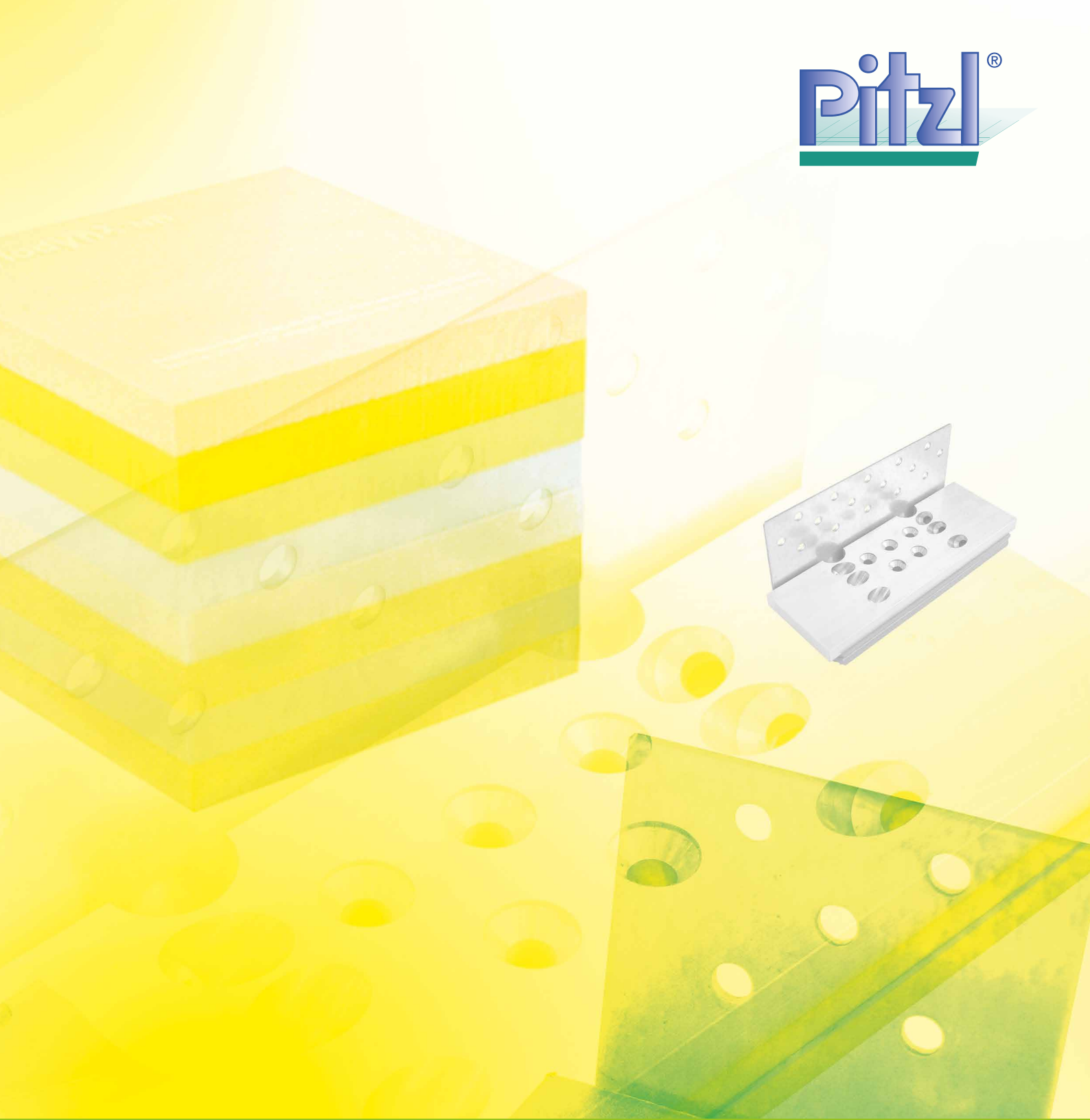


# Sound Protection

## 2020

Innovative timber connection systems for highest requirements.

