Chapter 6 - VIBRATION ISOLATION MATERIALS

TYPES OF VIBRATION ISOLATION MATERIALS

The definition of vibration isolation is the separation, or isolation, of the vibratory forces or motion of one object from another. This is generally accomplished by inserting a flexible material between the driving object and the driven object. Such materials, if sufficiently flexible, will transmit little of the vibrational forces to the driven object. Vibration isolators with little damping are capable of extreme reduction of vibration transmission at the higher frequencies but they permit a great transmission of vibration at the resonant frequency of the system. The addition of damping will limit the response at the resonant frequency but may also reduce the isolation capability at the higher frequencies.

There are two types of vibration isolation applications. The first type is designed to reduce the transmission of vibratory forces from a piece of equipment to the foundation on which it is mounted. The vibration isolation of reciprocating engines, large fans, electric motors, etc., are examples of this type of isolation application. The second type of vibration isolation application is designed to reduce the transmission of vibration velocity or amplitude to the piece of sensitive equipment that is mounted on the floor or to another structural member. The mounting of an optical bench on a massive table which rests on large vibration isolators is an example of this application type.

Some typical materials used for vibration isolators are elastomers, elastomeric foam, cork, felt, fiberglass boards, and steel in such forms as springs, pads, cables, etc. The essential features of vibration isolators are a resilient load-supporting member (stiffness) and energy-dissipating mechanism (damping). In certain types of isolators, the stiffness and damping functions are provided by a single element as in the case of elastomers, elastomeric foam, glass fiber boards, wire mesh, and wire cable isolators. Other types of isolators may employ separate, distinct means of providing stiffness and damping, as in the case of relatively undamped springs used with auxiliary damping elements such as viscous dashpots, coulomb (dry-friction) dampers, and capillary or orifice flow-restriction dampers (Figure 6-1).

All too often vibrating equipment is mounted on lightweight partitions or floors. Most vibration elements are designed with the concept that the mount is an infinite mass of perfect rigidity. The result is that natural vibration tendencies form a secondary fundamental resonance thereby negating the potential attenuation. Care in the design and selection of the elasticity of the mount are complex issues (Figure 6-2).
Shock Isolation

The technology and hardware of shock isolation is different from vibration isolation. A soft resilient spring, such as those used for vibration isolation, may permit much of a shock pulse to be transmitted to the member we wish to protect.

Vibration relates to the steady state, oscillatory motion of a piece of shaking equipment whereas a shock pulse is a substantial disturbance characterized by rise and decay of acceleration in a short period of time.

A shock isolator is a resilient support that isolates a system from a shock pulse. Such isolators are characterized by a long stroke which allows dissipation of energy over a long period of time.

Some Specific Vibration Isolation Materials

The common materials utilized for vibration isolation, such as cork, felt, glass fiber, or elastomers, offer a wide choice to fit most requirements. The main differences between these materials are their stiffness, or natural frequency characteristics, and the amount of damping each can provide. However, the selection of the particular material is usually based on such non-vibration-oriented requirements as resistance to chemicals, tear strength, abrasion resistance, cost, lateral stability, and load capacity. For example, natural rubber has good isolation characteristics and fair temperature dependent properties, but does not age well and does not have the resistance to chemicals possessed by some of the synthetics. Glass fiber which has been prestressed and compressed to high densities provides an effective vibration isolation system for floors of large buildings. Floating floor systems can be effective isolators, protecting sensitive instruments from building structural vibration, or preventing equipment vibrations from being transmitted to the building structure. Glass fiber pads are also used as unit isolators for machinery mountings.

Cork pads, which consist of natural cork granules compressed and steam baked to form slabs of the desired density, have fine aging characteristics and are particularly suitable for isolating concrete foundations.

Felt pads are used for applications in which an isolation material with good cementing characteristics is important. Felt has found widespread use in the textile machinery field and is generally recommended when machinery movement or rebound must be closely controlled.