Considerations In Selecting A Vibration Isolator

In the process of deciding on a vibration isolator for a particular application, there are a number of critical pieces of information which are necessary to define the desired functionality of the isolator. Some items are more citical than others but all should be considered in order to select, or design the appropriate product.

Some of the factors which must be considered are:

Weight, size, center-of-gravity of the equipment to be isolated — Obviously, the weight of the unit will have a direct bearing on the type and size of the isolator. The size, or shape of the equipment can also affect the isolator design since this may dictate the type of attachment and the available space for the isolator. The center-of-gravity location is quite important in that isolators of different load capacities may be necessary at different points on the equipment due to weight distribution. The locations of the isolators relative to the center-of-gravity—at the base of the equipment versus in the plane of the c.g., for example—could also affect the design of the isolator.

Types of dynamic disturbances to be isolated — This is basic to the definition of the problem to be addressed by the isolator selection process. In order to make an educated selection or design of a vibration/shock isolator, this type of information must be defined as well as possible. Typically, sinusoidal and/or random vibration spectra will be defined for the application. In many installations of military electronics equipment, random vibration tests have become commonplace and primary military specifications for the testing of this type of equipment (such as MIL-STD-810) have placed heavy emphasis on random vibration, tailored to the actual application. Other equipment installations, such as in shipping containers, may still require significant amounts of sinusoidal vibration testing.

Shock tests are often required of many types of equipment. Such tests are meant to simulate those operational (e.g., carrier landing of aircraft) or handling (e.g., bench handling or drop) conditions which lead to impact loading of the equipment.

Static loadings other than supported weight — In addition to the weight and dynamic loadings which isolators must react, there are some static loads which can impact the selection of the isolator. An example of such loading is that imposed by an aircraft in a high speed turn. This maneuver loading must be reacted by the isolator and can, if severe enough, cause an increase in the isolator size. These loads are often superposed on the dynamic loads.

Allowable system response — This is another basic bit of information. In order to appropriately isolate a piece of equipment, the isolator selector must know the response side of the problem. The equipment manufacturer or user should have some knowledge of the fragility of the unit. This fragility, related to the specified dynamic loadings will allow the selection of an appropriate isolator. This may be expressed in terms of the vibration level versus frequency or the maximum shock loading which the equipment can endure without malfunctioning or breaking. If the equipment manufacturer or installer is somewhat knowledgeable about vibration/shock isolation, this allowable response may be simply specified as the allowable natural frequency and maximum transmissibility allowed during a particular test.

The specification of allowable system response should include the maximum allowable motion of the isolated equipment. This is important to the selection of an isolator since it may define some mechanical, motion limiting feature which must be incorporated into the isolator design. It is fairly common to have an incompatibility between the allowable “sway space” and the motion necessary for the isolator to perform the desired function. In order to isolate to a certain degree, it is required that a definite amount of motion be allowed. Problems in this area typically arise when isolators are not considered early enough in the process of designing the equipment or the structural location of the equipment.

Ambient environment — The environment in which the equipment is to be used is very important to the selection of an isolator. Within the topic of environment, temperature is by far the most critical item. Variations in temperature can cause variations in the performance of many typical vibration/shock isolators. Thus, it is quite important to know the temperatures to which the system will be exposed. The majority of common isolators are elastomeric. Elastomers tend to stiffen and gain damping at low temperatures and to soften and lose damping at elevated temperatures. The amounts of change depend on the type of elastomer selected for a particular installation.

Other environmental effects — from humidity, ozone, atmospheric pressure, altitude, etc. — are minimal and may be typically ignored. Some external factors that may not be thought of as environmental may impact on the selection of an isolator. Such things as fluids (oils, fuels, coolants, etc.) which may be in

the area of the isolators may cause a change in the material selection or the addition of some form of protection for the isolators.

Service life — The length of time for which an isolator is expected to function effectively is another strong determining factor in the selection or design process. Vibration isolators, like other engineering structures have finite lives. Those lives depend on the loads imposed on them. The prediction of the life of a vibration/shock isolator depends on the distribution of loads over the typical operating spectrum of the equipment being isolated. Typically, the longer the desired life of the isolator, the larger that isolator must be for a given set of operating parameters. The definition of the isolator operating conditions is important to any semi-reliable prediction of life.

Specification of Isolator Selection Factors — This on-line catalog includes a questionnaire, or "Data Required" form, which is helpful in the definition of the above areas of information. If the indicated information is available, the selection of an isolator will be greatly enhanced. The theory that follows in the next section is worthless if the information to apply it is not available. If an equipment designer is attempting to select an isolator from this catalog, the job will be eased by having this information available. Likewise, if a company like Lord must be consulted for assistance in the selection or design of an isolator, then the communications and accuracy of response will be improved by having such information ready.