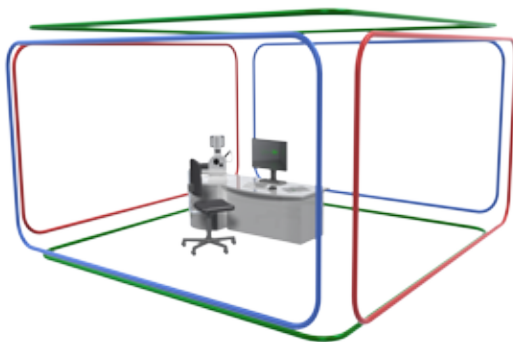




Solutions for a tranquilized laboratory by Bilz

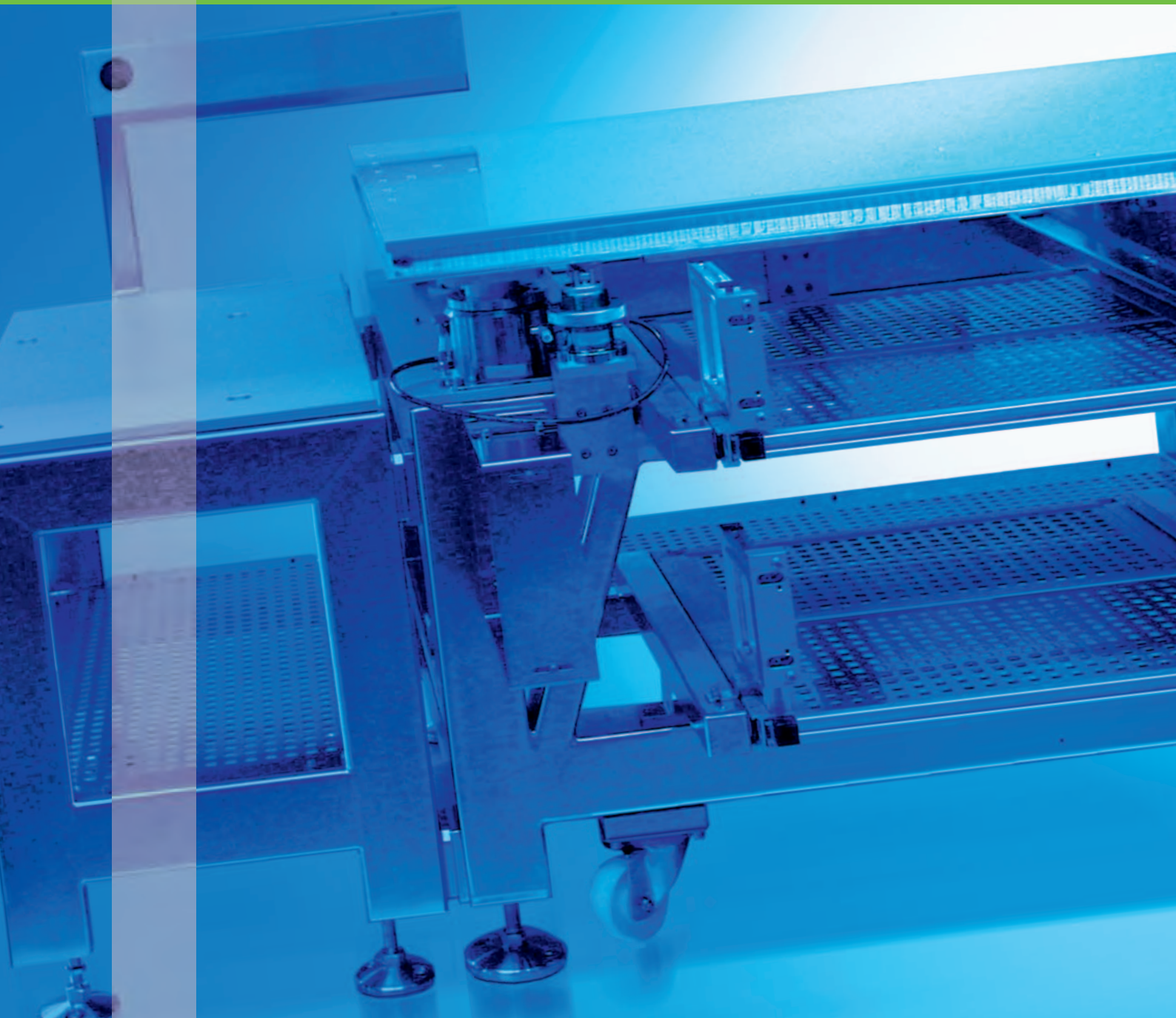


Contents:

- Vibration insulated laboratory tables
- VITAP® Vibration insulating table platform
- Active Isolation System AIS™ & AIS™ High Performance
- Magnetic field compensation
- Room acoustics and technical noise protection
- Measurement and vibration analysis

Vibration insulated tables

Individually tailored to your requirements.





LTH laboratory table

Particularly robust and resistant

Product properties

- Adjustable table feet
- Rigid, welded steel subframe
- BiAir® membrane air spring (vertical natural frequency approximately 3 Hz) between the subframe and table top
- Magnetic-pneumatic level control (level accuracy $\pm 1/100$ mm or $\pm 1/10$ mm, depending on the valve used)
- Table top made from hard stone with a ground finish
- Painting as desired by the customer
- Standard colour: RAL 9005

Applications

- Vibration-sensitive measuring and testing equipment
- Laser equipment
- Optical and electronic instruments
- Scales
- Medical instruments

Technology

The Bilz laboratory table LTH is a vibration insulated work place and can be used for all applications where vibrations and/or changes in level cause sustained disturbances to the experiment or work.

Disturbing vibrations from the environment are isolated by means of highly effective membrane air spring insulators and the solid hard stone plate.

At the same time the mechanical-pneumatic level control automatically ensures that the level is retained to an accuracy of up to $\pm 1/100$ mm even with load changes.

The maintenance unit for compressed-air conditioning is included.

LTH LABORATORY TABLE STANDARD SIZES

| Dimensions | LTH 60-50 | LTH 80-60 | LTH 100-63 | LTH 90-75 | LTH 100-80 | LTH 100-100 | LTH 120-80 | LTH 150-100 | LTH 200-100 |
|-----------------------------|-----------|-----------|------------|-----------|------------|-------------|------------|-------------|-------------|
| Width [mm] | 600 | 800 | 1,000 | 900 | 1,000 | 1,000 | 1,200 | 1,500 | 2,000 |
| Depth [mm] | 500 | 600 | 630 | 750 | 800 | 1,000 | 800 | 1,000 | 1,000 |
| Thickness (hard stone) [mm] | 100 | 120 | 100 | 100 | 140 | 160 | 160 | 190 | 220 |
| Working height [mm] | 760 | 760 | 760 | 760 | 760 | 760 | 760 | 760 | 760 |
| max. Load [N] | 2,500 | 2,500 | 3,000 | 3,600 | 7,000 | 7,000 | 7,000 | 18,000 | 28,000 |



LTO optical table

Excellent quality and functionality

Product properties

- As LTH (see page 69)
- Optical table tops:
 - HD steel honeycomb core with high natural damping, cover plate without thread insert
 - HDT as HD, but with thread inserts
- Variants: Standard, clean room (base plate in stainless steel)
- Also available with BiAir® OC or BiAir® PAS as an option (see p. 72/73)

Description of the table tops:

