simrit

Vibration Control

Technical Principles

Products

Vibration Control

Modern vibration control reliably protects increasingly complex machinery and units against vibration, thus extending their service life on a sustained basis. The simultaneous reduction of noise provides for greater system operating comfort, at the same time enabling adherence to legal regulations regarding noise emissions. Within the scope of vibration control, Simrit offers hydraulic cushioning components such as Hydro Mount and Hydro Bush as well as a broad spectrum of elastomer dampers (Ultra Bush, Spherical Mount, Conical Mount, Machine Mount, Tapered Mount, Instrument Mount, Centering Mount and much more).

Requirements

- General vibration reduction for protecting systems and their adjacent components
- Accommodation for axial, radial and torsional movements and cardanic deflection
- Damping of vertical vibrations
- Accommodation of horizontal forces, e.g. braking effect
- Mechanical vibration sound insulation for reducing noise emissions
- Equalising of components to extend the range of the operating conditions
- Limitation of movements.

© Freudenberg Simrit GmbH & Co. KG | Technical Manual 2007

Features

- Frequency and amplitude based or dependent damping
- Integrated limitation of the spring displacement and possibilities for load levelling
- Solutions for extremely rough operating conditions
- RoHS-compliant
- A high degree of adaptability to individual application situations
- Very robust design
- Excellent insulation behaviour at various frequency ranges.

Application areas

Vibration control-related solutions from Simrit are used around the world in agricultural and construction machinery, in general mechanical engineering, in ship building, in wind power plants, drive engineering and the railway industry.

- Engine mounts in construction and agricultural machinery, ships
- Roller bearing mounts in construction machinery
- Mesh bearing mounts in combine harvesters
- Generator bearing mounts (e.g. in wind power plants)
- Cabin and superstructure mounts
- Mounting of electronic assemblies
- Mounting of pumps, mixers, centrifuges
- Mounting of assemblies in rolling mills
- etc.
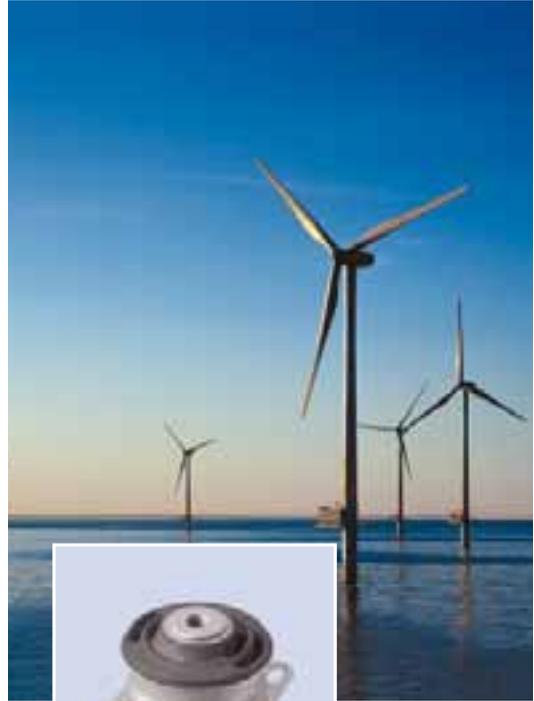
Engineering Basics

An example involving a driver's cabin is used here to clarify the factors that cause vibrations in a system of mounts with resilient and damping elements.

A vehicle cabin is affixed to a base frame with an elastic and damping mount configuration. The – for the most part rigid – base frame moves with large vibration amplitudes, owing to the travelling motion of the vehicle. The result of the movements of the base frame are vibrations of the cabin, which is equally as rigid.

The vibration amplitudes result from these influencing factors:

- Mass of the cabin
- Spring characteristics of the mount configuration
- Damping characteristics of the mounts
- Preloading of the mounts
  (e.g. compressive deflection at the working point)
- Kinetic energy of the cabin
- Excitation frequency
- Excitation amplitude.

If the base frame or the cabin are considered to be elastic, then a differentiated approach must identify and include additional influencing factors (that are not a part of the consideration). The objective of using vibration-control components is to reduce any vibration amplitudes that occur, whether in the form of noise or vibration.
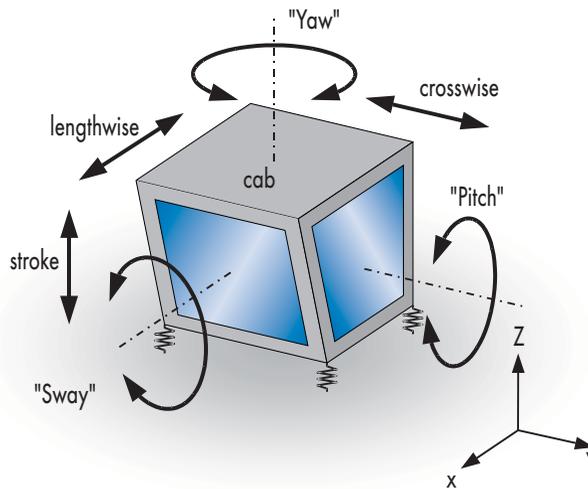
Possible movements:

Linear movement in x:	"Longitudinal motion"
Linear movement in y:	"Transverse motion"
Linear movement in z:	"Vertical motion"
Rotation about x:	"Sway"
Rotation about y:	"Pitch"
Rotation about z:	"Yaw"

Fig. 1   Possible movements of a rigid body

Modelling

One of the fundamental assessment aids in vibration control is the model of the single-mass oscillator with a degree of freedom, consisting of spring and mass (→ Figure 2). It has the typical characteristic of a natural frequency. It is used to examine and describe periodic processes (vibrations). The model presented here has been expanded by one damper. The damping mechanism provides for a reduction of vibrations.

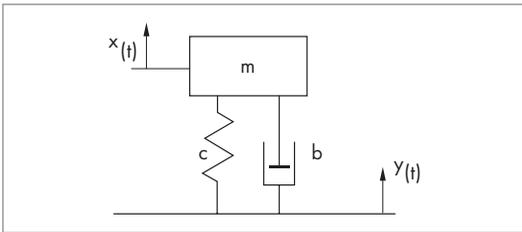Model of a single-mass oscillator (1 degree of freedom)

Fig. 2   Single-mass oscillator

Differential equation as the basis for the mathematical solution

$$[1] \qquad m\ddot{x} + b(\dot{x}-\dot{y}) + c(x-y) = 0$$

Amplification function as the result of mathematical considerations with various degrees of damping.

$$[2] \qquad \frac{\hat{x}}{\hat{y}} = \sqrt{\frac{1+(2D\lambda)^2}{(1-\lambda^2)^2 + (2D\lambda)^2}}$$

It is not intended to go into the application of mathematical equations here.
In the equation [1], the single-mass oscillator (→ Fig. 2) is described with its behaviour as dependent on the period and the other dimensions. Equation [2] describes the relationship of oscillation response to oscillatory excitations, dependent on the damping and the frequency ratio. With the assumption of a linear spring characteristic curve and a damping-free mounts, the natural frequency, see equations [3], can be read directly from the following Diagram 1.

$$[3] \qquad n_e = \frac{950}{\sqrt{s}}\left[\frac{1}{min}\right]$$

If superimposed vibrations occur translationally, rotationally or a combination thereof, see (→ Fig. 1), then the single-mass oscillator model, as depicted in Figure 2, can no longer be applied. The mathematical models describing the oscillatory behaviour must be extended. Modern software tools can be of assistance here.
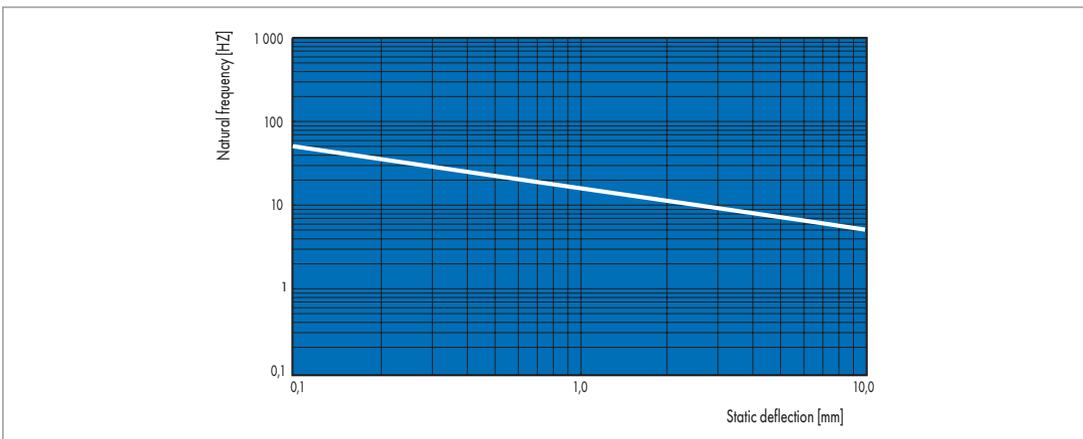

Diagram 1   Calculation of the spring deflection at the natural frequency [3]

Vibration Control is aTrade-off betweenConflictingObjectives

In very many instances, it is desirable to achieve significant reductions in the vibrations occurring at stipulated points.

The essential characteristic of oscillatory systems is the resonance. It occurs when there is synchronicity of the excitation frequency and the natural frequency, frequency ratio $\lambda \approx 1$, ($\rightarrow$ Diagram 2).

Theoretically, the amplitudes of the resonance can be infinitely large, see equation [2]. In reality, however, damping always occurs, limiting the oscillation amplitude.

Before optimisation: amplitude is +/− 1 mm

After optimisation: amplitude is +/− 0,2 mm
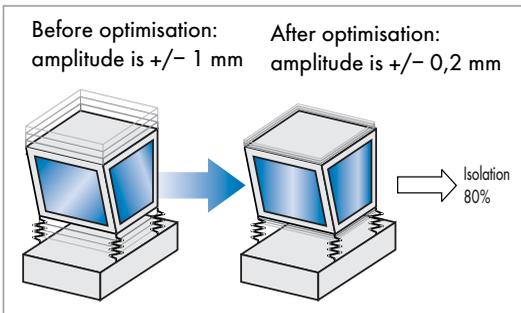
Isolation 80%

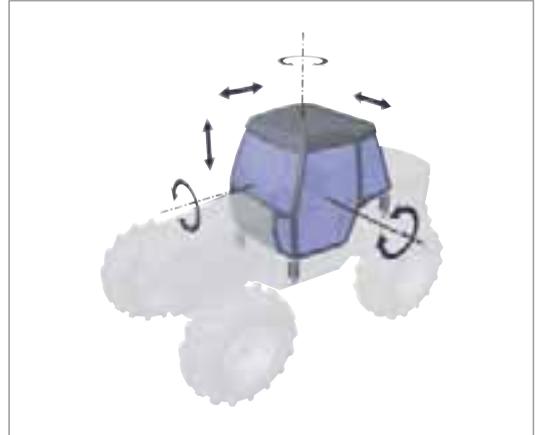Fig. 3   Optimisation of the cabin suspension

Fig. 4   Movement possibilities of the cabin

Fig. 5   Vertical vibrations of the cabin before optimisation

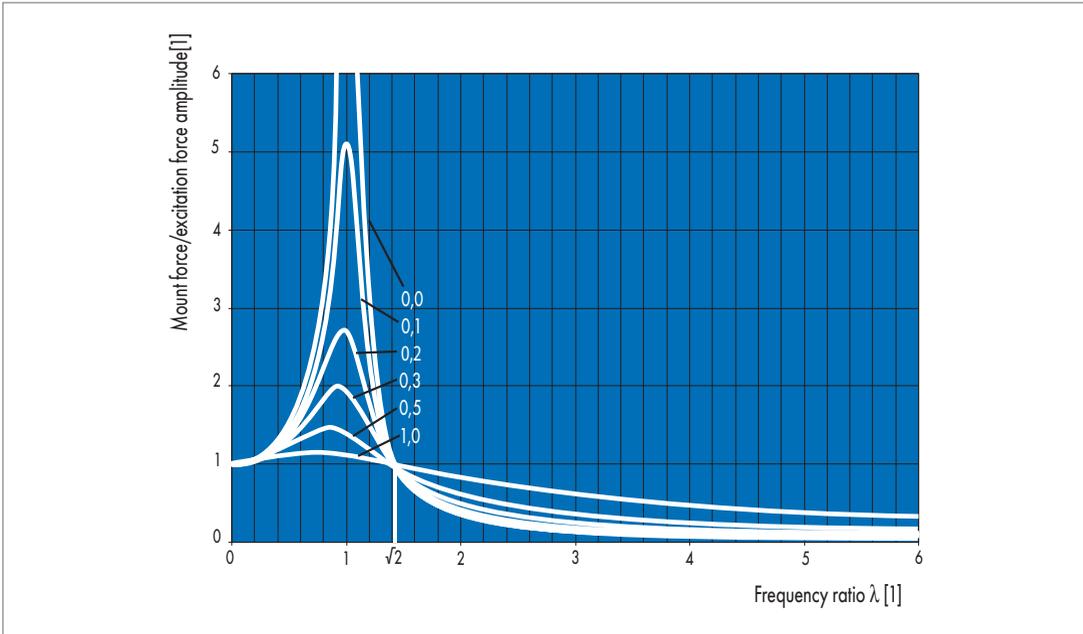Fig. 6   Vertical vibrations of the cabin after optimisation

Diagram 2 Amount of the transfer function (quotient resulting from the force reaction and exciter force amplitude)

Usage of damping in a targeted manner can significantly reduce the vibration amplitudes. In mounts with elastomeric components, a frequency ratio of greater than 2,5 to 3 and beyond can be recommended.

D >0	corresponds to steel and comparable materials
D ~0,1	corresponds to NR
D ~0,25	corresponds to AEM with high Shore hardness
D ~0,1... 0,3...	hydr. damping components.

Due to an increase in the damping, the reduction of the amplitudes, starting from a frequency ratio above √2, is lessened (→ Fig. 2). A significantly reduced amplitude at a frequency ratio greater than √2 requires reduced damping. This results in a central conflict of objectives in the design of the vibration control-related suspension and the selection of the suitable suspension components.

The assessment of the reduction of the amplitude of the vibrations is made based on the degree of insulation i. A degree of insulation of 80% means that only 20% of the original amplitude introduced to a suspension component is then further transmitted by it.

Procedure for Component Selection

Terms of reference

The objective is to select a suitable mount configuration on the basis of the target degree of insulation i.

Notes

The procedure described below is iterative, in other words it has to be repeated as often as necessary until the criterion is satisfied in accordance with the original postulations.

Calculation 1 (→ static deflection)

In the first step, the desired degree of insulation (step 1) is selected in diagram 3. If the excitation frequency is known (step 2), then the necessary compressive deflection which is required for the desired insulation can be determined (step 3). For this, a horizontal straight line is drawn mentally through the scale of the excitation frequency and at the chosen value through the selected insulation line running diagonally (step 2). Subsequently, through the intersection which this creates a perpendicular line is also drawn mentally that forms an intersection with the scale of the compressive deflection (step 3). This marks the necessary deflection required for the desired insulation at the viewed excitation frequency. The diagram can also be used in a different manner. For example, it allows for examining whether a chosen mount configuration consequentially has the necessary insulation at the excitation frequency that occurs.

Calculation 2 (→ mount reaction/force)

It is recommended to still determine the mount reaction (force F) based on the load distribution of the weight to be mounted. With this, the static compressive deflection $s_{in} \sim s_{max}/F_{max}*F$ is determined according to the factors s_{max} and F_{max} of the product selected from the catalog programme. The static compressive deflection should be a maximum of 80% of s_{max} with compressive deflection under load.

The static compressive deflection should be a maximum of 50% of s_{max} with compressive deflection under load and high dynamic loading. As a rule, numerous products can be identified for selection. An equal compressive deflection and the choice of identical mount components for a mass carried by the mounting components should be sought.

Calculation 3 (→ Notes)

It is recommended to examine the compressive deflection to be selected, with consideration being given to the safety factor. This takes into account the increase in amplitude (→ Diagram 2) of the suspended mass with the assistance of the amplification function of a simple suspension gradient. The amplification functions can be derived from relevant vibration control publications. Regarding handling of the safety factor, numerous details are given in the notes.

Criteria

The compressive deflection corresponding to the mount reaction should be harmonised with the compressive deflection for the desired insulation, while adhering to the safety factor.

A certain degree of flexibility is called for in the choice of i, the degree of insulation, because

- Geometric dimensions
- Design orientation
- Fitting and installation
- Requisite clearances
- Necessary oscillation limitations
- Resonance transient
- Vibration insulation in other spatial directions
- temperature range
- Media
- Other requirements

are all points that cannot be ignored.

Static Compressive Deflection

Based on Diagram 3, the requisite compressive deflection can be determined with the help of steps 1 to 3, leading to the desired degree of insulation i.

Step 1 Select the desired degree of insulation
Step 2 Select the excitation frequency
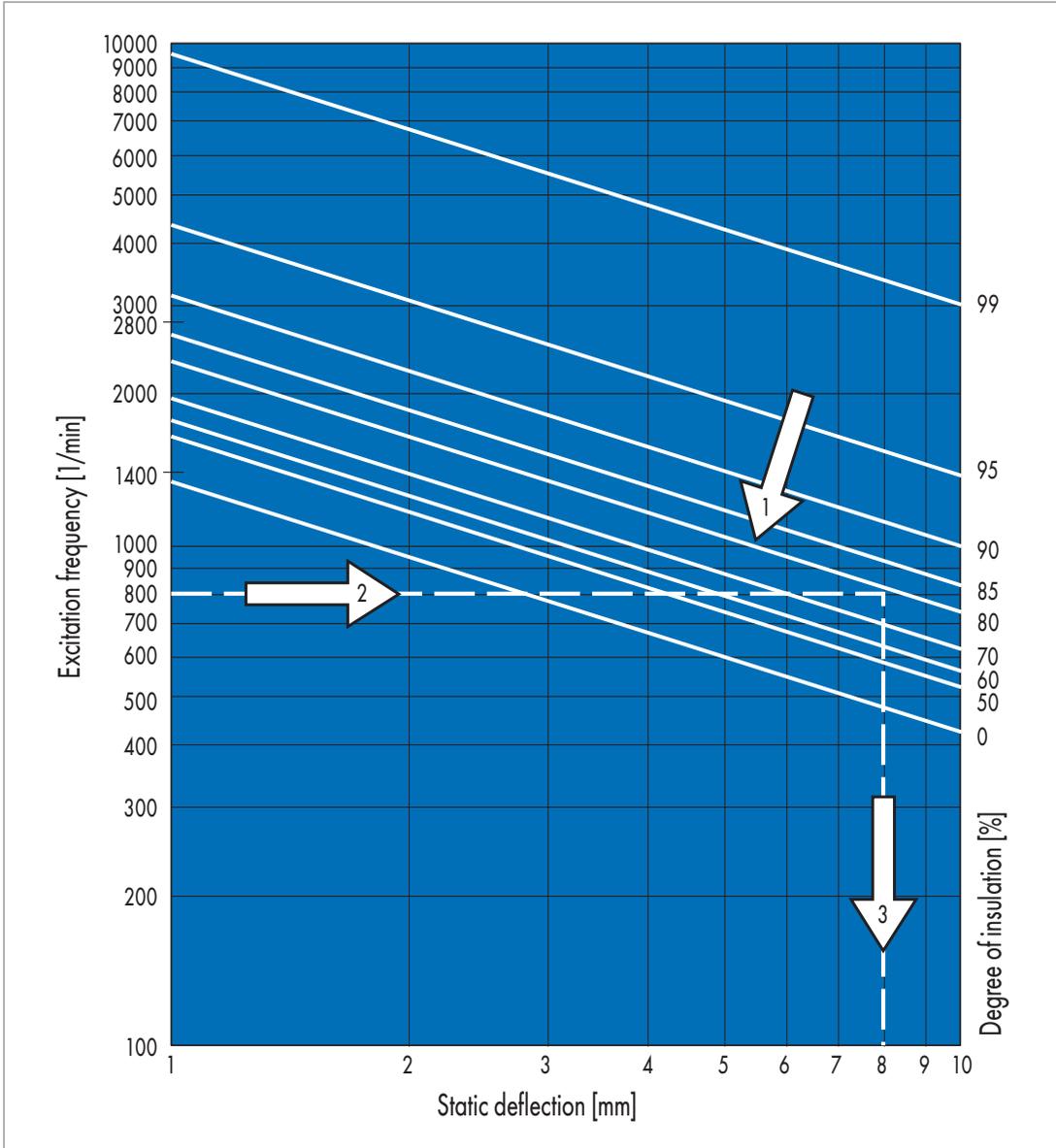Step 3 Take a reading of the compressive deflection

Diagram 3   Determining the static compressive deflection depending on the excitation frequency and the desired degree of insulation

Mount Reaction/Force

In order to position the weight properly (design requirements play an important role here) it is necessary to know the mount reaction.

