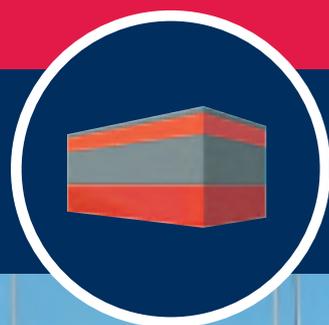


# SAHLBERG

100 years of intelligent solutions

Technical Manual

Resilient Mountings with KSD<sup>®</sup>

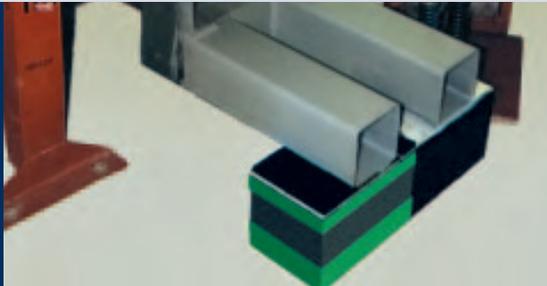
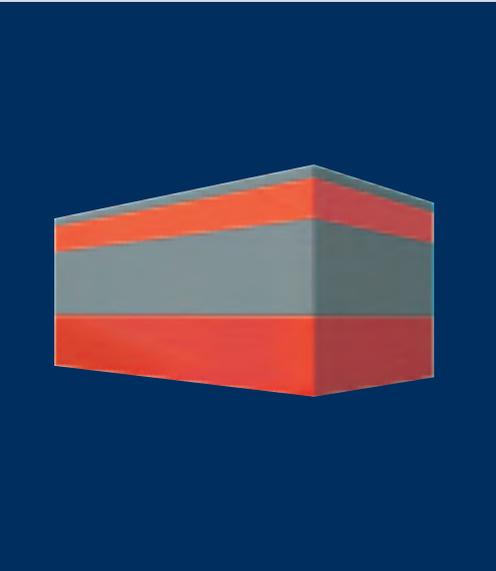


# Insulation Protection Absorption

**KSD®-Elements in use:**

Elevator support

Combined heat and power plant



Support of air conditioning units on the upper floor

Support of air conditioning units on the roof of an office building

## Resilient Mountings with KSD®: Product Presentation 4

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Piston compressor



Plastics press

**Double-elastic KSD®-Elements of the BBM Akustik TECHNOLOGIE company are highly efficient supports for machines, installations and equipment.**



## **KSD®-Elements insulate vibration and structure-borne noise**

Clearly more efficient than rubber or steel springs, KSD®-Elements prevent the transmission of intrusive vibrations and structure-borne noise into buildings.

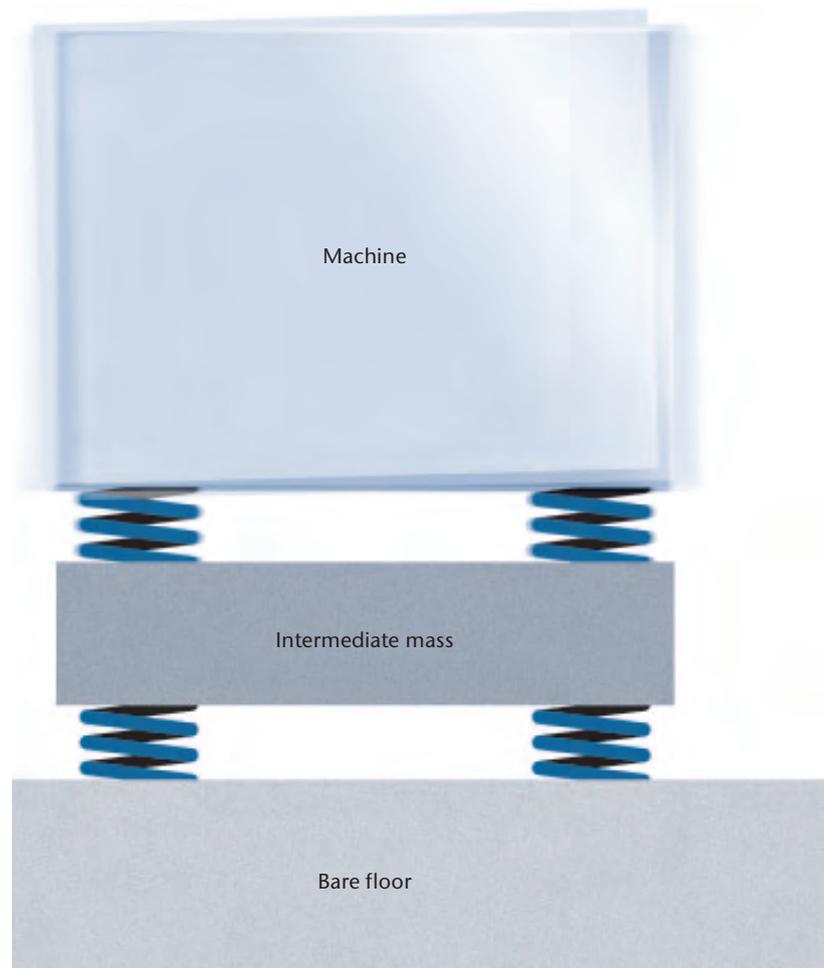
## **KSD®-Elements protect from noise**

The transmission of structure-borne noise in machine systems is reduced and adjacent rooms are protected. Noise levels which can be harmful to health and the environment are therefore reduced significantly.

## **KSD®-Elements absorb shocks**

KSD®-Elements absorb external shocks and vibrations, thus protecting sensitive equipment and systems.

## **Mounted without KSD®-Elements**



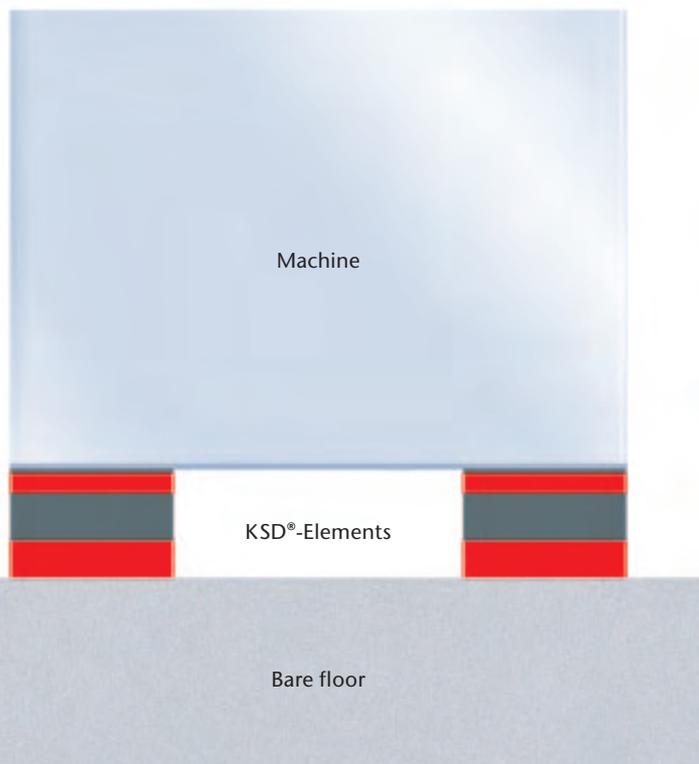
## KSD®-Elements in detail

A high-quality, double-elastic mounting is easily possible with KSD®-Elements. These elements are used where the insulating effect of a single-elastic mounting on rubber or spring elements is insufficient. A typical application would be, for example, where machines are situated above offices, living rooms and bedrooms, or in cinemas and concert halls.

A double-elastic mounting on traditional insulating elements can only be carried out by installing a heavy concrete intermediate foundation. KSD®-Elements, however, achieve a comparable effect without the need for any intermediate mass, resulting in less weight, a lower construction height and reduced costs.

## Mounted on KSD®

**The same effectiveness but a smaller mass, lower construction height, reduced costs, easier mounting**



## Important technical advantages:

- **Installation time can be reduced**  
Expensive foundations which take a long time to build, and additional floor loads, can largely be dispensed with.
- **KSD®-Elements are suitable for modular use**  
7 KSD® standard types are available for loads up to 20 kN per element. The dimensions of the different types are identical.
- **Flexible retrofitting is possible at any stage**  
Subsequent calculation and installation can easily be carried out.
- **KSD®-Elements insulate reliably**  
Technical rooms with noisy machines can be located near rooms where people need a quiet working environment.
- **Solution for the most demanding technical vibration requirements**  
With double-elastic elements, pulse-type oscillations, or shocks, are reliably insulated.