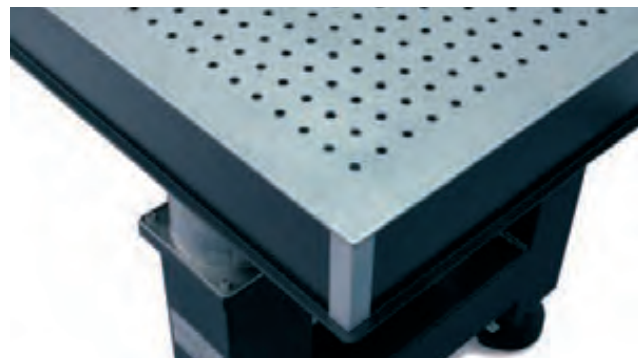
| | |
|-----------------------|---|
| Cover plate: | Stainless steel 3 mm, magnetic or non-magnetic, anti-reflective. |
| Base plate: | Steel sheet 3 mm |
| Clamping hole grid: | 25 mm (standard) |
| Core: | HD/HDT: Steel honeycomb made of galvanised 0.5 mm steel sheet, precision formed, bonded with specifically matched resin |
| Thread inserts (HDT): | Floating mounted threaded inserts M6, closed sleeves prevent any contact with the table core. Capability to displace the clamping bolts by 0.5 mm whilst simultaneously inclining by $\pm 3^\circ$. Maximum depth of thread 30 mm. |

Applications

- Construction of laser optical systems and interferometers
- Special microscopes

Technology

Work places from Bilz are distinguished by their excellent quality and functionality. Optical work places should offer optimum rigidity and damping with low density. Bilz LTO honeycomb tops are optimised in regard to their damping response so that the usual high resonance amplitude in the higher frequency range are attenuated by the tables in the HD series by their natural damping.



LTO OPTICAL TABLE STANDARD SIZES

| Dimensions | LTO 60-50 | LTO 90-60 | LTO 120-60 | LTO 150-90 | LTO 200-100 | LTO 240-120 | LTO 300-150 |
|---------------------|-----------|-----------|------------|------------|-------------|-------------|-------------|
| Width [mm] | 600 | 900 | 1,200 | 1,500 | 2,000 | 2,400 | 3,000 |
| Depth [mm] | 500 | 600 | 600 | 900 | 1,000 | 1,200 | 1,500 |
| Thickness [mm] | 100 | 100 | 100 | 150 | 200 | 200 | 300 |
| Working height [mm] | 760 | 760 | 760 | 760 | 760 | 760 | 760 |
| max. load [N] | 1,500 | 2,000 | 3,000 | 5,000 | 5,000 | 7,500 | 7,500 |

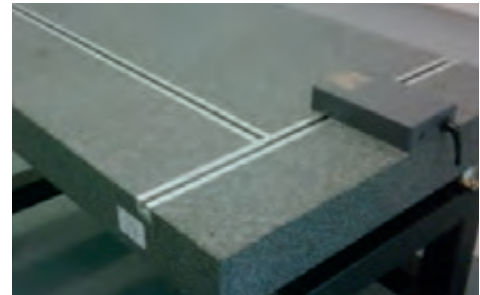
Further dimensions are available on request.

Right to make technical changes is reserved.

Individual design

Compile the equipment features for the optimum laboratory table for your application:

- Additional holes/threads in the table top and the subframe
- Special sizes on request
- Can be equipped with metal guide rails on request



Options

Different frames in standard or special sizes

Cover hood

Arm rest

Holders for monitor, keyboard, mouse

Set of rolls

Levelling elements

Profiles and brackets for additional components

Different materials (wood, metal) and colors for:

- Doors
- Base plates/inserted plates
- Housing

Wooden plate:

- Different sizes
- Cutout
- Rounded corners

Powder coating in RAL colors

Insulators

- Level control (mechanical or electronic)
- Accessories (e.g. compressed-air control)
- Insulators perfectly integrated in the subframe



BiAir®



FAEBI®

Subframe

Levelling elements and rollers are available in various different designs and sizes.



LTH-Laboratory tables with BiAir® OC

Product properties

- As LTH (see page 69)
- Table top from hard stone with ground finish
- Design with membrane air spring insulators BiAir® OC between table top and subframe
- Also available with optical tops as an option (see page 70)

Technology

Due to their increased air volume the newly-developed BiAir® OC air springs achieve a reduced natural frequency of approximately 2 Hz in the vertical plane. The laboratory tables with BiAir® OC air springs are suitable for applications with lower dynamics that require an excellent insulation effect.

Applications

- Vibration-sensitive measuring and testing equipment e.g. atomic force microscopes (AFM), interferometer



LTH LABORATORY TABLES WITH BIAIR® OC STANDARD SIZES

| Dimensions | LTH 60-50-OC | LTH 80-60-OC | LTH 100-63-OC | LTH 90-75-OC | LTH 100-80-OC | LTH 100-100-OC | LTH 120-80-OC |
|---------------------------|--------------|--------------|---------------|--------------|---------------|----------------|---------------|
| Width (mm) | 600 | 800 | 1,000 | 900 | 1,000 | 1,000 | 1,200 |
| Depth (mm) | 500 | 600 | 630 | 750 | 800 | 1,000 | 800 |
| Thickness Hard stone (mm) | 100 | 120 | 100 | 100 | 140 | 160 | 160 |
| Working height (mm) | 760 | 760 | 760 | 760 | 760 | 760 | 760 |
| max. load [N] | 2,500 | 2,500 | 3,200 | 3,200 | 7,000 | 7,000 | 7,000 |

OC = one chamber

LTH-Laboratory tables with BiAir® PAS

Product properties

- As LTH (see page 69)
- Table top from hard stone with ground finish
- Design with pendulum suspended membrane air spring insulators BiAir® between table top and subframe
- Also available with optical tops as an option (see page 70)

Technology

Newly developed pendulum suspended BiAir® PAS air springs achieve a reduced vertical natural frequency due to their increased air volume and also have reduced natural frequency in the horizontal plane due to their pendulum suspension arrangement.

This enables the laboratory table with pendulum air springs to reach a natural frequency of approximately 2 Hz in the vertical plane and approximately 1.2 Hz in the horizontal plane. The laboratory table with pendulum air springs is suitable for applications with low dynamics and higher requirements for vibration insulation in both the vertical and horizontal planes.

Applications

- Vibration-sensitive measuring and testing equipment e.g. atomic force microscopes (AFM), interferometers



LTH LABORATORY TABLES WITH BIAIR® PAS STANDARD SIZES

| Dimensions | LTH 60-50-PAS | LTH 80-60-PAS | LTH 100-63-PAS | LTH 90-75-PAS | LTH 100-80-PAS | LTH 100-100-PAS | LTH 120-80-PAS |
|---------------------------|---------------|---------------|----------------|---------------|----------------|-----------------|----------------|
| Width (mm) | 600 | 800 | 1,000 | 900 | 1,000 | 1,000 | 1,200 |
| Depth (mm) | 500 | 600 | 630 | 750 | 800 | 1,000 | 800 |
| Thickness Hard stone (mm) | 100 | 120 | 100 | 100 | 140 | 160 | 160 |
| Working height (mm) | 760 | 760 | 760 | 760 | 760 | 760 | 760 |
| max. Load [N] | 2,500 | 2,500 | 3,200 | 3,200 | 7,000 | 7,000 | 7,000 |

PAS = pendulum air spring



Subframe of a laboratory table with BiAir® PAS and LCV level control

BILZ-VITAP® Vibration insulating table platform

Product properties

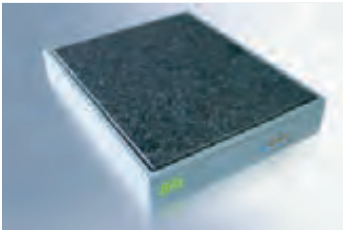
- Portable, robust, powder coated metal housing with integrated Bilz rubber air springs FAEBI® or optionally with Bilz membrane air springs BiAir®; colour: RAL 7037, dusty grey
- Equipped with very simple through to very convenient Bilz level control systems
- A ground-finished hard stone plate lies on the insulators as a support base and solid base mass
- Available with and without a connection to an external compressed air supply

Applications

- For very light and very small measuring or test equipment
- Weight range up to 200 kg
- Optical devices, optical microscopes, microscopes with a CCD camera, inspection microscopes, small surface roughness and roundness measuring equipment, hardness testers, analytical balances, applications in industrial production environments, laboratories and measuring rooms up to clean rooms. Also suitable for the portable use of these measuring devices.