This will be demonstrated here using the example of a four-point mounting system with an offset centre of gravity.
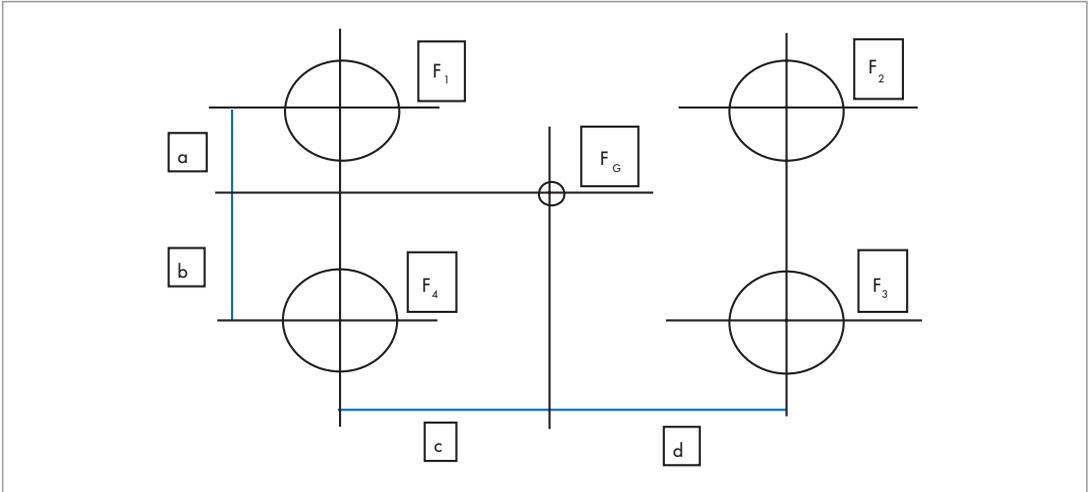

Fig. 7   Mount pattern (example)

Relationship of mount reactions to the weight force of the mass

[4] $F_1 = F_G \cdot \dfrac{b}{a + b} \cdot \dfrac{d}{c + d}$

[5] $F_2 = F_G \cdot \dfrac{b}{a + b} \cdot \dfrac{c}{c + d}$

[6] $F_3 = F_G \cdot \dfrac{a}{a + b} \cdot \dfrac{c}{c + d}$

[7] $F_4 = F_G \cdot \dfrac{a}{a + b} \cdot \dfrac{d}{c + d}$

Spacing of mount positions relative to the centre of gravity

Spacing		
	a	100 mm
	b	110 mm
	c	100 mm
	d	110 mm

Mount reaction		
	F_1	1098 N
	F_2	998 N
	F_3	907 N
	F_4	998 N

Tbl. 2   Mount spacing and mount reactions (forces)

Worked example

Weight [m]	400 kg
Gravitational acceleration [g]	approx. 10m/s²
Gravitational force [F_G]	4000 N

Tbl. 1   Weight and gravitational force

Notes

Safety factor for selection of products on the basis of compressive deflection

The following design implementations constantly refer to the contents of Figure 8. The following relationship to additional usage (disregarding the settling) can be recommended for the design of the mount configuration and the selection of the product (see Procedure for Component Selection).

[8] $0 \leq s_{max} - s_{in} - S \cdot A$

The recommendation applies to the working point. If a component is integrated, then it compresses due to the weight of the load.

The point up to which it compresses is called the working point. Retention of the inequality leads to a situation where the mounting component is stressed by the force path characteristic curve over a virtually linear range. The safety factor will be explained in more detail in the following text. As a rule, for the factor S a value of ~2 or larger is recommended. This way, with slight damping (D = 0,1 and smaller) of the resonance, it is entirely possible that superelevations of the oscillation amplitudes of 5 and higher occur (→ Diagram 2). The safety factor should be selected accordingly.
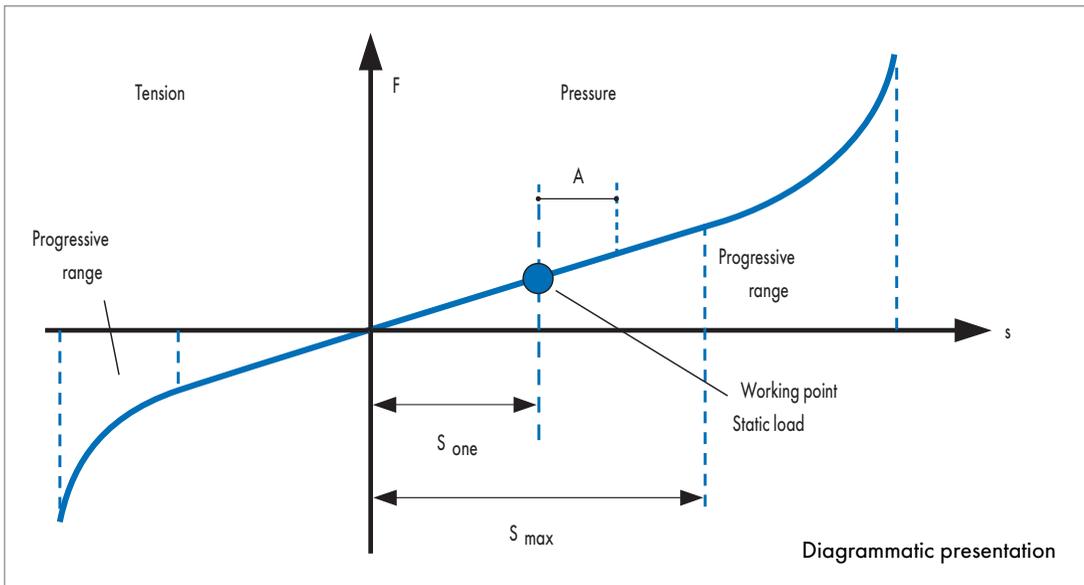

Fig. 8   Working point and oscillation amplitude
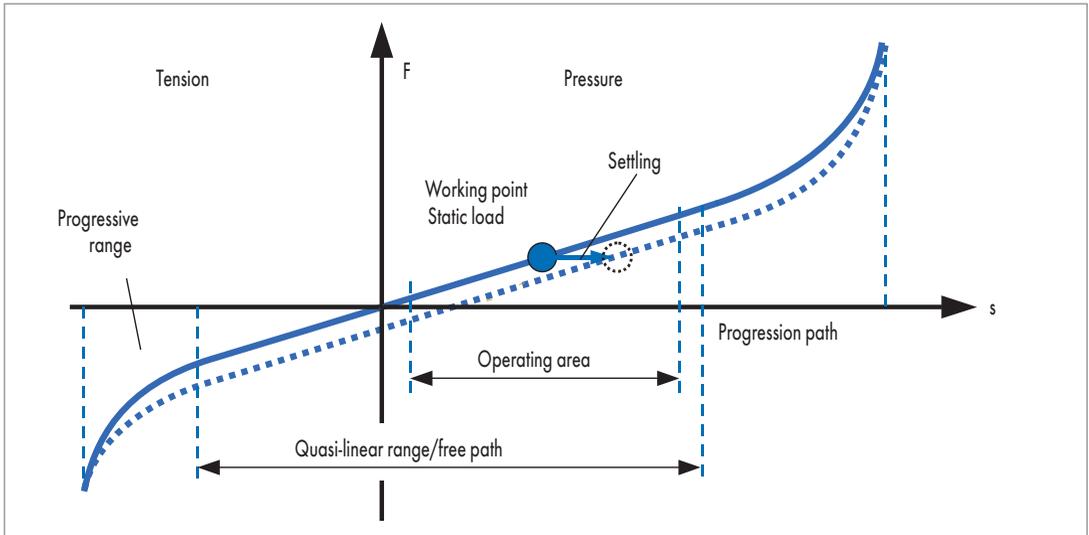
Settling of elastomeric components

Fig. 9   Settling of elastomeric components

Other considerations regarding settling of mounts

The settling of elastomeric components is a phenomenon which, under static load, leads to time-dependent, non-reversible, additional compressive deflection and is always component-specific and application-related. Simply stated, for many applications a settling amount of 20% of the compressive deflection can be assumed after 3 years. At increased temperatures and especially with dynamic loading of the component, this settling amount can be quickly reached. If necessary, the following points must also be considered: elastomer compound, load, the resultant load on the elastomer involved, geometry of the elastomer component, orientation of the component to the static primary load, and more.

Example of aspects of more complex terms of reference

Due to installation space limitations, there is a concrete requirement for the settling amount if maximum usage and good insulation is to be achieved with mounting components.

Step 1
Definition of a permissible threshold value for settling.

[9] $s_{max.\ settling} = 0{,}2 \cdot s_{in}$

Maximum settling should be 20% of compressive deflection under static load, after which the mounts will have to be replaced.

Step 2
Definition of a maximum permissible compressive deflection value under a static load.

[10] $s_{inmax} \leq 0{,}5 \cdot s_{max}$

Empirical data shows that this definition is frequently acceptance for components subject to highly dynamic loading.

Step 3

Establishment of the static compressive deflection value for further consideration.

[11] $s_{in} = 0,5 \cdot s_{max}$

This value should be arrived at as an optimum compromise between high insulation and allowance for the settling amount traded off against high utilisation of the component's virtually linear spring displacement.

Step 4

Definition of an inequality for design and selection of the mounting components.

[12]
$$0 \le s_{max} - s_{in} - S \cdot A - s_{setting\ max}$$
$$0 \le s_{max} - s_{in} - S \cdot A - 0,2 \cdot s_{in}$$
$$0 \le s_{max} - s_{in} - 0,2 \cdot s_{in} - S \cdot A$$
$$0 \le s_{max} - s_{in} \cdot (1-0,2) - S \cdot A$$

$$0 \le 1 - \frac{s_{in}}{s_{max}} \quad (1-0,2) - S \cdot \frac{A}{s_{max}}$$

$$0 \le 1 - 0,5 \cdot (1-0,2) - S \cdot \frac{A}{s_{max}}$$

$$0 \le 1 - 0,4 - S \cdot \frac{A}{s_{max}}$$

$$0 \le 0,6 - S \cdot \frac{A}{s_{max}}$$

The inequality [12] presented here for assessment applies under the following set of postulations:

- Steady-state operation at resonance
- The oscillatory system can be considered as a single-mass oscillator
- A present, yet minor damping
- Linear spring characteristic curve.

Once the maximum
compressive deflection has been determined, a suitable component can be selected in the product part.

Example:

The safety factor is selected in accordance with the maximum value of the amplitude increase at the point of resonance and, if excitation amplitudes occur, then it can lead to the following maximum deflection values corresponding to the inequality [12].

By selecting a correspondingly high damping rate the maximum required compressive deflection sinks, resulting in a greater availability of mount components for the product part. The compressive deflection or upward deflection can effectively be limited by stops.

Typically, mount components are selected so that the lowest excitation frequency is insulated. That does not generate the requirement for the assessment shown here. Reference is made again here to the design implementations with respect to the conflicting objectives of vibration control.

Explanatory notes on the safety factor

In case of weakly dampened vibration control systems, large vibration amplitudes can arise close to or at the natural frequency itself. In order to analyse these systems with forced vibrations (permanent excitations), a maximum increase of the response amplitudes with a specific frequency relationship (point of resonance) is just as important as the relationship between the response amplitudes and the excitation amplitude at the stationary operating frequency of the exciting system (insulation; see previous reference). The amplification functions are used for this assessment. Refer to the publications on these. At resonance, the following relationship can be posited.

[13] $S \ge V_{max}$

The excitation amplitude can, for example, be detected by measurement or detailed scrutiny of the exciting system already during the design. If a stationary state is no longer valid, then the point of resonance will be gone through with increasingly rapidity and the amplitudes are no longer formed in the same resounding manner. Less energy is "pumped" into the oscillatory system. An increase of the damping also reduces the vibration amplitudes at the point of resonance. Among other things, this offers the potential to utilise mounts that have a smaller s_{max}. This means that smaller mounts can be selected. According to diagram 2, a certain disadvantage can arise regarding the insulation at the operating frequency. A compromise depends o the criteria for selecting the degree of insulation.

Regarding loads

A conflict of objectives that is inherent with many suspension systems is the desire for good insulation at operating frequency and effective limitation of the amplitudes resulting from jolting excitations. Neither comfort and acoustic expectations should be reduced nor are component movements beyond a specific value desirable in order to avoid damage, for instance.

With oscillatory suspension systems, jolting loads lead to vibration excitations at the natural frequency. As a result of the singular input of energy, the excited vibration cannot increase unrestricted over a time period at the resonance frequency. However, larger shock-load impulses lead to remarkable counter-amplitudes, which can have a negative influence on the comfort and acoustics and cause component damage as well.

Mount configurations that have a low stiffness at the working point (compressive deflection through static load) and have stops for limiting the amplitudes are optimum for these demands. This recommendation is directed towards components that are evaluated against high insulation demands. However, the shock loads should seldom occur and the maximum operable forces stated in the product part should not be exceeded.

Stops are already provided for or can be made available for many components. Hydro Bush, Conical Mount, Tapered Mount and V Mount ought to be cited here as product examples that are included in the catalogue.

For the non-anchored installation of machines, units, devices, cabinets, etc.

A machine is supposed to be installed non-anchored on the workshop floor. After two years, the final location is supposed to be specified. Due to the presence of machines in the immediate vicinity, oil moistening on the floor can not prevented.

What factors will have to be taken into account in positioning the machine?

When selecting the mounts (M Mount, Buffer, etc.), attention should be given to oil-resistant elastomers such as NBR. The compressive deflection (also refer to mount reaction) of the mount should be identical or virtually identical. Here as well, the previously introduced inequality [8] for determining the compressive deflection can be used.

Oscillatory excitations in the horizontal direction should be avoided or, in any case, regarded within the context of the design.

Any further instructions?

The stability of the installation is improved by a low centre of gravity and a large, most evenly spaced horizontal spacing of the mounts to the centre of gravity. If necessary, a subframe would be suitable here. The moistening of the installation location due to lubricating oil or grease reduces the stability of the installation position. This plays an even greater role with correspondingly greater horizontal oscillatory excitations, possibly in interaction with substantial vertical oscillatory excitations and a smooth workshop floor as well. The likelihood of a moistening of the mounts can be reduced by oil pans for the machines in the vicinity.

Height adjusters (M Mount) or comparable solutions can be used to level the machines. If the final machine location is certain and the mount configuration has proven reliable, then it can be retained. The design should be examined if necessary, also the choice of the compressive deflection with consideration being given to the desired degree of insulation, as well as the compressive deflection resulting from the static load. If the varied requirements can only be met through compromise, then the catalog programme can offer another, more technically optimised offering (V Mount, Machine Mount, etc.).

The objective of these suggestions is a stable machine installation.

Assembly

Fitting is an essential step before using the vibration control-related components.
Proper execution ensures the functionality and has a major influence on the service life of the mounting component.

For a proper fitting, care must be given to the proper arrangement of components. Please ensure that:

■ The radially loaded cylindrical mounts are arranged centred and perpendicular to the equidistant axis of symmetry
■ Cylindrical mounts whose interior are not positioned in a centred manner and are also loaded radially, are positioned so that the greatest distance from the axle inner sleeve to the axle outer sleeve is reduced throughout the plane by both axles
■ Cylindrical mounts, if possible, absorb the load / vibrations over the entire cylindrical geometry
■ Axially loaded cylindrical mounts are positioned both centric and coaxially to the axis of the main load
■ Non-cylindrical mounts with a distinctive axis of symmetry under axial load are positioned centric and coaxial to the to the axis of the main load
■ Non-cylindrical mounts with a distinctive axis of symmetry under radial load are positioned centred and perpendicular to the axial symmetry.

When preparing for fitting, it is important to observe that:

■ The mounting surfaces for threaded connections on the mounting component, such as on housings, consoles and the mass to be carried, are flat and free of damage and contamination
■ Threaded holes and threaded studs for fastening are ready, with standard commercial threaded fasteners and nuts
■ Surfaces for a lengthwise pressure seat are not damaged and are free of contamination
■ Threads are not damaged and are free of contamination
■ The connection geometries and their connective surfaces are flat and free of fluids and clinging particles, such as burs
■ In the movement space of the mounts, particularly on the exposed elastomer surfaces, no sharp edges, tips or other components non-essential to the function are jutting inside
■ Mounting components should not be installed closed to sources of heat. The mounting components should not be exposed to any higher-level heat radiation. Similarly, with highly dynamically loaded mounts the self-generated heat can accumulate, possibly preventing necessary cooling
■ While preparing for fitting, the mounting component should not be subjected to any loads
■ No rough damage occurs during preparation for fitting of the corrosion protection of the mounting component.

While carrying out the fitting and applying the forces, it should be ensured that:

- The fitting force is equally distributed across the contact surfaces of the force-transmitting components.
- As regards cylindrical mounts with thin-walled metal parts, forces used to press in and on, as well as press out, are distributed equally over the face surfaces of the precision sleeves.
- The loads are distributed across the entire flange surface intended for the fitting.
- The forces are applied over large, flat surfaces for threaded connections; by using plain washers, for example.
- The axial main loads are applied equally across the entire connection geometries on the connective surfaces.
- The radial main loads are applied equally across the entire connection geometries on the connective surfaces.
- Boreholes for the pressing-in of mounting components are provided with a chamfer at the insertion opening, chamfer angle < = 15, chamfer length approx. 3 mm (depending on the tolerances of the bore and the outside diameter of the mounting component).
- Studs for the pressing-in of mounts are provided with a chamfer at the insertion opening, chamfer angle < = 15, chamfer length approx. 3 mm (depending on the tolerances of the stud and the inside diameter of the mounting component).
- The ends of the threaded fasteners are screwed into the threaded hole at least the 1,25 times.
- The elastomer component is not heated or cooled any more than what is permissible (see the product description) while fitting.
- The mounting component is not subjected to any unintended loads.
- No rough damage occurs while fitting the corrosion protection of the mounting component.
- Friction-reducing fluids are used when joining the lengthwise pressure seat. Plain machine oil is usually sufficient. Attention: after fitting, approx. 1 day should pass before applying load.
- Washers should be used when fastening flanges.

Standards

- Ensure that the boreholes for accommodating the threaded studs are compliant with DIN EN 20273.
- It is advisable to use DIN-compliant threaded fasteners and corresponding components for fitting.

Fitting results

- Compensation of minor, fitting-related offset or angular offset is possible, depending on the component.
- Ensure that the connection geometries are tightened properly in relation to each other after the static load has been applied.

Usage, application of force

- The force of impact of the mounting component should be introduced in the direction of the main load.

Product environment, housing

- Care should be taken to ensure that fasteners, brackets, frames, etc. do not restrict the area of movement of the mounts.
- Please prevent sharp edges, tips or other components non-essential to the function from jutting into the movement space of the mounts, particularly where there are exposed elastomer surfaces.

Corrosion protection

- When applying corrosion protection to the elastomer component, it must be ensured that it is not heated any more than what is permissible (see product description).
- Ensure that, when applying corrosion protection, the elastomer component does not come into contact with any solvents or fluids containing solvents, or any acidic or base substances.

Basic and operational characteristics of elastomer materials

The basic characteristics of an elastomer are essentially determined by the base polymer used. The technical operational characteristics can, of course, be influenced within specific limits by a corresponding mixture design and adapted to the respective requirements.

Given the multiplicity of basic elastomers available and the variety of compound orders developed by Freudenberg, it is possible to select the ideal elastomeric material for virtually any application.

ACM

Vulcanisations made of polyacrylate rubbers (ACM) exhibit excellent ozone, UV and weather resistance as well as excellent resistance to high temperatures. Essentially, ACM vulcanisations have a significantly higher damping than vulcanisations made of NR and NBR along with a comparatively restricted low-temperature applicability.

AEM

By contrast, vulcanisations made of the ethylene-acrylate rubber VAMAC® (AEM) contain ethylene groups in their polymer even series, which result in an improved suitability for low temperatures combined with improved water and glycol resistance. On the other hand, they offer no resistance to acids and alkalis and only limited resistance to mineral oil. AEM vulcanisations are also strongly cushioning materials.

CR

Chloroprene rubber (CR) is distinguished from natural rubber by a better temperature resistance and good weather and ozone resistance.
CR vulcanisations distinguish themselves by a moderate resistance to grease and oil as well as good nonflammability. On the other hand, CR inferior to NR with regard to damping and regarding suitability for low temperatures.

EPDM

Ethylene-propylene rubber (EPDM) is the material of choice if resistance to valent media (e.g. water, water vapour, watery media and glycol) must be ensured. Furthermore, EPDM offers outstanding resistance to ozone and UV and weathering combined with excellent high and low temperature resistance (-50 °C to 130 °C, or transient 140 to 150 °C). Compared to NR, EPDM attains only a low level of firmness. EPDM is also not resistant to mineral oil or grease.

HNBR, FKM, …

In addition we offer many customer-specific material solutions. Thus, for example, we also process HNBR (hydated nitrile rubber) or FKM (fluoro rubber).

NBR

Acrylonitrile butadiene rubber is a polymerisation made of butadiene and acrylonitrile. The acrylonitrile (ACN) portion of the material can be between 18% to 50%. NBR is used as a standard material especially for mineral oil applications and also suitable for covalent media. With a low ACN content, the material has excellent low-temperature flexibility (approx. -38 °C), however, with reduced oil and fuel resistance. A higher ACN content provides for optimum oil and fuel resistance, but at the same time, however, with a lower temperature flexibility (approx. -3 °C).

