Vibration Isolation Concepts

Source of Vibration

There are three primary sources of vibration which can disturb a payload, such as ground vibrations, acoustic noises, and direct force disturbances.
At one extreme, the ground vibration environment may consist of low level seismic disturbances present everywhere on earth and the disturbances, imperceptible under ordinary circumstances, present operating problems for highly sensitive equipment. When cultural vibration effects are added, even wider range of sensitive equipment is affected.
For example, even low-amplitude vibration can affect the performance and yield of lithography equipment such as stepper, the resolution of electron microscopes, the accuracy of measuring machines, and the performance of many types of precision equipments and instruments for electro-optical research. The cultural disturbances affecting the sensitive equipments are man-made and caused by phenomena such as vehicle and foot traffic, human activity, air handling systems, elevators, machinery and numerous other sources.

3 Factors In Dynamic System

In discussing vibration isolation, it is useful to identify three elements of a dynamic system.

1. The equipment need to be isolated.
2. The support structure (floor).
3. The isolation system between the equipment and the support structure.

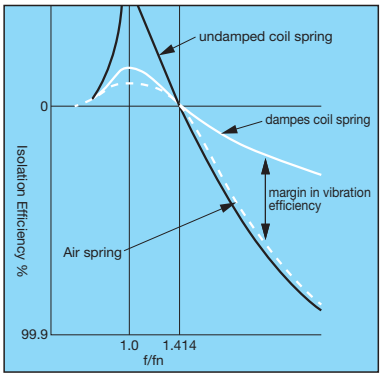
Vibration Isolation

In a passive isolation system, two factors affecting isolation efficiency are the natural frequency and damping of the isolator. The natural frequency is the rate of free oscillation per unit time and damping is the characteristic which dissipates energy in a dynamic system.
The ratio of forcing frequency (the disturbing frequency) to natural frequency (f/fn) is used to determine the isolation efficiency of any isolation systems.

Transmissibility $Tr = | 1 - (f/fn)^2 / 1 | \times 100\%$

where

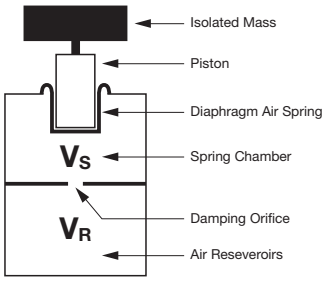
f/fn = the ratio of forcing frequency to natural frequency



Graph shows typical plots of isolation efficiency Notice that when f/fn is less than f2=1.414, the curves show that the vibration is magnified, when the forcing frequency is equal to the natural frequency (f/fn=1), maximum magnification occurs. At ratios above 1.414, the curves are in the isolation range. Typically isolators which exhibit the greatest magnification at resonance have the best isolation efficiency (undamped coil spring).

Generally speaking, low amplification at resonance as shown for the plot of a damped coil spring is desirable; however, notice that this is accomplished at the expense of isolation efficiency. Pnumatic isolators with an air spring and damping chamber on the other hand, combines the desirable characteristics of low magnification at resonance and high isolation efficiency as shown the graph.

The equation for determining the natural frequency of a pneumatic isolators is



$$fn = \frac{1}{2\pi}\sqrt{\frac{\gamma AG}{V}}$$

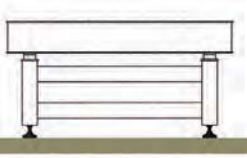
Where

γ = Ratio of spectific heat, 1/4 for air
A = Effective area of air piston, cm^2
G = Gravity acceleration
V = Volume of air chamber, cm^3

As seen from equation, the natural frequency of the pneumatic isolator depends on the ratio of the piston area to the volume of the air isolator