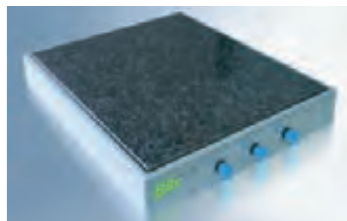
VITAP®-F

With long-term tried and tested Bilz FAEBI® rubber air springs with non-return valve. Integrated hand pump, no compressed air supply necessary.



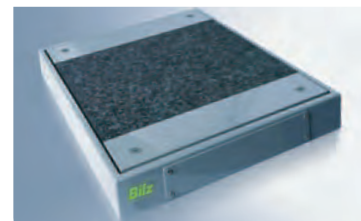
VITAP®-FP

With long-term tried and tested Bilz FAEBI® rubber air springs with precision pressure control for convenient height adjustment. Connection to an external compressed air supply.



VITAP®-BM

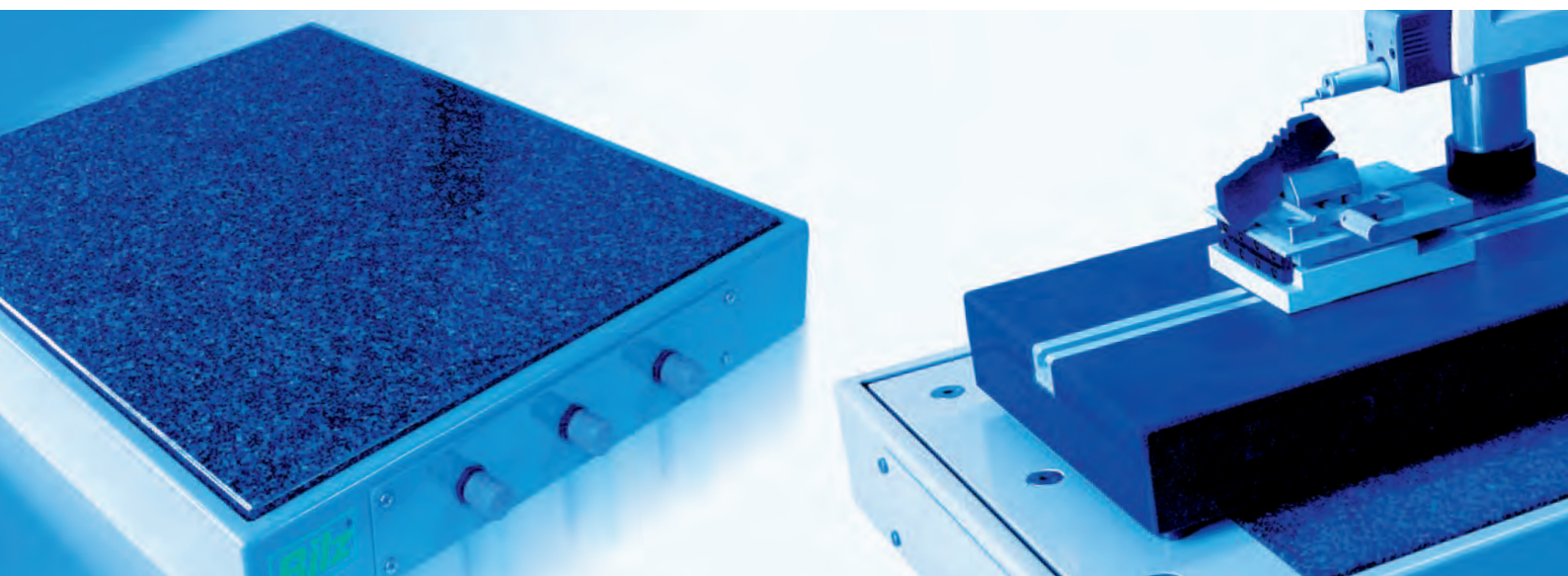
With highly efficient Bilz BiAir® membrane air springs and with mechanical-pneumatic level control (MPN) with automatic level compensation in response to load changes. Connection to an external compressed air supply.



TECHNICAL DATA VITAP®-F, VITAP®-FP, VITAP®-BM

| | Item no.. | Dimensions mm Platform box | Dimensions mm Installation surface | Height mm | Load capacity N | Natural frequency Hz | Compressed air supply |
|------------------|-----------|-------------------------------|---------------------------------------|--------------|--------------------|-------------------------|----------------------------|
| VITAP®-F 50-40 | 56-0008 | 540 x 440 | 500 x 400 | 95 | 600 | 4.5 – 6 | autonomous/air pump |
| VITAP®-F 60-50 | 56-0009 | 640 x 540 | 600 x 500 | 95 | 1,300 | 4.5 – 6 | autonomous/air pump |
| VITAP®-FP 50-40 | 56-0010 | 540 x 440 | 500 x 400 | 95 | 600 | 4.5 – 6 | 4 bar/air pressure network |
| VITAP®-FP 60-50 | 56-0011 | 640 x 540 | 600 x 500 | 95 | 1,300 | 4.5 – 6 | 4 bar/air pressure network |
| VITAP®-BM 50-40a | 56-0006 | 540 x 440 | 500 x 400 | 95 | 750 | 1.8 – 3 | 6 bar/air pressure network |
| VITAP®-BM 50-40b | 56-0005 | 540 x 440 | 500 x 400 | 95 | 1,500 | 1.8 – 3 | 6 bar/air pressure network |
| VITAP®-BM 60-50a | 56-0002 | 640 x 540 | 600 x 500 | 95 | 1,500 | 1.8 – 3 | 6 bar/air pressure network |
| VITAP®-BM 60-50b | 56-0003 | 640 x 540 | 600 x 500 | 95 | 2,000 | 1.8 – 3 | 6 bar/air pressure network |

Right to make technical changes is reserved.



Active Isolation System AIS™

AIS™
Active Isolation System

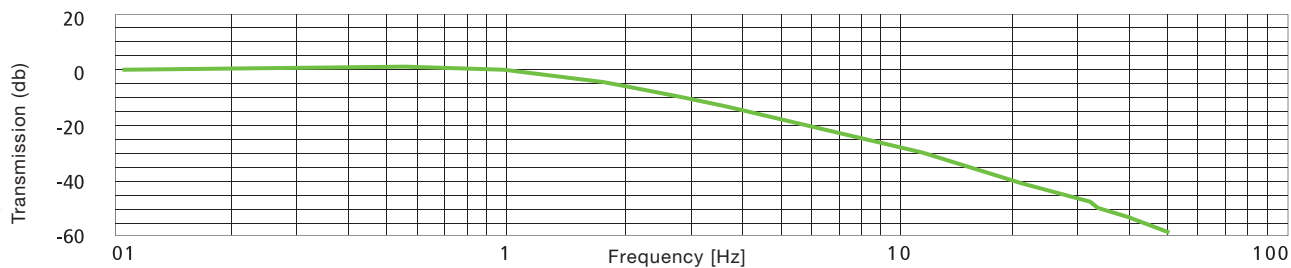
Active electronic-pneumatic vibration insulation system with powerful real-time control for the highest demands on effective insulation, deflection and constant level.