NR

Natural rubber (NR) is still the widely used rubber today for vibration control owing to its unsurpassed mechanical characteristics over a wide application temperature range (-45 °C to 100 °C). Vulcanisations of NR are distinguished by an exceptionally high strength class combined with low crack propagation speed (greater tearing propagation resistance), which derives from a self-reinforcing effect through crystallisation upon elongation. In contrast to synthetic rubber, this also applies to very soft and even unfilled vulcanisations. Its high elasticity is accompanied by a low loss factor, which only leads to a low self-warming with dynamic loading. Its cold temperature characteristics are excellent, the resistance to heat is, however, limited. It can be raised through the optimisation of materials in a targeted manner, however, up to a peak temperature of 100 °C. NR vulcanisations are not resistant to mineral oil or grease.

Overview

Base elastomer	Natural rubber			Acrylonitrile butadiene rubber		Acry- late rubber	Ethylene acrylate rubber	Chloroprene rubber		Ethylene propylene rubber	
Compound order, code (ISO)	NR			NBR		ACM	AEM	CR		EPDM	
Compound order	NR 11	NR 39	NR 97	NBR 38	NBR 68	ACM 18	AEM 33	CR 56	CR 57	EPDM 22	EPDM 32
Hardness range (Shore A)	35 ... 80	40 ... 75	40 ... 75	45 ... 85	45 ... 85	50 ... 75	55 ... 85	40 ... 80	40 ... 80	50 ... 80	45 ... 80
Tensile strength	Very high	High	High	High	High	Low to medium	Medium to high	High	High	Medium to high	Medium to high
Rebound elasticity	Very high	High	High	Medium	Medium	Low	Low	Medium	Medium	Medium	Medium
Damping	Very low	Low	Low	Medium	Medium	High	High	Medium	Medium	Medium	Medium
Flexibility when cold (to °C)	−45	−40	−45	−40	−25	−5	−20	−30	−30	−40	−40
Maximum long-term safe temperature (°C)	+60	+90	+90	+80	+90	+120	+120	+100	+100	+130	+120
Transient temperature (°C)	+80	+100	+100	+100	+110	+150	+150	+130	+130	+150	+130
Shrinkage behaviour	Medium	very good	very good	Good	Good	Medium	Medium	Medium	Medium	very good	Good
Aging and weather resistance	Medium to good	Medium to good	Medium to good	Good	Good	very good	very good	Good	Good	very good	Good
Mineral oil resistance	Low	Low	Low	very good	very good	very good	Medium	Medium	Medium	Low	Low
Resistance to diluted acids and alkalis (low temp.)	Good	Good	Good	Good	Good	Low	Low	moderate	moderate	very good	Good
Water 80 °C	Medium	Medium	Medium	Good	Good	Low	Low	Medium	Medium	very good	Good

Tbl. 3

Products

simrit®

Pre-Selection Vibration Control

The table is based on years of supplier activity and is adapted to current knowledge.

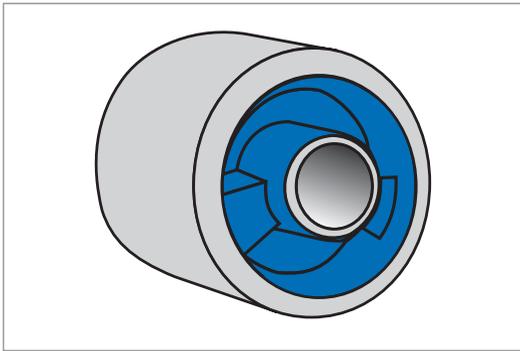|	Hydro Bush	Hydro Mount DL	Hydro Mount VL	Hydro Mount KL	Ultra Bush	Spherical Mount	Conical Mount	V Mount	MO Mount	Machine Mount	Flat Mount	Rails	
Exhaust-air ducts, exhaust pipes, ...									●				
Electrical/electronic components and subassemblies					●		●						
Instruments, devices, displays, ...					●								
Levers, steering gear, coupling links, ...					●	●							
Cabs, superstructures, ...	●	●	●	●	●		●				●		
Radiators					●				●				
Bearings general	●	●	●	●	●	●	●	●	●	●	●	●	
Measuring devices	●	●	●	●				●					
Reaction-support links	●	●	●	●	●	●	●	●					
Pumps	●	●	●	●	●		●	●		●	●		
Mixers, separators, centrifuges, agitators, ...	●	●	●	●	●		●			●	●		
Stirrers	●	●	●	●	●	●	●		●		●		
Screen mounts					●								
Panels									●				
Rolling mills								●		●	●	●	
Maintenance-free articulation					●	●						●	
Machine tools	●	●	●	●	●		●	●	●	●	●	●	
Engines, units, compressors, ...	●	●	●	●	●		●	●	●	●	●	●	
Subassemblies, attached devices, ...	●	●	●	●	●	●	●	●	●	●	●		
Stationary machines and gearboxes, ...	●	●	●	●	●		●	●		●	●	●	
Levelling													
Limitation of movements													
Hydraulic and pneumatic hoses													

Tapered Mount	Double U-Shear Mount	Circular Mount	Buffer	M Mount	Instrument Mount	O-Shaped Mount	Top Mount	Sperical Roller Bearing	Layered Springs	Additional components	O-Bush	Pipe Mounting Block	Rubberised Sprockets	Belt Pulley with Elastomer Track	Decoupled Chain Gear	Decoupled Gears	Decoupling Elements
	●	●				●			●			●					
	●	●			●	●			●	●							●
	●	●			●	●			●	●							
									●	●							
●									●								
		●							●	●							
●	●	●	●	●	●	●	●	●	●	●							
	●	●		●	●	●			●	●							
		●	●				●		●	●							
●		●							●	●							
●		●	●	●					●								
		●	●														
											●						
		●			●				●	●							
		●			●		●										
		●								●							
●	●	●	●	●	●	●	●	●									
●		●				●			●	●			●	●	●	●	●
●	●	●	●	●	●	●	●		●	●							●
●		●		●				●	●					●		●	●
									●								
									●								
												●					

Hydro Bush

Hydro Bush

Product advantages

- Frequency & amplitude selective damping
- Integrated limitation of the spring displacement
- Allowing twist in all directions
- Easily installed
- RoHS-compliant.

Application

Suitable for mountings of combustion engines, cabs, pumps and compressors, mainly in agricultural machines and construction machinery.

Product description

Hydro bushes are elastomer springs with integrated hydraulic damping.

Material

Standard material	Hardness
Natural rubber NR 11	35, 45, 55, 62, 68 Shore A

Operating conditions

Compressive forces in Z direction	1100 N ... 4200 N	Maximum permissible force
Max. temperature	+60 °C, transient +80 °C	
Min. temperature	−45 °C	
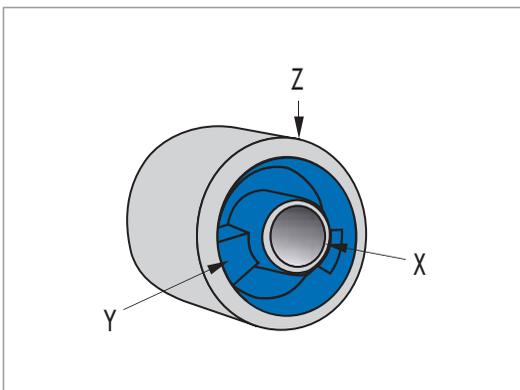
Primary load directions

They are specifically suited when low frequencies occur as excitation frequency in the mount system. They achieve a high damping in the natural frequency range of the system as well as gut isolation properties above this range. Vibrations in the mount system which have a sound-conducting or radiating characteristic, generated primarily through excitation amplitudes or dynamic forces in the audible frequency range are significantly reduced. The integrated hydraulic mechanism in the bush with the frequency and amplitude dependent damping is designed for effect in the Z direction. By matching the damping maximum of the hydro bush to the critical frequency (resonance frequency) of the spring-supported mass, the resonance magnification can be noticeably reduced. For higher

frequencies, the insulating capability of elastomer bond components can be utilised. The hydro bushes are designed so that the translatory stiffness increase in the order X,Z,Y. The bushes are designed for the primary load in the radial (Z direction) as well as the axial direction (X direction) but can also absorb slight cardanic and torsional deformations. Depending on the design, limiters for deflection (labelled as HD) with or without reinforcement can be integrated in the Z direction.

Design notes

The mount configuration comprises an elastomer-metal composite with load-bearing element in Vee-shape, stops, fluid chambers and overflow ducts. The composite is mounted in an outer sleeve and fluid-filled.

Fitting & installation

- Hydro bushes have an outside fit and accommodate a threaded fastener on the inside for installation
- Hydro bushes can be secured with Loctite or other, similar adhesive if a press fit is not desired
- Individual components permit slight adjustment to allow for in-situ offset
- Always install hydro bushes centred and at right angles to the axis of primary radial load and if possible, utilise the entire cylindrical surface area of the outer sleeve as the bearing surface
- If possible, utilise the entire cylindrical length of the inner sleeve bore as the bearing surface
- Position the bush relative to the weight load in such a way as to reduce the largest distance between the axis of the inner sleeve to the axis of the outer sleeve in the place through both axes.

Installation instructions

Loading case I

$1/2\, F_Z$ $1/2\, F_Z$

Installation direction

F_Z (Frame)

Loading case II

Installation direction

F_Z

$1/2\, F_Z$ (Frame) $1/2\, F_Z$ (Frame)

Fitting

R5

Ø100 H9

Rz16

Radiused edge indicates direction for fitting the hydro bush
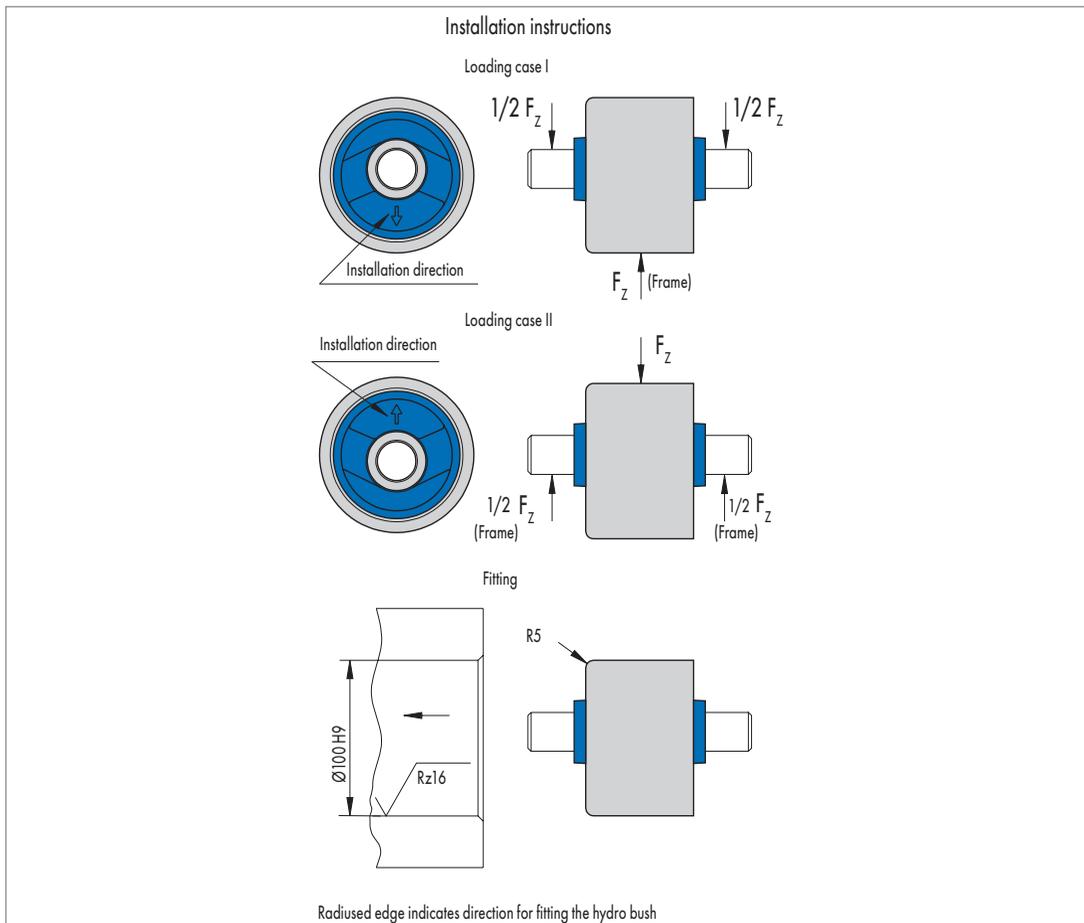
Fitting & installation instructions: Hydro Bushes

Hydro Mount DL

Hydro Mount DL

Product description

The hydro mount, as a hydraulically damping rubber mount, solved the designer's conflict of how to mount a mass that is excited by wide frequency spectrum. Particularly if low frequencies – between 5 Hz and 15 Hz – can occur as the excitation frequency, on the one hand high damping in the natural frequency range of the system, and on the other, a good isolation property above this natural frequency (supercritical mounting) is necessary.

Product advantages

- Frequency & amplitude selective damping
- Cross-stiffness
- Integrated capability for levelling the load
- HD version for "extra-hard" use
- RoHS-compliant.

Application

Hydro Mounts DL are suitable for use as mounts for pumps, compressors and engines in utility vehicles and in boats and for vehicle superstructures, particularly driver's cabs.

Material

Standard material	Hardness
Natural rubber NR 11	40, 45, 50, 55, 60, 65 Shore A

Operating conditions

Compressive forces in Z direction	700 N ... 1700 N	Maximum permissible force
Max. temperature	+60 °C, transient +80 °C	
Min. temperature	−45 °C	

Primary load directions

Static spring characteristic curve in Z direction
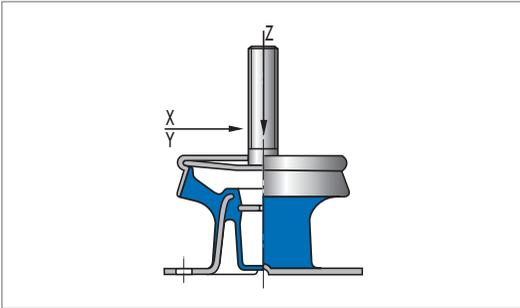
Hydro Mounts DL are predominantly used in vehicles of all types. In these applications the related assembly must be mounted as softly as possible to achieve a good structure-borne sound isolation. At low frequencies near the natural frequency of the spring-mass system engine/engine mounts, such soft mounting results in inadmissibly high amplitudes at the motor. Hydro Mounts DL have a soft spring characteristic and thus a large static deflection.

c_1 = load bearing spring
c_2 = bulge spring
d = hydraulic damper
m = dimensions
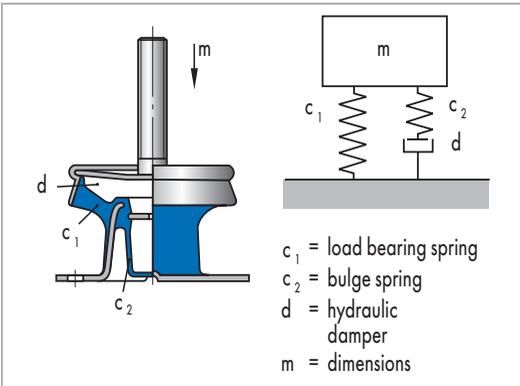
Mode of operation

The hydraulic mechanism with frequency and amplitude dependent damping integrated in the mount is designed for effect in the Z direction. By matching the damping maximum of the mount to the critical frequency (resonance frequency) of the spring-supported mass, the resonance magnification can be noticeably reduced. For higher frequencies, the insulating capability of elastomer bond components can be utilised. These hydro mounts have a greater flexibility in the Z direction than in the X,Y direction. Hydro mounts are designed for primary loading in the axial as well as radial direction but they can also withstand cardanic deformation. The longitudinal axis should be selected for the introduction of the static primary load.

Transient of the loss angle as a function of frequency

Dynamic spring rate as a function of frequency

Graph labels: Dynamic spring rate C_{dyn} in N/mm, Frequency f in Hz

Curve labels: 3618700 HD / 3618 029, 3618701 HD / 3618 028, 3618702 HD / 3618 026
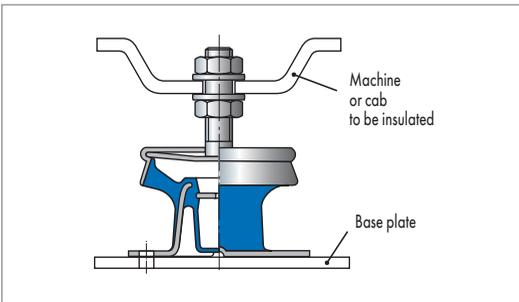
Fitting & installation instructions: Hydro Mount DL

Labels: Machine or cab to be insulated; Base plate

Design notes

The mount configuration comprises a conical mount with integrally moulded/integral expansion bellows with threaded stud. The expansion bellows is filled with a special fluid. A control plate is located between the expansion bellows and the securing plate for setting of the specific hydraulic damping characteristics.

Fitting & installation

- Hydro mounts are designed to be secured by means of the threaded fastener with securing plate assembly and the flange of the conical mount
- Individual components permit slight adjustment to allow for in-situ offset or angular offset
- It is important to ensure that the mating faces of the frame and the mass carried by the mount are flat and smooth
- In particular, the area underneath the flange mount must be free of sharp edges, burrs and filings, so that the rubber element can expand on it without risk of damage
- Position the mount relative to the static load in such a way that securing plate and flange are preloaded relative to each other
- Use HD-rated hydro mounts by preference for applications with extra-harsh conditions characterised by many hard shock loads: fork-lift trucks running on solid-rubber tyres is a typical example.

Hydro Mount VL
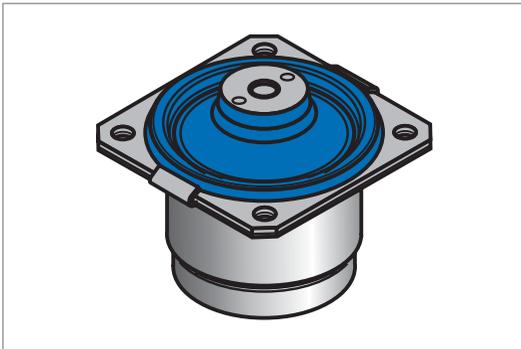
Hydro Mount VL

Product advantages

■ Broad-band damping at high amplitudes
■ Significantly reduced damping at low amplitudes
■ Optimised elastomer spring
■ Compact
■ RoHS-compliant.

Application

The Hydro Mount VL offers a wide range of possible applications such as cab and engine mounts, for agricultural and construction machinery, industrial vehicles, forest machinery, communal vehicles, ships and for mounting superstructures, pumps and compressors. It is equally suited for mounting machinery and systems/units with severe resonance transients.

Product description

The mount design, the chosen fluid and the hydraulic mechanism provide the characteristic wide-band damping. In cases with remote excitation frequencies in the lower frequency range, the use of this hydro mount permits an optimal mounting. By precise reduction of the fluid chamber stiffness of one of the chambers, a significantly improved compromise of effective vibration reduction and structure-borne sound isolation is achieved as opposed to the hydro mounts without this design.

Material

Standard material	Hardness	Special design
Natural rubber NR 11	40, 45, 50, 55, 60, 65 Shore A	on enquiry

Operating conditions

Axial forces in Z direction	3000 N ... 8500 N	Maximum permissible force
Max. temperature	+60 °C, transient +80 °C	
Min. temperature	−45 °C	
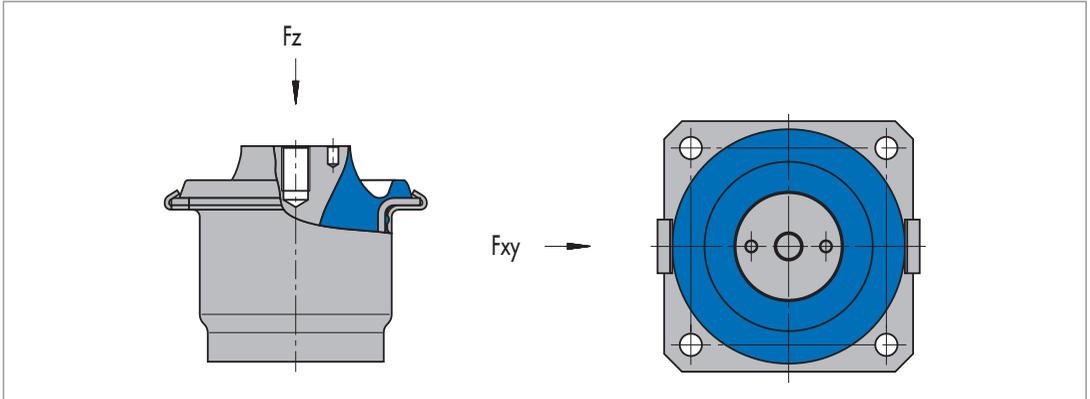
Primary load directions

The hydraulic mechanism with frequency and amplitude dependent damping integrated in the mount is designed for effect in the Z direction. The effective damping over the wide-band frequency is also present for changes to the spring-supported mass. At low excitation amplitudes, the Hydro Mount VL has a significantly reduced damping. Hydro Mounts VL have a greater flexibility in the Z direction as in the X,Y direction. The mount configuration is designed for primary loading in the axial as well as radial direction but it can also withstand cardanic deformation. The longitudinal axis should be selected for the introduction of the static primary load.
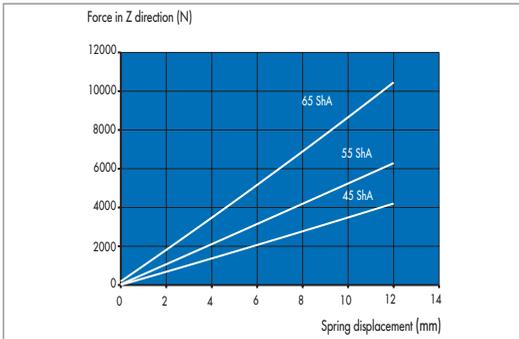

Force-deflection characteristics, 036 18 704
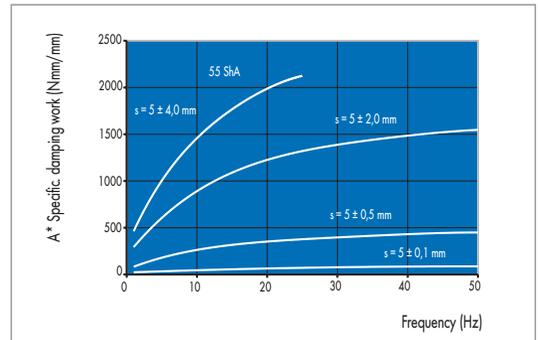
Specific damping work, 036 18 704; 55 ShA
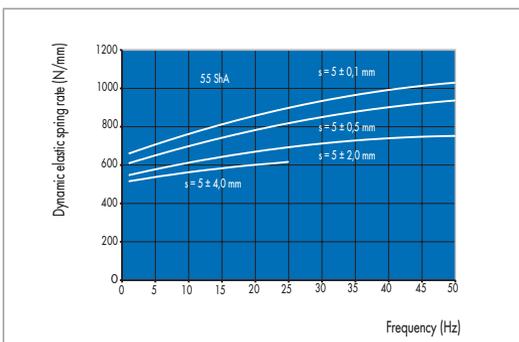
Dynamic spring rate, 036 18 704; 55 ShA

Design notes

The mount configuration comprises a conical mount with outer metal component with rectangular flange and bore holes. It also contains an inner metal component with central thread hole to which a washer is attached which extends into a fluid-filled chamber. This is formed by the tapered mount and the cup mounted on the tapered mount. The base of the cup is closed off with a diaphragm.