# 1. Elastic Mounting on KSD<sup>®</sup>- and D-Elements

## 1.1 Introduction

KSD<sup>®</sup>- and D-Elements have been used for more than 30 years as support for machines and installations. KSD<sup>®</sup>-Elements are double-elastic and D-Elements are single-elastic elements.

A considerably higher insulating effect of structure-borne noise and vibrations is achieved using double-elastic KSD<sup>®</sup>-Elements compared to single-elastic spring elements. The VDI directive 2566, sheets 1 and 2 [1], show how KSD<sup>®</sup>-Elements can be used especially for elevator systems with or without an engine room. The following is a detailed description of the properties of KSD<sup>®</sup>-Elements, as well as the advantages resulting from noise-reducing measures.

## 1.2 KSD<sup>®</sup>-Elements

- Provide a far better level of insulation of structure-borne noise than rubber or steel springs (see 1.6).
- Are available for different nominal loads though all have the same dimensions.
- Possess high internal damping. Machines will not move unduly during start-up or operation.
- Are easy and quick to install and retrofit.

## 1.3 Influence on the Construction

- Machines mounted on KSD<sup>®</sup>-Elements do not cause any disruptive structure-borne noise in the building.
- High-quality rooms which need to be protected can be situated adjacent to technical rooms.
- KSD<sup>®</sup>-Elements do not cause any noticeable additional load. Heavy foundations can usually be dispensed with.
- Expensive noise-reducing constructions are mostly no longer required.
- Optimum use of rooms is possible.
- It is mostly not necessary to build concrete foundations during the brickwork phase of building.
- Lightweight equipment can be directly mounted on the floating screed when using KSD<sup>®</sup>-Elements.

## 1.4 Structure

D-Elements consist of one, and KSD<sup>®</sup>-Elements of two, layers of mixed-cell polyurethane elastomers. The two layers of the KSD<sup>®</sup>-Elements are separated by a heavy intermediate mass. A hot-dip galvanised steel plate on top of the elements ensures a uniform spread of the load onto the elastomer layer. This plate can absorb point and line loads.

KSD<sup>®</sup>-Elements are designed for static loads up to 20 kN per element. Depending on the load, there are seven different types available which all have the same geometric dimensions, allowing variable combinations.

## 1.5 Application

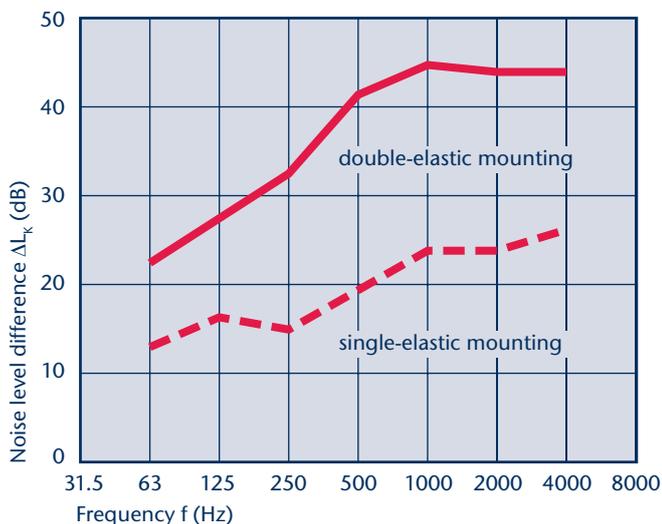
KSD<sup>®</sup>-Elements can be easily mounted under the machine frame; in most cases of vertical load, the elements do not have to be screwed down or otherwise fixed. The KSD<sup>®</sup>-Elements are delivered with a friction mat which is installed between the underside of the machine and the load spreading plate, to avoid slipping. Special screwable types are also available for specific applications.

All elements have the same dimensions but their stiffness varies. This allows machines and units with an eccentric centre of gravity and specified support points to be erected horizontally.

## 1.6 Comparison between Double-Elastic and Single-Elastic Mounting

With a double-elastic mounting on KSD®-Elements, structure-borne noise transmission in the building is reduced by up to 20 dB, compared to a single-elastic mounting. The following diagram shows the noise level difference in frequency between a single and a double-elastic mounting on KSD®-Elements.

### Noise level differences measured in a single and a double-elastic mounting acc. to [3]



## 1.7 Resistance

KSD®-Elements are made of resilient polyurethane, which provides excellent resistance to oil, grease and humidity. However, contact with solvents should be avoided. Although KSD®-Elements are resistant to moisture, they should not permanently stand in water. If exposed to intensive UV radiation, the colour of the elastomer layer may fade and the surface may become slightly brittle, but the physical properties of the elements will not be altered. The service temperature of the elements ranges between  $-30\text{ °C}$  and  $+70\text{ °C}$ .

## 1.8 Application Range

- Ventilation systems (air conditioning systems)
- Refrigerating machines, liquid chillers, compressors
- Pumps
- Emergency power-generating units, power generators, block-type thermal power station modules
- Elevator systems (suitable for VDI 2566 requirements)
- Machines and mills in the food industry
- Support of floor slab to increase impact noise protection in case impact noise insulation of usual floor structures is insufficient.



## 2. Selection Criteria for the Use of KSD<sup>®</sup>- and D-Elements

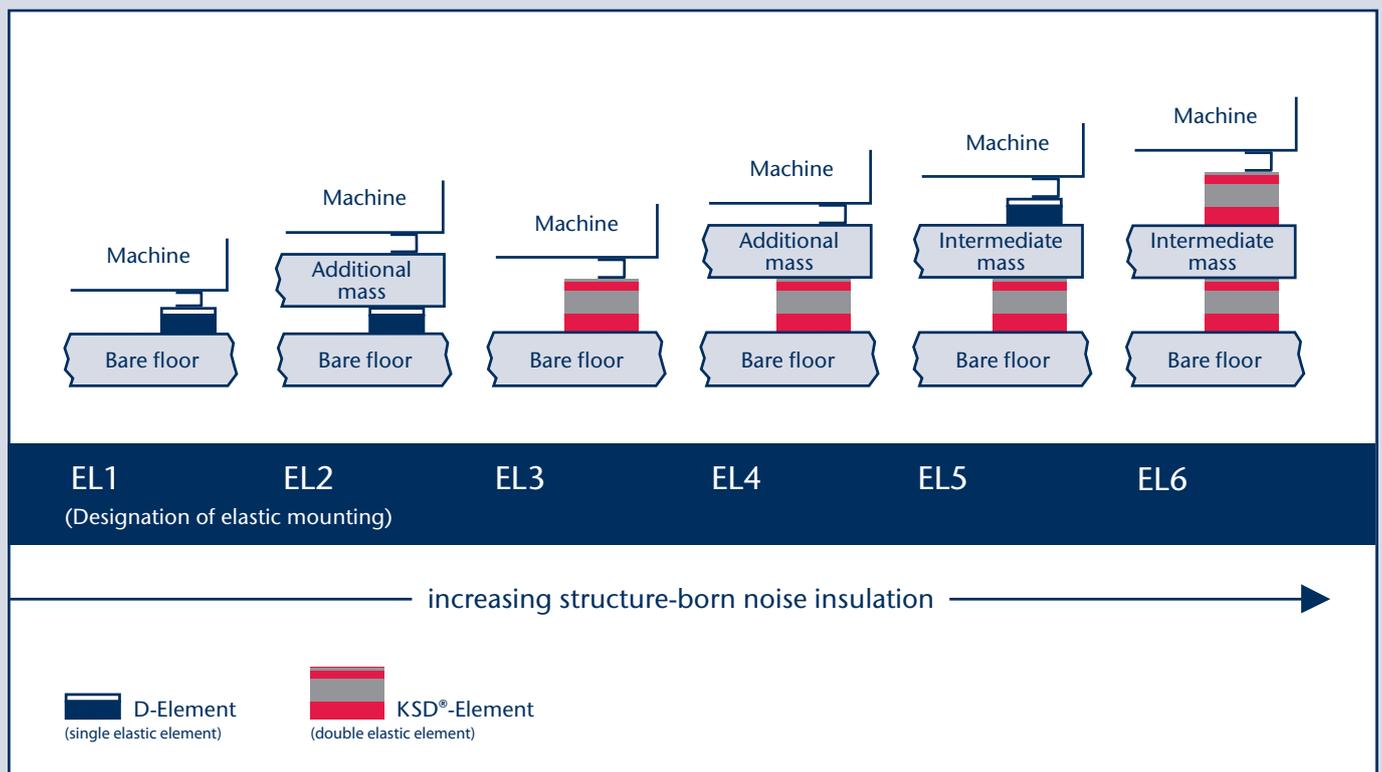
With KSD<sup>®</sup>-Elements, machines can be installed without the need for extensive noise-reducing measures, even in the direct vicinity of high-quality rooms. In other words, equipment can be installed exactly where it is needed. To facilitate the selection of elastic mountings of machines and equipment in buildings (see [2]):

- machines are classified in groups of comparable structure-borne noise emissions (see Table 1).
- elastic mountings are indicated complying with different requirements (see Fig. 1) and
- for different machines and installation sites, it shows which elastic mounting should be selected to meet a value of 30 dB(A) in the nearest high-quality room (see Fig. 2).