- Active electronic-pneumatic vibration insulation with up to 6 controlled degrees of freedom.
- Air springs work as passive air springs and as actuators
- Highly efficient vibration insulation without resonance peaks
- Optimum positional accuracy in the vertical direction and horizontal plane
- Minimum deflection and settling time in response to machine load changes
- Very powerful real-time control
- PLC, CAN bus and one controller and one highly dynamic proportional valve per degree of freedom
- Each controller has a microprocessor and integrated high resolution sensors for position, pressure, and acceleration
- User-friendly, intelligent WinSNI/Web-Visu-Software for commissioning and diagnostics
- Simple digital switching capability between scanning mode (during sensitive machine operations) and loading mode (in response to machine load changes)
- No feed forward signal required
- No disturbing heat generation, magnetic field fluctuations or high power consumption as is the case with electromagnetic actuators



TRANSMISSION FUNCTION AIS™



Membrane air spring BiAir®/-ED/HE-MAX



COMPASS PRO Wafer Inspection Machine

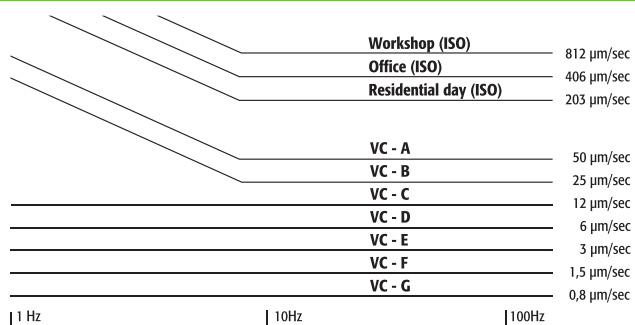


Electron microscope on a vibration insulating platform



AIS™ on Bilz measuring and test bed

VIBRATION CRITERIA VC



APPLICATION AREA

Optimum vibration insulation system for highly dynamic measuring and testing machines, laser high-resolution microscopes as well as inspection and production machines in the semiconductor industry.

AIS™ is used when the insulation effect and reaction times of conventional passive air spring insulators and a customary level control system are not sufficient.

TASKS

- Protection of vibration-sensitive machinery from floor vibrations.
- Minimization of structure borne vibration within a system. These are caused by load changes or movements of the machine.
- Settling time reduction.

AIS™ enables the highly efficient, vibration insulated installation of highly dynamic machines without loss of performance or cycle time.

Active Isolation System AIS™

The Bilz AIS™ system is comprised of a PLC, CAN bus, 16-bit state controller, highly dynamic proportional valves, the BiAir® membrane air spring and the HAB™ horizontal air spring. A wide range of different sizes of valves and air springs for system design are available.

One controller and one valve are assigned to one air spring or one group of air springs. AIS™ works with at least three controlled groups of air springs and can be used with up to 6 degrees of freedom. The controllers are linked with the PLC via CAN bus.

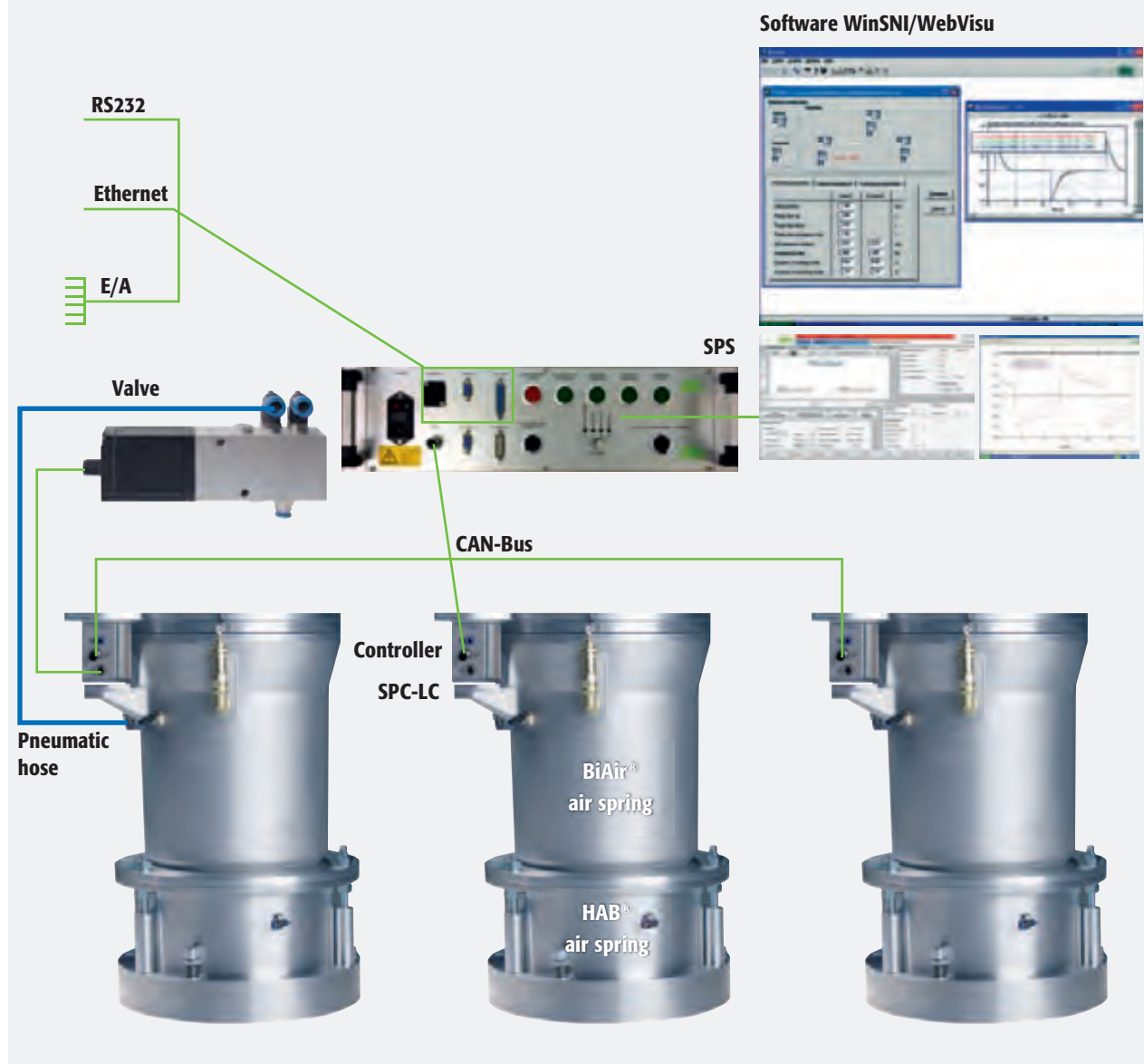
A PC can be linked via a series RS-232 or Ethernet interface for commissioning and diagnostic purposes. The controller is mechanically coupled with the air spring insulator or to the machine in the direction of the force. Integrated on each controller is a microprocessor, a displacement measuring system for position feedback (resolution 0.2 μm), as well as an accelerometer (resolution 8 μg) and a pressure sensor (resolution 0.2 mbar). The signal sensor sampling rate is 4 kHz. As not only the higher-level control, but also each controller is equipped with a microprocessor and highly dynamic proportional valves



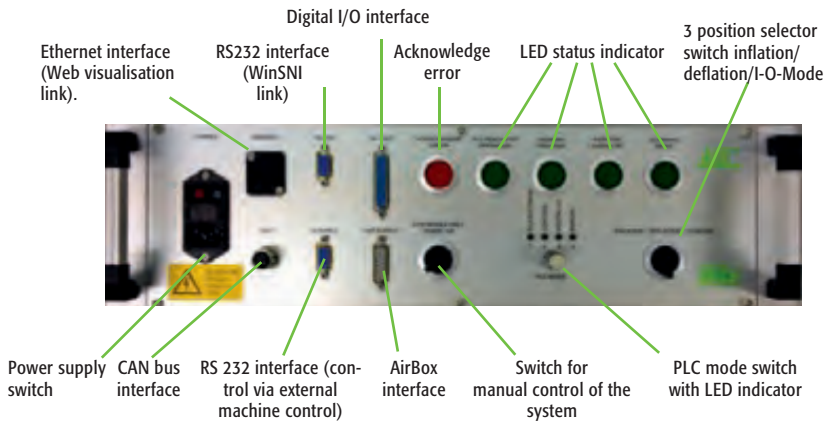
are used, we can consider the system to be a powerful real-time control and an elaborate feed forward control from the machine manufacturer can be omitted.