Fitting & installation

- ■ Hydro Mounts VL are designed to be secured by means of threaded fasteners
- ■ Individual components permit slight adjustment to allow for in-situ offset
- ■ The flat part of the flange must make full-surface contact with the supporting structure
- ■ It is important to ensure that the mating face is flat and smooth, and the same applies to the mating face of the mass carried by the mount. It is also important to ensure full-surface contact with the inner metal part of the mount
- ■ Position the mount relative to the static load in such a way that the inner metal part of the conical mount and the flange are preloaded relative to each other.

Hydro Mount KL
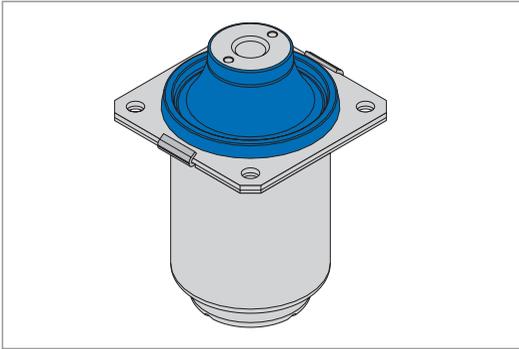
Hydro Mount KL

Product description

The new Hydro Mount KL is ideally suited for mounting systems with the highest comfort and acoustic demands. The mount configuration can be individually adjusted to suit the specific customer application.

Product advantages

- Characteristics can be customised to suit the specific application
- Frequency and amplitude-selective damping
- Good insulation at low excitation amplitudes
- Optimised elastomer spring
- Two selectable cross-stiffness stages
- Can be used in combination with sturdy tensile stops
- RoHS-compliant.

Application

Through the use of the Hydro Mount KL, an efficient, narrow-band damping effect in a wide frequency range is achieved. This resilient connecting element thus has wide application for the mounting of cabs, superstructures, engines, pumps and compressors.

Material

Standard material	Hardness
Natural rubber NR 11	40, 45, 50, 55, 60, 65 Shore A

Operating conditions

Axial forces in Z direction	1900 N ... 8200 N	Maximum permissible force
Max. temperature	+60 °C, transient +80 °C	
Min. temperature	−45 °C	
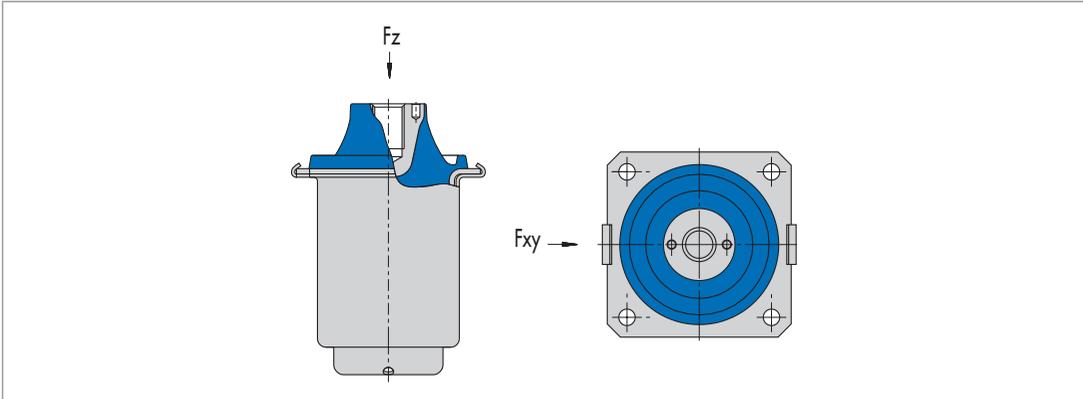
Primary load directions

The mount component can be specifically mounted with different components for realising different definable characteristics which are primarily based on the additional hydraulic damping characteristics to the conical mount characteristics. The integrated hydraulic mechanism in the mount with the frequency and amplitude dependent damping is designed for effect in the Z direction. By matching the damping maximum of the mount to the critical frequency (resonance frequency) of the spring-supported mass, the resonance magnifi-

cation can be noticeably reduced. With small excitation amplitudes (structure-borne noise), these mounts have a very slight damping. The Hydro Mounts KL have a greater flexibility in the Z direction than in the X, Y direction; The stiffness relationship has two adjustment levels. They are designed for the primary loading in axial and radial direction but can also withstand cardanic deformation. The longitudinal axis should be selected for the introduction of the static primary load.
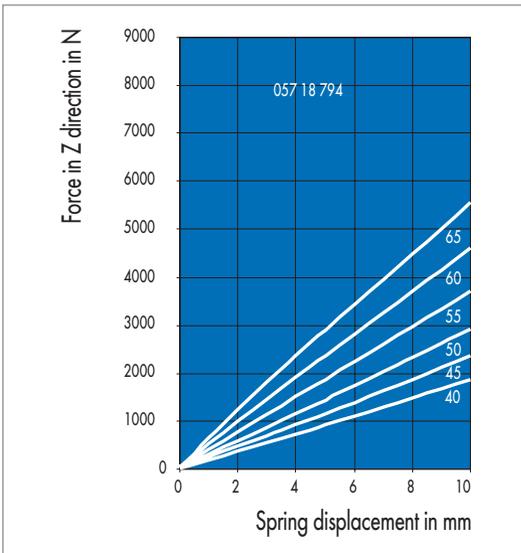
Static spring characteristic curves in Z direction
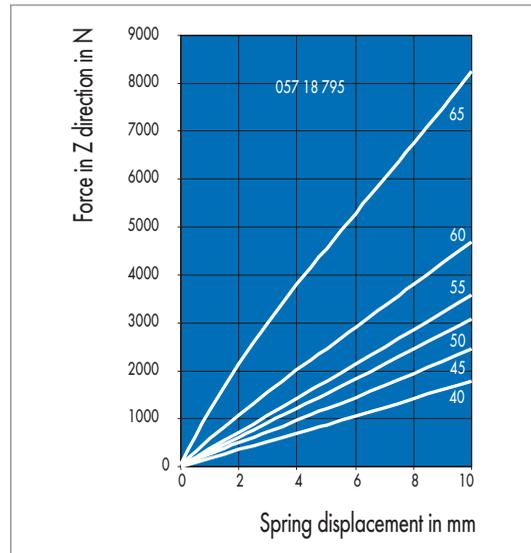
Static spring characteristic curves in Z direction
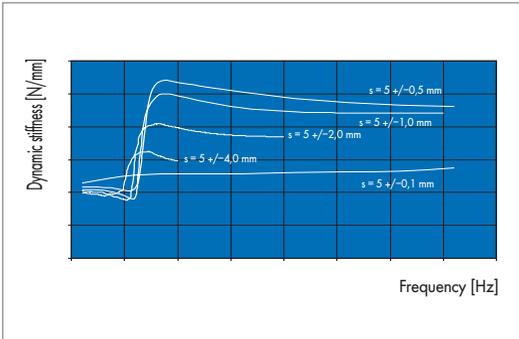
Dynamic stiffness
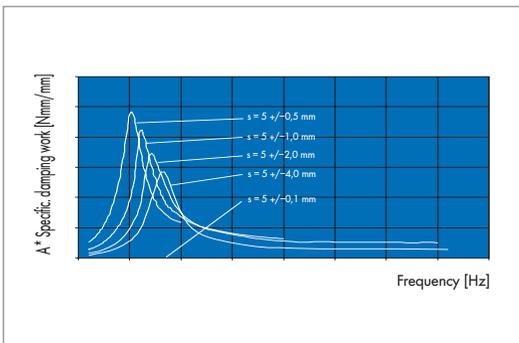
Specific damping work as a function of frequency
(example, qualitative)
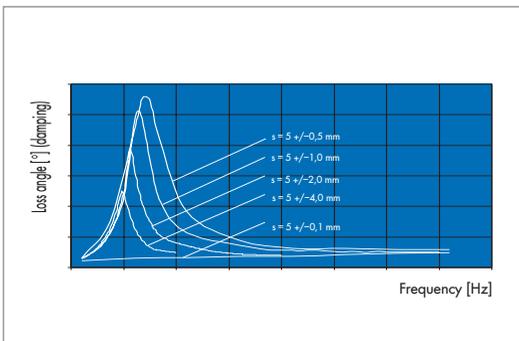
Transient of the loss angle as a function of frequency
(example, qualitative)

Design notes

The component consists of conical mount and hydraulic element filled with a special damping fluid and formed by a cylindrical sheet-steel housing containing a fluid-tight, roll-shaped diaphragm.

Fitting & installation

- Hydro Mounts KL are designed to be secured by means of the threaded fastener through the core and in the flange of the mount
- Individual components permit slight adjustment to allow for axial, radial or angular in-situ offset
- The flat part of the flange must make full-surface contact with the supporting structure
- Size the diameter of the bore only a few tenths of a millimetre larger than the diameter of the housing (108 mm) or as a slight interference fit
- Ensure that the mating face is flat and smooth, and the same applies to the mating face of the mass carried by the mount. It is also important to ensure full-surface contact with the inner metal part of the mount
- Position the mount relative to the static load in such a way that the inner metal part of the conical mount and the flange are preloaded relative to each other.

Ultra Bush
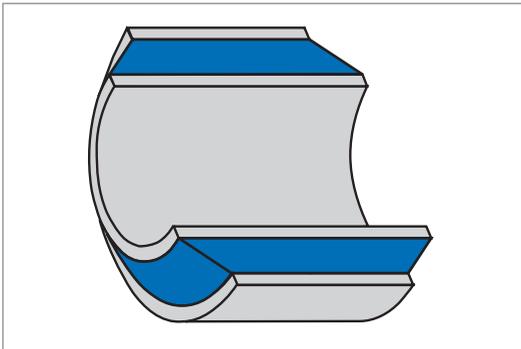
Ultra Bush

Product description

The ultra bush is a cylindrical bush capable of absorbing axial, radial and torsional movements and cardanic deflections.

Product advantages

■ Maintenance-free
■ Prevents sound transmission
■ Adjustment of manufacturing tolerances
■ Usable as a coupling element in drives/powertrains
■ Reduced settling under radial load
■ Increases load-bearing capability in the radial direction
■ RoHS-compliant.

Application

Ultra bushes have a wide range of possible applications as resilient connecting element. Typical applications are elastic articulations on vibrating machines or bearing blocks for shafts, axles as well as steering gears and couplings.

Material

Standard material	Hardness
Ethylene-acrylate rubber AEM 23, AEM 33	60 Shore A
Natural rubber NR 11, NR 91, NR 39, NR 97	40, 45, 60, 70 Shore A
Acrylonitrile-butadiene rubber NBR 68	60 Shore A

Operating conditions

Radial forces	350 N ... 460000 N	Maximum permissible force
Axial forces	120 N ... 60000 N	Maximum permissible force
Max. temperature	60 °C, transient +80 °C	
Min. temperature	−45 °C	
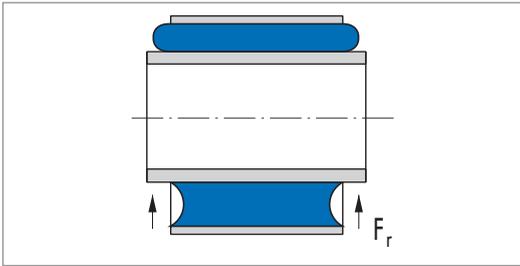
Radial load
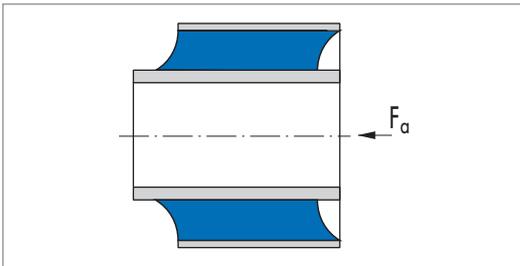
Axial load
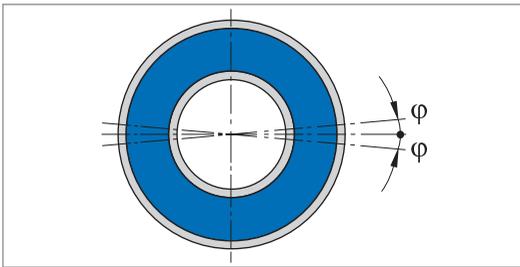
Torsional load
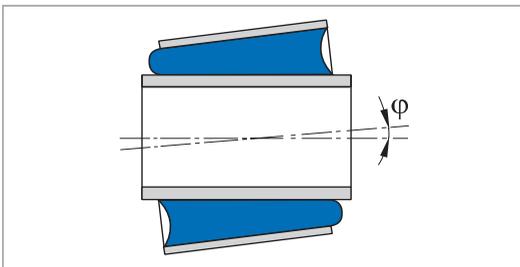
Cardanic deflection

Ultra bushes are available in different versions by the specified article (see article list) which range for applications up to load ranges of 460 kN. Ultra bushes can tolerate radial axial, torsional and also slight cardanic deformation. The recommended primary loading direction is perpendicular to the longitudinal axis and centred to the longitudinal elongation (radial load).

When calculating dynamic loading, use values of s_a and s_r reduced by approx. 50%.

Design notes

They are manufactured from an inside and outside precision metal sleeve which are joined together by a vulcanised elastomer insert. Ultra bushes have a pressure "preloaded elastomer" that is produced by permanently reducing the outside diameter of the outer sleeve and increasing the inside diameter of the inner sleeve through plastic deformation of the metal parts. This increases the service life considerably.

Fitting & installation

- Ultra bushes are designed for inner and outer press fitting
- Individual components permit slight adjustment to allow for in-situ planar or angular offset
- If possible, ensure that the entire cylindrical surface area of the sleeves is utilised as load-bearing contact surface
- Always apply installation and removal press-fit forces uniformly to the end faces of the precision sleeves.
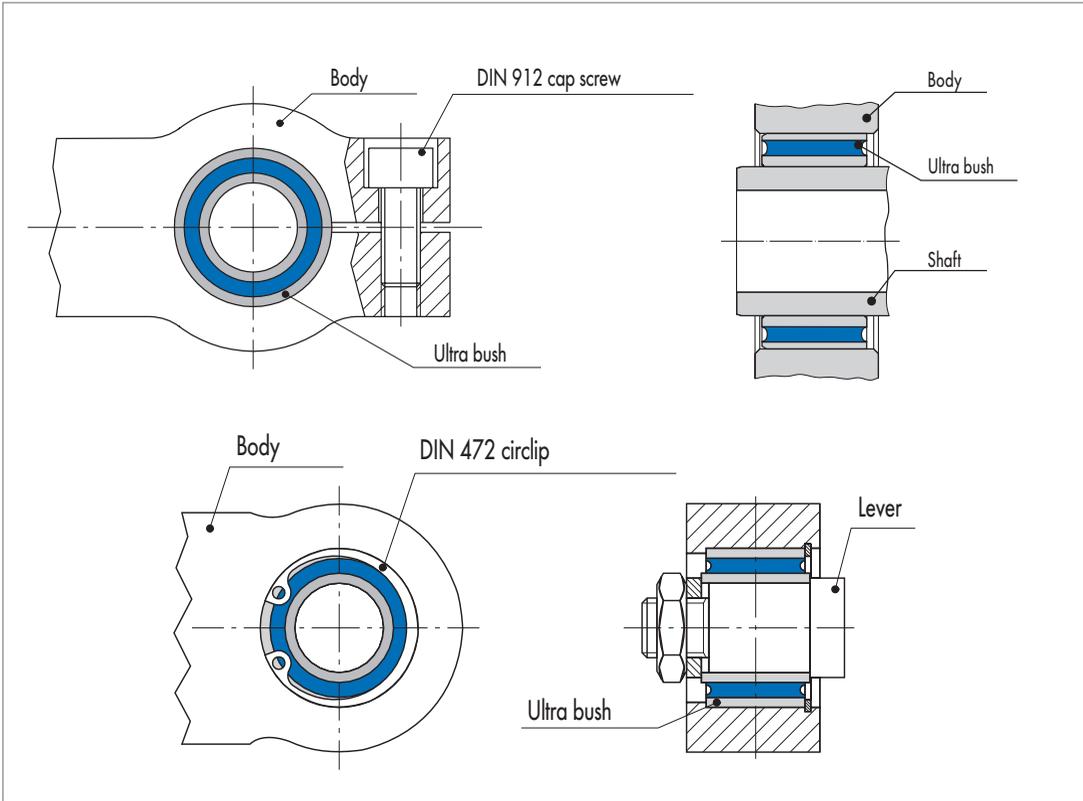
Fitting & installation instructions: Ultra Bushes

O-Bush
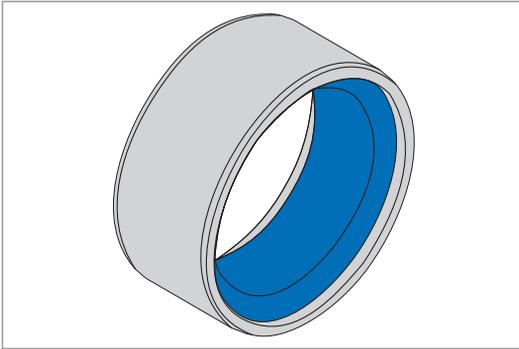
O-Bush

Product description

O-bushes receive forces in the radial direction. They isolate and compensate for tolerances of the stud. Radial deflection of the mass carried by the mount is also limited.

Product advantages

- Low weight
- Low space requirements
- Independent centring
- Tolerance compensation
- RoHS-compliant.

Application

The O-bushes are particularly suitable as a resilient connecting element for mounting auxiliary units, electronic components, small units, pumps and compressors in mobile and stationary applications.

Material

Standard material	Hardness
Natural rubber NR 11, NR 13	50, 60, 70 Shore A
Acrylonitrile-butadiene rubber NBR 68	50, 60, 70 Shore A
Chloroprene rubber CR 57	50, 60, 70 Shore A

Operating conditions

O-bushes have different stiffness in axial and radial direction. In the radial direction the stiffness is many times that of the axial direction. The primary load direction is recommended to be perpendicular to the longitudinal axis and central to the longitudinal extension.

Design notes

The O-bush with central through-bore consists of a pipe section with an elastomer pad vulcanised to its inner sheath. It can be designed in an axial and a radial direction. During assembly the elastomer pad is compressed radially. This makes the O-bush self-holding, forms the friction connection between the elastomer pad and the stud and increases the service life. The radial stiffness depends on the size of the cover. Only slight forces should be applied in the axial direction.