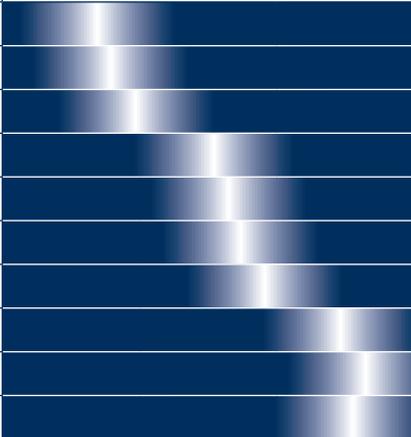
D-Elements show a structure-borne noise insulation comparable to rubber springs as they only have one elastic layer. Whether D or KSD<sup>®</sup>-Elements should be used to mount a machine is also shown in Figures 1 and 2.



**Figure 1 – Schematic view of the elastic mounting of machines and equipment indicating the increase of structure-borne noise insulation**



**Table 1 – Classification of technical building equipment in machine groups of comparable structure-borne noise emission**

Machine Group	MG I	MG II	MG III
Structure-borne noise emission	low	medium	high
Type of Machine	increasing  structure-borne noise emission		
Dry Cooler			
Centrifugal Ventilators			
Axial Ventilators			
Piston Pumps			
Turbo Compressors			
Scroll Compressors			
Screw Compressors			
Elevator Machines			
Piston Compressors			
Emergency Generators			

**Note:** The light-coloured spaces indicate orientation values for the classification of machines in machine groups. For very heavy or very light-weight machines, the assessment of the machine group may either be higher or lower (darker areas).

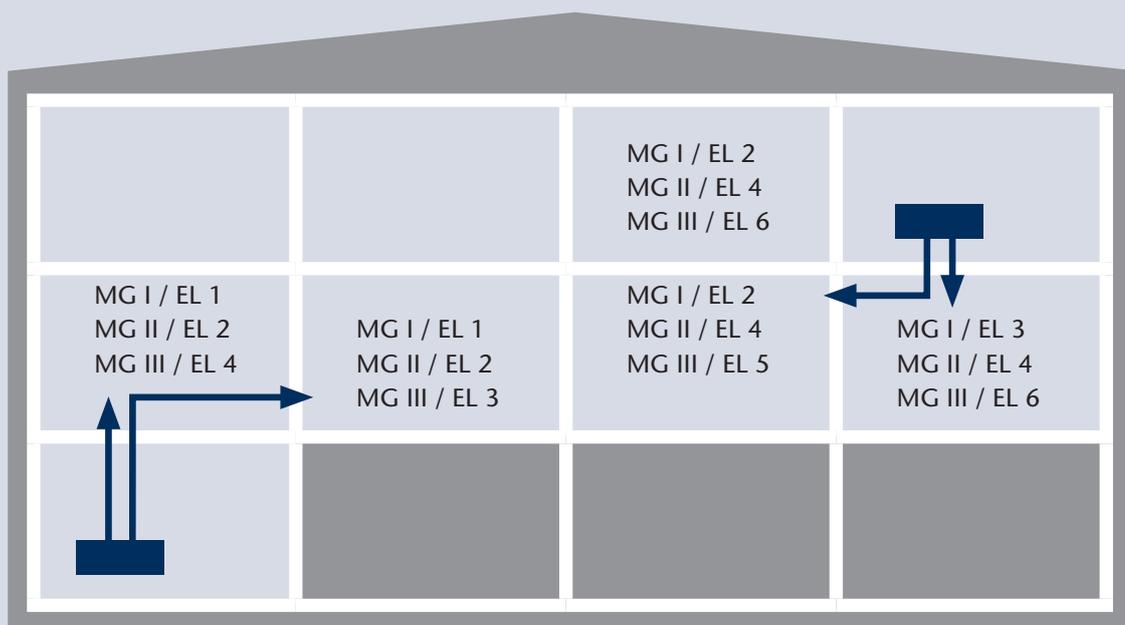
Publications:

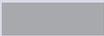
[1] VDI 2566 page 1 “Schallschutz bei Aufzugsanlagen mit Triebwerksraum / Acoustical design for lifts with a machine room” Dec. 2001, VDI 2566 page 2 Entwurf: “Schallschutz bei Aufzugsanlagen ohne Triebwerksraum” Aug. 2001

[2] Saalfeld, M.: Körperschalldämmende Maßnahmen bei haustechnischen Anlagen, VDI Berichte Nr. 1121, 1994

[3] Müller, H.A.: Schalltechnische Erfahrungen mit doppelt elastischen Maschinenlagerungen, Sonderdruck aus Jahrbuch der Schiffbautechnischen Gesellschaft 59 (1965), p. 326 – 334

**Figure 2 – Correlation between location of the high-quality room (L AF, max = 30 dB(A)), installation site of the machine and elastic support required. Orientation values for solid construction buildings with reinforced concrete floors.**



-  Machine
-  No high-quality room
-  High-quality room

**Note:** MG I to MG III indicate the type of machine (see Table 1) and EL1 to EL6 show the structure-borne noise insulation required (see Figure 1) including flexible pipe and cable connections. The requirements for airborne noise insulation of building elements between the technical centre and high-quality rooms can be determined following DIN 4109, November 1989, Table 5.

## 3. Information necessary for the Design of Elastic Mountings with KSD<sup>®</sup>- and D-Elements

The following details about the equipment or machine, the installation site and the surrounding building construction are required:

### 3.1 Information about the Equipment or Machine

- Type of equipment or machine (ventilation system, piston pump, turbo or piston compressor, block-type thermal power station module, emergency power-generating unit, press, punching machine etc.)
- Drawing or suitable sketch indicating the structure and dimensions of the machine to be mounted
- Structure and position of the machine bearings or the base frame
- Weight-forces acting on the individual machine bearing or framework during operation, or the position of the centre of gravity during operation and the dimensions of possible points of support
- In the case of combined machines, indicate individual weights and 3-D arrangement of the machine parts as well as the position of the connecting areas where the machine elements are screwed together
- Main excitation frequencies of the machine (speed, number of pistons, number of rotor blades etc.)

### 3.2 Information about the Installation Site

- Size and structure of the technical centre or the machine room
- Position of the machine (distance from the walls, ceiling etc.)
- Location of the technical centre or the machine room in the building indicating the use of adjacent rooms (bedrooms, living rooms, foyer, working rooms etc.)

### 3.3 Information about the Surrounding Building Construction

- Substructure of the installation site for the equipment or machine (reinforced concrete ceiling, ribbed ceiling, wood joist ceiling, steel platform, natural ground etc.)
- Floor structure of the installation site for the machine (bare floor, floating screed etc.)
- Structure of the walls of the technical centre or the machine room



