Polyurethane Materials for Vibration Isolation
Getzner Materials in Construction and Industry
Getzner Werkstoffe specialises in foamed polyurethane elastomers, which are used in the rail, construction and industry sectors for isolating vibrations. The company, which has developed materials such as Sylomer® and Sylodyn®, has almost 50 years of experience.

What can Getzner materials do?

Peace and quiet is essential for a high quality of life, whether within one’s own four walls or at work in the office. But there are countless sources of noise, especially in cities. For example, footfall noise and the noise generated by rail and road traffic, which all have a huge detrimental effect on the quality of life and can even reduce the value of whole properties. Getzner materials ensure a high quality of life by decoupling entire buildings, parts of buildings or even the service facilities (lifts, air-conditioning equipment, bath tubs, pumps, etc.) from vibrations.

They prevent vibrations from propagating into sensitive parts of the building and generating disruptive vibrations or noise.

The polyurethane-based materials, Sylomer® and Sylodyn®, are ideal for industry, as many industrial products require load-resilient elastic components: the materials are available in any number of forms and combine properties such as high spring and/or dampening properties, outstanding elastic recovery and a long service life.

Getzner materials can also be used for not only the bedding or damping of components but also for entire machines. Depending on the application, they provide a longer service life (less downtime/maintenance), greater machine precision, less machine noise, more comfortable operation, etc.
One-dimensional mass-spring system

Most vibration problems can be physically represented as one-dimensional mass-spring systems (MFS). This approach allows the best possible resilient bedding to be calculated.

Should a brief external force (F) disrupt the balance of a mass (m), the mass will produce a vibration with the natural frequency $f_0$. The amplitude of the vibration reduces over time. How quickly this happens depends on the damping (D) of the spring (c). The extent of the damping by Sylomer® or Sylodyn® gives the mechanical loss factor.
The isolating efficiency or insulation provided by a resilient bearing is represented by the transmission function $V(f)$.

The transmission function describes the mathematical relationship between an effect (excitation amplitudes) on a system and its response (vibration amplitudes). It is the ratio between the natural frequency and the excitation frequency ($f/f_0$). The isolating efficiency is in the frequency range $f/f_0 > \sqrt{2}$ (1.41). If the excitation frequency is known and the natural frequency of the system has been calculated, conclusions can then be drawn regarding the possible isolating efficiency of the elastic bearing. Generally speaking, the higher the frequency ratio $f/f_0$, the higher the isolating efficiency. The natural frequency of the elastic system can be significantly influenced by two factors: the mass of the system and the spring constant or stiffness of the elastic bearing. How the spring constant $C$ required to compute the frequency is calculated is illustrated below. The modulus of elasticity describes the correlation between stress and strain in the deformation of a solid body. This value can be found in the data sheets for the various types of Sylomer® and Sylodyn® product. A further factor affecting the spring constant is the ratio between the bearing surface and the thickness of the material: the thicker the selected elastic bearings, the smaller (softer) the spring constant. The deflection and the form factor - the ratio between bearing surface and lateral surface - also have to be taken into account. Getzner Werkstoffe engineers are available to assist in the calculation and selection of the elastic bearing with a view to achieving the optimum vibration damping and insulation.

$$f_0 = \frac{1}{2\pi} \sqrt{\frac{c}{m}} = \frac{1}{T}$$

$T$ = period length in s  
$f_0$ = natural frequency in Hz 
$c$ = spring constant in N/m 
$m$ = vibrating mass in kg 

$$C = \frac{E \cdot A}{d}$$

$E$ = dynamic modulus of elasticity in N/mm²  
$A$ = bearing surface in mm²  
$d$ = material thickness in mm
The effects of vibrations or shocks can be experienced in practically all aspects of everyday life: the dashboard in your car rattles, window panes vibrate when a train goes by, machine tools no longer machine workpieces accurately, the rumble of the metro can be heard in a 10th floor apartment.

All these phenomena are derived from the so-called structure-borne noise. When fixed bodies start to vibrate, noise propagates through them, which then emerges as secondary airborne noise (rumbling of the metro). Structure-borne noise can be suppressed in two ways.

1.) Source isolation
Providing an elastic bearing for the initiator – in other words the source (motor, air-conditioning equipment, train, etc.) – to a large extent prevents the propagation of structure-borne noise.

