The manufacture and characterisation of ever smaller components, including structures consisting of just a few molecules or atoms, poses a huge challenge in terms of the vibration isolation required to protect the vibration-sensitive facilities.

In order to precisely carry out sensitive experiments and measurements on a scale of nanometres (1 nanometre = one millionth of a millimetre), external disturbances, such as fluctuations in temperature, humidity and air pressure, noise, electromagnetic fields and ground vibrations must be kept to a minimum. BILZ Vibration Technology AG has developed international expertise as a professional partner in providing solutions such as lab isolation (foundation block or platform isolation) or direct isolation of highly-sensitive machines (installation of isolation systems in facilities/equipment).

Passive membrane air springs, air bearings or active vibration isolation systems are used to provide high-quality vibration isolation. Depending on customer requirements, BILZ can also create the complete foundation block or platform design, or help with the layout and structural integration of the isolation system into the machine.

We are very proud to have equipped the most modern research labs in the world with sound and vibration isolation, such as the "Präzisionslaboratorien MPI Stuttgart" (Precision Laboratories) and the "Noise-Free Labs" of the Binnig and Rohrer Nanotechnology Centre (IBM/ETH Zurich).

In the semiconductor industry, many famous companies such as Applied, Vistec and Zeiss number among our valued customers.
Active Isolation System AIS™

- Active electro-pneumatic vibration isolation providing control in six degrees of freedom.
- Optimal vibration isolation performance without any amplification at resonance.
- Excellent level accuracy in both the vertical and horizontal plane.
- Minimal deflection and settling time after an acceleration or deceleration of a moving mass within the machine, shorter settling times equals greater machine throughput.
- Very efficient realtime control.
- PLC, CAN-Bus, one Controller and one High Speed electro-pneumatic servovalve for each degree of freedom.
- Each Controller consists of a microprocessor and integrated, high resolution sensors for position, air-pressure and acceleration.
- Easy-to-use, intelligent WinSNI-Software for setting up and optimizing the AIS™ and for providing system diagnostics.
- Two different modes of operation can be selected simply using a digital I/O. For example, scanning mode (during sensitive machine operations) to loading mode (during moving mass within the machine).
- Feedforward-signal is not required from the machine controller.
- No disturbing heat generation, magnetic variations or high electrical power consumption as by electromagnetic actuators / linear motors.

Range of application

Optimal vibration isolation performance for machines with high dynamic forces that are performing sensitive measurements and inspections, lithography equipment, laser machines, high resolution electron microscopes and machinery for the semiconductor industry. The AIS™ is utilized when the efficiency of isolation and the settling time of conventional air-springs with electro-pneumatic leveling systems is insufficient.

AIS™ has two primary functions:

One function is to protect the precision machine from floor vibration. The other primary function is to improve the performance of the machine by minimizing structure borne vibration created by the high dynamic forces produced during an acceleration or deceleration of a moving mass within the machine. In addition, settling time is reduced which minimizes the delay time before the machine can start performing its sensitive operation.
The AIS™ consists of a PLC, CAN-Bus, 16 bit-Controllers, High Speed electropneumatic servovalves and BiAir air springs and/or HAB™ ho-
horizontal air springs. A range of sizes are available for both the vertical
and horizontal air springs. One 16 bit-controller and one High Speed
electro-pneumatic servovalve is used for each air spring or group of
air springs. The AIS™ works with a minimum of 3 groups (degrees of
freedom) to a maximum of 6 groups (degrees of freedom).
The 16 bit-controller can be mounted directly to the air-spring itself
or to the machine, in the same direction as the isolator motion. Loca-
ted Inside the 16 bit-controller is a microprocessor, a position sensor
(resolution 0.2 µm), an acceleration sensor (resolution 8 µg) and an
air-pressure sensor (resolution 0.2 mbar). The signals from each of
these sensors will be sampled at the rate of 4 kHz.
Since each 16 bit-controller has a microprocessor with specially
developed control algorithms along with a special high dynamic
pneumatic servo valve, the resulting performance is a very efficient
realtime control and no feedforward signal is required.
The 16 bit-controllers are connected by a CAN-BUS to the PLC.

The PLC can be connected to a PC by a standard RS-232 for initial set-
up and diagnosis. The primary function of the PLC is to manage and
watch over the 16-bit controllers. In addition, the PLC has digital In-
puts and Outputs. For example, Ready, Motion Complete, Inspection
of Position, Pressure and Power Supply, Switch over from Scanning
Mode to Loading Mode, Emergency Stop.
The PLC also provides the possibility to switch from scanning mode
to loading mode by using a digital I/O. The PLC takes care of down-
loading all of the necessary parameters to each 16 bit-controller to
achieve the two different modes. The advantage of providing two
different modes is the performance of the system can be optimized
for each mode. For example, during scanning mode when machine is
performing sensitive operations the system should be very soft and
not be very aggressive otherwise forces created by the isolation sys-
tem can affect the machine performance. During loading mode, level
accuracy and shortest possible settling times are the most important
factors and a very stiff, fast and aggressive system will provide the
best performance.
Transmissibility of new active BILZ controller at scanning mode with membrane air-springs BiAir®/HE and horizontal air-bearing HAB™ with 6 controllers.