The PLC also provides digital inputs and outputs, such as ready, pressure monitoring, position and tension, switching between scanning/loading mode, emergency stop. The user friendly switching capability between scanning and loading mode offers the advantage of parameterizing the insulation system for machine load changes so that it achieves the greatest rigidity, fastest response and accurate positioning and during machine operations so that it responds very gently and not aggressively.

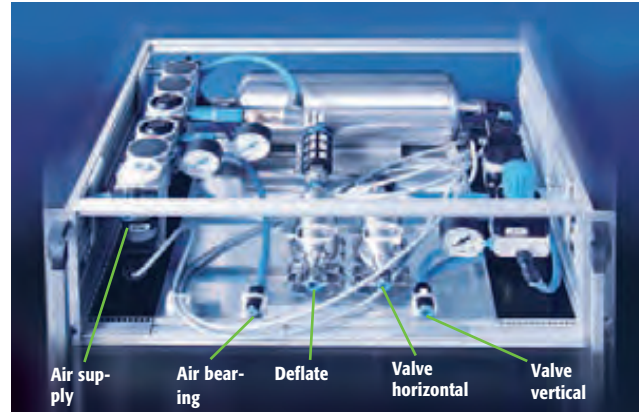
SYSTEM DESIGN



CONTROLLER 19" PLC AND AIR SUPPLY 19" AirBox



Dimensions: W / H / D / 483 x 133 x 270 mm

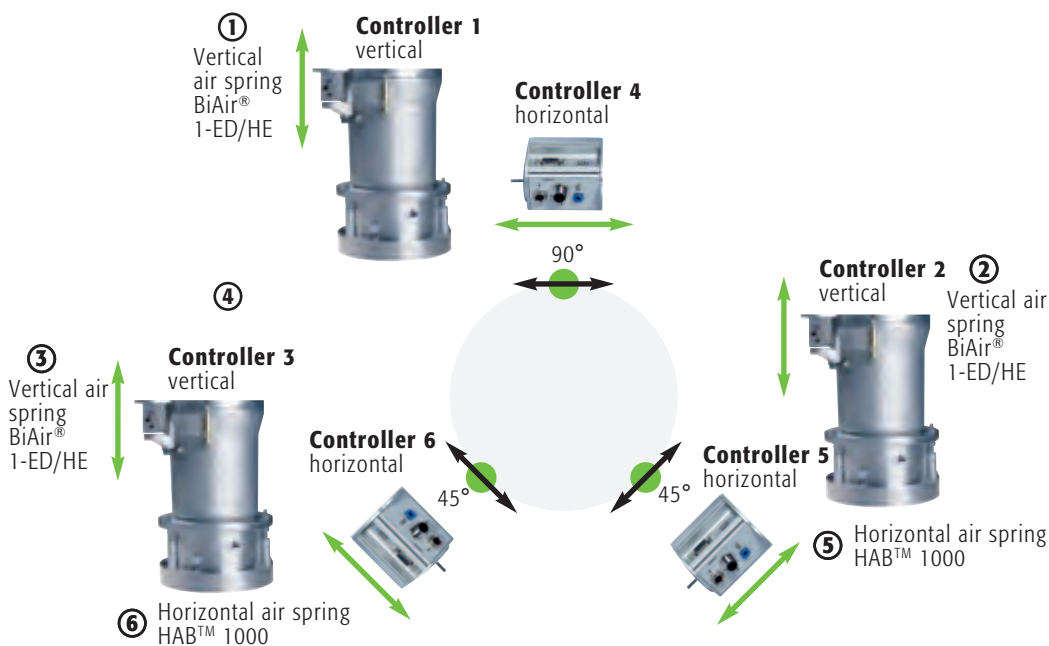


Dimensions: W / H / D / 483 x 177 x 384 mm

CONTROLLER SPC-LC



ARRANGEMENT OF THE AIS™ SYSTEM FOR AIR SPRINGS AND CONTROLLERS WITH 6 DEGREES OF FREEDOM



Application example: Electron microscope on a vibration insulating platform

Right to make technical changes is reserved.

Active Isolation System AIS™ High Performance

AIS™
Active Isolation System

Active vibration insulation in 6 degrees of freedom offering the best possible insulation effect



FUNCTION

With an elastic machine mount on vertical air springs (such as Bilz BiAir®-ED) the insulated mass is carried on a volume of air enclosed by a membrane in the interior of the insulator. Because of the elastic properties of this air spring membrane the insulator has free movement in the vertical plane, and also a limited movement in the horizontal plane.

For extremely sensitive and high-precision applications, which must be mounted with 6 degrees of freedom, these slight horizontal elastic properties can have undesired influence on the work results.

In this case the HAB horizontal air spring is used purely as an air bearing to reduce frictional effects; the required horizontal counter forces are generated by additional BiAir® elements. These additional BiAir® elements are fitted rotated 90° and replace the air hoses of the regular HAB™ air springs (see the Horizontal air springs section).