2.) Recipient isolation
Elastic decoupling of the recipient (buildings, space, devices, etc.) prevents structure-borne noise from entering and disturbing the occupiers of the property.
**Sylomer®**
High elasticity, long service life

**Material characteristic:**
- Mixed cellular
- Static application area from 0.011 N/mm² to 1.2 N/mm²
- Load peaks up to 6.0 N/mm²
- Very low amplitude dependence
- Proven long-time behaviour
- High fatigue strength
- Finely graded range (10 standard types) for optimum system design
- Ability to provide customer-specific modifications

Universally applicable elastic PU material, spring-damper combination, proven for more than 45 years

**Application examples:**
- As pressurised spring for vibration isolation in construction/rail sectors and for machinery
- Mass-spring systems, under ballast mats, sleeper pads, rail pads and baseplate pads
- Full-surface, strip and point bearings for buildings
- Impact noise insulation
- Bearings for stairs and landings
- Machinery and foundation bearings
- Elastic components for transport rollers and belts
- Flexible elastic press mats
- Highly flexible press mats
- Highly flexible seals moulded parts, semi-finished articles

**Sylodyn®**
High dynamic Durability

**Material characteristic:**
- Closed cell
- Static constant load of standard types from 0.075 N/mm² to 6.0 N/mm²
- Load peaks up to 18 N/mm²
- Very low amplitude dependence
- Low creep tendency
- Stiffening factor \(C_{\text{dyn}}/C_{\text{stat}}\) from 1.15 to 1.40
- Proven long-time behaviour
- Fatigue strength
- Finely graded range (7 standard types) for optimum system design
- Ability to provide customer-specific modifications

**Technical spring** with pronounced dynamic and highly elastic properties, proven in the field for more than 20 years

**Application examples:**
- As pressurised spring for vibration isolation in construction/rail sectors and for machinery
- Mass-spring systems, under ballast mats, sleeper pads, rail pads and baseplate pads
- Full-surface, strip and point bearings for buildings
- Bearings for stairs and landings
- Machinery and foundation bearings
- Elastic components for transport rollers and belts
- Flexible elastic press mats
- Highly flexible seals
- Moulded parts, semi-finished articles

**Sylodamp®**
- high damping
  (mechanical loss factor 0.46 – 0.61)

**Sylomer® FR**
- fire resistant
  (S4/SR2/ST2 according to DIN 5510-2)

**Highly resilient bearing HRB-HS**
- Load peaks up to 9.0 N/mm²

**Products**
- Acoustic Floor Mat
- Acoustic Floor Blocks
- Bearings for stairs and landings
- Foundation bearings
- Elastic ceiling hangers
- Elastic bearings in timber construction
- Bearing of machine foundations
- etc.
Sylomer® Material type

### Properties

<table>
<thead>
<tr>
<th>Material</th>
<th>Color</th>
<th>Test procedures</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>yellow</td>
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<tr>
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<td>violet</td>
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#### Test procedures

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<tbody>
<tr>
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<td></td>
</tr>
<tr>
<td>Load peaks in N/mm²</td>
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<tr>
<td>Mechanical loss factor</td>
<td>DIN 53513²</td>
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<tr>
<td>Rebound elasticity in %</td>
<td>EN ISO 8307</td>
</tr>
<tr>
<td>Compression set in %</td>
<td>EN ISO 1856</td>
</tr>
<tr>
<td>Static modulus of elasticity in N/mm²</td>
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</tr>
<tr>
<td>Dynamic modulus of elasticity in N/mm²</td>
<td>DIN 53513¹</td>
</tr>
<tr>
<td>Static shear modulus in N/mm²</td>
<td>DIN ISO 1827²</td>
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<tr>
<td>Min. tensile stress at rupture in N/mm²</td>
<td>DIN EN ISO 527/5/100²</td>
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<tr>
<td>Min. tensile elongation at rupture in %</td>
<td>DIN EN ISO 527/5/100²</td>
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<tr>
<td>Abrasion in mm³</td>
<td>DIN EN ISO 4649</td>
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<tr>
<td>Coefficient of friction (steel)</td>
<td>Getzner Werkstoffe</td>
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<tr>
<td>Coefficient of friction (concrete)</td>
<td>Getzner Werkstoffe</td>
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<tr>
<td>Specific volume resistance in Ω·cm²</td>
<td>DIN IEC 60093</td>
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<tr>
<td>Thermal conductivity in W/mK</td>
<td>DIN EN 12667</td>
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<tr>
<td>Operating temperature in °C</td>
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<tr>
<td>Temperature peak in °C</td>
<td>short term ¹</td>
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<tr>
<td>Flammability</td>
<td>EN ISO 11925/2</td>
</tr>
</tbody>
</table>

1. Data valid for a form factor of q = 3
2. Tests according to respective standards
3. Testing parameters vary depending on density
4. Application-specific

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Material

Mixed cellular PU elastomer (Polyurethane) with combined spring and dampening properties.