ETA-10/0413 ETA-15/0187

Pitzl Metallbau GmbH & Co. KG
DIN EN 1090-2

ZiNiP max protection

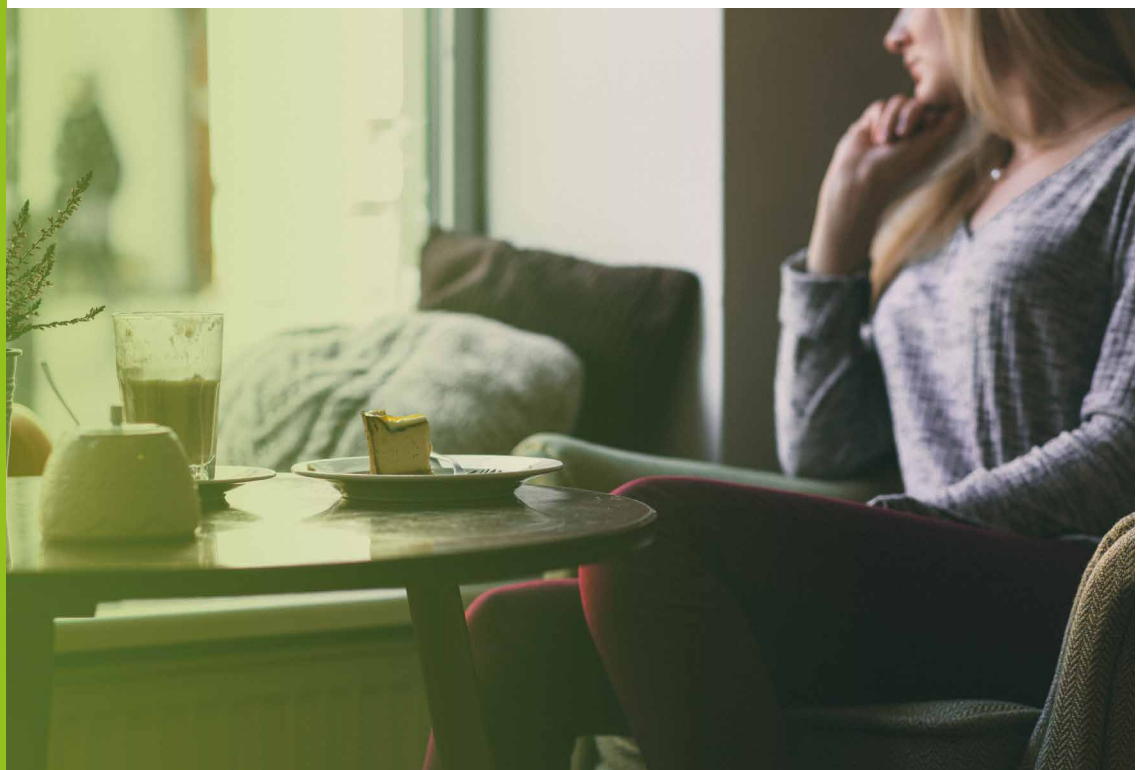
schwerlast HVP heavy duty

# Sound protection

In the current, very fast moving, society, people wish for more calm and relaxation. To be able to relax, they need a quiet home. Thus also higher requirements are necessary on sound insulation at home, but also at the workplace.

In order to meet the increasing demands Pitzl Metallbau works steadily on new and innovative solutions. In close cooperation with Getzner Materials GmbH Pitzl Metallbau GmbH & Co. KG developed a comprehensive sound insulation - concept.

Together with the company Getzner Werkstoffe GmbH and the timber engineering unit of the University Innsbruck, Pitzl Metallbau GmbH & Co. KG has developed a powerful perfectly sound-decoupled angle bracket for CLT constructions.



# Basics

## Air-borne sound

For example, music or voice volumnes makes the air vibrate, which spreads in wave form spread and brings construction components such as walls and ceilings indirectly in oszillation.

These construction parts emit that oszillation to adjacent rooms, brings the air in vibration and generate noises.

## Structure-borne sound

If vibrations are going directly into the building structures - for example through plumbings, by heel strikes, hammering or vibrations of household appliances-we are speaking of structure-borne sound.

## Impact sound

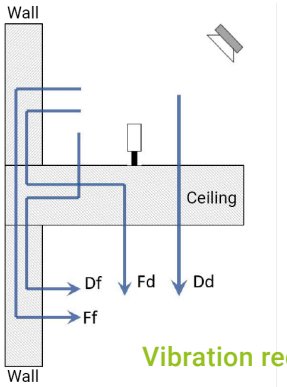
A special form of structure-borne noise is the impact sound. It is initiated due to walking (heel strike) on floors or stairways or moving and/or dropping objects directly onto construction parts.

In order to determine the impact sound insulation of a component, a standard hammering plant specifically activates the component.

## Sound transmission over edges (flank transmission)

All single structural components must always be considered together with the total building system. A substantial part of the sound transmission also takes place via the so-called flank buildings parts (flank transmission). Also doorways, ducts or pipe penetrations are additional sound transmission paths. The noise level always depends on the interaction and sum up of all transmission paths.

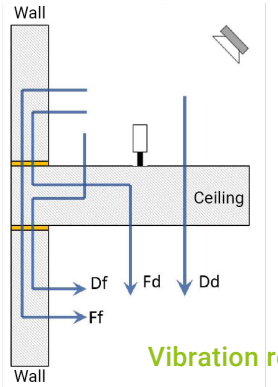
Rigid bearing situation




**Vibration reduction index $K_{ij}$**

| | | |
|---|---|---|
| Rigid | Path Ff | 24 dB |
| | Path Fd | 12 dB |
| | Path Df | 12 dB |

Completely decoupled (incl. elast. fasteners)




**Vibration reduction index $K_{ij}$**

| | | |
|---|---|---|
| Decoupled | Path Ff | 35 dB |
| | Path Fd | 22 dB |
| | Path Df | 22 dB |

# Sound protection angle bracket with power

The so called „GePi-Winkel“, which was created as part of this cooperation, has a much higher load-bearing capacity than comparable concepts on the market. On the basis of test results the TVFA-Innsbruck confirms characteristic loads up to 62 kN for the GePi 240. An additional advantage of this system is the energy dissipation without any breakage in the earthquake case. Cyclic stresses impressively confirm the efficiency due to acting dynamic loads of the revolutionary GePi-concept.

