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The KSI Solution...

VIBRAPLANE Provides a Flexible,

All-Purpose Solution to Vibration Isolation

VIBRAPLANE Airmount Isolation Is Better

Conventional isolators are constructed using metal springs or rubber blocks. They have low internal damping, and tend to be effective only at frequencies near 10 Hz. Also, they provide almost no isolation at frequencies above 30 Hz because of "harmonic standing waves" occurring at sonic velocities in the metal or rubber.

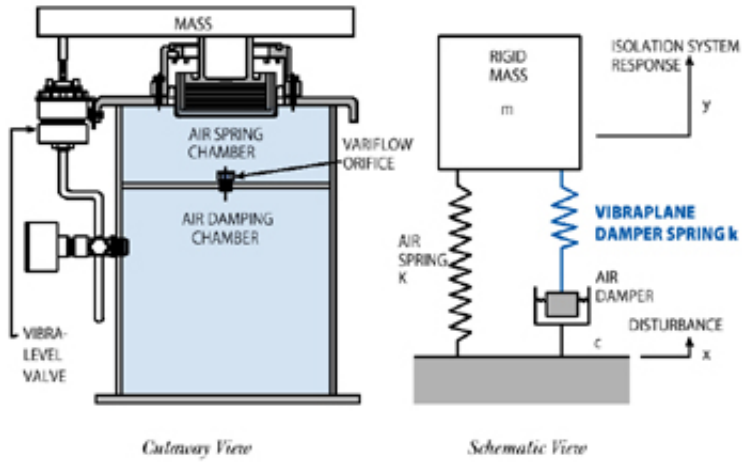


FIGURE 43.1
VIBRAPLANE Airmount

The VIBRAPLANE design concept is shown in Figure 43.1. This design eliminates the metal springs or rubber blocks used in conventional isolator designs. The VIBRAPLANE utilizes a frictionless rolling diaphragm air seal to support a load carrying piston in conjunction with dual air chambers as the spring and damping medium. The air spring stiffness is a function of the combined air volume of the dual chambers. This conveniently provides the required very low stiffness to obtain the desired very low natural frequency necessary for high efficiency isolation. "Harmonic standing waves" cannot occur in the VIBRAPLANE System due to its dual air chamber internal damping design.

VIBRAPLANE Systems are Mobile

Since current and future building vibration requirements are uncertain, the safest, most cost-effective concept of vibration control in high technology facilities is vibration isolation of individual pieces of sensitive equipment at the point of installation. For both OEM and end user installations, VIBRAPLANE high performance systems provide vibration control independent of building

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construction. Unlike concrete inertia blocks or fixed support piers, VIBRAPLANE isolation systems are relatively compact and mobile, and may be easily moved or changed as future needs develop. The alternative, modifying buildings and internal structures, is costly and permanent with little or no margin for future requirements.

Our vibration surveys indicate that most building vibrations are complex, and may be characterized as a broadband random vibration spectrum with multiple superimposed strong discrete “tonal” frequencies. The broadband random vibration spectrum extends from 8 to 200 Hz. The multiple discrete tonal frequencies tend to occur between 8 to 80 Hz and are caused by motors, generators, blowers, pulleys, and gears, etc. The observed vibrations are mostly vertical, with horizontal vibrations averaging about 25% to 30% of the vertical. The frequency spectrum is essentially invariant, however discrete frequency amplitudes can vary by several orders of magnitude depending on the location and distance from the source of the disturbance.

Regardless of location, the above generalizations establish an 8 to 200 Hz frequency spectrum of concern for selecting vibration control to avoid damaging environmental frequencies which may coincide with equipment natural frequencies. KSI’s standard VIBRAPLANE vibration isolation systems are designed with a low 1 to 2 Hz natural frequency that will attenuate all potentially damaging vibration amplitudes in the 8 to 200 Hz environment spectrum.

Better Damping

The VIBRAPLANE utilizes a unique proprietary VARIFLO™ orifice design for flow control between air chambers, and therefore, better damping control is realized both high and low amplitudes and frequencies. This design ensures an even air flow at all amplitudes without choking, thereby maintaining the effectiveness of both (airspring) chamber volumes.