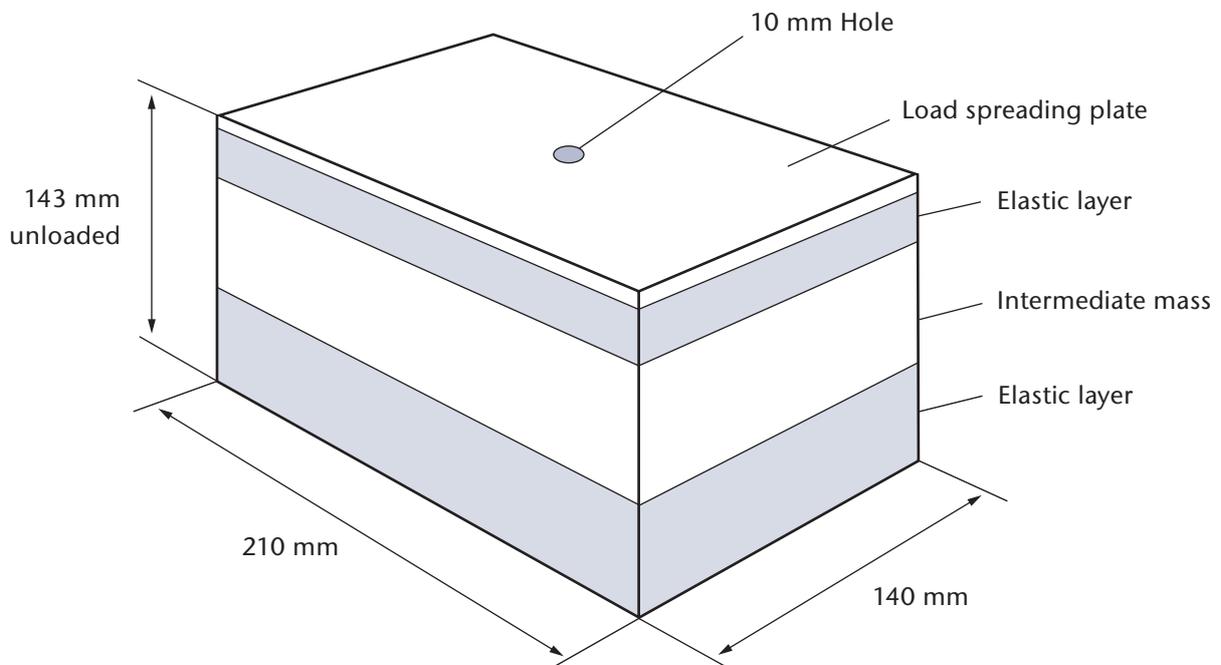
### 4.1 KSD®-Elements Standard Type Dimensions – Admissible Loads

KSD®-Elements do not usually require any fixing by screws or bolts in the case of vertical loads. The scope of delivery of the elements includes friction mats to be mounted between the underside of the machine and the load spreading plate.

For further information, please see “Maintenance and Installation of KSD®-Elements”, page 15.

#### Dimensions valid for all types:

Length:	210 mm
Width:	140 mm
Height (unloaded):	143 mm
Weight:	16 kg



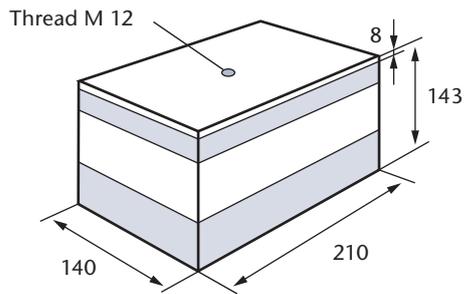
Type	Colour	Max. load
KSD® Type R	blue	700 N
KSD® Type L	green	1,500 N
KSD® Type M	brown	3,000 N
KSD® Type G	red	5,000 N
KSD® Type V	grey	9,000 N
KSD® Type T*	turquoise	16,000 N
KSD® Type H*	violet	20,000 N

These types are only for use on sufficiently rigid foundation.