81000.0100

81000.0240

81010.0000

## GePi - Connect

| Item no. | Labeling | Dimension | | | | Screwing 8 mm | | Characteristic load-bearing capacity [kN] *) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | H | s | Horizontal (TK 8 x 80 TG) | Vertikal (SK 8 x 160 VG) | $F_{1,k}$ | $F_{2/3,k}$ | $F_{4/5,k}$ |
| 81000.0100 | GePi 100 | 100 mm | 100 mm | 100 mm | 3 | 5 | 4 | 16 | 12 | 20 |
| 81000.0240 | GePi 240 | 100 mm | 240 mm | 100 mm | 3 | 16 | 11 | 54 | 62 | 55 |

* Values determined with experimental tests from the University Innsbruck. European Technical Assessment (ETA) applied.

| Item no. | Labeling | Material | | |
|---|---|---|---|---|
| | | Angle bracket | Sylodyn® | Supporting plate |
| 81000.0100 | GePi 100 | Steel S250GD + Z275 | Closed cellular pore structure | Steel S235 |
| 81000.0240 | GePi 240 | Steel S250GD + Z275 | Closed cellular pore structure | Aluminium EN AW 6082 |

In coparision to a lot of other conventional building materials, elastomers have a distinctive pronounced non-linear material behavior. That means, material parameters such as static- and dynamic stiffnesses are dependent on the particular load situation. In order for an ideal use of the material Sylodyn®, we recommend a mounting kit to ensure a defined preload.

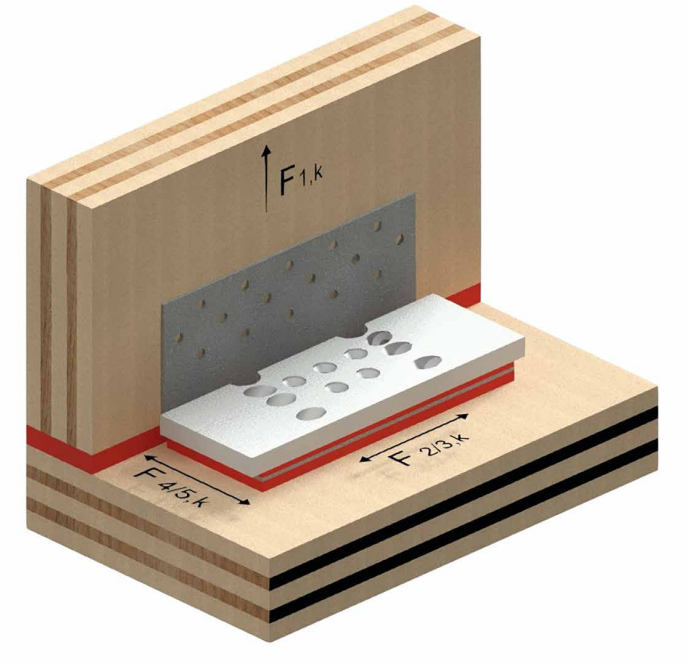
## Accessories

Fitting tool

| Item no. | Description |
|---|---|
| 81010.0000 | Fitting tool, 2-parts for GePi angle bracket |

Screws

| Item no. | Description | d | l | lg | dk | Screw-driver |
|---|---|---|---|---|---|---|
| 99200.0880 | Washer-head screw | 8 | 80 | 60 | 18,0 | T-40 |
| 99211.0816 | Counter-sunk screw | 8 | 160 | 150 | 14,8 | T-40 |




## Characteristic Load-bearing capacity up to 62 kN

acc. to EN 1995:2014

## Applications

Angle brackets for shear loads with decoupled flanks
- Connection timber-timber
- High wind forces
- Earthquake loads (GePi 240)
- Lifting forces
- Increased requirements on sound insulation

## Advantages and benefits

- High shear- and tensile strength
- Sound transmission decoupled connection
- Proofed sound insulation
- Resistant to earthquakes (GePi 240)
- Reliability for Engineers and users
- Approved product quality

# Sylodyn® and Sylomer® insulation band

Work against sound transmission.

Sylodyn® tapes in different thicknesses, widths and designs ensures an efficient sound insulation for all kind of constructions.

The decades-long experience of the company Getzner with vibration insulation-systems in the applications of railway, construction and industry allows architects, designers and building physicists as well as carpentries, to fulfill the high sound insulation and structural requirements on buildings where people live.

The tapes are as required 6.25, 12.5 or 25 mm thick and are available in different dimensions depending to customer requirements. To ensure an optimized sound insulation for a wide range of load levels products with different stiffenesses are manufactured and installed between the wall- and slab elements. For highly stressed components with high compression forces also spezial Sylodyn® grades are available on demand.