Fitting & installation

■ O-bushes are prepared externally for installation
  in a locating bore with press fitting
■ The internal dimensions are designed for press-in
  of a stud with cover
■ A slight axial offset required by the installation is
  possible depending on the component
■ Always apply installation and removal press-fit forces
  uniformly to the end faces of the pipe section.
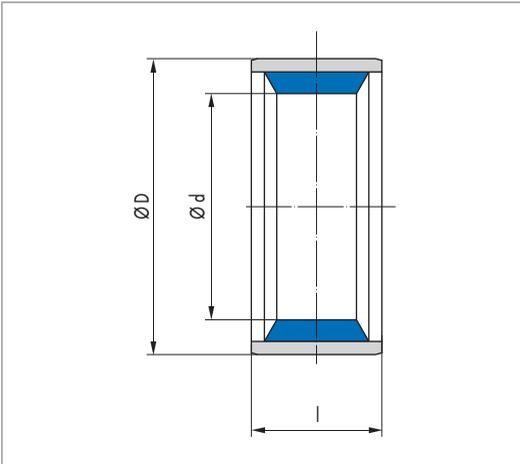
Dimensional drawing of O-Bush

Spherical Mount
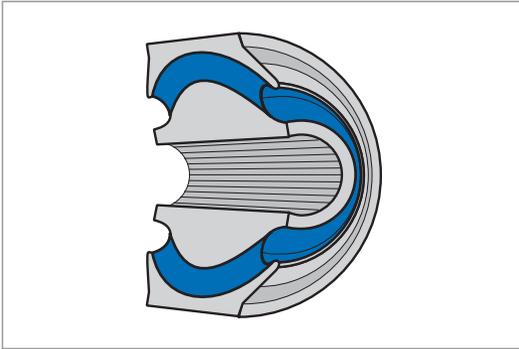
Spherical Mount

Product description

Spherical mounts, as the name suggests, are spherical bushes capable of absorbing axial, radial and torsional movements and cardanic deflections.

Product advantages

■ Maintenance-free articulation
■ Reduced settling under radial load
■ Increased cardanic loading
■ Allowing twist in all directions
■ RoHS-compliant.

Application

Spherical mounts are ideal vibration-control components for articulations that are subjected to twisting in all directions. The mounts are primarily used in bearings, brake levers and steering gears in buses and trucks as well as in reaction-support links in industrial applications.

Material

Standard material	Hardness
Natural rubber NR 11, NR 13	50, 60, 65, 70 Shore A

Operating conditions

Radial forces	1200 N ... 46000 N	Maximum permissible force
Axial forces	1600 N ... 20000 N	Maximum permissible force
Max. temperature	up to + 60 °C, transient up to +80 °C	
Min. temperature	−45 °C	
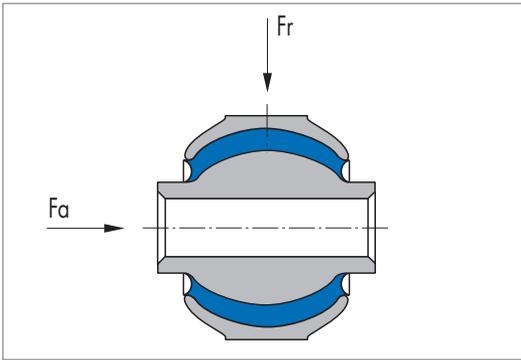
Primary load directions

Spherical mounts are generally stiffer in the radial direction than in the axial direction and permit angular deflections of 4°−9° for all three spatial axes.

Design notes

This component consists of an inner ball and an outer spherical shell; the joining element is a vulcanised elastomer insert between ball and shell.
Spherical mounts have a preloaded rubber element, so, as is the case with Ultra Bushes, the mount can be calibrated (see the description of Ultra Bushes) for extended durability.

Fitting & installation

■ As a rule, spherical mounts are designed for press fitting of the outer
metal part and have a threaded fastener on the inner metal part
■ Alternatively, the inner metal ball can be designed to push onto a stud for preloading against a collar or for press-fitting on a stud
■ Individual components permit slight adjustment to allow for in-situ planar or angular offset
■ If possible, utilise the entire cylindrical surface of the outer sleeve as the bearing surface for spherical mounts
■ If the inner stud has threaded ends, ensure full-surface contact of the flats in the threaded fastener
■ If the inner sleeve is thin, if possible, utilise the entire cylindrical inner face of the inner-sleeve bore as the bearing surface of the spherical mount
■ Always apply installation and removal press-fit forces uniformly to the end faces of the precision sleeves.

Conical Mount
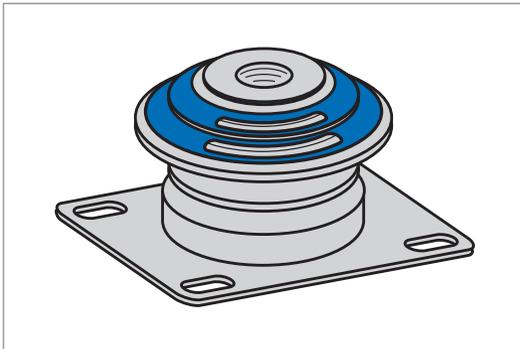
Conical Mount

braking). Conical mounts are delivered without washers as standard. The suitable washers and stops can be found in the section on Washers and Centering Washers as well as in Rubberised Stop Washers.

Product advantages

- Long service life
- Optimum settling
- Auto-centring under axial load
- RoHS-compliant.

Application

Conical mounts are ideal, resilient connecting elements for mounting engines, driven machinery and superstructures for both stationary operation and in vehicles and ships.

Product description

Conical mounts damp vertical vibrations, isolate against structure-borne noise and can simultaneously accept large horizontal forces (e.g. deceleration forces under

Material

Standard material	Hardness
Natural rubber NR 11, NR 39	35, 40, 45, 50, 55, 60, 65, 70, 76, 80 Shore A
Acrylonitrile-butadiene rubber NBR 68	55, 65, 70 Shore A
Ethylene-acrylate rubber AEM 33	55, 60 Shore A

Operating conditions

Axial forces	500 N ... 30000 N	Maximum permissible force
Max. temperature	up to 60 °C, transient up to +80 °C	
Min. temperature	up to −45 °C	
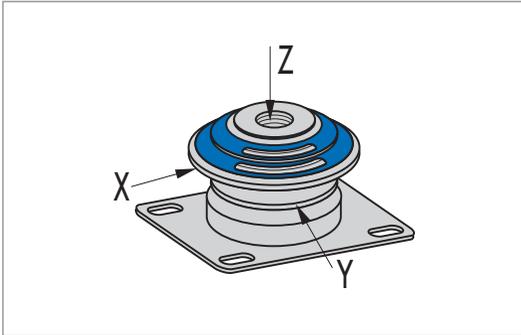
Primary load directions

Properly positioned conical mounts for mounting engines lightly cushions the torque which reduces the vibrations introduced into the anchorages and thus contributes to a better running smoothness. The weight should primarily be absorbed in the longitudinal axis (+Z). The range of conical mounts offers a large number of different designs for the optimal solution of all conceivable application/installation cases. Tear-off or separation protection is also thus possible.

Design notes

The mount configuration is manufactured from an inner and outer metal part. The outer metal part has a multi-hole flange and the inner metal part has a through-hole with or without a thread or a tapped blind hole. Both tapered metal parts are connected in tapered parallel orientation by an elastomer insert.

Fitting & installation

- The conical mounts are designed to be secured by means of threaded fasteners
- Individual components permit slight adjustment to allow for in-situ offset
- It is important to ensure that the mating faces of the frame and the mass carried by the mount are flat and smooth
- Ensure that the underside of the flange is in full-surface contact with the mating face of the frame anchorage
- Position the mount relative to the static load in such a way that the inner metal part and the flange are preloaded relative to each other
- Avoid tensile loads or use the stop and centering washers to limit these loads (see the section on stop washers).
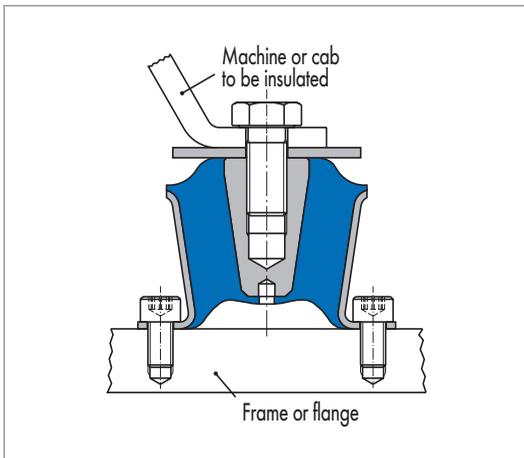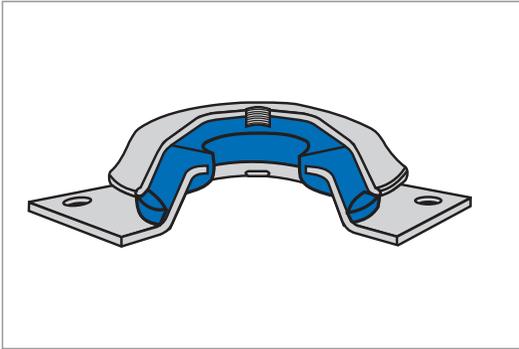

Secured by threaded fasteners in base
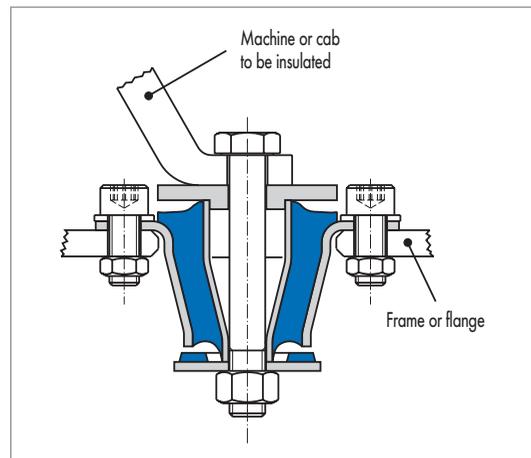
Secured by threaded fasteners in flange

V Mount

V Mount

Product description

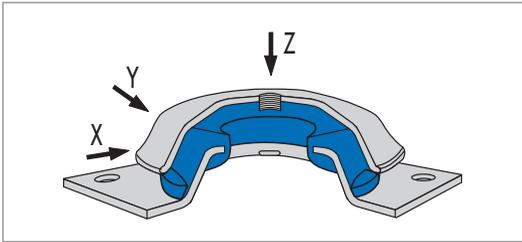V mounts are ideal for a multiplicity of applications in vibration control and structure-borne sound insulation.

Product advantages

- Chrome-free galvanisation for optimum corrosion protection
- Easy fitting
- Maintenance-free
- Good insulation even at low interference frequencies
- RoHS-compliant.

Application

The range of possible applications for V mounts includes internal combustion engines, electric motors, pumps, compressors and tool machines. V mounts are also used for maritime engineering. There are versions with type approval from Lloyds Register of Shipping available.

Material

Standard material	Hardness
Natural rubber NR 11	40, 45, 50, 60, 65 Shore A

Operating conditions

Axial forces in Z direction	500 N ... 32000 N	Maximum permissible force
Max. temperature	up to 60 °C, transient up to +80 °C	
Min. temperature	up to −45 °C	

Primary load directions

Design notes

V mounts comprise a flat, cylindrical metal cap with threaded insert and a base plate with rectangular flange and through-holes. Both metal parts are aligned parallel on top of each other and joined with a vulcanised elastomer insert.

V mounts feature a robust compressive-deflection stop in the vertical direction (Z direction). The same high stiffness in both horizontal directions (X,Y) prevents a "floating", i.e. a lateral deflection of the vibration-insulated driven machinery, the machine or the engine. Versions with built-in tensile stops are also offered which limit the limit rebound in (−Z) direction. All V mounts are limited in their radial spring displacement at the same time. The bell-shaped designed top section of the mount protects against too strong a compressive deflection and dripping media (e.g. oil). When subjected to extreme overload a positive lock forms between the top and bottom section of the mount. The progressive spring characteristic and a thin rubber layer on the stop collar of the bottom section prevents a hard metal impact. The primary load direction (+Z) is perpendicular to the planes of attachment centred to the cap.

Fitting & installation

- V mounts are designed to be secured by means of threaded fasteners
- Individual components permit slight adjustment to allow for in-situ offset
- It is important to ensure that the mating faces of the frame and the mass carried by the mount are flat and smooth
- Position the mount relative to the static load in such a way that the cap and the flange are preloaded relative to each other.
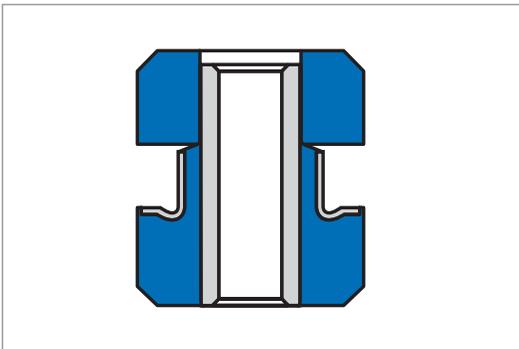
MO Mount
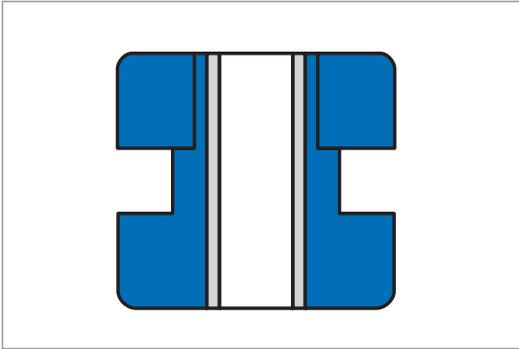
MO Mount 753
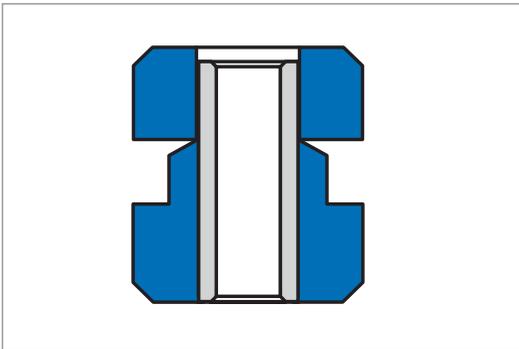
MO Mount 754

MO Mount 755

Product description

MO mounts are suitable for use as resilient connecting elements.

Product advantages

- Dependable limitation of radial deflection
- Compact
- Good insulating capability in the longitudinal direction
- RoHS-compliant.

Application

The range of possible applications for MO mounts is wide, extending from applications with driven machinery, PTOs and radiators up to small cabs for vehicles, and also including attachments for exhaust-air ducts and exhaust pipes in maritime engineering.

Material

Standard material	Hardness
Chlorine-butadiene rubber CR 57	42, 45, 50, 55, 60, 64, 75 Shore A

Operating conditions

| Radial forces	1000 N ... 2800 N	Maximum permissible force
Axial forces	1800 N ... 2400 N	Maximum permissible force
Max. temperature	+100 °C, transient +130 °C	
Min. temperature	−30 °C	

MO mounts feature equal stiffness in the horizontal directions (X,Y). These mounts have a greater flexibility in the Z direction which leads to a correspondingly higher isolation. The limitation of the spring displacements in the radial direction generally appear more than in the axial direction. The longitudinal axis is recommended as the primary load direction.

Design notes

The MO mount with central borehole comprises an elastomer body and a vulcanised elastomer metal part. These parts attached to each other create an annular clamping groove. This mount configuration is expandable through layers or spatially corresponding limiter components for the axial spring displacement which leads to a progressive spring characteristic curve and serves as tear-off protection at the same time.
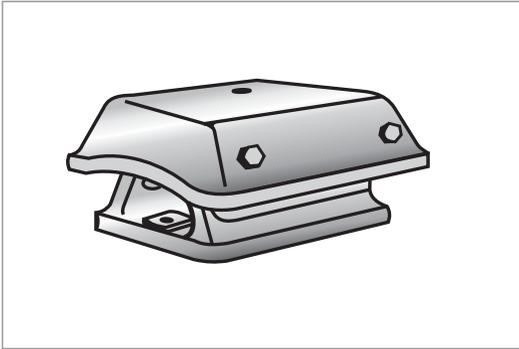
Fitting & installation

- MO mounts are designed to accommodate a threaded fastener inserted through the central borehole
- Individual components permit slight adjustment to allow for in-situ offset
- Combine the mount with a tubular spacer if tightening torques are high
- Depending on the quality of the material selected, threaded-fasteners of at least one strength class higher can be used
- Select a tubular spacer with an outside diameter allowing slight play for the inside diameter d_1 of the MO mount
- Select the through-hole of the tubular spacer to accommodate the securing screw according to DIN EN 20273
- The surfaces for force transfer to the threaded fastener by the elastomer part should be large and flat
- Position MO mounts such that the rubber-metal part bolts directly to the component to be insulated
- Install the elastomer-only part with a washer (see the section on washers and centering washers for details of the washer)
- Make sure that the edges of bore S_D are chamfered, or preferably radiused, at both ends
- MO mounts with steel reinforcement (Type 3) require this radiusing only at the rubber-only end.
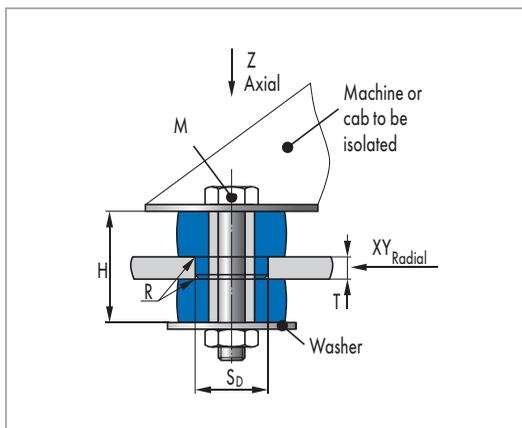
Fitting & installation instructions: MO Mount with load directions

simrit
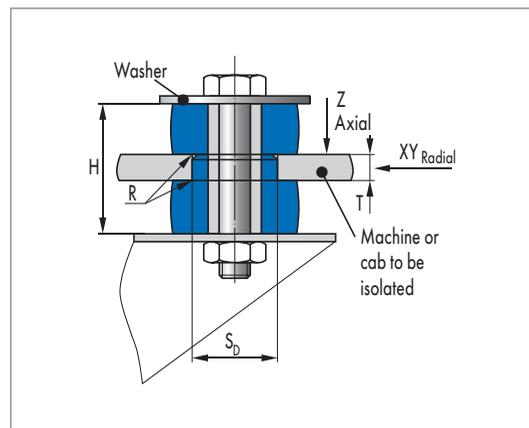
Machine Mount

Machine Mount

Product description

The special shape of the machine mount protects the built-in flat mount against mechanical damage and oil attack.

Product advantages

- Elastomer spring elements are replaceable and the metal connecting components are reusable
- Spring elements are protected against random damage and direct oil splashes
- Reduced settling in the Z direction
- RoHS-compliant.

Application

Machine mounts are particularly suitable for mounting heavy machines, compressors, engines, etc. They enable machine- and unit-generated vibrations introduced into the foundation or the enclosing building to be reduced by a significant margin.

Material

Standard material	Hardness
Natural rubber NR 11	45, 50, 55, 60, 70 Shore A

Operating conditions

Axial forces in Z direction	1400 N ... 16000 N	Maximum permissible force
Max. temperature	+60 °C, transient +80 °C	
Min. temperature	−45 °C	
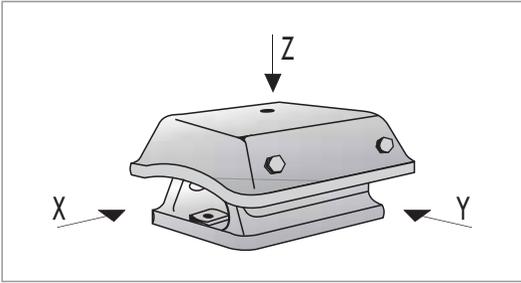
Primary load directions

The combined compression and shear loading of the flat mounts fitted provides a long service life and good vibration insulation, even at lower interference frequencies (i.e. lower rotational speed). The mount is easily attached to the foundation and the machine using the standard boreholes and threads. Anchoring to the foundation and the machine permits the application of compressive loads (Z direction) to the mount as well as shear loads (X & Y direction). The primary load direction is perpendicular to the planes of attachment, centred to the cap.

Design notes

The machine mount comprises a rectangular cap and two metal parts with equally angled side faces and flange. Flat mounts are screwed in between the two stacked metal parts. Both metal parts are provided with through-holes or threaded holes.

Fitting & installation

- Machine mounts are designed to be anchored by threaded fasteners
- Individual components permit slight adjustment to allow for in-situ offset
- It is important to ensure that the mating faces of the frame and the mass carried by the mount are flat and smooth
- Position the mount relative to the static load in such a way that the cap and the flange are preloaded relative to each other.

simrit®
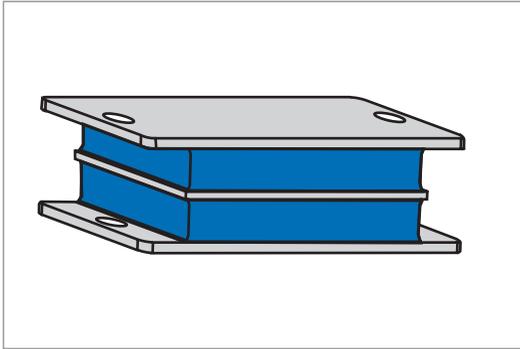
Flat Mount

Flat Mount

Product description

Flat mounts are mount configurations for custom applications.

Product advantages

■ Easily integrated into assemblies
■ Easily installed
■ Spring characteristics can be widely adapted to the construction
■ RoHS-compliant.