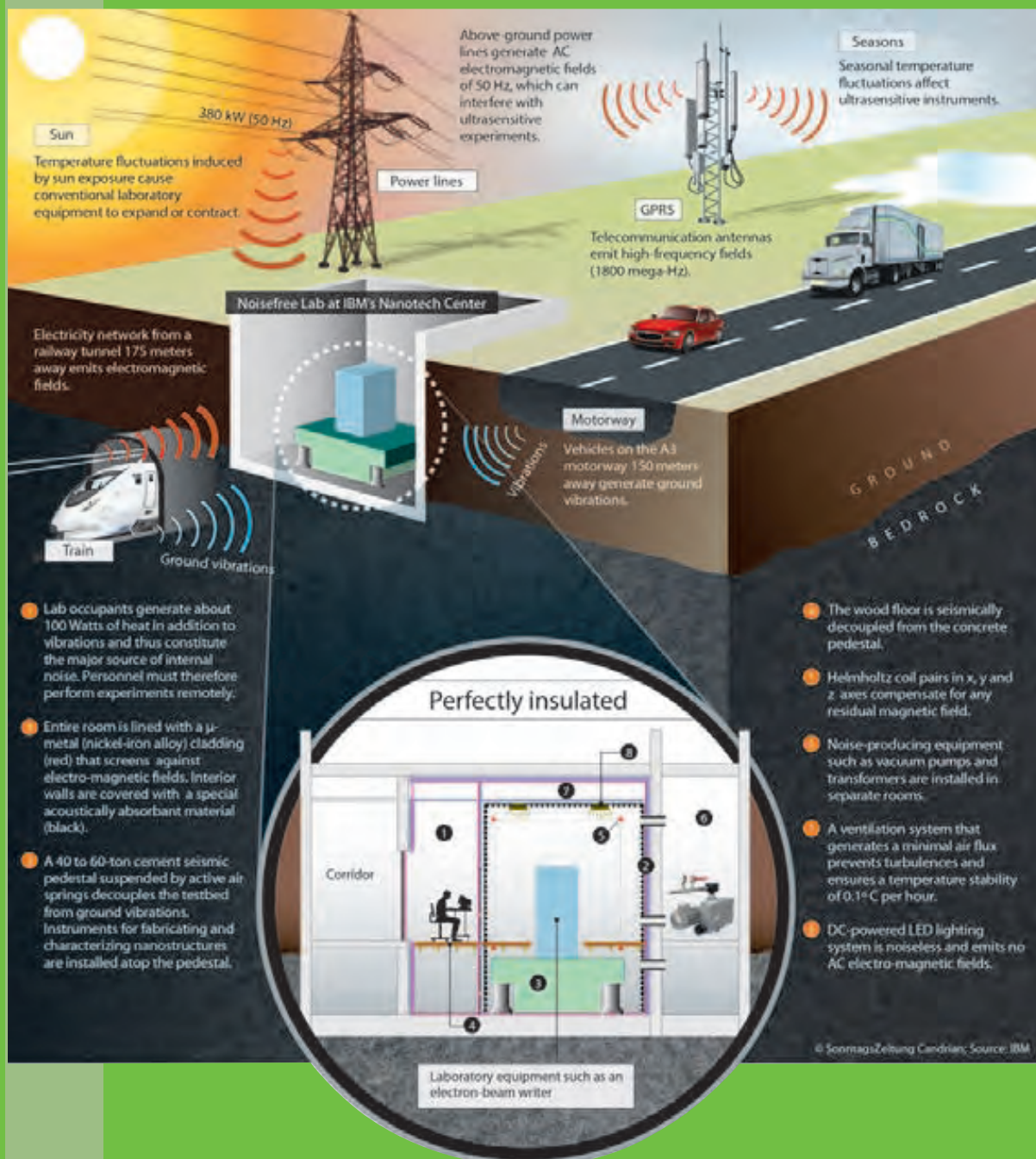
ADVANTAGES

- Best possible insulation properties specifically for applications with critical limit curves in the low frequency range.
- For applications with higher horizontal dynamics significantly higher counter forces can be realized by the additional BiAir® air springs than with standard AIS with 6 degrees of freedom.

ALS™

Active Isolation System

Noise and vibration insulation of research laboratories



The illustration shows some of the most important measures for reducing external disturbing influences in the "noise-free labs" of Binnig and Rohrer Nanotechnology Centers of IBM and ETH in Zurich.

The manufacture and characterising of ever smaller components, down to structures comprising of only a few molecules or atoms, make the highest demands on vibration insulation to protect the vibration-sensitive systems.

In order to precisely perform sensitive experiments and measurements in the nanometre range (1 nanometre = one millionth of a millimetre), the external disturbing influences such as temperature, humidity and air pressure fluctuations, noise, electromagnetic fields or floor vibrations must be kept to an absolute minimum level.

Globally respected as a competent partner, Bilz have specialized in solutions such as laboratory insulation (foundation block or platform insulators) or the direct insulation of highly sensitive machines (installation of insulation systems in machinery/plant.)

Passive membrane air springs, air springs or active vibration insulator systems are used for high-quality vibration insulation.

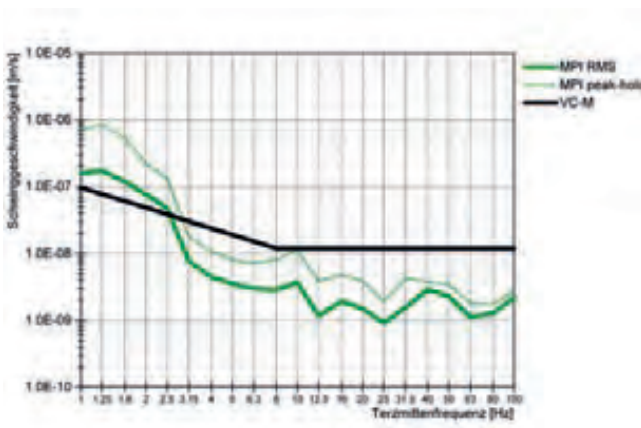
Depending on the customer's wishes Bilz also creates the complete foundation block or platform design, or provides support in the design and constructive integration of the insulation in the machine.

We are very proud to have equipped the most modern research laboratories in the world with noise and vibration insulation, these include the "Precision laboratories MPI Stuttgart" or the "Noise-free lab" of the Binnig and Rohrer Nanotechnology Centre (IBM/ETH Zurich).

In the field of semiconductors renowned companies such as Applied Materials, Visotec and Zeiss are among our most esteemed customers.



Active vibration insulation AIS™ High Performance by Bilz, which suspends the glass fibre reinforced plastic armoured foundation block weighing 75 tons on air cushions.



Result of vibration measurements on a foundation block insulated with Bilz membrane air springs.



Experimentation room with 4.2 m clear room height and acoustic insulation materials (supplied and installed by Bilz).

Source: Binnig and Rohrer Nanotechnology Center (IBM Research, Zurich).

Magnetic field compensation

Effective and reliable shielding from low frequency magnetic fields for highly sensitive devices and applications such as electron microscopes, nanotechnology and biomagnetic examinations.

Disturbing influences are extensively neutralised with opposing fields with reversed polarity. Cable loops are laid around the work area to be protected and opposing fields are generated in real time using magnetic field compensation devices that continuously measure the actual electromagnetic value.

This method is an effective and cost-efficient alternative to expensive magnetic field shielding, for example with metal.

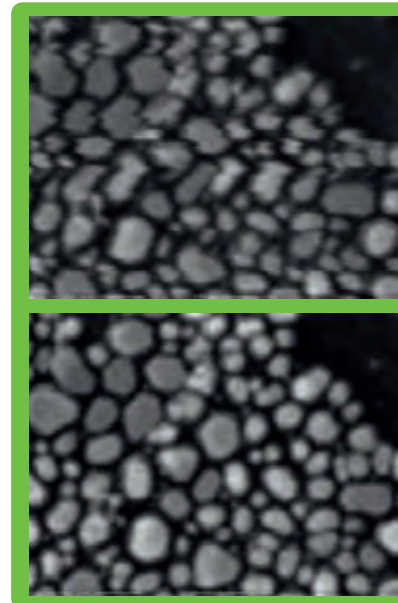


Besides natural magnetic fields that exist everywhere in the universe, the majority of problems encountered when operating sensitive devices arise from low-frequency magnetic fields that are caused by human activities, such as those emanating from electrical power cables, railways vehicles, elevators, etc. These fields occur as soon as electricity flows through a conductor. Without suitable shielding, they expand outwards in a circular form and are quite capable of passing through most materials unhindered.

Magnetic field compensation has established itself as the most cost-effective solution. With this method the magnetic field is continuously measured and a compensation device, which includes the necessary control electronics and power amplifier for the direct connection of compensation coils, generates an opposing field. The compensation coils can be made of coiled cables that are laid at the edges of the laboratory, or as a complete solution integrated in a self-supporting aluminium frame.

Applications

- Image enhancement in electron microscopy (REM and TEM)
- Biomagnetic applications
- Compensation of mains frequencies (50/60 Hz) and harmonic waves
- Suppression of slow and stepped magnetic fields caused by vehicles, moving magnetic objects, elevators, etc.
- A special version for MRI applications is available



REM image without (above) and with (below) magnetic field compensation

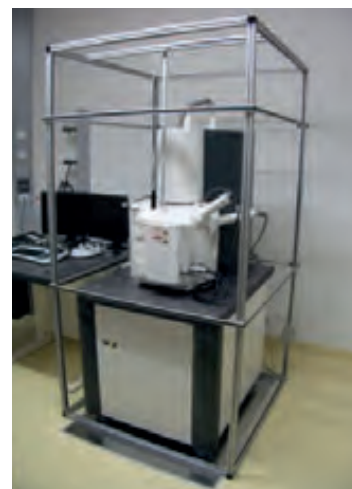


Bilz magnetic field compensation system

- 3 axis automatic real-time compensation of low frequency magnetic field disturbance
- Frequency range DC to 1,000 Hz (1kHz)
- Fluxgate magnetic field sensor with sub Nano Tesla resolution
- Controller mode: AC, DC, AD+DC
- 40 db typical suppression of 50 Hz disturbance
- Compensation coil connection capability
- Measured value and alarm display