## Sylodyn®

| Material parameter | Test method | NB | NC | ND | NE | NF | HRB HS 3000 | HRB HS 6000 | HRB HS 12000 |
|---|---|---|---|---|---|---|---|---|---|
| Colour | | red | yellow | green | blue | violet | dark-green | dark-blue | dark-brown |
| Item no. | | 81100 | 81200 | 81300 | 81400 | 81500 | 81601 | 81602 | 81600 |
| 12.5 mm tape, width 100 mm | | | | | _____.1100 | | | | |
| 12.5 mm tape, width 120 mm | | | | | _____.1120 | | | | |
| Static application[1] in MPa | | 0,075 | 0,150 | 0,350 | 0,750 | 1,500 | 3,000 | 6,000 | 12,000 |
| Load peaks[1] in MPa | | 2,00 | 3,00 | 4,00 | 6,00 | 8,00 | 12,00 | 18,00 | 24,00 |
| Mechanical loss factor | DIN 53513 [2] | 0,07 | 0,07 | 0,08 | 0,09 | 0,10 | 0,07 | 0,07 | 0,08 |
| Rebound elasticity in % | EN ISO 8307 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 |
| Compression set[3] in % | EN ISO 1856 | < 5 | < 5 | < 5 | < 5 | < 5 | < 5 | < 5 | < 5 |
| Static modulus of elasticity[1] in MPa | | 0,75 | 1,10 | 2,55 | 6,55 | 11,80 | 33,20 | 74,00 | 181,00 |
| Dynamic modulus of elasticity[1] in MPa | DIN 53513 [2] | 0,90 | 1,45 | 3,35 | 7,70 | 15,20 | 49,10 | 113,80 | 323,00 |
| Static shear modulus[1] in MPa | DIN ISO 1827 [2] | 0,13 | 0,21 | 0,35 | 0,61 | 0,80 | 2,40 | 3,50 | 4,00 |
| Dynamic shear modulus[1] in MPa | DIN ISO 1827 [2] | 0,18 | 0,29 | 0,53 | 0,86 | 1,18 | 2,80 | 4,20 | 5,30 |
| Min. breaking stress in tension in MPa | DIN EN ISO 527-3/5/100 [2] | 0,75 | 1,50 | 2,50 | 4,00 | 7,00 | 12,00 | 15,00 | 16,00 |
| Min. breaking elongation in tension in % | DIN EN ISO 527-3/5/100 [2] | 450 | 500 | 500 | 500 | 500 | 400 | 400 | 400 |
| Abrasion[3] in mm³ | DIN EN ISO 4649 | 1.400 | 550 | 100 | 80 | 90 | 100 | 80 | 70 |
| Friction coefficient (steel) | Getzner Werkstoffe | ≥ 0,7 | ≥ 0,7 | ≥ 0,7 | ≥ 0,7 | ≥ 0,7 | ≥ 0,7 | ≥ 0,7 | ≥ 0,4 |
| Friction coefficient (concrete) | Getzner Werkstoffe | ≥ 0,7 | ≥ 0,7 | ≥ 0,7 | ≥ 0,7 | ≥ 0,7 | ≥ 0,7 | ≥ 0,7 | ≥ 0,6 |
| Specific contact resistance in Ω · cm | DIN IEC 60093 | > 1010 | > 1010 | > 1010 | > 1010 | > 1010 | > 1010 | > 1010 | > 1010 |
| Thermal conductivity in W/mK | DIN EN 12667 | 0,060 | 0,075 | 0,090 | 0,100 | 0,110 | 0,160 | 0,170 | 0,190 |
| Working temperature in °C | | | | | -30 to 70 | | | | |
| Temperature peak in °C | short term / instantaneous [4] | | | | 120 | | | | |
| Fire behavior | EN ISO 11925-2 | | | | Class E/EN 13501-1 | | | | |

1 values are valid for form factor q = 3
2 Measurement / evaluation based on the respective standard
3 The measurement datas depend on density and varying test parameters
4 Custom-designed