Application

Used as mounts for machines, engines or subassemblies in mechanical-engineering and automotive applications.
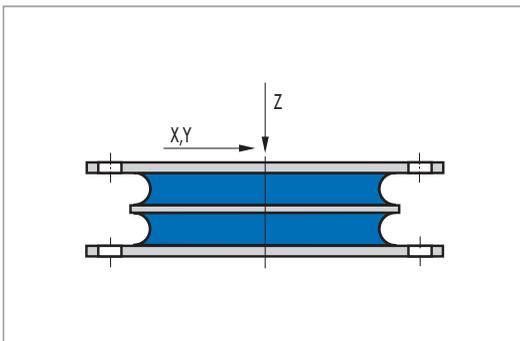
Material

Standard material	Hardness
Natural rubber NR 11	45, 50, 55, 60, 65, 70 Shore A

Operating conditions

Shear forces X,Y direction	440 N ... 7500 N	Maximum permissible force
Compressive forces in Z direction	1200 N ... 98000 N	Maximum permissible force
Max. temperature	+60 °C, transient +80 °C	
Min. temperature	−45 °C	

Primary load directions

Depending on the installation conditions or required degree of vibration insulation, compressive loads (Z direction), shear loads (X, Y direction) or combined compressive/shear loads (mount tilted by a specific angle) can be applied to flat mounts. The mounts achieve an optimal utilisation and thus also the highest dynamic load with a compressive/shear loading.
The loading is dependent on the surface area of the rubber, shape, thickness of the pad and hardness of the rubber. The static loading and the dynamic forces and deflection must be taken into account for continuous use. Flat mounts have different stiffness in the shear direction (X,Y) and compressive direction (Z) in

dependence on the width, length and thickness and their total number in the mount component. The effective stiffness of the mounts can be varied by turning of the mount to the static load. The primary load direction can be absorbed perpendicular to or at an angle to the attachment levels.

Design notes

Flat mounts consist of parallel metal plates paralleled one on top of the other and separated by vulcanised elastomer pads.

Fitting & installation

- Flat mounts are designed to be secured by means of threaded fasteners
- Individual components permit slight adjustment to allow for in-situ offset
- It is important to ensure that the mating faces of the frame and the mass carried by the mount are flat and smooth
- It is also important to ensure full-surface contact between the outer metal plates and the frame and the mass carried by the mounts
- Position the mount relative to the static load in such a way that the cap and the flange are preloaded relative to each other.

Rails
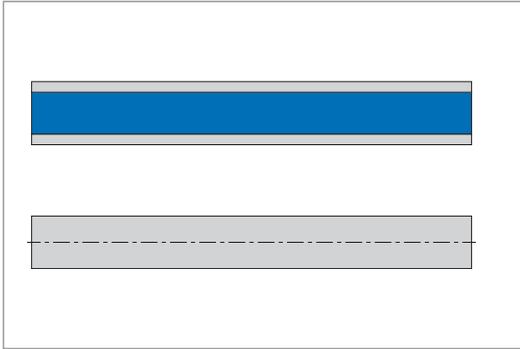
Rails

Product description

Rails are often used when space is at a premium or if loads are too high to permit the use of buffers.

Product advantages

- Mount can be customised
- Rails have the flexibility to be adapted to the load
- Universal
- RoHS-compliant.

Application

Rails from Simrit are suitable for mounting the most heavy machines, plants, units and foundations. They are suitable for a wide range of possible application for mounting ships engines, large stationary engines, heavy-duty lathes, hoists for lifts as well as vibratory machines of all kinds.

Material

Standard material	Hardness
Natural rubber	57 Shore A

Operating conditions

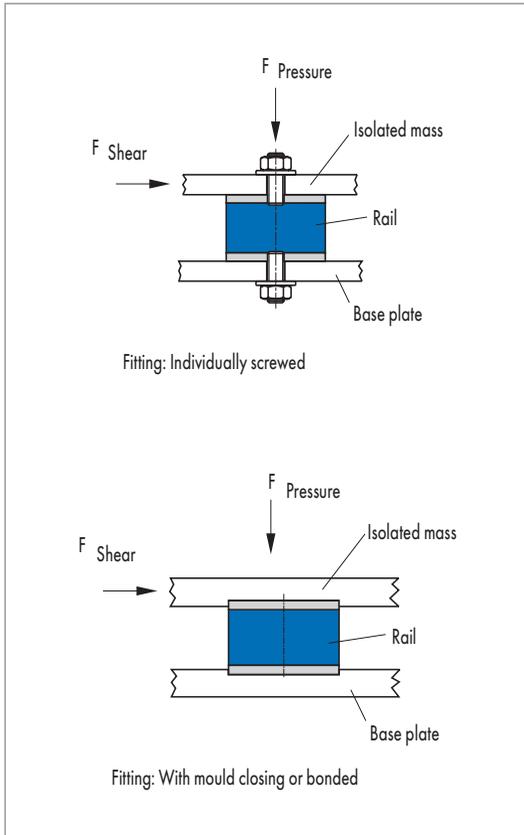| Length of rail in mm	25 ... 2000
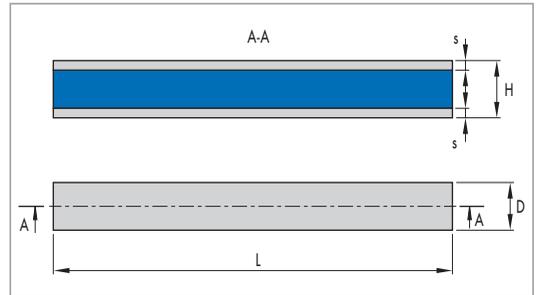
Primary load directions

The rails are available in 2000 mm lengths. You must ensure that the length is not shorter that the section width. Approximately 10% of the rubber height "h" can be pressed together under static load.

Design notes

The component consists of two metal parts separated by a vulcanised elastomer pad.
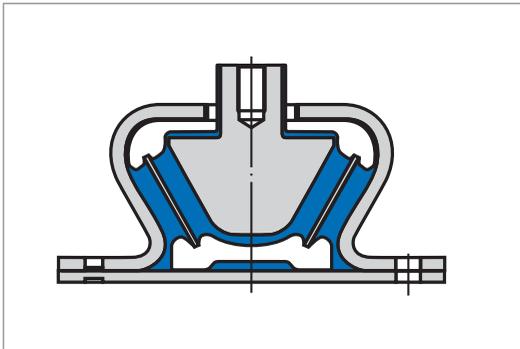
simrit

Fitting & installation

- Rails can be drilled and chased on site to accommo-
  date threaded fasteners
- Rails can also be installed without threaded fasteners
  if compressive-load deflection is significantly greater
  than maximum amplitude.

F Pressure

Isolated mass

F Shear

Rail

Base plate

Fitting: Individually screwed

F Pressure

Isolated mass

F Shear

Rail

Base plate

Fitting: With mould closing or bonded

Fitting & installation: rails with load directions

Tapered Mount

Tapered Mount

Product description

Tapered mounts are used primarily to carry light, medium and heavy engines for mobile and stationary applications.

Material

Product advantages

■ Robust
■ Slight settling on compressive deflection in the Z direction
■ Effective limitation of compressive and rebound deflection
■ Limitation of horizontal spring displacement
■ Narrow, ideal for mounting on steel sections
■ RoHS-compliant.

Application

Tapered mounts can be utilised for agricultural and construction machinery. They are also suited for mounting generators of ships' engines.

Standard material	Hardness
Natural rubber NR 39	40, 42, 45, 50, 60 Shore A

Operating conditions

Compressive forces in Z direction	1750 N ... 14000 N	Maximum permissible force
Max. temperature	+80 °C, transient +100 °C	
Min. temperature	−45 °C	
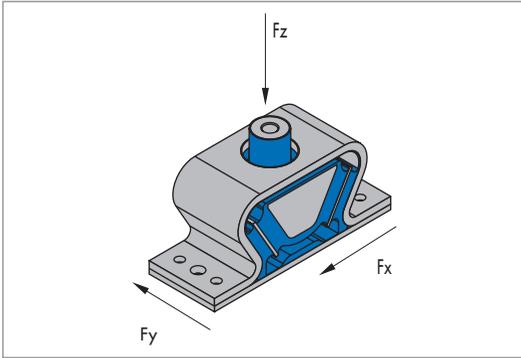
Primary load directions

Tapered mounts have limiters for deflection in all spatial directions whereby the deflection in the Z direction is especially robust. In compressive-deflection direction Z, the mount also has a "soft" end stop. The stiffness depend primarily on the thickness, length, height and the wedge angle to the Z axis. Through the use of intermediate metal sheets, the Z stiffness, for example, is at least doubled for the same operating environment. The primary static load should be perpendicular to the planes of attachment.

Design notes

The tapered mount comprises an outer omega-shaped bracket with flange and through-hole. An inner metal part with threaded hole partially plunges through a borehole of the bracket. Elastomer pads are vulcanised between both metal parts in Vee shape.

Fitting & installation

- Tapered mounts are designed to be secured by means of threaded fasteners
- Avoid non-load-dependent offset of the inner metal part relative to the flange
- Individual components permit slight adjustment to allow for in-situ offset
- It is important to ensure that the mating faces of the frame and the mass carried by the mount are paralleled, flat and smooth

Double U-Shear Mount
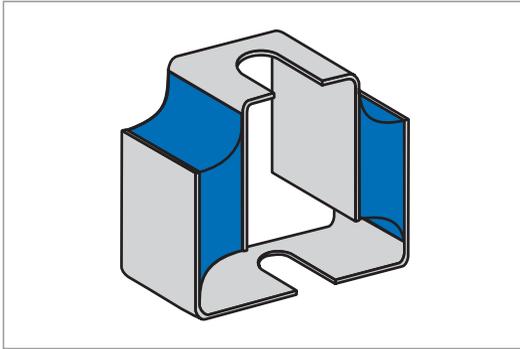
Double U-Shear Mount

Product description

Double U-shear mounts are especially suited for isolation tasks. These mounts have an especially simple design and a high ease of installation.

Product advantages

- Good insulating capability in the Z direction
- Effective limitation of shock loads in the compressive-deflection direction
- Virtually no progression
- Linear characteristic
- RoHS-compliant.

Application

Double U-shear mounts are used to mount instruments, units, pumps, compactors and compressors. They are equally suitable for the decoupling of exhaust-air ducts because of their ability to compensate for structure-borne sound and thermal expansion.
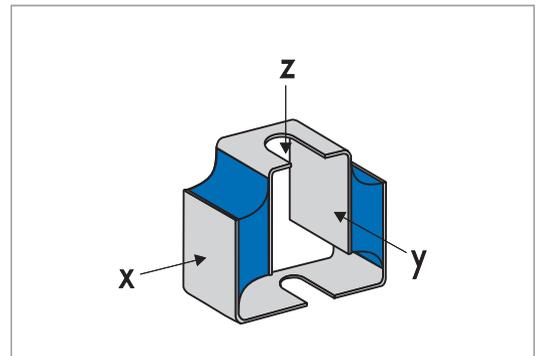
Material

Standard material	Hardness
Natural rubber NR 11	45, 50, 60, 70 Shore A

Operating conditions

Shear F_z/F_y	120 N ... 2000 N	Maximum permissible force
Max. temperature	+60 °C, transient +80 °C	
Min. temperature	−45 °C	

Primary load directions

They are designed so that the stiffness to resist shear increases in the order Y, Z, X. Depending on the type, they limit strong shock loads in the compressive-deflection direction (+Z). The effective stiffness can be adjusted by turning the mount on the static load (Z axis). Select the primary load direction +Z so that it is perpendicular to the planes of attachment.

Design notes

A mount of this type consists of two dovetailed U-shaped
steel channel sections held together by elastomer pads.

Fitting & installation

- Double U-shear mounts have threads to
  accommodate grooves.
- Avoid non-load-dependent offset of the U-shaped
  channel sections relative to each other
- Individual components permit slight adjustment
  to allow for in-situ planar or angular offset
- It is important to ensure full-surface contact between
  the mating faces of the U-shaped channel sections
  and the frame on the one hand and the supported
  mass on the other.

Circular Mount
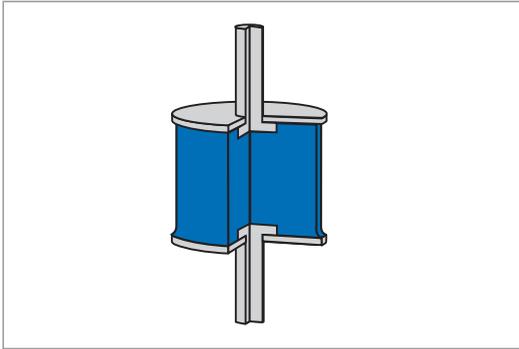
Circular Mount

Product advantages

- Uniform stiffness in the radial direction
- Easily installed hexagon version available
- RoHS-compliant.

Application

Circular mounts are used to carry driven machinery, engines, compressors, pumps, test machines, and so on.

Product description

Circular mounts are widely used components for adjustment of tension and manufacturing tolerances.
The also function as protection against shock loading.

Material

Standard material	Hardness
Natural rubber NR 11	45, 55, 60, 70, 75, 80 Shore A
Ethylene-acrylate rubber AEM 23, AEM 33	60 Shore A
Chloroprene rubber CR 56, CR 57	45, 60 Shore A

Operating conditions

Radial forces	14 N ... 24000 N	Maximum permissible force
Axial forces	18 N ... 80000 N	Maximum permissible force
Max. temperature	+60 °C, transient +80 °C	
Min. temperature	−45 °C	

Primary load directions

Compressive and shear loading
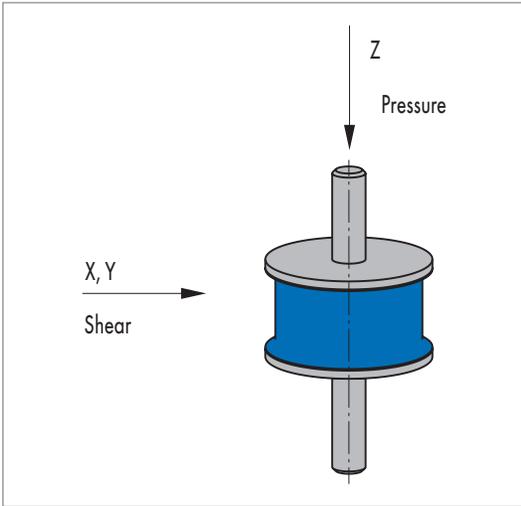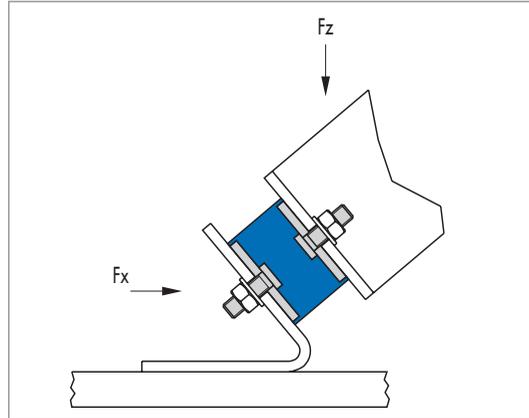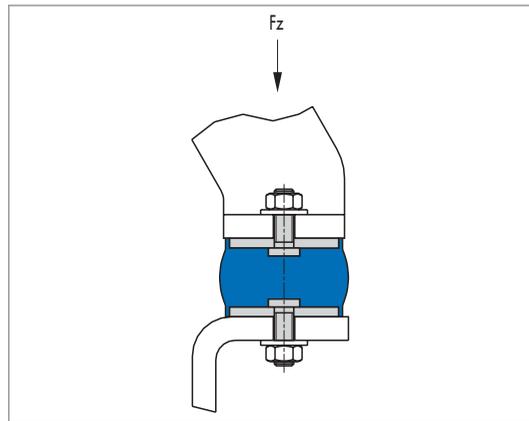
Circular mounts have a uniform stiffness in the shear directions X,Y. The compressive load stiffness F_{max} in the Z direction has, depending on the component, approx. 1 to 10 times the value of the stiffness in the shear directions. The primary load direction corresponds to the shear load X,Y since this is where the greatest isolation is to be achieved.
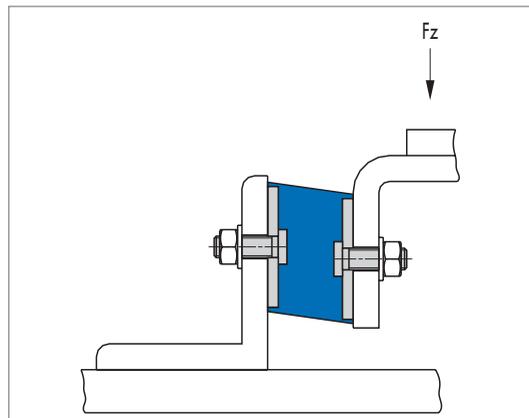
Design notes

The circular mount comprises two round or square metal discs joined by a vulcanised rubber layer. The metal discs can each have a threaded stud or threaded nut. The circular mounts are available with cylindrical contour as well as with constricted-body elastomer contour. Mounts with constricted-body contour can be specially designed with an elongation of ~10% for high dynamic loads in the horizontal direction. The constricted design provides for significantly higher durability with high dynamic loading with otherwise equal compressive deflection.


Compressive loading

Shear loading

Fitting & installation

- Circular mounts are designed to be anchored by threaded fasteners
- Avoid non-load-dependent offset of the metal plates relative to each other
- Individual components permit slight adjustment to allow for in-situ offset
- The form of the boreholes to accommodate the threaded studs or securing screws must be compliant with DIN EN 20273
- The securing plates must be in full-surface contact with the mating faces
- It is important to ensure that the mating faces of the frame and the mass carried by the mount are flat and smooth
- When installing a mount that combines a circular securing plate at one end with a hexagonal plate at the other, always tighten the fastener for the circular plate first
- Minimum strength class for screws/nuts is 4.6.

Buffer
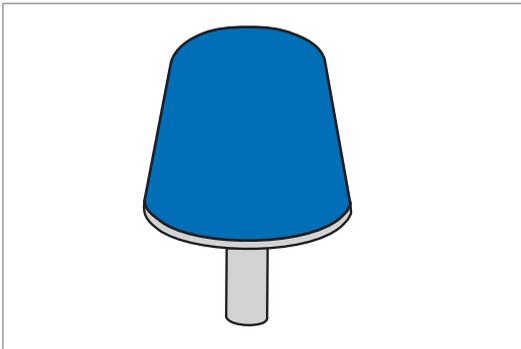
Buffer

Product advantages

- Effective buffering and damping of shock loads
- Easily installed
- RoHS-compliant.

Application

Buffers are particularly suited as resilient deflection limiters and for buffering shock loads with mobile and non mobile driven machinery, machines and as stops in general.

Product description

Buffers feature a very robust design. The wide selection of sizes allows for a universal use.

Material

Standard material	Hardness
Natural rubber NR 11	40, 45, 50, 55, 60, 70 Shore A

Operating conditions

Axial forces	37 N ... 18300 N	Maximum permissible force
Max. temperature	+60 °C, transient +80 °C	
Min. temperature	−45 °C	

Buffers with constricted body contour are specifically designed for high dynamic loads. The cone-shaped buffer design (observed in the longitudinal section) achieves a "softer" transient of the characteristic curve compared to cylindrical designs. The constricted design for circular buffers leads to significantly higher service life with otherwise equal deflection. Circular buffers that contact a flat surface can generate noise on impact. Cone buffers dramatically reduce these noise levels.

Design notes

The buffers consist of an elastomer body with an end face to which a metal plate with threaded stud/nut is vulcanised. The elastomer body is available in cone-shaped, in cylindrical form as well as with constricted-body elastomer contour.

Fitting & installation

- Buffers are designed to be secured by means of threaded fasteners
- Ensure that the metal plate is in full-surface contact with the mating face
- It is important to ensure that the mating face of the frame and the stop flat of the buffered mass are flat and smooth
- The form of the boreholes to accommodate the threaded studs must be compliant with DIN EN 20273
- Align the centreline of the buffer coaxially with the direction of impact
- Do not permit torque to act through the rubber element.

M Mount
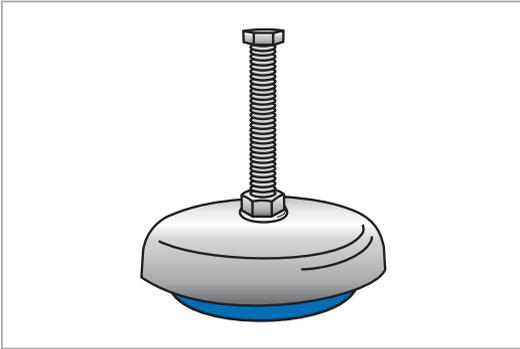
M Mount

Product advantages

- Oil-resistant elastomer material
- Non-anchored installation
- Reduced transmission of structure-borne noise
- Good insulating capability
- Built-in capability for levelling the load
- RoHS-compliant.

Application

M mounts are used for non-anchored installation and heavy driven machinery. They feature the capacity for levelling of the attached machine and provide vibration insulation.