Bilz magnetic field compensation using room coils



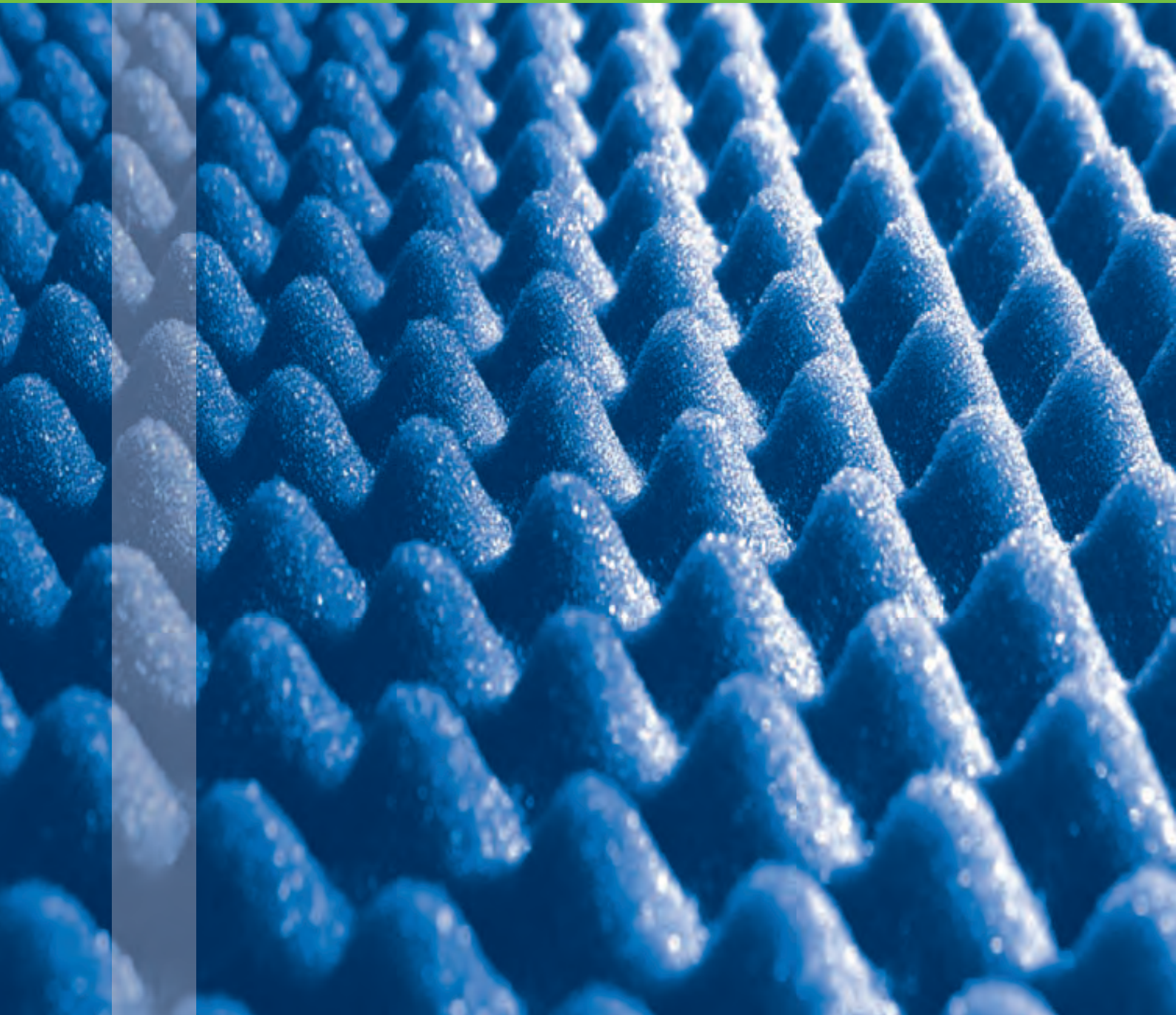
Integrated coil frame from Bilz for magnetic field compensation

For further information about our products and installation services please call to arrange a personal consultation.

Room acoustics and technical noise protection

Bilz acoustic elements enable optimized room acoustics and airborne noise insulation in office and industrial buildings, laboratories and test cells.

Our high-quality solutions for absorbing noise energy are distinguished by maximum noise insulation and minimisation of the associated sound pressure levels and the resulting resonance period.



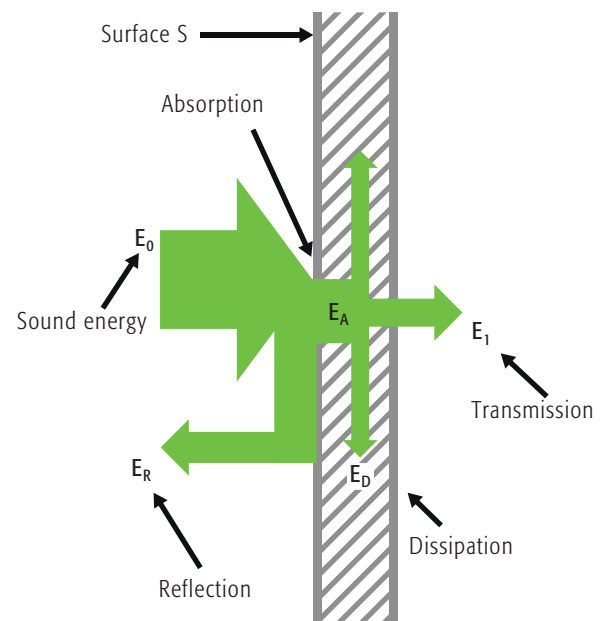


Variable and cost-effective acoustic solutions using Bilz surface elements. Very easily retrofitted.

When a sound wave strikes a body it is partially absorbed and partially reflected depending on the hardness and porosity of the material. The ratio between the occurring and absorbed sound energy is therefore the sound absorption coefficient, which usually lies between 0 (complete reflection) and 1 (complete absorption).

The **sound absorption** E_A therefore indicates the process of reducing sound energy E_0 in particular (but not necessarily) by conversion into heat.

The distinction from dissipation E_D is that this exclusively refers to the conversion into energy other than sound, in particular heat.



Source: Binnig and Rohrer Nanotechnology Center (IBM Research, Zurich).

Bilz absorber foam element. Excellent insulation properties due to its distinctive profiling

NOTE:

Bilz acoustic elements are available in various versions to match individual requirements such as wall elements, ceiling sails, enclosures, etc. Our delivery range also includes impact resistant, non-flammable (material class A2 according to DIN 4102) to suit the particular application.

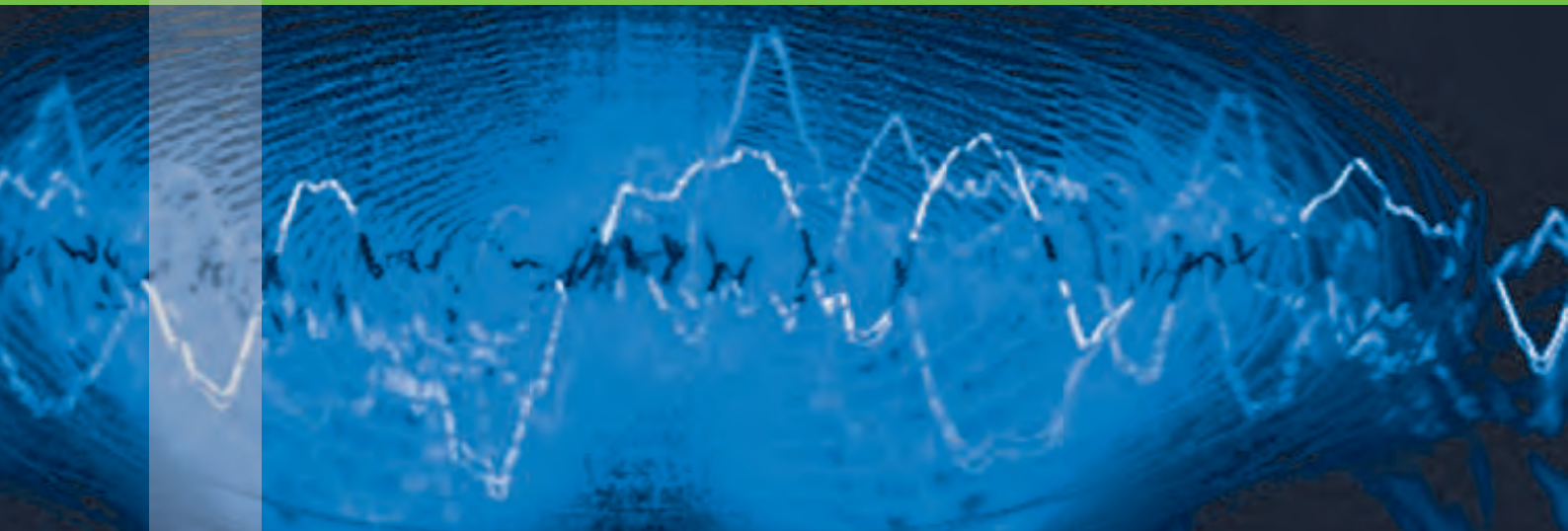
The material can also be colour dyed or covered with printable fabric on request.