## Sylomer®

| Material parameter | Test method | SR 11 | SR 18 | SR 28 | SR 42 | SR 55 | SR 110 | SR 220 | SR 450 | SR 850 | SR 1200 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Colour | | yellow | orange | blue | pink | green | brown | red | gray | tur-quoise | burg-undy |
| Item no. | | 84200 | 84700 | 84400 | 84000 | 84300 | 84110 | 84100 | 84800 | 84900 | 84500 |
| 12.5 mm tape, width 100 mm | | | | | | _____.1100 | | | | | |
| 12.5 mm tape, width 120 mm | | | | | | _____.1120 | | | | | |
| Static application[1] in MPa | | 0,011 | 0,018 | 0,028 | 0,042 | 0,055 | 0,110 | 0,220 | 0,450 | 0,850 | 1,200 |
| Load peaks[1] in MPa | | 0,50 | 0,75 | 1,00 | 2,00 | 2,00 | 3,00 | 4,00 | 5,00 | 6,00 | 6,00 |
| Mechanical loss factor | DIN 53513 [2] | 0,25 | 0,23 | 0,21 | 0,18 | 0,17 | 0,14 | 0,13 | 0,12 | 0,11 | 0,11 |
| Rebound elasticity in % | EN ISO 8307 | 40 | 40 | 45 | 55 | 55 | 55 | 55 | 60 | 60 | 60 |
| Compression set[3] in % | EN ISO 1856 [2] | < 5 | < 5 | < 5 | < 5 | < 5 | < 5 | < 5 | < 5 | < 5 | < 5 |
| Static modulus of elasticity[1] in MPa | | 0,06 | 0,08 | 0,19 | 0,22 | 0,34 | 0,83 | 1,47 | 3,36 | 7,23 | 9,37 |
| Dynamic modulus of elasticity[1] in MPa | DIN 53513 [2] | 0,20 | 0,29 | 0,42 | 0,60 | 0,73 | 1,52 | 2,58 | 5,42 | 11,08 | 15,62 |
| Static shear modulus[1] in MPa | DIN ISO 1827 [2] | 0,04 | 0,06 | 0,07 | 0,09 | 0,11 | 0,22 | 0,38 | 0,58 | 0,84 | 0,94 |
| Dynamic shear modulus[1] in MPa | DIN ISO 1827 [2] | 0,10 | 0,12 | 0,14 | 0,17 | 0,20 | 0,34 | 0,57 | 0,82 | 1,15 | 1,28 |
| Min. breaking stress in tension in MPa | DIN EN ISO 527-3/5/100 [2] | 0,30 | 0,35 | 0,40 | 0,50 | 0,60 | 0,80 | 1,20 | 1,80 | 2,50 | 2,70 |
| Min. breaking elongation in tension in % | DIN EN ISO 527-3/5/100 [2] | 300 | 300 | 250 | 250 | 250 | 220 | 200 | 170 | 170 | 160 |
| Abrasion[3] in mm³ | DIN EN ISO 4649 | 1.400 | 400 | 1.300 | 1.200 | 1.100 | 1.100 | 1.000 | 400 | 300 | 350 |
| Friction coefficient (steel) | Getzner Werkstoffe | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 |
| Friction coefficient (concrete) | Getzner Werkstoffe | 0,7 | 0,7 | 0,7 | 0,7 | 0,7 | 0,7 | 0,7 | 0,7 | 0,7 | 0,7 |
| Specific contact resistance in Ω · cm | DIN EN 62631-3-1 [2] | > $10^{10}$ | > $10^{10}$ | > $10^{10}$ | > $10^{10}$ | > $10^{10}$ | > $10^{10}$ | > $10^{10}$ | > $10^{10}$ | > $10^{10}$ | > $10^{10}$ |
| Thermal conductivity in W/mK | DIN EN 12667 | 0,045 | 0,050 | 0,050 | 0,055 | 0,060 | 0,075 | 0,090 | 0,110 | 0,130 | 0,140 |
| Working temperature in °C | | | | | | -30 to 70 | | | | | |
| Temperature peak in °C | short term / instantaneous [4] | | | | | 120 | | | | | |
| Fire behavior | EN ISO 11925-2 | | | | | Class E/EN 13501-1 | | | | | |

1 values are valid for form factor q = 3
2 Measurement / evaluation based on the respective standard
3 The measurement datas depend on density and varying test parameters
4 Custom-designed

# Elastic washers

Elastic washers EW are used to decouple screw connections to avoid any kind of structure-borne sound. The polyurethane material Sylodyn® effectively isolates vibrations and have a long working period. In addition to the sound insulation, the elastic washers also electrically non-conductive and resistant to common oils and greases.