Example of positioning of AIS™ system air-springs, controllers and valves with 6 degrees of freedom
# HAB™ Horizontal Air Spring

<table>
<thead>
<tr>
<th>Type</th>
<th>Ø A (mm)</th>
<th>Ø W (mm)</th>
<th>H (mm)</th>
<th>leveling screw</th>
<th>Max. vertical load at 5,5 bar (N)</th>
<th>Max. horizontal load at 1 bar (N)</th>
<th>Adjustable horizontal natural frequency (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAB™ 280</td>
<td>200</td>
<td>180</td>
<td>101</td>
<td>M 10 x 1,5</td>
<td>3400</td>
<td>150</td>
<td>1,1 – 1,9</td>
</tr>
<tr>
<td>HAB™ 660</td>
<td>250</td>
<td>230</td>
<td>118</td>
<td>M 10 x 1,5</td>
<td>7200</td>
<td>380</td>
<td>1,1 – 1,9</td>
</tr>
<tr>
<td>HAB™ 1000</td>
<td>300</td>
<td>276</td>
<td>159</td>
<td>M 12 x 1,5</td>
<td>11000</td>
<td>490</td>
<td>1,1 – 1,9</td>
</tr>
<tr>
<td>HAB™ 1000-HL</td>
<td>300</td>
<td>276</td>
<td>159</td>
<td>M 12 x 1,5</td>
<td>14000</td>
<td>490</td>
<td>1,1 – 1,9</td>
</tr>
<tr>
<td>HAB™ 24 000</td>
<td>350</td>
<td>326</td>
<td>172</td>
<td>M 16 x 1,5</td>
<td>23500</td>
<td>700</td>
<td>1,1 – 1,9</td>
</tr>
<tr>
<td>HAB™ 38 000</td>
<td>422</td>
<td>398</td>
<td>187</td>
<td>M 16 x 1,5</td>
<td>38000</td>
<td>1100</td>
<td>1,1 – 1,9</td>
</tr>
</tbody>
</table>

Bigger sizes upon request!

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**Advantages of new HAB™ in comparison to conventional air-springs:**

- Adjustable horizontal natural frequency.
- Adjustable horizontal dampening.
- Very low natural frequency / very efficient vibration isolation.
- Friction free operation, no stick-slip or hysteresis.
- When used as part of the AIS™ System no amplification at resonance
- Very high dampening,
- Minimum settling time,
- Excellent level accuracy.

**Design**

The pneumatic horizontal vibration isolator HAB™ is constructed of a cylindrical top and bottom housing. Air tubes placed into the annular space between the two housings provide the horizontal force to counter any relative movement between the two housings.

The horizontal force or natural frequency of the HAB™ can be adjusted by changing the air pressure of these air tubes. A specially designed air bearing handles the vertical load and provides friction free smooth horizontal movement between the top and bottom housings.
Vibration isolated platforms

Our years of experience in the field of vibration isolation combined with our broad range of standard products guarantee the best technical and cost-effective solution.

1. Vibration Analysis
To optimize the design layout and achieve the best isolation results BILZ starts by conducting an on-site vibration analysis. BILZ uses high-end FFT-Analyzers along with the best seismic acceleration sensors and geophones on the market.

2. Engineering and Design
Complementing our broad range of products, BILZ offers customized systems and solutions that guarantee superior results. Engineering and design is part of our core business and our technical leadership is advanced through R&D and continuous improvement.

3. Production
Production, assembly and quality control is in-house and located within our headquarters in Stuttgart-Leonberg, Germany. Special requirements such as: Cleanroom packaging or special logistic solutions can also be offered. BILZ is ISO 9001 certified.

4. Installation
System installation can be conducted by BILZ field service engineers or by trained customer staff. The BILZ Active Electro-Pneumatic Isolation System can be installed and put into operation, including acceptance test, in one or two days. BILZ guarantees global service and support, with representatives in more than 20 countries.
Field of application
In many leading-edge industries the equipment and process requirements are becoming more demanding. Sub-micron, nano or even angstrom resolution is becoming a common customer requirement. Due to facility and on-site conditions, e.g. floor vibration, these resolutions are very hard to reach. High-end microscopes, metrology, inspection and repair equipment as well as other sensitive tools in the semiconductor industry, micro-biology and scientific research will not perform to specification without adequate vibration isolation. Isolated platforms are used when the equipment does not have an internal vibration isolation system or when the internal system is not effective enough in isolating the external vibration.

System design
Based on customer requirements of isolation performance and on-site conditions, BILZ can design and build customize systems using cost-effective passive isolators with mechanical level control or for high-end requirements the cutting-edge active AIS™ isolation system in 6 degrees of freedom. The platforms are customized and optimized in terms of rigidity, weight, dimensions, center-of-gravity, and choice of isolators according to customer requirements.

Results
Depending on the customer requirements, floor conditions and system design of the isolated platforms, BILZ will enable your machine to meet vibration criteria of VC-D (<6μm/s) and VC-E (<3μm/s). This allows our customers to reach specification from nano to sub-angstrom resolution.