For further information about our products and installation services please call to arrange a personal consultation.

Measurement and vibration analysis

Measurement of vibrations and shocks using state of the art instruments – FFT Analyser and analysis software



Assignment

Due to our decades of experience in the field of vibration technology and isolation, we guarantee you technically and economically reliable problem solutions. The on site measurement and analysis of vibration emissions and immissions is an essential part of our consulting services with regard to vibration and vibration insulation. Based on the measurement results, we develop vibration technical measures to comply with legally prescribed limits.

The assessment of periodic and non-periodic vibrations in the frequency range from 1 Hz to 80 Hz is e.g. based on the DIN 4150 "Vibrations in buildings; Effects on persons in buildings". Requirements and reference values are stated herein, in general the considerable disturbance of people in domestic properties and similar premises is to be avoided in order to comply with these regulations.

Procedure

In the first step the maximum value of the vibration levels for the three directional components x, y and z are determined. The largest of these three values KBF_{\max} is compared with the reference values A_U and A_O according to Table 1

- If KBF_{\max} is less than or equal to the (lower) reference value of A_U , then the requirements of this standard are met.
- If KBF_{\max} is more than the (upper) reference value of A_U , then the requirements of this standard are not met.
- For short-term impacts and those that do not occur often, the requirement of the standard is met if KBF_{\max} is less than or equal to A_O .

Another current example of the requirement for a vibration analysis is the storage of high-precision 3D-measurement machines, as well as other testing, measuring or grinding machines. Typically measurements must be carried out by such machines at the planned site, to ensure that existing ground vibrations do not exceed the permitted values (see Chart 1). To do this, the vibration acceleration is

determined within a given frequency spectrum (1–100 Hz), as a simple sum value measurement would provide insufficient information about the exact environmental conditions. The analysis of the acceleration time signals is carried out using a fast-fourier-analyser, which indicates the corresponding measurement value (vibration acceleration in g) for each frequency of the spectrum. If the disturbances (vibration interference) are out of the permissible range, the appropriate insulation can be determined with the help of our PC calculation program.

Very accurate vibration analysis in the lower frequency range are carried out with highly sensitive Geophones. Vibration speeds from below 0.01 $\mu\text{m/s}$ in the range from 0.2 to 30 Hz can be recorded with the Geophones. Extremely precise measurements of vibration are necessary for an optimal and customer-specific design, particularly in the semiconductor and Nanotech industry as well as for high-precision 3D-measurement machines.

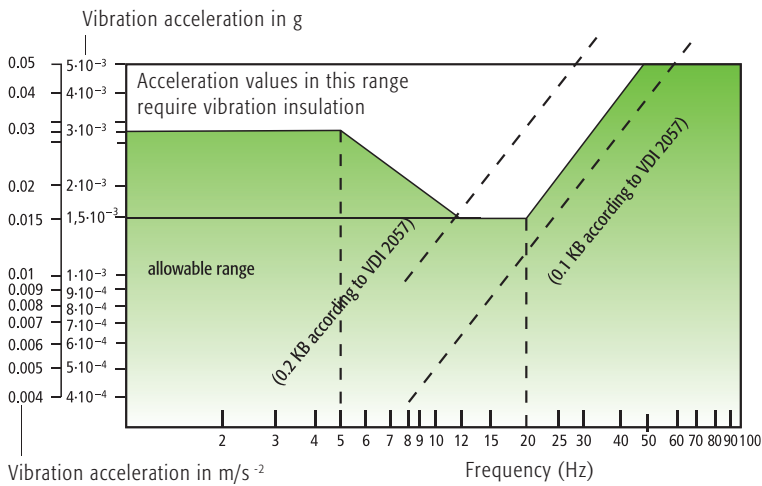


Chart 1: Example CMM limit curve

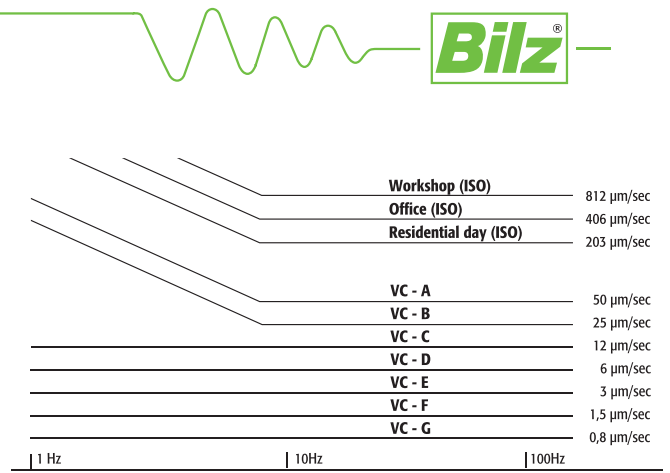


Chart 2: Vibration Criteria VC



FFT Analyser



Geophone

REFERENCE VALUES A FOR THE ASSESSMENT OF VIBRATION EMISSIONS

in domestic property and similar premises

| Line | Impact site | daytime | | | nighttime | | |
|------|--|----------------|----------------|----------------|----------------|----------------|----------------|
| | | A _U | A _O | A _R | A _U | A _O | A _R |
| 1 | Impact sites, in whose vicinity only commercial facilities and where appropriate are housed with the exception of where the owner and manager of operations, as well as supervisory and stand-by persons are housed (see Industrial estates § 9 BauNVO)) | 0.4 | 6 | 0.2 | 0.3 | 0.6 | 0.15 |
| 2 | Impact sites, in whose vicinity mainly commercial facilities are housed (see Industrial estates § 8 BauNVO) | 0.3 | 6 | 0.15 | 0.2 | 0.4 | 0.1 |
| 3 | Impact sites, where neither predominantly commercial facilities nor predominantly domestic property are housed (see Core areas § 7 BauNVO, mixed areas § 6 BauNVO, village areas § 5 BauNVO) | 0.2 | 5 | 0.1 | 0.1 | 0.2 | 0.15 |
| 4 | Impact sites, in whose vicinity predominantly or exclusively domestic property is housed (see Pure residential areas § 3 BauNVO, General residential areas § 4 BauNVO, Small housing estates § 2 BauNVO) | 0.15 | 3 | 0.07 | 0.1 | 0.2 | 0.3 |
| 5 | Particularly vulnerable impact sites, for example in hospitals, sanatoriums, in so far as the are situated in those areas specially designated for them. | 0.1 | 3 | 0.05 | 0.1 | 0.15 | 0.07 |

In brackets the areas of the Federal Land Utilisation Ordinance = BauNVO are specified, usually represented by the designations under line 1 to 4. A schematic equation is not possible because the designations under line 1 to 4 are only made after the grounds have been established to protect against exposure to vibration, the zoning of the area in the BauNVO takes into account however also other planning requirements.