Types of Vibration Isolation Systems

Optical Tables
OSDVID Series

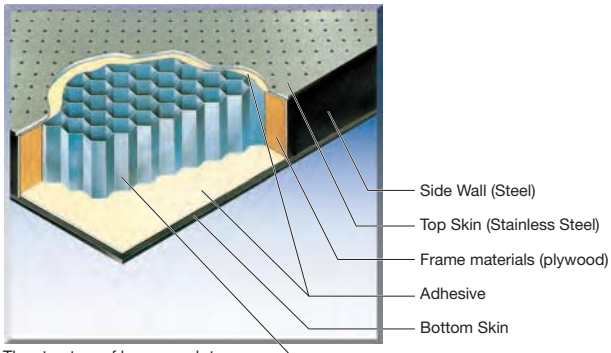


Lab Desk Isolators
OSDVID Series

Desk Top Isolators
OSDVIT Series

Structure of Flat Benches

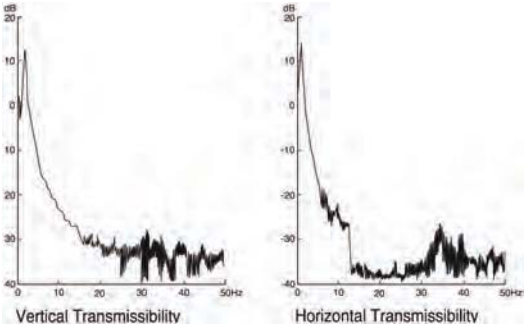
- Optical Tops consist of ferro-magnetic stainless steel (SUS430) top skin plates, carbon steel bottom skin plates (SPHC), plated steel honeycomb (0.25mm foil, 3.2cm^2 cell size) sandwiched between two plates and side steel panels, all bonded with high strength adhesive.
- High-damping optical tops apply Broadband Damping technologies and have excellent dynamic stiffness.
- Honeycomb cores (cell size 3.2cm^2) made of 0.25mm thick plated steels give maximized stiffness, extensive contact surface with two plates for high rigidity.
- Top skins are precisely grinded to minimize surface curves, pressure bonded to achieve excellent top flatness,lightly sanded with a circular pattern to remove burrs and non-reflecting & non-glare finished.



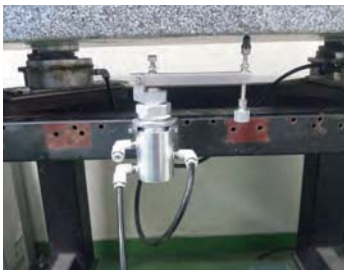
The structure of honeycomb tops

- Since all mounting holes on top plates are lead-screw tapped instead of using inserts, deformation or looseness of holes does not occur. The M6(1/4-20) tapped holes are for mounting optical components, arranged in a regular interval 25mm (1").
- Honeycomb cores, top/bottom plates and side walls are rigidly bonded with specially formulated high strength adhesive which allows no elastic bending and hysteresis. Since all parts are made of structural steels having the same coefficient of expansion, deformation such as overall distortion does not occur even in the repeatable temperature changes.
- Cylindrical cups are attached on the bottom of top skins for sealing tapped holes to prevent the inflow of any chemical substances into inside honeycomb cores.
- Upon customers' requests, special mounting holes and various configurations of optical tops are available.

Table Frame



- Pneumatic Vibration Isolator
  Pneumatic vibration isolation supports provide an effective vibration isolation performance both in vertical and horizontal direction in regular laboratories of 10Hz – 60Hz. Compressed air supply systems are required.
- Damping
  Pneumatic vibration isolation supports have damping orifices quickly decreasing and settling the movement of optical tops affected by external force or weight transfer.
- Auto Leveling System
  Pneumatic vibration isolation supports are equipped with three auto leveling valves adjusting the inside pressure of the air spring chambers automatically. This is to maintain the height and level of table tops even under eccentric load.
- Pneumatic vibration isolation supports come with casters and levelers for easy movement and installation.
- Pneumatic vibration isolation supports consisting of 4 isolators can support from 500kg to 2,000kg load. For higher load, long optical tops or joined tables, quantity of isolators can be increased.



Delivery Cost

Because the vibration isolator and laboratory bench are heavy, extra shipping costs are required in addition to the price of those products. Also, to carry in those products, transport, personnel and equipment appropriate to the delivery site are required. At the time of a quotation, please provide our International Sales Division with the Carry-In Route and Installation Environment Question Sheet on .