It can be seen in the schematic representation of Figure 43.1, that VARIFLO damping incorporates a “filtering” spring. This contrasts with vibrations the conventional isolator model of Figure 42.1 where the damper is direct coupled to the mass and causes a loss of isolation at high frequencies as shown in Figure 42.2. The VARIFLO damping (air) spring effectively decouples the damper at high frequencies and therefore no isolation is lost where high damping forces would tend to reduce efficiency in a conventional isolator.

Zero Friction

The VIBRAPLANE design uses a thin wall frictionless rolling diaphragm to support the (airspring) piston. This unique design prevents friction locking, which is a principle cause of loss of isolation for low frequency, micro-inch disturbances in conventional
Isolators.

VIBRAPLANE Transmissibility

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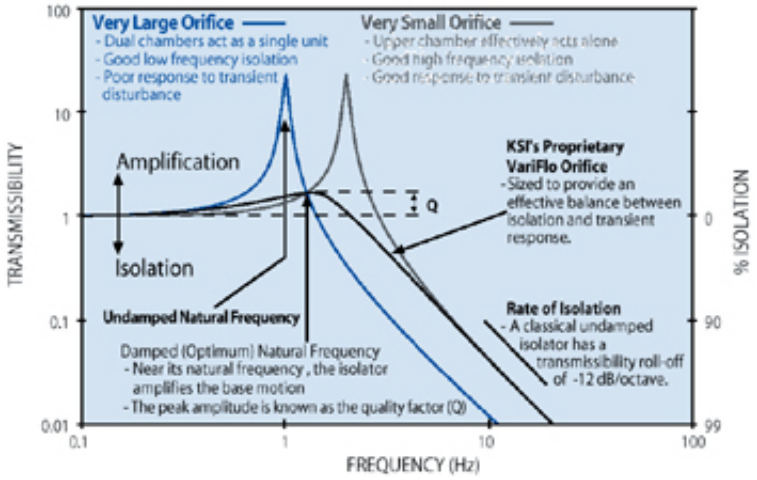


FIGURE 45.1
VIBRAPLANE Transmissibility

The dual chamber design of the VIBRAPLANE produces a unique optimization of its vibration Transmissibility performance. See Figure 45.1. At low frequencies the air volume in both air chambers is effective, resulting in large air volume and a soft low natural frequency system. This is represented by the "left" branch of the Transmissibility curve. At high frequencies, the orifice gradually restricts the air flow and eventually only the small chamber is effective with a resulting stiffening of the system. This action is represented by the "right" branch of the Transmissibility curve. KSI's proprietary orifice design is amplitude sensitive and configured to produce the "optimum" transmissibility bounded by the left and right branches. VIBRAPLANE thus affords the ideal conditions of maximum damping at resonance and minimum damping at high frequencies for better isolation than possible, using conventional isolation systems.

Active-Air Leveling

VIBRAPLANE Active-Air leveling provides leveling compensation and a wide load range. By utilizing a compressed air source and our proprietary VIBRALEVEL Air Servo Valves, air is fed into or bled from the (airsprings) to maintain a preset "zero deflection" level and compensate for load changes.

Horizontal Vibration Control

Horizontal vibrations in buildings average 25% to 30% of the vertical and are usually less critical. Nevertheless, the VIBRAPLANE System includes the Kinematic Horizontal Isolation Piston to provide isolation for any vibration environment regardless of direction. The piston is internally constructed with rubber-in-shear elements that simultaneously translate and rock in a low frequency coupled response action to horizontal inputs. KSI BaseMate Platforms use an onmi-directional low frequency pendulum system to eliminate horizontal vibrations. Early on, KSI recognized precise system leveling is essential for proper horizontal vibration isolation, and was the first to introduce mechanical leveling feet on all workstations. This assures the maximum efficiency of our zero friction design. These leveling feet serve to equalize piston extension and prevent rubbing friction due to frame tilt.

Structural Damping

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The structural damping used by Kinetic Systems eliminates the “ringing” caused by resonances in frame, table, and platform structures external to the VIBRAPLANE airspring suspension system. All structures experience resonance no matter how stiff or massive. Damping augmentation is the most efficient means to dissipate vibration energy. KSI’s engineering staff conducts continuing research and development of new and improved damping technologies which are incorporated into the production of all VIBRAPLANE systems. We use viscoelastic damping laminations and “tuned absorbers” on solid, composite, and honeycomb tables and platforms. In addition, frame structures are bolted through viscoelastic laminations.

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