81900.0812

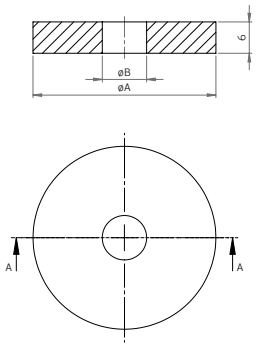
81900.1612

81901.1008

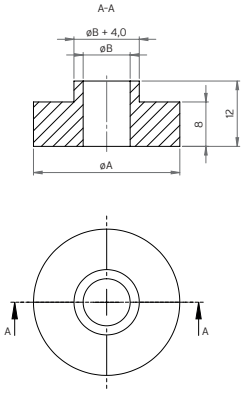
81901.1208

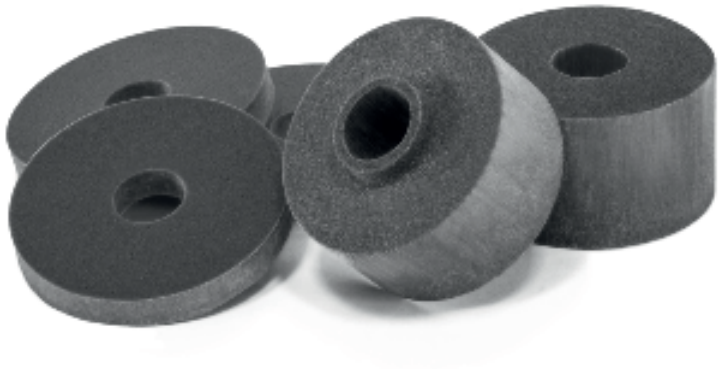
| Art-No. | Description | Thickness | Screw dimension | Ø A | Ø B |
|---|---|---|---|---|---|
| 81900.0806 | EW M8-6 | 6 mm | M8 | 35 mm | 9 mm |
| 81900.1006 | EW M10-6 | 6 mm | M10 | 40 mm | 11 mm |
| 81900.1206 | EW M12-6 | 6 mm | M12 | 50 mm | 13 mm |
| 81900.1606 | EW M16-6 | 6 mm | M16 | 55 mm | 17 mm |
| 81901.0808 | EW M8-8 | 8 mm | M8 | 28 mm | 9 mm |
| 81901.1008 | EW M10-8 | 8 mm | M10 | 34 mm | 11 mm |
| 81901.1208 | EW M12-8 | 8 mm | M12 | 44 mm | 13 mm |
| 81901.1608 | EW M16-8 | 8 mm | M16 | 56 mm | 17 mm |
| 81900.0812 | EW M8-12 | 12 mm | M8 | 35 mm | 9 mm |
| 81900.1012 | EW M10-12 | 12 mm | M10 | 40 mm | 11 mm |
| 81900.1212 | EW M12-12 | 12 mm | M12 | 50 mm | 13 mm |
| 81900.1612 | EW M16-12 | 12 mm | M16 | 55 mm | 17 mm |
| 81901.0821 | EW M8-21 | 21 mm | M8 | 28 mm | 9 mm |
| 81901.1021 | EW M10-21 | 21 mm | M10 | 34 mm | 11 mm |
| 81901.1221 | EW M12-21 | 21 mm | M12 | 44 mm | 13 mm |
| 81901.1621 | EW M16-21 | 21 mm | M16 | 56 mm | 17 mm |

Standard solution




With centering





## Execution

In addition to the standard solution are also washers with centering (fold) available to facilitate installation and accurate positioning of the screw to the borehole. For screw sizes M8, M10, M12 and M16 are different dimensions available, adapted on different bearing thicknesses and various stifnesses. Please ask for the maximum torsional moment.

## Advantages

- Effective sound- and vibration insulation
- Durable material properties
- No embrittlement (free of plasticizers)
- Assortment for different screw sizes
- Variants with centering aid
- Fire behavior according to DIN EN 13501-1
- Surface protection
- Electrically non-conductive
- Resistant to oils and greases
- Thermally insulating

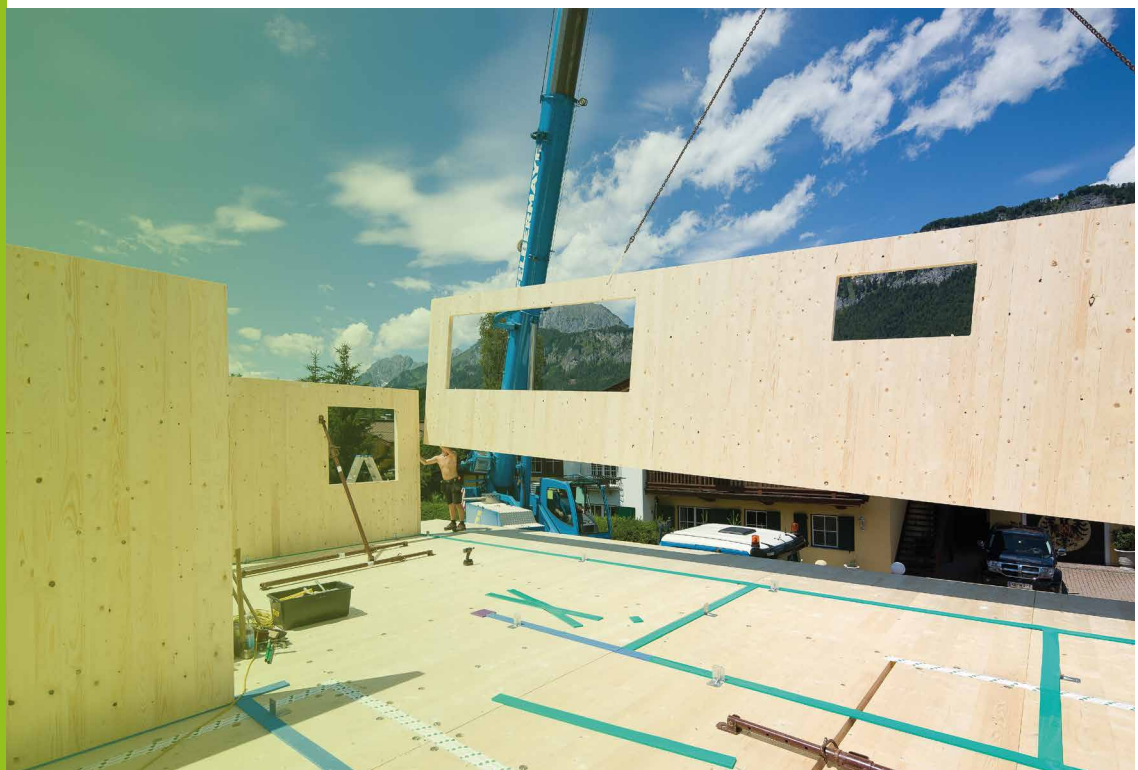
# Selection of sound insulaltion

For a smooth and efficient workflow, the following procedure is recommended:

1. Based on structural conditions and defined floor and wall assemblings one have to determine the required positions of  sound insulation bands.