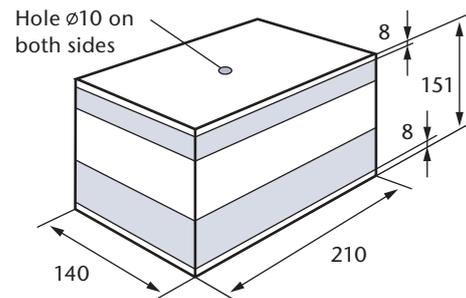
## 4. KSD®-Elements

### 4.2 KSD®-Elements Special Types Dimensions and Models

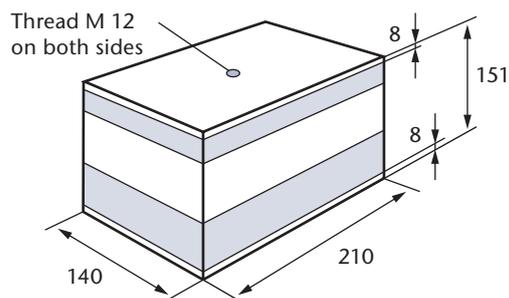
**Model A**



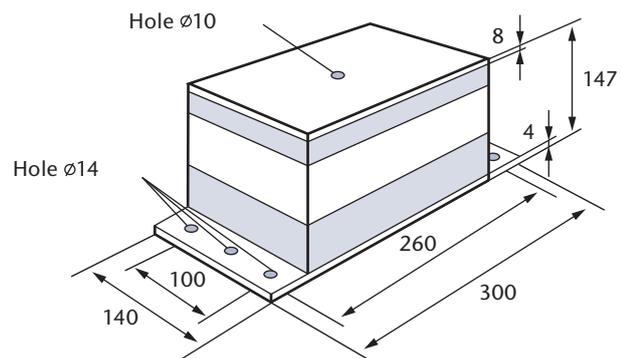
**Model B**



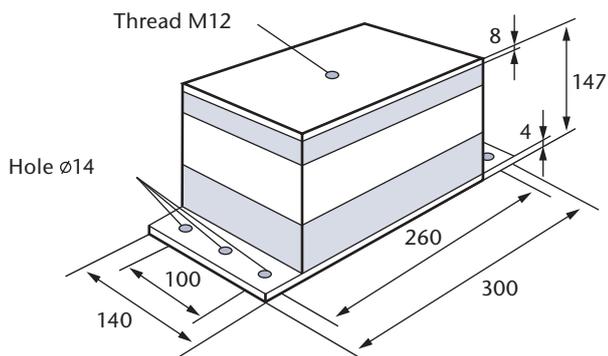
**Model AB**



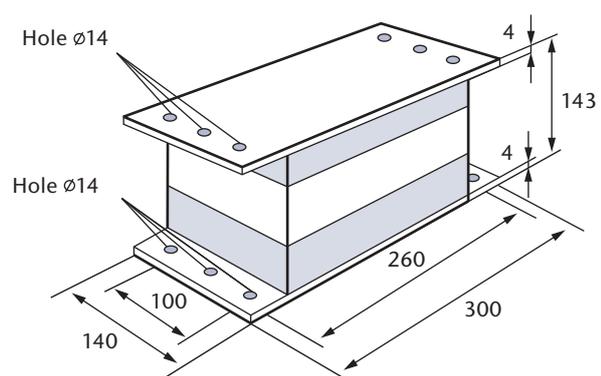
**Model C**



**Model AC**



**Model CC**

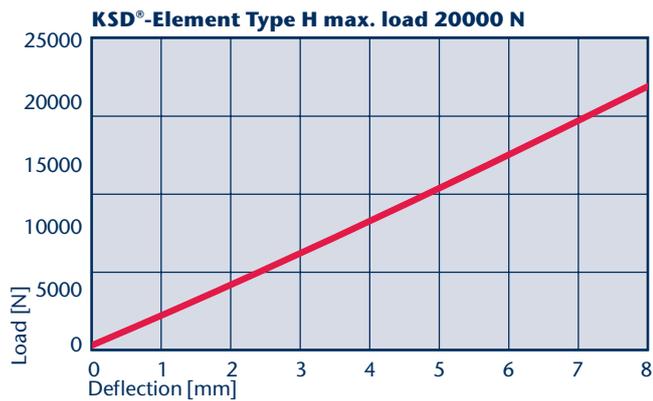
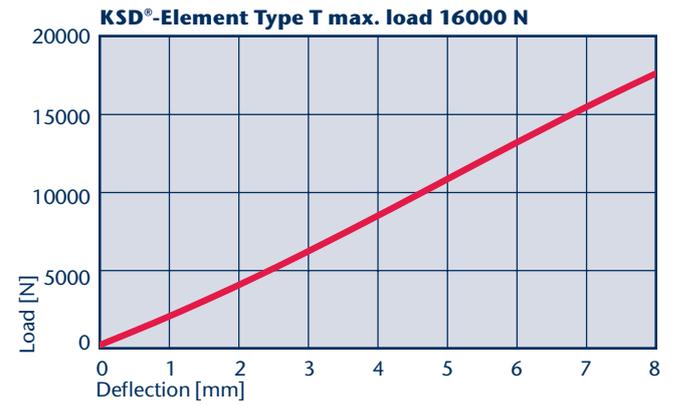
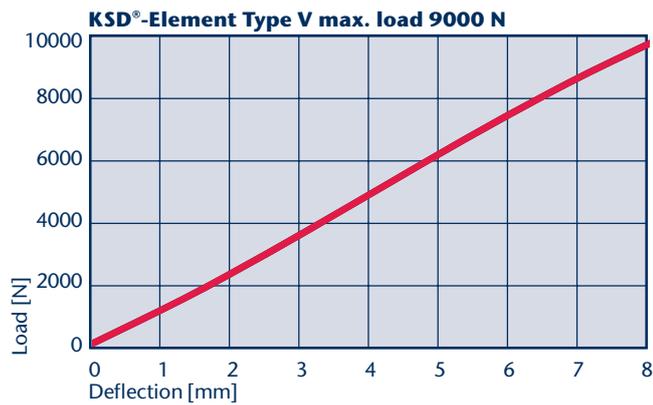
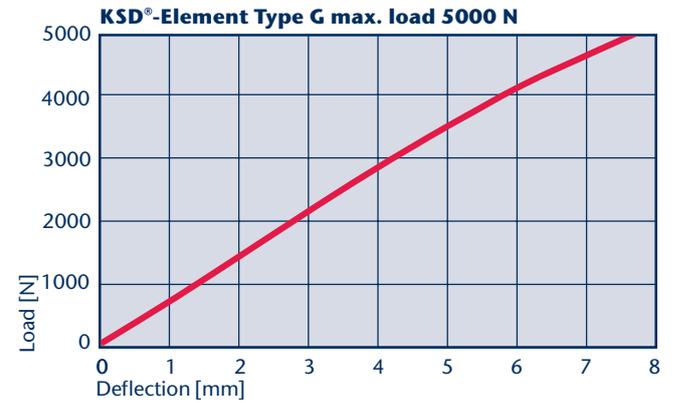
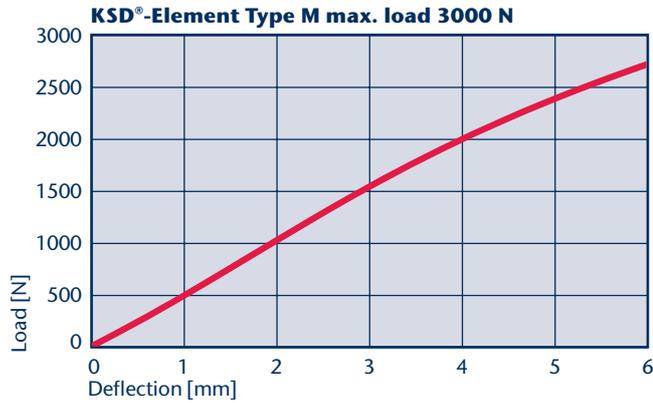
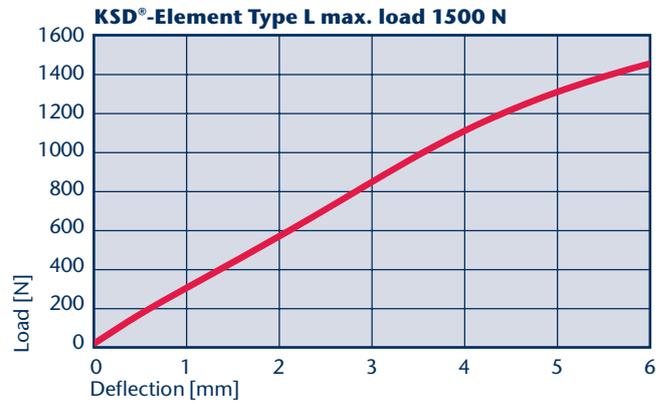
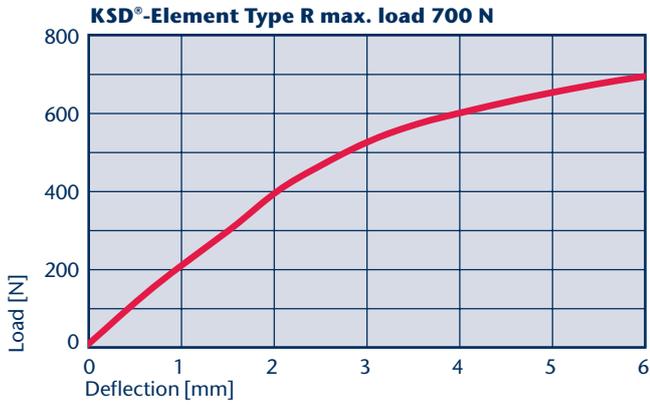


All dimensions in mm

Model	Additional equipment to the standard type
A	Thread M12 (centric) in the load spreading plate
B	Second load spreading plate (bottom)
AB	Second load spreading plate (bottom) with 1 x thread M12 (centric) in top and bottom load spreading plate
C	1 x installation plate at the bottom
AC	1 x installation plate at the bottom and 1 x thread M12 (centric) in top load spreading plate
CC	1 x installation plate on the top (instead of the load spreading plate) and 1 x installation plate at the bottom

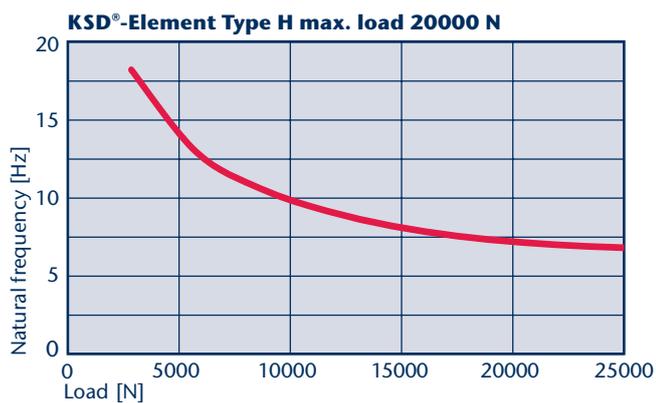
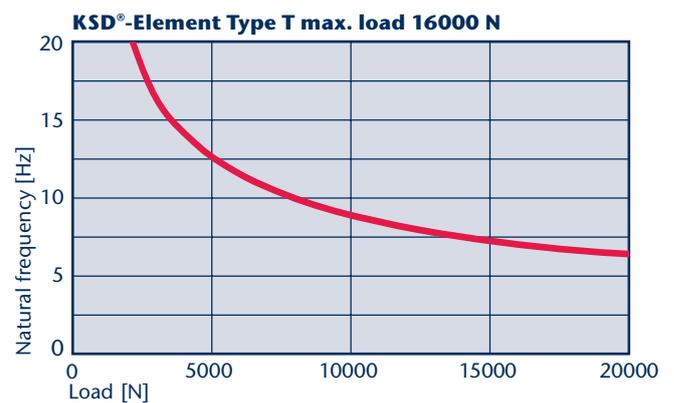
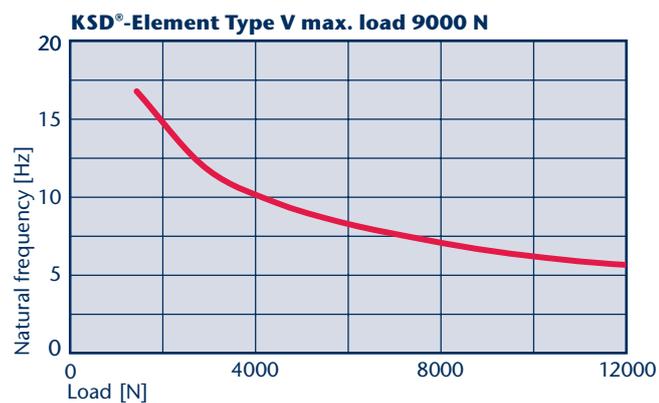
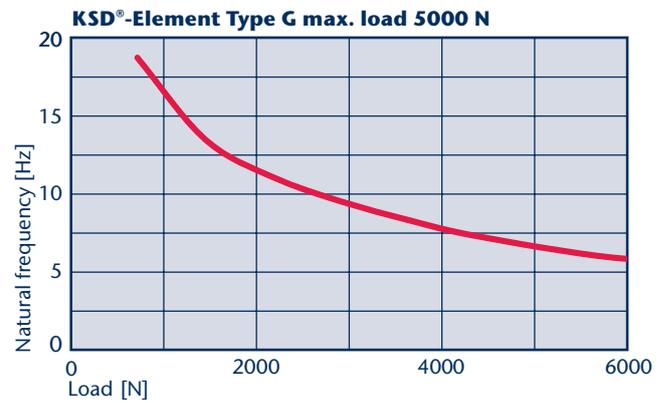
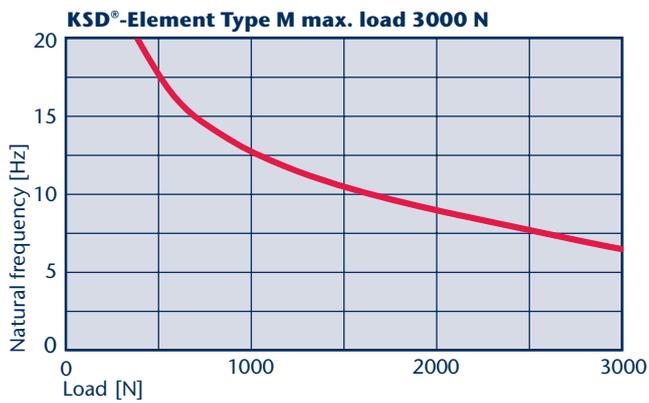
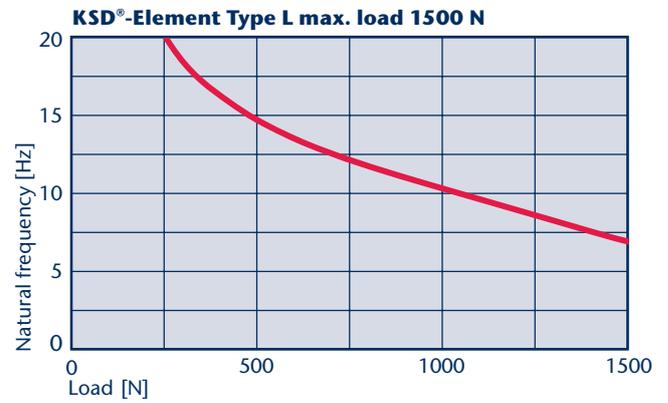
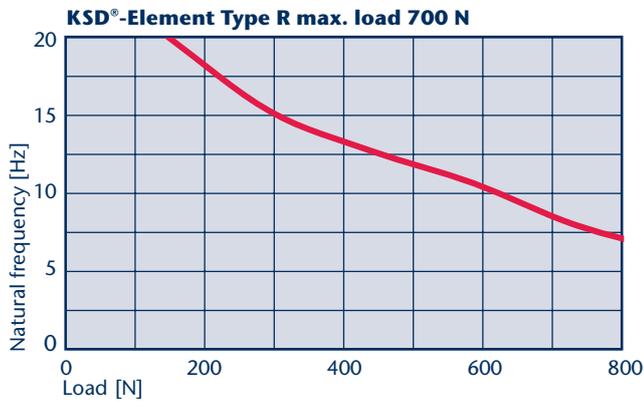


