properties as a function of hardness 1 | | | | | | |
|---|---|---|---|---|---|---|
| **Mechanical properties** | **ISO test standard** | **Unit** | | **Shore A/D hardness** | | |
| | 868 | | 83/29 | 89/35 | 92/36 | 95/40 |
| Density | 1183 | $Mg/m^3$ | 1,26 | 1,26 | 1,26 | 1,26 |
| Stress at 100% elongation | 37 | MPa | 4,3 | 5, | 8,0 | 10,6 |
| Stress at 300% elongation | 37 | MPa | 7,8 | 10,4 | 12,8 | 15,8 |
| Tear resistance | 37 | MPa | 50 | 5,4 | 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 | | | | | |
| 70h / 23°C | | % | 8 | 9 | 10 | 14 |
| 24h / 70°C | | % | 18 | 19 | 19 | 20 |

# High-performance – Low energy loss during deformation and high thermal stability

## Compressive deformation at various temperatures

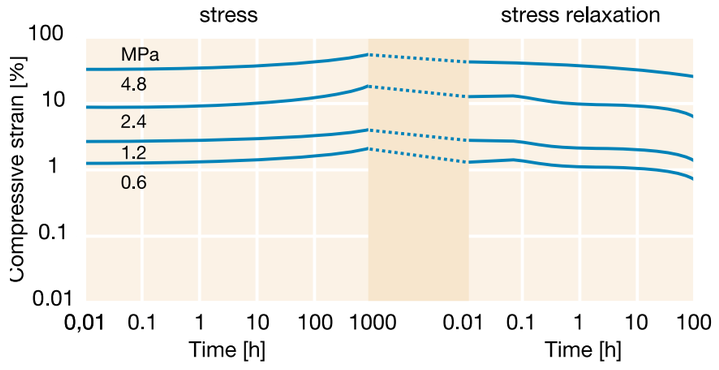
In a compression test, the stress application and removal curves for solid Vulkollan® are very close together, indicating very low energy losses. This is particularly advantageous in the case of repetitive and sustained dynamic loading.




## Consistently dimensionally stable – 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 hysteresis curve. The compressive deformation performance of solid Vulkollan® exposed to sustained loading can be demonstrated by the tensile creep test to DIN 53444. At constant load, only slight permanent deformation occurs over time. Rollers and wheels made of Vulkollan® therefore 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.




Product:
Vulkollan® 21
(approx. 90 Shore A)

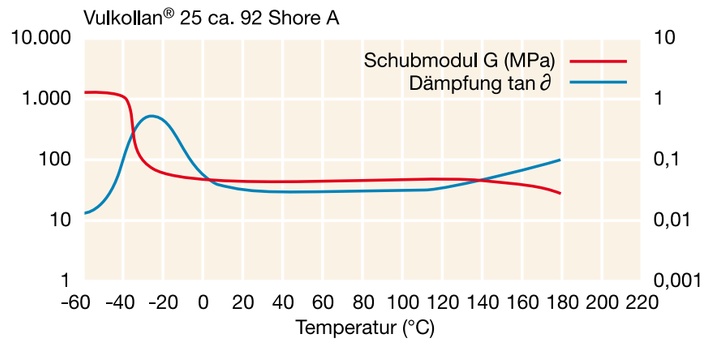
Specimen:
20 mm Ø x 20 mm high

Pre-stresssing:
0,04 MPa

Test atmosphere:
23 °C / 50% rel. humidity

# Impressive dynamics –
## Top test bench results

If elastomer components are subjected 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.




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

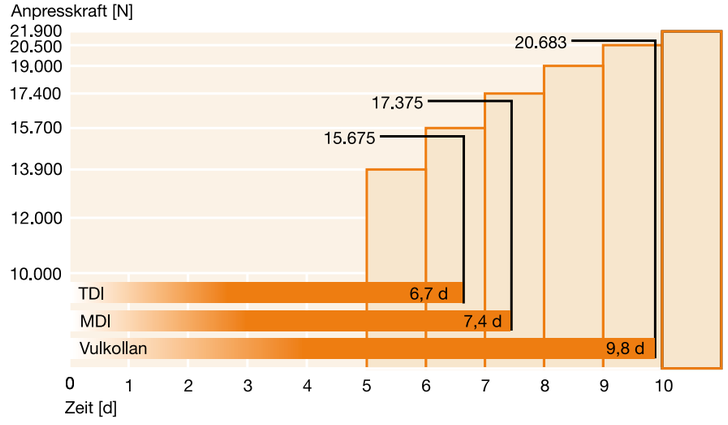
The shear modulus is virtually constant over a temperature range from approx. –10 °C to +120 °C. In other words, consistent deformation behavior is seen across a very wide temperature range.