Product description

M mounts combine a low-line compact design with good insulation capabilities and the possibility of levelling load.
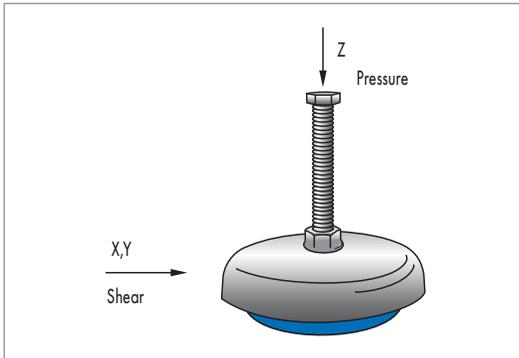
Material

Standard material	Hardness
Acrylonitrile-butadiene rubber NBR 68	45, 55, 60, 65, 70, 75, 85 Shore A

Operating conditions

Compressive forces in Z direction	1200 N ... 55000 N	Maximum permissible force
Max. temperature	+90 °C, transient +110 °C	
Min. temperature	−20 °C	

Primary load directions

M mounts feature an increasing stiffness over the compressive deflection in the Z direction. Through no anchoring in the foundation or frame, no shear forces should be transferred. The weight is absorbed in the longitudinal axis. M mounts made from stainless steel and special rubber compounds can be supplied on enquiry for special application cases (e.g. food processing or chemical industries and shipbuilding).
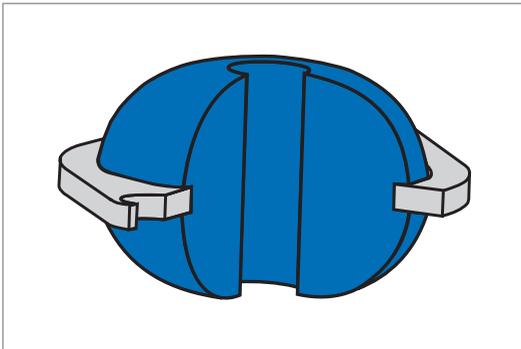
Design notes

The mounts consist of two metal parts that are joined by a vulcanised elastomer pad. An adjusting screw allows for levelling of the attached machine. The special mixture of nitrile-rubber (Perbunan) used for the M Mount is oil-resistant.

Fitting & installation

- M mounts have an adjusting screw for securing them to the mass they carry, and are designed to sit on the supporting surface without being anchored
- Ensure that the mating face of the mass carried by the mount is parallel with the supporting surface, and make sure that the supporting surface is level and smooth
- The nut is for securing the leg of the machine to the mount
- This arrangement means that the weight of the machine does not impose a load on the nut in the bowl of the mount
- Do not under any circumstances attempt to sandwich the leg of the machine between two nuts
- The form of the boreholes to accommodate the threaded studs or securing screws must be compliant with DIN EN 20273
- It is important to ensure that the mating faces of the frame anchorage and the mass carried by the mount are flat and smooth
- M mounts can also be installed without threaded fasteners if compressive-load deflection is significantly greater than maximum amplitude.

Instrument Mount

Instrument Mount

Application

Instrument mounts are utilised for vibration insulation of electronic components, measuring devices and precise mechanical apparatuses and for instrument panels or control panels in industrial applications. A common requirement of these mounts is that they keep vibrations or shock loads introduced via the anchorages away from the instrument or device. The mounts help to protect sensitive instruments from external shock loads in mobile and non mobile use Another possible use is insulation against structure-borne sound, for example in small electric engines or pumps that have to be mounted on "resonators" (sheet metal).

Product description

The mounts protect sensitive instruments against impact and dynamic excitation.

Product advantages

- Reduced transmission of structure-borne noise
- Compact
- Easily installed
- Uniform stiffness in the radial directions
- RoHS-compliant.

Material

Standard material	Hardness
Natural rubber NR 11	40, 50, 60 Shore A

Operating conditions

Axial forces	80 N ... 260 N	Maximum permissible force
Max. temperature	+60 °C, transient +80 °C	
Min. temperature	−45 °C	
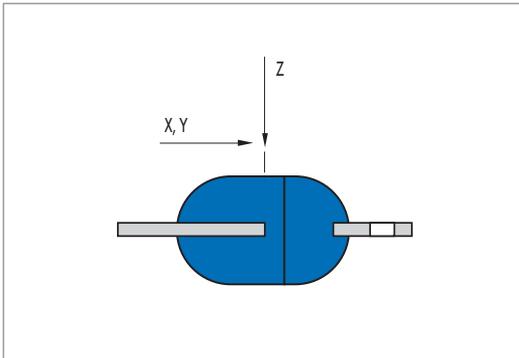
Primary load directions
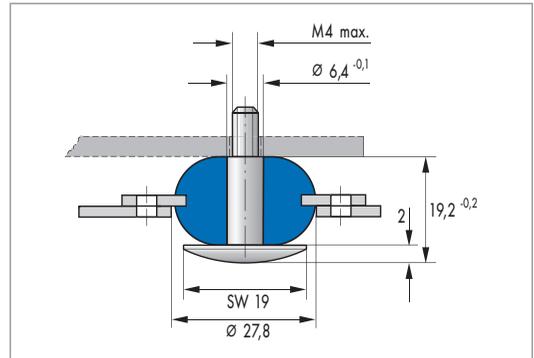
Installation diagram with stud SW19

Instrument mounts are generally designed with the same stiffness in all translatory deformation directions. The limitation of the spring displacements in the radial direction generally appear more than in the axial direction. The static load of the weight should primarily be absorbed in the longitudinal axis.

Design notes

The instrument mount comprises a carrier washer with connected or vulcanised elastomer body with central through-hole. Through-holes are attached outside in the flange of the carrier washer. A stiffening metal part can be vulcanised into the middle of the elastomer body.

Fitting & installation

■ Instrument mounts are designed to be anchored by threaded fasteners
■ Slight, non-load-related, installation-related offset of the central securing screw relative to the flange is permissible. The same applies to slight angular offset
■ Locate instrument mounts in line with the axis of the static primary load
■ Make sure that the cut-out to be occupied by the elastomer body is free of burrs and at least 1/10 mm larger than the outside diameter of the elastomer part
■ Allow for the requisite spring displacement when selecting the length of the central screw and sizing the cut-out to accommodate the mount
■ When securing the flange use washers and make sure that a large, flat and smooth surface is available for force transferral from threaded fastener to elastomer part.

© Freudenberg Simrit GmbH & Co. KG | Technical Manual 2007
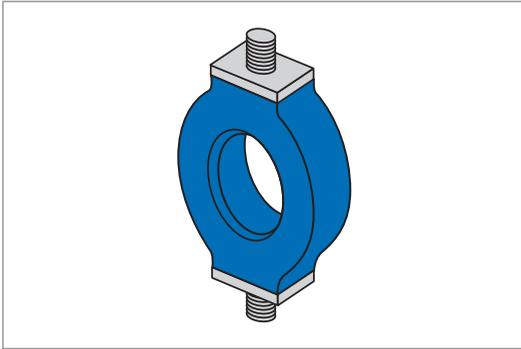
O-Shaped Mount

O-Shaped Mount

Product description

O-shaped mount shave a very soft spring characteristic and are therefore commonly referred to as low-frequency mounts.

Product advantages

■ Reduced transmission of structure-borne noise
■ Compact
■ Deformable in various planes
■ Easily installed
■ RoHS-compliant.

Application

O-shaped mounts are of a design that enables good vibration insulation for the loads that typically occur in instrumentation and control applications.

Material

Standard material	Hardness
Natural rubber NR 11	40, 45, 60 Shore A
Acrylonitrile-butadiene rubber NBR 68	60 Shore A
Ethylene-propylene rubber EPDM 22	60 Shore A

Operating conditions

Axial forces	20 N ... 215 N	Maximum permissible force
Max. temperature	up to +60 °C transient up to +80 °C for NR 11	
Min. temperature	−45 °C for NR 11	
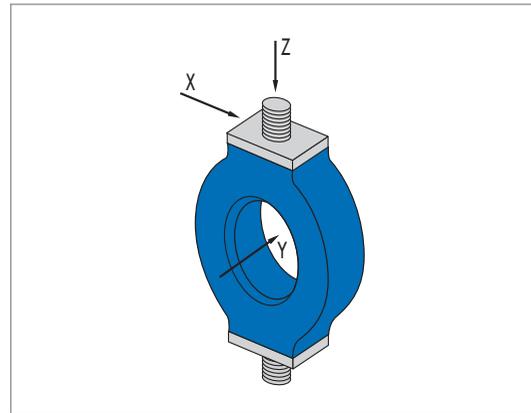
Primary load directions

The spring characteristic of the O-shaped mount increases in the order X,Y and Z, whereby depending on the orientation, an optimal vibration insulation can be achieved. The primary load direction is the ongitudinal axis of the threaded studs (Z direction).

Design notes

The component consists of a ring-shaped elastomer body with each flat vulcanised to securing plates with screws.

Fitting & installation

- Individual components permit slight adjustment to allow for in-situ offset
- The form of the boreholes to accommodate the threaded studs must be compliant with DIN EN 20273
- The securing plates must be in full-surface contact with the mating faces.
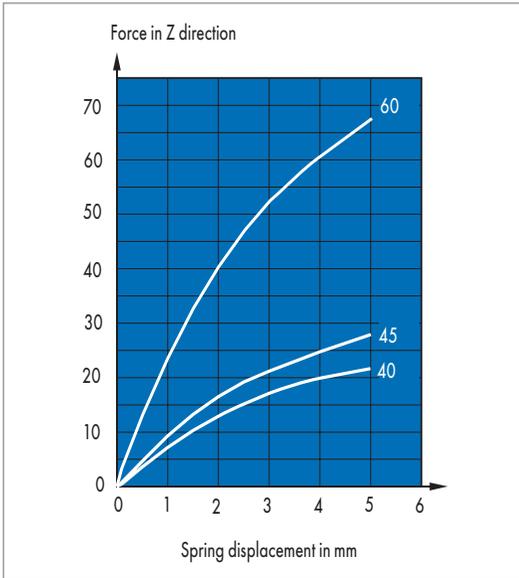
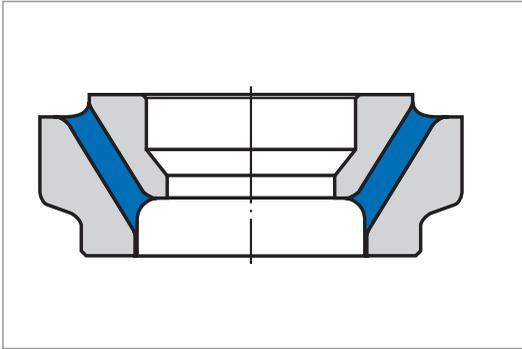Spring characteristic O-Shaped Mount 055 18 001
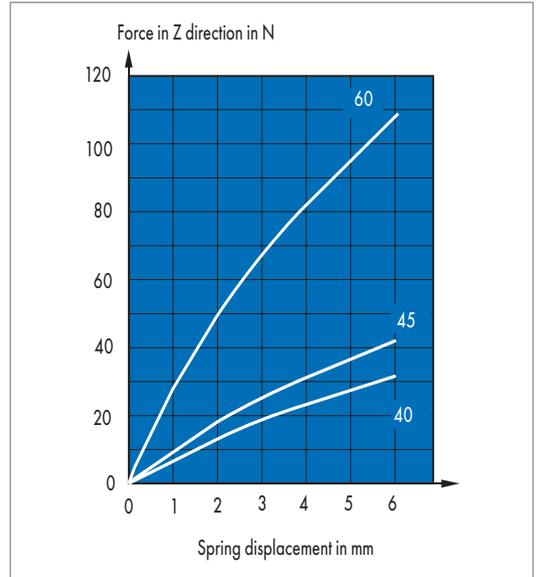
Spring characteristic O-Shaped Mount 055 18 002
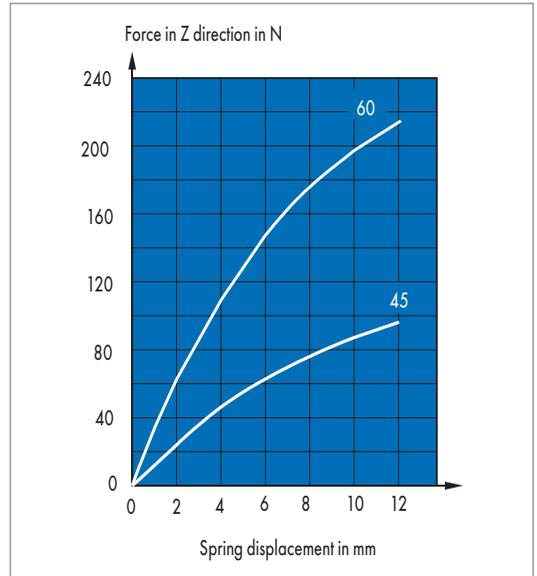
Spring characteristic O-Shaped Mount 055 18 003

Top Mount

Top Mount

Product description

Top mounts can permit radial, axial and angular movements.

Product advantages

- Good insulating capability in the Z direction
- Easily installed
- Spacing can be varied to suit the application
- RoHS-compliant.

Application

Top mounts are particularly suitable for connecting a dynamically loaded subassembly such as an engine or gearbox to a fixed assembly such as a frame.

Material

Standard material	Hardness
Natural rubber NR 11	50, 60, 70 Shore A

Operating conditions

Transverse forces in Z direction	10500 N ... 25300 N	Maximum permissible force
Max. temperature	+60 °C, transient +80 °C	
Min. temperature	−45 °C	
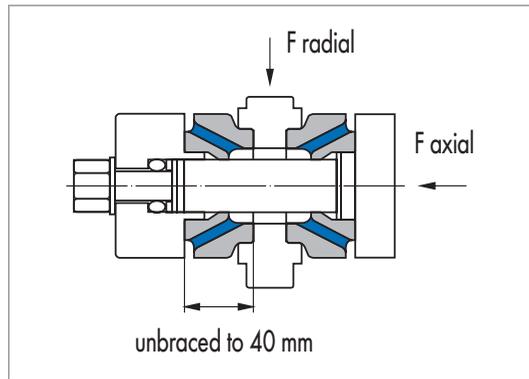
Fitting & installation instructions: Top Mount with load directions

The mount configurations feature the same stiffness in the radial directions (X and Y direction). The ratio of stiffness in the radial direction and in the axial direction varies in considerable dependence to the tapered angle. Top mounts are designed for primary loading in the radial as well as axial directions. They are designed for pairwise use, aligned facing each other with defined axial preloading. Support mounts can permit and limit radial, axial and angular movements. The primary load direction should be absorbed in the longitudinal axis or perpendicular to it.

Design notes

A top mount consists of two tapering tubular
components held together by a rubber layer.

Fitting & installation

- Top mounts are designed to be secured by
  means of fits
- Individual components permit slight adjustment
  to allow for in-situ offset
- Always install top mounts centred and at right angles
  to the axis of primary radial loading and utilise the
  entire cylindrical surface area on both the inside and
  the outside as the bearing surfaces
- Position the mounts in counteracting pairs, positioned
  in such a way that the inner and outer metal parts of
  the top mounts are preloaded relative to each other
- The elasticity of the material permits offset to be
  compensated in all directions.

Spherical Roller Bearing
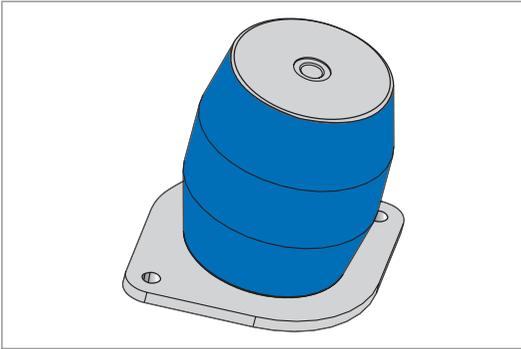
Spherical Roller Bearing

Product description

Spherical roller bearings are ideal for their vertical loading and insulation against low-amplitude vibrations.

Product advantages

- Parallel fastening surfaces
- Installation with standard screws
- Prepared for heat dissipation
- Low proportion of metal
- RoHS-compliant.

Application

Masses that experience or themselves cause minor vibration amplitudes according to deflection can be mounted on spherical roller bearings. This makes this mount configuration suitable for selected engines, compressors, units, mounting equipment and also heavy duty switch cabinets, control systems, stationary control panels, measurement equipment.

Material

Standard material	Hardness
Natural rubber NR 11	45, 55, 65 Shore A

Operating conditions

Axial forces	9000 N ... 20000 N
Max. temperature	60 °C, transient +80 °C
Min. temperature	−45 °C

Spherical roller bearings have different stiffness in axial and radial direction. In the axial direction the stiffness is many times that of the radial direction. The primary load direction is recommended to be in the longitudinal axis and central to the installation area.

Design notes

A key feature of the spherical roller bearings is the generally cylindrical to convex shape with central through-bore in the elastomer body. There is a metal plate with a central thread on one side on the front side, which is vulcanised to the elastomer body. On the opposite front side there are several nuts vulcanised into the elastomer. The cylindrical to convex shape should be taken into account in the design of the consoles. This mount should only be used with axial preloading. Note that only small radial deflections are permitted.

Fitting & installation

- Rubber mounts are designed to be fitted vertically by means of threaded fasteners
- A sufficient radial spacing to the console components is required
- The installation areas must be free of fluids. There must be no metal shavings or sharp edges in the vicinity of the installation areas
- It is beneficial to ventilate the central bore in the elastomer body
- Radial or angular offset of the fastening areas caused by installation should be prevented
- Uniform screw tightness is required.
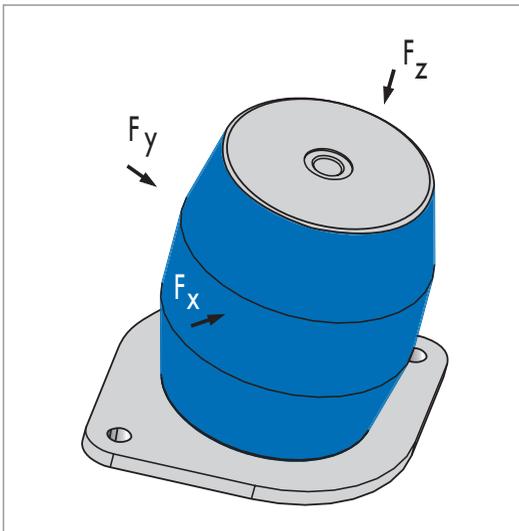
Primary load direction

Layered Springs
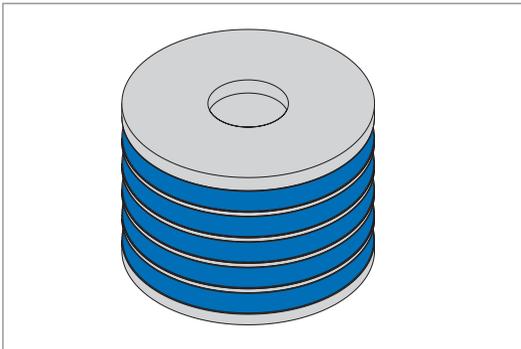
Layered Springs

Product advantages

- Good insulating capability in the radial direction
- Compressively stiff in the axial direction
- Easily installed
- RoHS-compliant.

Application

Layered springs are resilient mounts suitable for use as bearers for subassemblies such as engines or gearboxes.

Product description

Layered springs are specifically used for the decoupling of horizontal vibrations. These mounts remain very stiff at the same time.
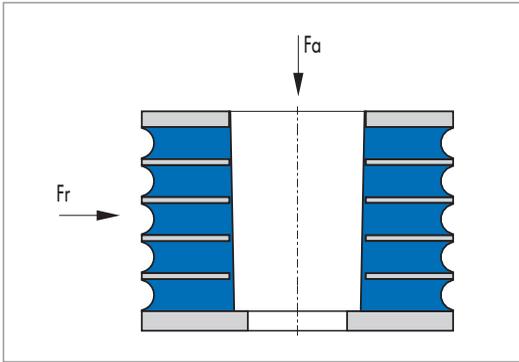
Material

Standard material	Hardness
Natural rubber NR 11	40, 50, 60, 70 Shore A
Natural rubber NR 39, 97	60 Shore A
Chloroprene rubber CR 57	60 Shore A

Operating conditions

Transverse forces in Z direction	29000 N ... 800000 N	Maximum permissible force
Max. temperature	+100 °C	
Min. temperature	−45 °C	

Layered springs have the same stiffness in the radial directions (X and Y direction) and are especially stiff in the vertical direction (Z direction). The effective stiffnesses can be varied by turning of the mount to the static load. Layered springs are designed for the primary load in the axial and radial direction but can also be loaded angled to the vertical primary load. The weight should be absorbed in the longitudinal axis for this.

Design notes

The layered spring comprises at least two metal components arranged in parallel on top of one another which are firmly attached to elastomer inserts located between them through vulcanisation. Layered Springs are designed as bearings but they can also be arranged angled to the vertical primary load.

Fitting & installation

■ Individual components permit slight adjustment to allow for in-situ planar or angular offset
■ Layered springs are generally installed in axial alignment with the primary load. Utilise the entire flat surface areas of the other metal parts as bearing surfaces and apply the load uniformly
■ Install the mount so that the outer metal parts of the layered springs are preloaded relative to each other
■ When installing angled to the vertical primary load, it is important to ensure sufficient lateral mould closing – full-surface attachment of the outer metal parts. Ensure that the outer metal parts are preloaded relative to each other.