### 4.3 KSD®-Elements Characteristic Curves Static Spring Characteristics



## 4. KSD®-Elements

### Lower natural frequencies



#### 4.4 Maintenance and Installation of KSD®-Elements

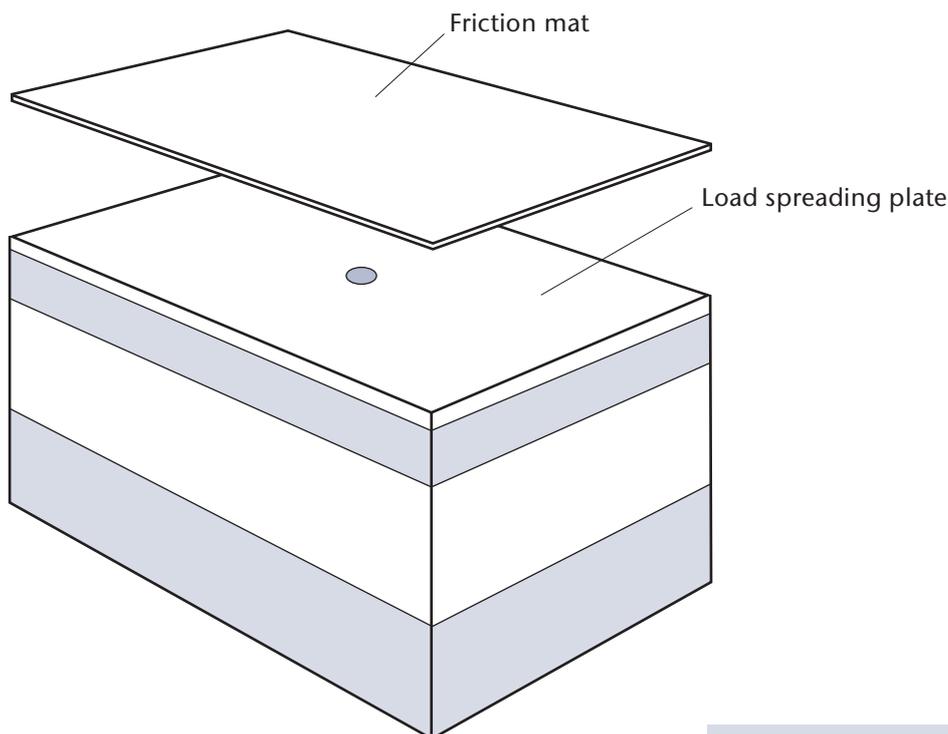
KSD®-Elements do not require any maintenance, provided that the following instructions are observed when installing them:

##### Installation

KSD®-Elements must always be arranged with the load spreading plate on top. For vertical loads the elements do not usually need to be screwed or otherwise fixed. Each KSD®-Element is delivered with a friction mat to be mounted between the underside of the machine and the load spreading plate to avoid slipping. Any further fixing is not necessary, as the oscillations of conventional machines during operation are considerably lower than the deflection of the elements. The elements are therefore subjected to constant load.

When installing machines which generate horizontal forces, and where elements are submitted to tensional loads, special bearing types are required. Suggestions for the design of such bearings can be provided upon request.

The static nominal load for KSD®-Elements must not be exceeded. Short dynamic peak loads of up to three times the nominal load will be absorbed without causing permanent deformations or alterations in the dynamical properties. Unavoidable thrust loads (horizontal forces) should not exceed a maximum of 25% of the pressure load (vertical forces) acting on the KSD®-Elements.



## 4. KSD®-Elements

### Mounting

When mounting the elements, make sure that they fully rest on the bottom surface and that the floor underneath is clean. The ground should be made as smooth as possible and sloping surfaces levelled. KSD®-Elements must not be in contact with any adjacent construction elements as this leads to a reduction in noise insulation. The elements must therefore be installed at a distance of at least 2 cm away from adjacent construction elements. The elements must be placed underneath the machine and insulated in such a way as to ensure uniform deflection of the elements under load. As all KSD®-Element types have the same height, machines with an eccentric centre of gravity can be installed without any problem. The stability of machines with a small projected area and a high centre of gravity must be checked.

If machines have to be mounted in a precise horizontal position or at a specific height, it must be taken into account that certain creeping effects in the resilient material may occur under permanent load. Such effects will result in a slightly increased deflection under long-term constant load. Any remaining differences in height can be compensated by intermediate metal sheets after a few days. The influence of the creeping effect on the dynamic behaviour of the elements is negligible.

### Resistance

KSD-Elements are made of a resilient material which is resistant to oil, grease, and humidity. However, contact with solvents should be avoided. Although KSD®-Elements are resistant to moisture, they should not permanently stand in water.

If exposed to intensive UV radiation, the colour of the elastomer layer may fade and the surface may become slightly brittle, but the physical properties of the elements will remain constant. The service temperature of the elements ranges between  $-30\text{ °C}$  and  $+70\text{ °C}$ .



#### **4.5 Text for Invitation to Tender for KSD®-Elements**

KSD®-Elements are used for the point-loaded structure-borne noise insulated erection of equipment and machinery.

The elements consist of two layers of mixed-cell polyurethane elastomers separated by a heavy intermediate mass. A hot-dip galvanised steel plate situated on top of the elements is designed to ensure a uniform spreading of linear and point loads on the elastomer surface.

Included in delivery is a friction mat which is to be placed between the machine frame, or the underside of the machine and the load spreading plate. It is not generally necessary to screw the KSD®-Elements to the machine.

For different loads, there are seven different types of KSD®-Elements available which all have the same dimensions. Elements can therefore be combined, dependent upon the resulting loads.

The information required for the design of resilient mounting on KSD®-Elements is given on page 10.