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

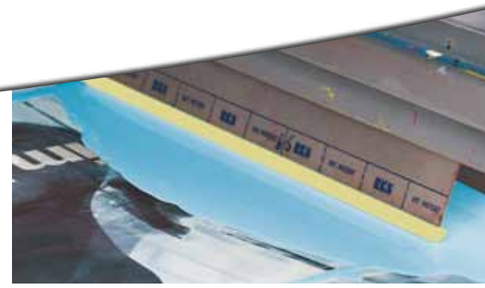
The quality of the elastomer itself, and the strength of the bond between the material and the metal, are carefully assessed.

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

**Prüfungsergebnis (TÜV München) als mittlere Bruchlast/Bruchzeit bei stufenweiser Lasterhöhung; 6 km/h Prüfgeschwindigkeit; Raddimensionen 250 x 130 mm**




# Solid Vulkollan® –
# Applications in peak form



### 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. Vulkollan® 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® –
## Effective damping and shock absorption

### For greater comfort and safety

The automotive 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 must 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 consistent characteristics. It shows hardly any signs of fatigue under load, meaning that components made of the performance elastomer have a long service life and maintain their value. As a result, the consumption of raw material in their manufacture is at very sustainable levels.

### For space-saving designs

With its good mix of high-level material properties, cellular Vulkollan® 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 must remain functional even in small spaces.

### Vulkollan® - The ultimate performance of an elastomer

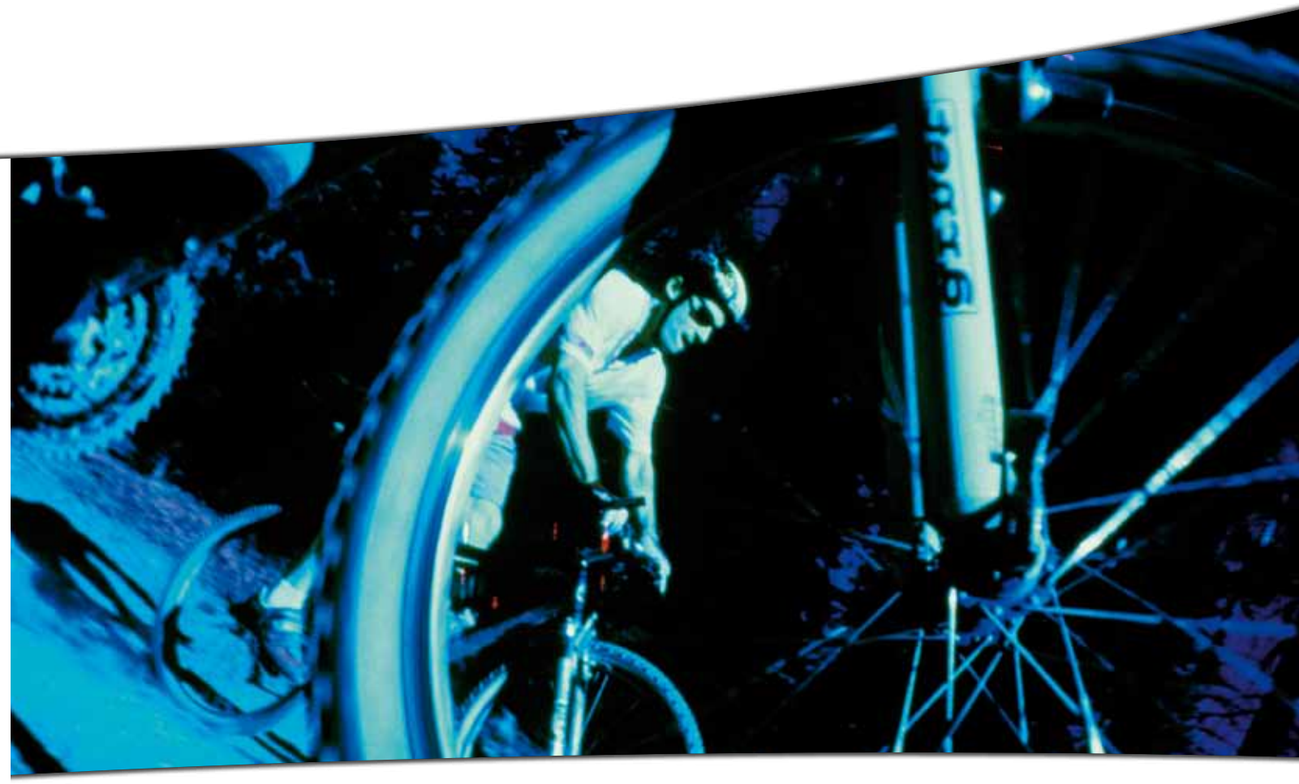
- highest mechanical load-bearing properties
- optimum dynamic load-bearing capacity
- Made from Desmodur® 15