Height Adjusters
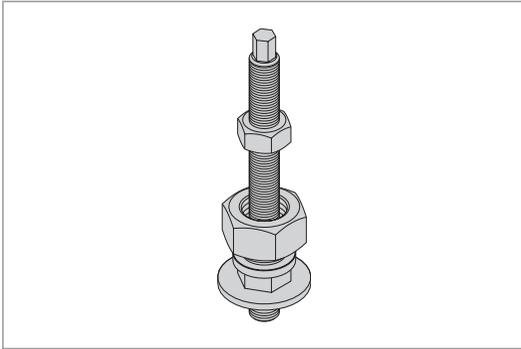
Height Adjusters

Product description

Height adjusters can have an added beneficial effect on the usability of various components.

Product advantages

■ Robust
■ Easily installed
■ Optional
■ RoHS-compliant
■ For optimal threaded connections, all components are corrosion-resistant according to EN 12476 Fe/ Zn 6-10 ph/r/3.

Application

Height adjusters are versatile components for levelling subassemblies, gearbox mounts, reaction support links, engine mounts and compressor bearers.

Material

Standard material	Special design
Steel grade 5.8	on enquiry

Operating conditions

Thread diameter stud	M12, M16, M20, M24

The levelling elements, depending on design, are suitable for flanges with heights corresponding to the thread diameter and larger. The weight should be absorbed in the longitudinal axis.

Design notes

The height adjuster is an additional component for individual height adjustment to the customer application. It comprises a threaded stud with a spacer nut, two additional nuts and a washer.

Fitting & installation

■ Screw the threaded end without nut of the height adjuster into the mating component a distance equal to 1,25 times the thread diameter or more
■ Position the load to be levelled on the large nut and tighten the small nut as a locknut.

Rubberised Stop Washer
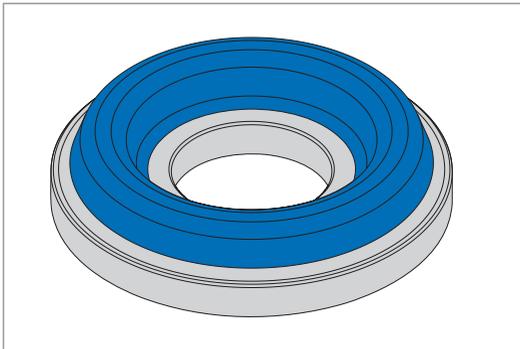
Rubberised Stop Washer

Product advantages

■ Robust
■ Easily installed
■ Optional
■ RoHS-compliant.

Application

Stop Washers effectively limit movements of loads with moving and unmoving units, machines and stops. They are preferably used for axial path limitation with Conical Mounts or Ultra Bushes.

Product description

Stop Washers are versatile components for effectively limiting movements.

Material

Standard material	Hardness
Natural rubber NR 11	60, 70, 80 Shore A
Acrylonitrile-butadiene rubber NBR 68	70 Shore A

Operating conditions

Diameter, outside in mm	40, 49, 65, 75, 90
Max. temperature	+60 °C, transient +80 °C
Min. temperature	−45 °C

Elastomer-coated stop washers have different stiffnesses and damping properties primarily in dependence on the rotation cross section, the height of the elastomer pad and the elastomer as well. They have the same stiffness in the radial directions (X and Y direction) and are considerably stiffer in the axial load direction. The trapezoid design of the elastomer pads (observed in the cross section) will achieve, for otherwise equal

sizes, diameters and heights, a "softer" distribution of the characteristic curve as opposed to the rectangular design. The constricted body design produces smaller stiffnesses in the axial direction and, as a rule, leads to higher service life for otherwise equal deflection. The stiffness in the axial direction increases noticeably from variant I to III. The weight should be absorbed in the longitudinal axis.

simrit

Design notes

The mount consists of a washer with or without central hole, with an elastomer pad vulcanised onto one side.

Fitting & installation

- Position stop washers centred relative to and normal to the axial primary load, and ensure that load is transferred by a smooth and flat face opposite to and making full-surface contact with the elastomer pad
- Make sure that fasteners such as screws, etc., do not restrict the range of deflection of the stop faces.

Washers and Centering Washers
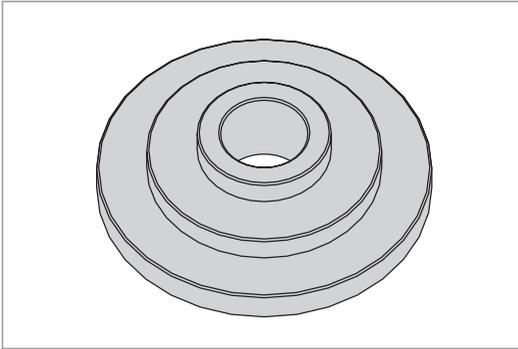
Washers and Centering Washers

Product description

Washers and centering washers are simple and cost-effective add-on elements and are available in different dimensions.

Product advantages

- Robust
- Easily installed
- Optional
- RoHS-compliant.

Application

Washers and centering washers are frequently used as stops for the elastomer bodies of selected conical mounts, MO mounts and ultra bushes.

Material

Steel	min. 270 N ... 340 N

Operating conditions

Diameter, outside in mm	35, 40, 48, 50, 60, 70, 75, 80, 100, 104, 110

The weight load should be applied along the longitudinal axis..
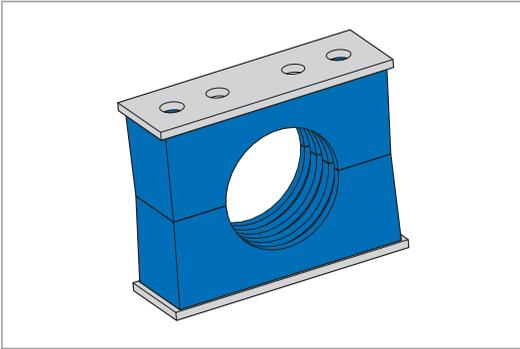
Design notes

Washers and centering washers are additional components made of a cylindrical semifinished product. Each washer or centering washer has a central through-hole and a stepped shoulder on one face.

Fitting & installation

- It is advisable to use DIN-compliant screws and other components for fitting and installation.

Pipe Mounting Block

Pipe Mounting Block

Product description

Pipe mounting blocks reduce the transmission of pulsation-induced vibrations from media-carrying pipes and hoses to the supporting structure. In the reverse direction they damp vibration transmission along the pipes and hoses to other anchorages.

Product advantages

- Parallel fastening surfaces
- Installation with standard screws angled according to DIN hose clamps
- Premounting with pipe unions with up to 6 pipes possible
- Different pipe diameters can be used
- "Fail-safe" behaviour within the securing screws
- High temperature resistance up to 90 °C
- Good resistance to many oils
- Good corrosion protection without chrome
- RoHS-compliant.

Application

The main area of application is decoupling or reducing dynamic relative movement between the media-carrying hoses and pipes as well as the supporting structure. This makes these components suitable for all applications in which media are transported and high pressure pulses occur. Examples are harvesters, construction machinery, processing machines, preparation machines, stationary and mobile pressure units in which there are oil hoses or pipes.

Material

Standard material	Hardness
Chloroprene rubber CR 57	45, 55, 65 Shore A

## Operating conditions

Max. temperature	up to + 100°C, transient +130°C
Min. temperature	−30 °C

Pipe mounting blocks can decouple hoses or pipes from the supporting structures, or damp relative movements. They have a suitable design and optimised elastomer selection for sustained temperatures up to 90 °C. The radial stiffness is many times the axial stiffness. The grooves in the hose retainers are designed to decouple acoustically effective excitation amplitudes. The primary load direction is recommended in the direction of the screws.

Design notes

The pipe mounting blocks have a single cubic shape
and can generally hold 1 to approximately 6 and
in some cases more hoses or pipes. Metal sheets for
uniform distribution of the clamping forces on the
individual hose holders are vulcanised in place. Sleeves
for guiding the screws and positioning the metal sheets
are installed. The hose holders have grooves along the
bore in a circumferential direction. They are used for
modifying the stiffness for small vibration amplitudes.
Make sure that only small axial deflections occur.
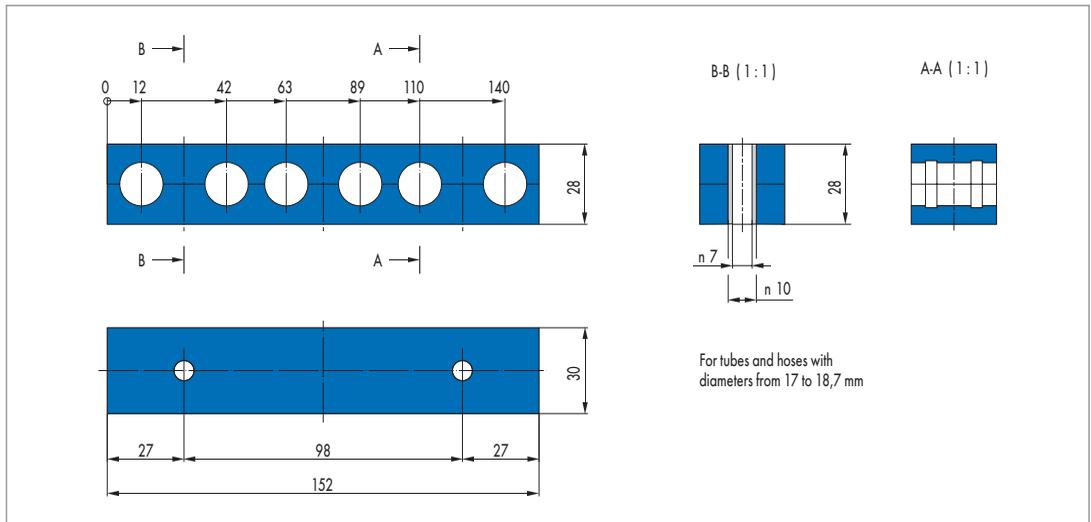

Dimensional drawing Type 039 18 775

Fitting & installation

- Pipe mounting blocks are designed to be fitted
  by means of threaded fasteners
- Make sure that there is a closed gap between to
  pairs of components of the pipe mounting block
- The installation area must be free from fluids.
  There must not be any metal shavings or sharp
  edges/stones in the vicinity of the installation areas
  or between the elastomer bodies or between them
  and the metal sheets
- Make sure that all screws are installed in
  multiple pipe mounting blocks
- Heat accumulation under covers or similar
  must be avoided
- Uniform screw tightness is required.
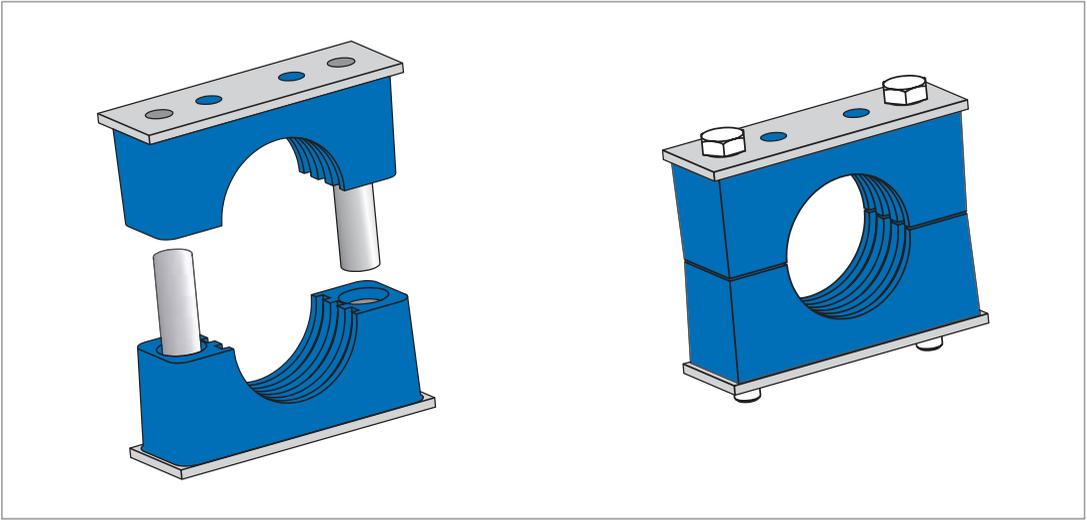
Fitting & installation Type 039 18 777
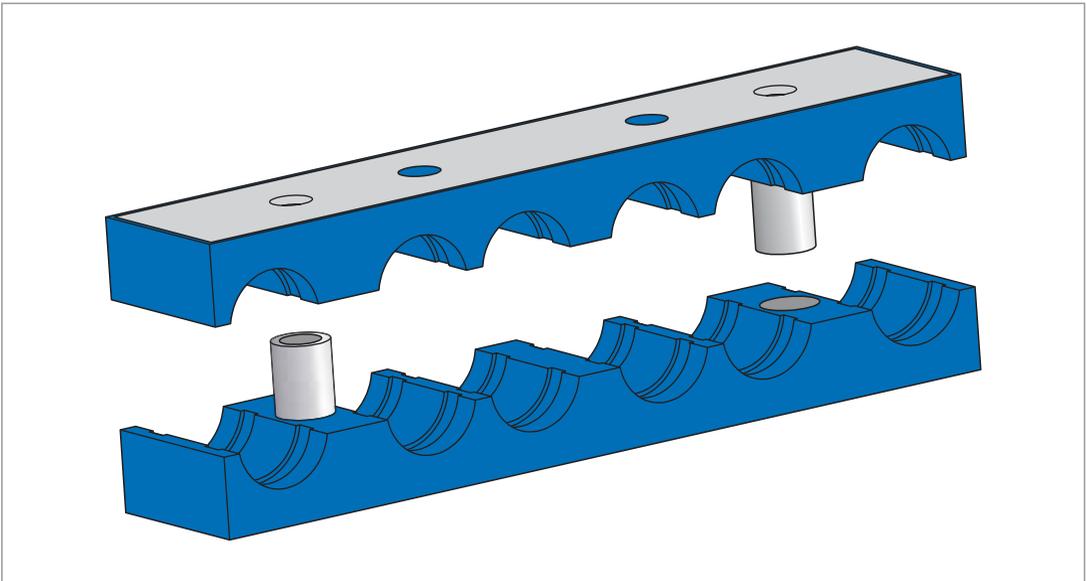
Fitting & installation Type 039 18 776 HD

Rubberised Sprockets

Rubberised Sprockets

Application

- Engines with chain drives
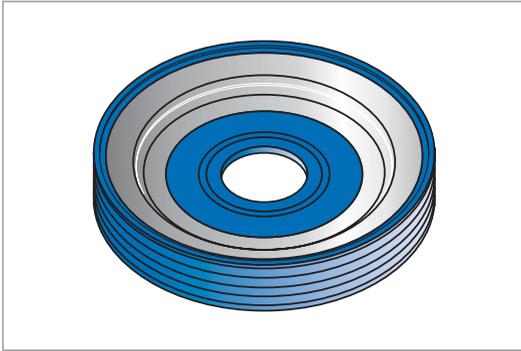- Steel or sintered sprockets for high-speed chain drives.

Material

Elastomer	HNBR
Sprocket	steel

Operating conditions

Media	Engine oil
Temperature	−25 ... +140 °C

Product description

In the engine area chains and sprockets wheels are used to drive crankshafts and camshafts as well as auxiliary units. The advantages of chain drives are the long service life and low maintenance requirements. However, conventional chain drives tend to be relatively noisy. As a result Simrit has developed rubberised steel or sintered sprockets for high-speed chain drives. Defined elastomer pads on both sides of the sprockets make the system run more smoothly. The damping effect comes from the fact that the chain enters the elastomer before it reaches the metal sprocket surface. This effectively damps noises caused by vibrations in the chain.

Product advantages

- Long-life designs with maximum friction resistance and quiet chain running with high degree of expertise in elastomer combinations and specially developed HNBR elastomers
- Noise levels significantly reduced at medium r.p.m. by approximately 1 to 3 dB (A).

Belt Pulley with Elastomer Track

Belt Pulley with Elastomer Track

Product description

The belt pulley with elastomer track is used to damp vibration and noise. Drive pulleys and drive belts are used for power transmission in motorcycles in some cases. These drive pulleys begin to vibrate at specific speed ranges and generate noise. To solve the problem Simrit has developed a drive pulley with vulcanised, defined elastomer pads. This damps the vibrations of the pulley and reduces noise.

Product advantages

■ Long-life designs with a high degree of expertise in elastomer combinations and specially developed HNBR elastomers
■ Significant reduction of vibrations and noise.

Application

■ Spur gear drive of auxiliary units in diesel engines, spur gear of an air compressor
■ Engines for construction machinery, tractors and other agricultural machinery.

Material

Elastomer	HNBR
Pulley	steel

Operating conditions

Media	Engine oil
Temperature	−25 ... +140 °C

Decoupled Chain Gear

Decoupled Chain Gear

Application

- Deflection wheel for chain drive of a diesel engine
- Steel or sintered sprockets for high-speed chain drives
- Medium and large diesel engines with sprocket/ spur gear drive for construction machinery, tractors and other agricultural machinery.
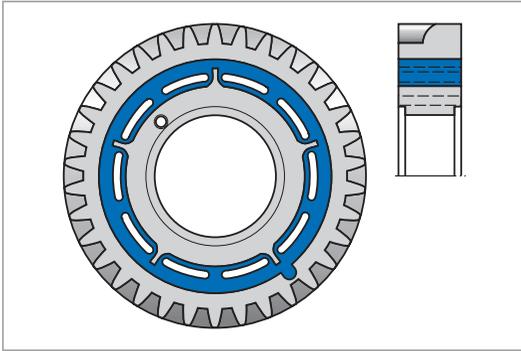
Material

Elastomer	HNBR
Sprocket	steel
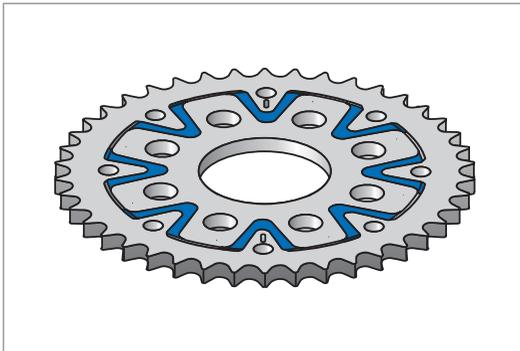
Product description

In the field of engines chains and sprocket are frequently used to drive crankshafts and camshafts as well as auxiliary units. The gear teeth a contact conditions in the chain drive are similar to the geared drive. The chain links grip so deeply into the spaces between the teeth that both edges are in contact with them. In the chain drive vibrations occur when the load on the chain is relieved. Simrit has developed a deflection wheel in the reference case that decouples the shaft from the gear wheel to prevent transmission of vibrations by bonding elastomer between the inside component attached to the shaft and the outer gear wheel. Vibrations and noise can be significantly reduced. Because the elastomer is incompressible, there is still a reliable power transmission.

Operating conditions

Media	Engine oil
Temperature	−25 ... +140 °C
Pressure	max. 3 bar

Product advantages

- Significant noise reduction by approximately 1 to 3dB (A)
- Long-life designs with a high degree of expertise in elastomer combinations and specially developed HNBR elastomers.

Decoupled Gears

Decoupled Gears

Product description

Spur gears are used to drive the camshafts and auxiliary units for diesel engines. The auxiliary units develop unwanted vibrations that cause noise and affect the smoothness. Solution: the gears are separated radially, joined by an elastomer component again and thus decoupled. Vibrations and noise can be significantly reduced.

Product advantages

- Noise reduction by approximately 1 to 3dB (A)
- Long-life designs with a high degree of expertise in elastomer combinations and specially developed HNBR elastomers.

Application

- Gears for spur gear drives
- Camshaft gear
- Medium and large diesel engines with spur gear drive for construction machinery, tractors and other agricultural machinery.
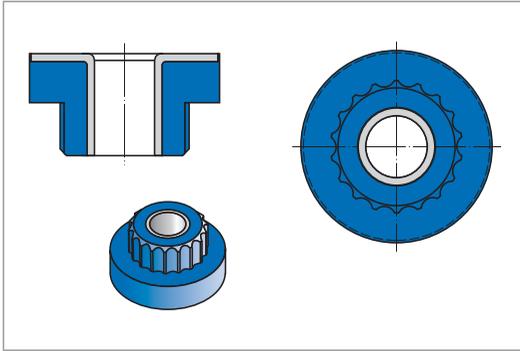
Material

Elastomer	HNBR
Spur gear	steel

Operating conditions

Media	Engine oil
Temperature	−25 ... +140 °C
Pressure	max. 3 bar

Decoupling Elements

Decoupling Elements

Product description

Various elastomer-metal design components are used to reduce vibrations and noise in the area of engines and auxiliary units. These components are used amongst others on the resilient attachment as well as sealing of metal components on the oil sump, the cylinder head cover on the engine block and injector valves. One example in the engine controller of commercial vehicles, which is attached to the vehicle with screws. Elastomer composite components are used for resilient vibration-decoupling attachment.

Product advantages

- Decoupling of structure-borne noise and vibrations
- Reduced components by use of elastomer composite components
- Application-specific design with a wide range of elastomers.

Application

- Resilient attachment as well as sealing of metal components on the oil sump, cylinder head cover on the engine block, injector valves
- Attachment of engine controller (electronic)
- Engines and auxiliary units for construction machinery, tractors and other agricultural machinery.

Material

Composite component of metal and elastomer (with/without bond)

Elastomer	VMQ with low hardness (Shore)
Support component	steel

Operating conditions

Media	Engine oil, spray
Temperature	−25 ... +140 °C