#### **Summary:**

- KSD®-Element
- Type depending on load
- Dimensions length x width x height  
= 210 x 140 x 143 mm
- Weight 16 kg
- Consisting of: load spreading plate, elastic top layer, intermediate layer and elastic bottom layer
- Scope of delivery includes 1 friction mat

## 5. D-Elements

### 5.1 D-Elements Standard Type Dimensions – Admissible Loads

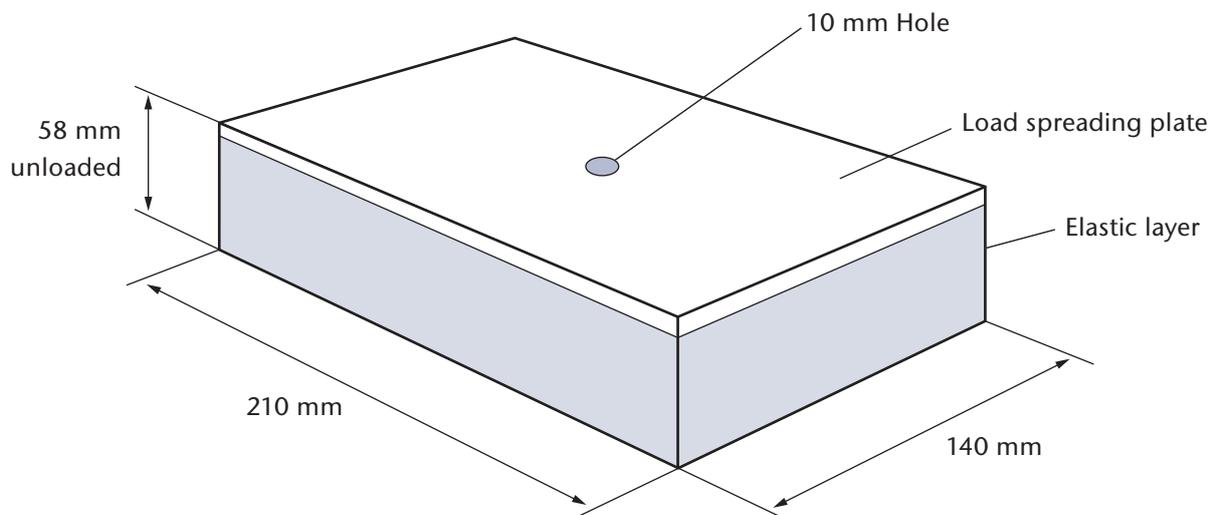
D-Elements are single-elastic mountings with a load spreading plate. The application depends on the selection criteria for elastic mountings (see page 10).

D-Elements usually do not require to be screwed or otherwise fixed. The scope of delivery includes a friction mat which must be placed between the underside of the machine and the load spreading plate of the D-Element.

For mounting instructions, please see “Maintenance and Installation of D-Elements” on page 21.

#### Dimensions valid for all types:

Length:	210 mm
Width:	140 mm
Height (unloaded):	58 mm
Weight:	2.5 kg

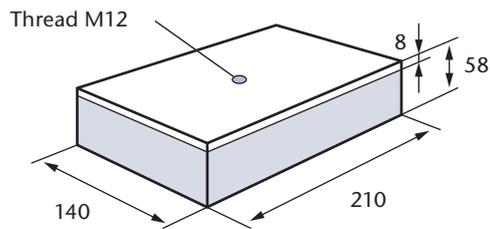


Type	Colour	Max. load
D Type R	blue	700 N
D Type L	green	1,500 N
D Type M	brown	3,000 N
D Type G	red	5,000 N
D Type V	grey	9,000 N
D Type T*	turquoise	16,000 N
D Type H*	violet	20,000 N

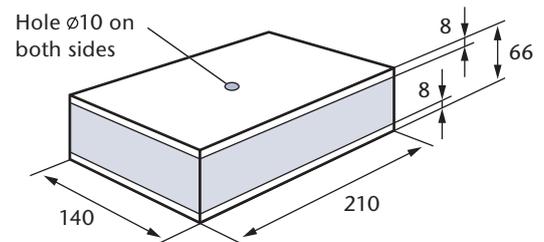
\* These types are only for use on sufficiently rigid foundation.

## 5.2 D-Elements Special Types Dimensions and Models

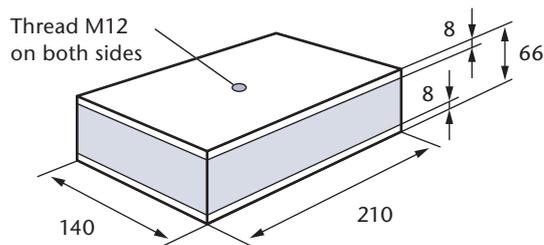
**Model A**



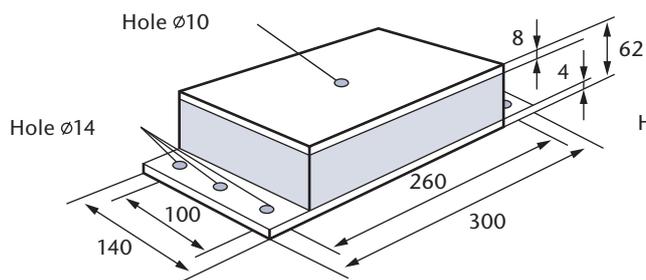
**Model B**



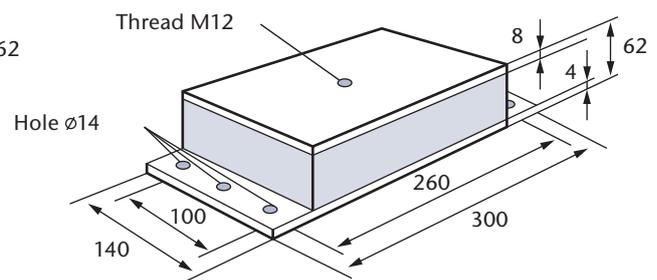
**Model AB**



**Model C**



**Model AC**

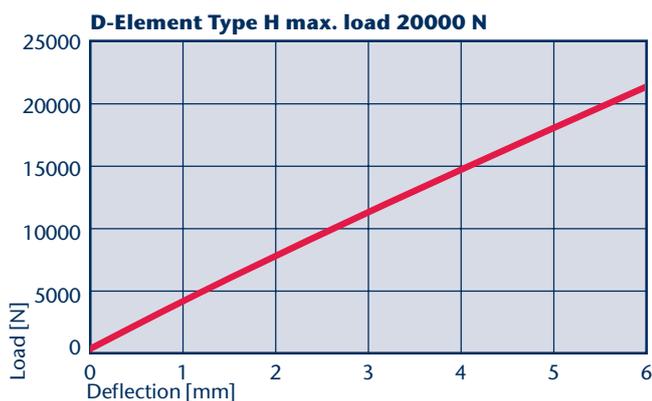
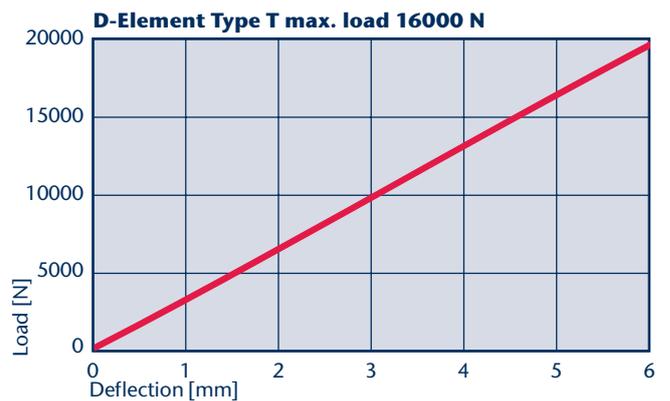
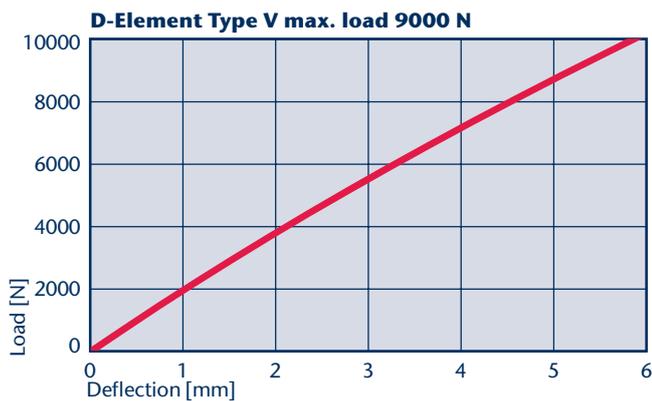
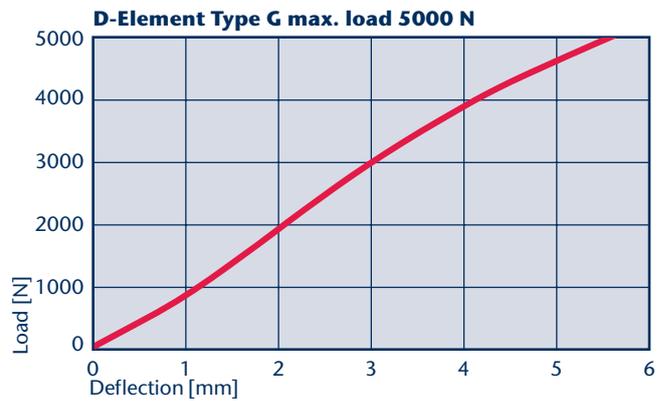
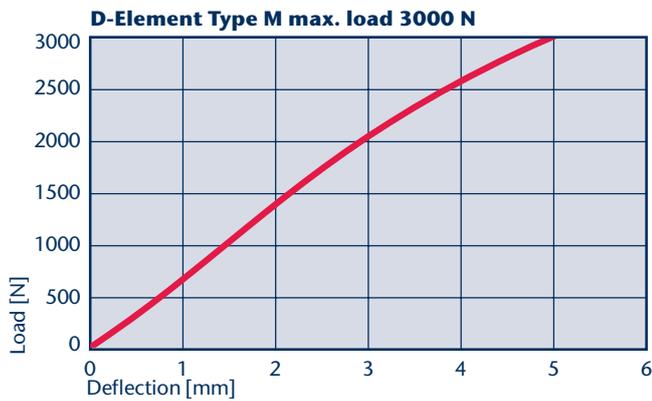
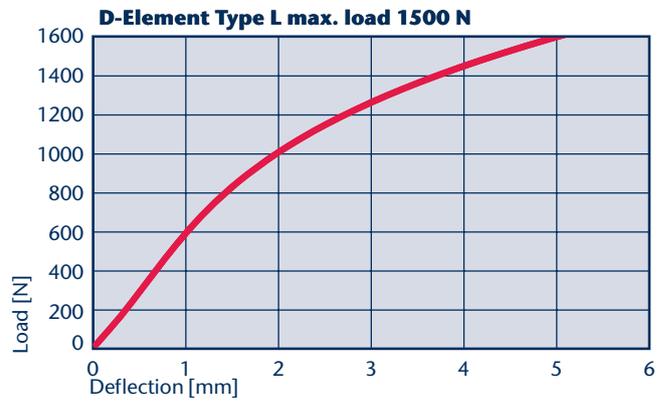
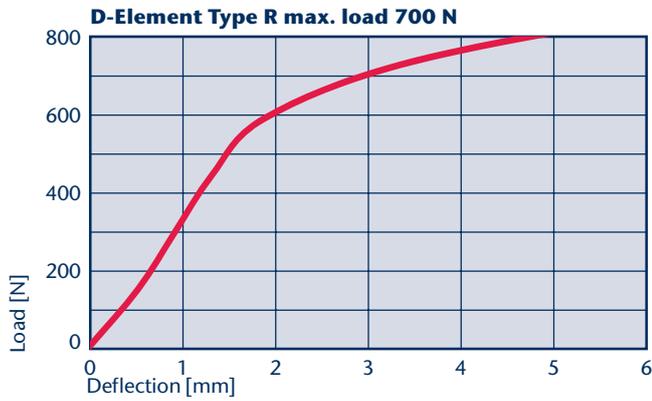


