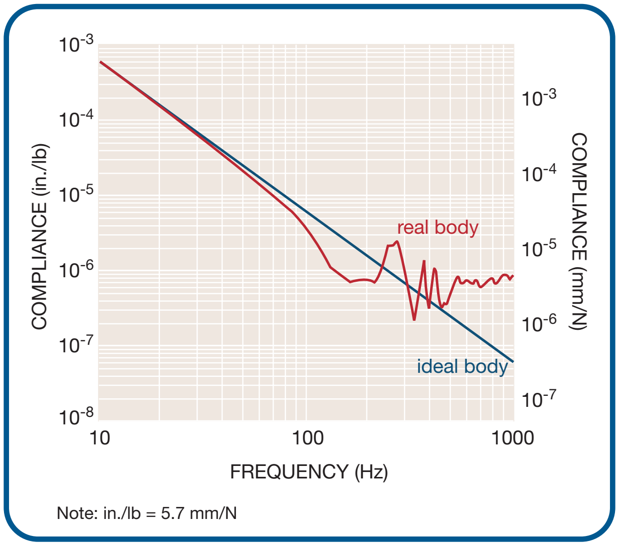

Typical compliance curve for the UltraPlus Series of tables, measured at the table corner

Also, notice how the peaks at compliance resonances decrease in size towards higher frequency. As the frequency increases, the denominator in the compliance expression becomes large, and therefore the compliance is reduced. This means that as the frequency increases, a given excitation force produces a smaller amplitude excitation in the table.

The low-frequency peaks are the most important for two reasons. First, these are the largest peaks, corresponding to the weakest points in the compliance spectrum. Second, typical vibrations from laboratory equipment are usually below 150 Hz. The peaks should be at the highest frequency possible in order to keep the compliance in the 0 to 150 Hz region as low as possible.

Summary of Key Points

- More Sensitive Setups Require Tabletops with a Lower Compliance
- Below the First Resonant Frequency, Compliance is Primarily Determined by the Stiffness of the Tabletop
- At Resonance, the Compliance of the Table depends on the Degree of Damping
- Only at High Frequencies, Above Resonance, Does the Mass of the Table Make any Significant Impact on Compliance

Implications for Table Selection

For optimum performance, an optical table must meet several conditions. The first resonant frequency should be as high as possible, at least above the frequency of the noise sources. The table should be as stiff as possible, and it should also be well damped, particularly near the resonant frequency of the table. Thorlabs' optical tables and breadboards are designed to be light but stiff structures, which incorporate good damping.

Selecting the Isolation System

Vibration isolation or elimination at an optical surface is a two part problem. As discussed in the notes on optical tabletops, an optical table is designed to have zero or minimal response to a deflective force or vibration. This in itself is not sufficient to ensure a vibration-free working surface. The rigid table may still vibrate without deforming (i.e., vibrations of the table on the mounting system may occur). These types of vibration are constrained translations and/or rotations of the optical table.

The entire table system is subjected continually to vibrational impulses from the laboratory floor. These vibrations may be caused by large machinery within the building or even by wind- or traffic-excited building resonances (swaying).

Vibrations of a floor in a building can be divided into two basic types: vertical and horizontal. Typically, vertical components are in the 10 to 50 Hz range and horizontal components are in the 1 to 20 Hz range. To prevent such vibrations from disturbing a setup or test, it is important to mount the table in such a way as to isolate it vibrationally from the laboratory floor (e.g., mount the table such that its instantaneous position is independent of the periodic motions of the laboratory floor). This type of mounting is seismic mounting. When an object is seismically mounted with respect to the floor, the motions of the object and the floor are completely uncoupled and separate.

Transmissibility

Consider a ball suspended from an enormous mass by a spring. For now, we shall ignore the pendulum motions and consider a system having only one degree of freedom (i.e., capable only of vertical extension motions).

In the absence of vibrational impulses, the ball is stationary at its rest position. Suppose the object from which the ball is suspended is not infinitely large or not infinitely stiff so that the point at which the spring is anchored starts to vibrate. Some of the vibration energy may be felt at the ball, causing it to vibrate at the same frequency.

The frequency of this motion is given by

$$f_n = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$$

where f_n is the resonant frequency of the oscillation, m is the mass moving during the oscillation, and k is the spring constant (related to the stiffness of the spring).

The transfer function most commonly used to express this flow of vibrational energy is termed transmissibility and is defined as the ratio of the dynamic output to the dynamic input (i.e., the ratio of the amplitude of the transmitted vibration to that of the forcing vibration).