# Cellular Vulkollan® –
## Outstanding dimensional stability

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.

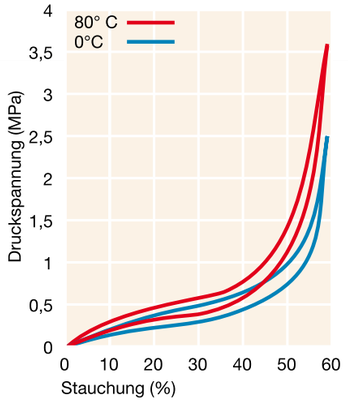
The advantages of cellular Vulkollan® make it particularly well suited to use in motor vehicles. For example, it is used to make auxiliary springs as well as being an excellent solution to suspension-related problems, cellular Vulkollan® is increasingly popular in many other areas, such as sound insulation, where Vulkollan® is proving to be very effective in decoupling vibrating components while vastly improving vibration damping.

| Mechanical properties | | | | | | |
|---|---|---|---|---|---|---|
| | | Test standard | | | | |
| Density | kg/m³ | ISO 845 | 350 | 450 | 550 | 650 |
| Tear resistance | MPa | ISO 37 | 3,0 | 4,0 | 5,5 | 7,0 |
| 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 | | | | |
| 70h / 23°C | % | | 3,0 | 3,0 | 3,0 | 3,0 |
| 24h / 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 hysteresis curves 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 amount of heat built-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 in cellular Vulkollan®.

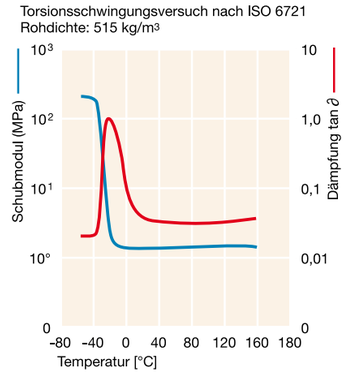
Zelliges Vulkollan Hysteresiskurven
bei 0° C und bei 80° C, RD 505 kg/m³



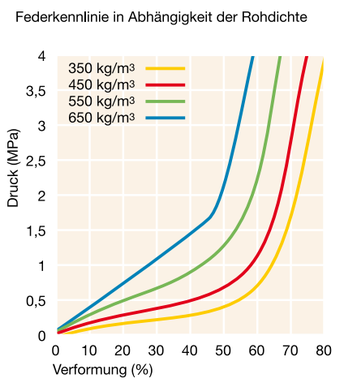

# Design advantages –
## Saves space and weighs less

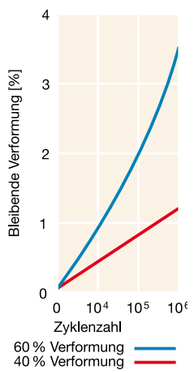
**The superior advantages of cellular Vulkollan®** beprove their worth in innumerable motor vehicles of virtually all makes around the world. One primary application is spring struts. Auxiliary springs made of cellular Vulkollan®, together with the shock absorbers and steel springs, are the main components 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 exceptionally well-damped elastic resonance and a reduction in the transmission of structure-borne noise into the body and the vehicle interior.




**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.




**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

It can also withstand temperatures of over +120 °C for short periods. The properties of cellular Vulkollan® change only gradually under sustained dynamic load. Whether at room temperature or at +80 °C, the hysteresis curve is always of the same order of magnitude. Even after 1 million compressions to 60 percent, permanent deformation is still only 3.5 percent!

# Vulkollan® – Use our know-how and service

With Vulkollan®, you also are putting our expertise to use. The Bayer MaterialScience marketing team comprises highly qualified chemists, business professionals and technical specialists who would be happy to provide you with any advice or practical information you need. You can contact us at our headquarters in Leverkusen, Germany, and in many countries around the world. We look forward to hearing from you!

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## For your notes