All dimensions in mm

Model	Additional equipment to the standard type
A	Thread M12 (centric) in the load spreading plate
B	Second load spreading plate (bottom)
AB	Second load spreading plate (bottom) with 1 x thread M12 (centric) in top and bottom load spreading plate
C	1 x installation plate at the bottom
AC	1 x installation plate at the bottom and 1 x thread M12 (centric) in top load spreading plate
CC	1 x installation plate on the top (instead of the load spreading plate) and 1 x installation plate at the bottom

# 5. D-Elements

## 5.3 D-Elements Static Spring Characteristics



## 5.4 Maintenance and Installation of D-Elements

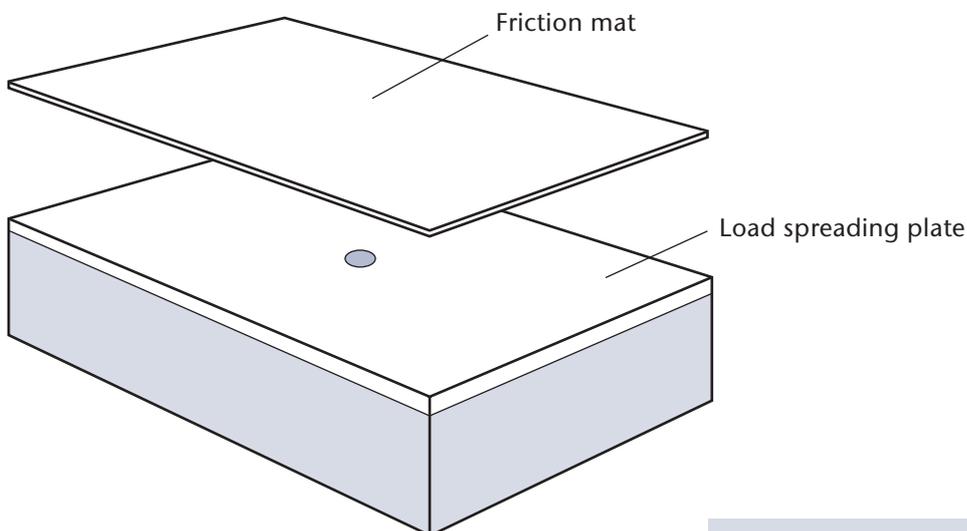
D-Elements do not require any maintenance, provided the following instructions are observed when installing and using the elements:

### Installation

D-Elements must always be arranged with the load spreading plate situated on top. For vertical loads the elements do not normally need to be screwed or otherwise fixed. Each D-Element is delivered with a friction mat which has to be mounted between the underside of the machine and the load spreading plate. Any further fixing is not necessary, as the oscillations of conventional machines during operation are considerably lower than the deflection of the elements. The elements are therefore subjected to constant load.

When installing machines which generate horizontal forces, and where elements are submitted to tensional loads, special bearing types are required. Suggestions for the design of such bearings can be provided upon request.

The static nominal load for D-Elements must not be exceeded. Short dynamic peak loads of up to three times the nominal load will be absorbed without causing permanent deformations or alterations in the dynamical properties. Unavoidable thrust loads (horizontal forces) shall not exceed a maximum of 25% of the pressure load (vertical forces) acting on the D-Elements.



## 5. D-Elements

### Mounting

When mounting the elements, make sure that they fully rest on the bottom surface and that the floor underneath is clean. The ground should be made as smooth as possible and sloping surfaces levelled. D-Elements must not be in contact with any adjacent construction elements as this leads to a reduction in noise insulation. The elements must therefore be installed at a distance of at least 2 cm from adjacent construction elements.

The elements must be placed underneath the machine and insulated in such a way as to ensure uniform deflection of the elements under load. As all D-Element types have the same height, machines with an eccentric gravity centre can be installed without any problem. The stability of machines with a small projected area and a very high centre of gravity must be checked.

If machines are to be mounted in a precise horizontal position or at a specific height, it must be taken into account that certain creeping effects in the resilient material may occur under permanent load. Such effects will result in a slightly increased deflection under long-term constant load. Any remaining differences in height can be compensated by intermediate metal sheets after a few days. The influence of the creeping effect on the dynamical behaviour of the elements is negligible.

### Resistance

D-Elements are made of a resilient material which is resistant to oil, grease and humidity. However, contact with solvents should be avoided. Although D-Elements are resistant to moisture, they should not permanently stand in water.

If exposed to intensive UV radiation, the colour of the elastomer layer may fade and the surface may become slightly brittle, but the physical properties of the elements will remain constant. The service temperature of the elements ranges between  $-30\text{ °C}$  and  $+70\text{ °C}$ .

## 5.5 Text for Invitation to Tender for D-Elements

D-Elements are used for the point-loaded, structure-borne noise insulated erection of equipment and machinery.

The elements consist of a 50 mm thick layer of mixed-cell polyurethane elastomers and a hot-dip galvanised steel plate glued on top of the element. The steel plate is designed to ensure a uniform spreading of linear and point loads on the elastomer surface.

Included in delivery is a friction mat which must be placed between the machine frame or the underside of the machine and the load spreading plate. It is not generally necessary to screw the D-Elements to the machine.

For different loads, there are seven different types of D-Elements available which all have the same dimensions. Elements can therefore be combined, dependent upon the resulting loads.

The information required for the design of resilient mounting on D-Elements is given on page 10.

### Summary:

- D-Element
- Type depending on load
- Dimensions length x width x height = 210 x 140 x 58 mm
- Weight 2,5 kg
- Consisting of: load spreading plate, elastic layer
- Scope of delivery includes 1 friction mat



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