Standard delivery specifications

- Thickness: 12.5 mm / 25 mm
- Rolls: 1.5 m wide, 5.0 m long
- Strips: up to 1.5 m wide, up to 5.0 m long

Other dimensions, punched and moulded parts on request.

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All information and data is based on our current knowledge. The data can be applied for calculations and as guidelines, are subject to typical manufacturing tolerances, and are not guaranteed. We reserve the right to amend the data.
Material
Closed cellular polyurethane (PUR) with highly elastic properties.

Standard delivery specifications
Thickness: 12.5 mm / 25 mm
Rolls: 1.5 m wide, 5.0 m long
Strips: up to 1.5 m wide, up to 5.0 m long
Other dimensions, punched and moulded parts on request.

Sylodyn® Material type

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<th>Properties</th>
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<tr>
<td>Color</td>
<td>red yellow green blue violet dark green dark blue</td>
</tr>
<tr>
<td>Static range of use¹ in N/mm²</td>
<td>0.075 0.150 0.350 0.750 1.500 3.000 6.000</td>
</tr>
<tr>
<td>Load peaks¹ in N/mm²</td>
<td>2.00 3.00 4.00 6.00 8.00 12.00 18.00</td>
</tr>
<tr>
<td>Mechanical loss factor</td>
<td>DIN ISO 8307 0.07 0.07 0.08 0.09 0.10 0.07 0.07</td>
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<tr>
<td>Rebound elasticity in %</td>
<td>EN ISO 1856 &lt;5 &lt;5 &lt;5 &lt;5 &lt;5 &lt;5 &lt;5</td>
</tr>
<tr>
<td>Compression set² in %</td>
<td>EN ISO 1856 &lt;5 &lt;5 &lt;5 &lt;5 &lt;5 &lt;5 &lt;5</td>
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<tr>
<td>Static modulus of elasticity¹ in N/mm²</td>
<td>0.75 1.10 2.55 5.55 11.80 33.20 74.00</td>
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<tr>
<td>Dynamic modulus of elasticity¹ in N/mm²</td>
<td>DIN 53513² 0.90 1.45 3.35 7.70 15.20 49.10 113.80</td>
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<tr>
<td>Static shear modulus¹ in N/mm²</td>
<td>DIN ISO 1827² 0.13 0.21 0.35 0.61 0.80 2.40 3.50</td>
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<tr>
<td>Dynamic shear modulus¹ in N/mm²</td>
<td>DIN ISO 1827² 0.18 0.29 0.53 0.86 1.18 2.80 4.20</td>
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<tr>
<td>Min. tensile stress at rupture in N/mm²</td>
<td>DIN EN ISO 527-3/5/100³ 0.75 1.50 2.50 4.00 7.00 12.00 15.00</td>
</tr>
<tr>
<td>Min. tensile elongation at rupture in %</td>
<td>DIN EN ISO 527-3/5/100³ 450 500 500 500 500 400 400</td>
</tr>
<tr>
<td>Abrasion³ in mm³</td>
<td>DIN EN ISO 4649 1.400 5.50 10.00 8.0 90 100 80</td>
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<tr>
<td>Coefficient of friction (steel)</td>
<td>Getzner Werkstoffe ≥0.7 ≥0.7 ≥0.7 ≥0.7 ≥0.7 ≥0.7 ≥0.7</td>
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<td>Specific volume resistance in Ω·cm</td>
<td>DIN IEC 60093 &gt;10⁴ &gt;10⁴ &gt;10⁴ &gt;10⁴ &gt;10⁴ &gt;10⁴ &gt;10⁴</td>
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<tr>
<td>Thermal conductivity in W/mK</td>
<td>DIN EN 12667 0.070 0.085 0.110 0.135 0.150 0.155 0.160</td>
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<tr>
<td>Operating temperature in °C</td>
<td>-30 to 70</td>
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<tr>
<td>Temperature peak in °C</td>
<td>short term¹ 120</td>
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<tr>
<td>Flammability</td>
<td>EN ISO 11925-2 class E/EN 13501-1</td>
</tr>
</tbody>
</table>

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² Tests according to respective standards
³ Testing parameters vary depending on density
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Application Examples
Construction

- Bedding of buildings
- HVAC equipment
- Screed floating floors
- Building foundation bearings
- Sylodyn® strips for decoupling of the flanking transmission
- Bearing systems for stairs
Application Examples

Industry

Decoupling of metal parts using spring damper elements

Polishing pads

Pump bearing

Sealing element for vacuum lifting device

Decoupling of yacht flooring

Floating floors for rolling stock

Machine foundation bearings