2. The Sylodyn® aound insulation bands adapted to the load situations are calculated with the help of the calculation program TimberCalc, available for free on http://apps.getzner.com.

3. In the input screen all necessary data for the determination of the optimal Sylodyn® insulation are registered.
   - Position number
   - Length and width of the product
   - Characteristic loads



4. The program determines the optimal Sylodyn® type and shows all relevant material
   - Existing compression stress
   - Optimal material
   - Load limit of the material
   - Defelection (after 1 day and 10 years)
   - Eigen frequency
   - Material utilization

5. The data can also be easily transferred to other programs, e.g. Excel or PDF for further processing.

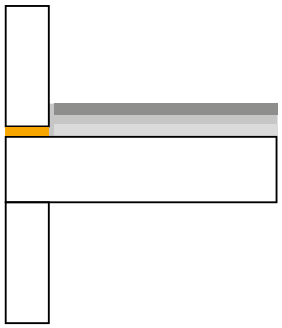
6. With this data a parts list and with the existing drawings one can create a layout-drawing.

7. The Sylodyn® tapes are installed according to the parts list and teh layout-drawings which is only created on customer's request (seperate offsetting). This will ensure a flawless installation. In addition a expert monitoring of the installation of the Sylodyn® tapes on the construction site by a Getzner employee is also possible.


TimberCalc

# Design rules

At the joints below, Sylodyn® strips should be used as shown

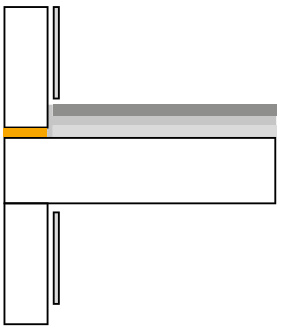


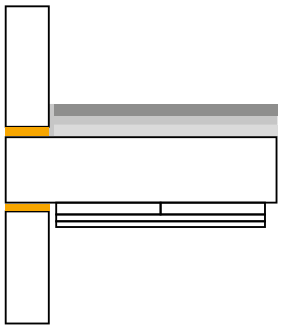
## Sylodyn® above the slab

without facings on the wall and no suspended ceilings

## Sylodyn® above the slab

with facings on the wall and no suspended ceilings





## Sylodyn® above and below the slab

without facings on the wall and with suspended ceiling

# Design concept

In the verification of the sound decoupling, two design criteria has to be considered.

## Serviceability limit state (sound insulation)

To achieve a dynamically optimal effectiveness  a so-called static application range $\sigma_{R,perm.}$ has to be complied. The quasi-permanent loads, which are permanently exist and stresses the material accordingly long term, should be within the static range of work. This ensures that the dynamic properties get over decades remain and the optimal vibration isolation occurs over the standard building occupancy.
Temporary overloads or load reductions usually have no relevant influence on the material properties of Sylodyn®.

## Ultimate limit state (structural analysis)

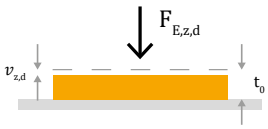
For the proof of the load carrying-capacity for constructions usually only tested and approved elastomers are installed. For the materials Sylomer® and Sylodyn® the requirements in each case are assessed with a general building approval (abZ) according to building regulations list B, part 1 - edition 2013/1, 1.7.2 Elastomeric bearings. The non-linear material properties has a positively affect onto the maximum design ultimate limit stress $\sigma_{R,d}$. The load carrying-capacities $\sigma_{R,d}$ were detected both internally and externally, are permanentely controlled and can be used for the calculation from the following tables or the general building approval.

## Approval

A general building approval is a reliable proof for an construction product with regard to structural engineering requirements for the product applicarion. In addition the approval ensures that the consistent quality of the product is regularly proven by external experts.

## Vertical load transmission

For the dimensioning of the Sylodyn® tapes one have to take the applied loads from the structural calculation. The proof is provided depending on the material properties with the following equation:




### Verification of storage in the ultimate limit state

$F_{E,z,d} \leq F_{R,z,d}$

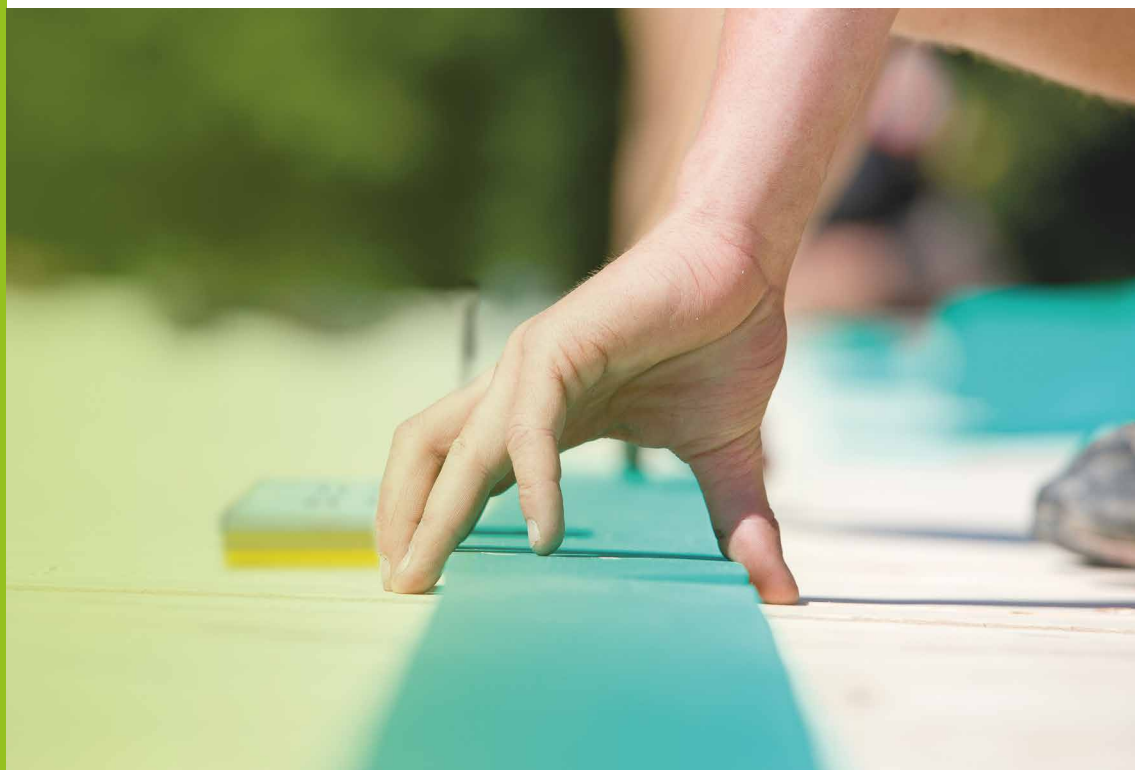
### Vertical bearing resistance at ULS

$F_{R,z,d} = \sigma_{R,d} * A$

### Area determination for rectangular

$A = a \cdot b$

| | |
|---|---|
| A | Loaded area of the Sylodyn tape |
| a, b | Side lengths of a rectangular bearing |
| $E_z$ | E-modulus of the material at ULS |
| $F_{E,z,d}$ | Vertical applied load at ULS |
| $F_{R,z,d}$ | Vertical compression strength of the Syslodyn at ULS |
| $\sigma_{R,d}$ | Load-carrying capacity at ULS |
| $v_{z,d}$ | Vertical deformation at ULS |



## Horizontal load transmission

The maximum horizontal bearing resistance $F_{R,xy,d}$ which can be briefly absorbed by a bearing may be taken as the restoring force of the bearing which results from a shear distortion of $\varepsilon_{xy}$ = 20 % of the unloaded bearing thickness $t_o$. This bearing resistance can be used as a secured value for the load transfer of short-term shear forces.


### Verification of horizontal load transmission

$F_{E,xy,d} \leq F_{R,xy,d}$

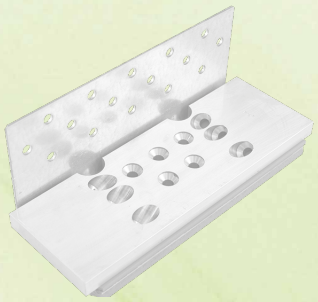
### Horizontal bearing resistance at ULS (Max. 20 % Shear distortion)

$F_{R,xy,d} = G \cdot A \cdot \varepsilon_{xy,d} < G \cdot A \cdot 0{,}2$

| | |
|---|---|
| A | Loaded area of the bearing |
| $F_{E,xy,d}$ | Horizontal applied load at ULS |
| $F_{R,xy,d}$ | Horizontal load carrying-capacity at ULS |
| G | Shear modulus (values in table) |
| $\varepsilon_{xy,d}$ | Design value of shear distortion |
| $v_{xy,d}$ | Deformation from horizontal load |

| Art-No. | Type | $\sigma_{R,d}$ [N/mm²] | $E_z$ [N/mm²] | G [N/mm²] |
|---|---|---|---|---|
| 81100 | NB | 0,163 | 0,597 | 0,155 |
| 81200 | NC | 0,345 | 1,23 | 0,234 |
| 81300 | ND | 0,838 | 2,92 | 0,469 |
| 81400 | NE | 2,01 | 8,34 | 0,832 |
| 81500 | NF | 4,02 | 17,8 | 1,250 |
| 81601 | HRB HS 3000 | 8,02 | 36,7 | 3,560 |
| 81602 | HRB HS 6000 | 16,6 | 76,3 | 5,130 |

Rated resistance, Young's modulus and shear modulus of Sylodyn® for the form factor q = 3
Further calculation models and characteristic values can be found in Getzner's design concept.



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