Step by Step Selection of AVM's to achieve good System Design

THE OBJECTIVE

Tackling vibration and shock isolation problems with isolators or AVMs falls into three main areas.

Isolating the source of vibration

The transmission of vibration through structures, buildings and equipment is often best tackled by applying isolation techniques at source. By employing correctly selected AVMs under the vibration source, e.g. a generating set or compressor unit etc., the effects of the vibration on the supporting structures, can be substantially reduced.
Where the subsequent vibration amplitude is considered to be too high, extra mass, usually in the form of an inertia base frame, is added to the equipment and the whole assembly (equipment connected rigidly to the base frame), is isolated.

N.B. For the isolation of the source to be effective it is vital that all service connections are flexible and are designed and selected correctly.
E.g. External service pipe connections to engines should incorporate flexible bellows, compensators or pipes. (Product groups 72 to 75 inclusive).

Protection of equipment from external vibration:- passive isolation

Where equipment is to be mounted into a vibration environment and it is not possible to reduce vibration in the support structure by treatment at source, AVM's can be used to support the equipment on the structure, to provide isolation from the effects of the vibration present.

Shock protection

Consider a simple example of equipment being transported, fitted solidly to its packing case. If dropped several centimetres onto a floor, the equipment accelerates under the influence of gravity, impacting on the floor with a finite velocity. When the case strikes the floor, the equipment is brought to rest very quickly crushing and deforming the packing case and generating very large shock forces into the equipment.
If the same equipment had been supported within the package on shock/vibration mountings, with clearance all around the equipment, then if this package were dropped, as the case strikes the floor it is brought to rest quickly.
The equipment however, continues moving, deflecting the shock mountings until the kinetic energy generated by the fall is converted into potential energy stored in the shock mountings. Part of this energy will be dissipated on the initial deflection and the remainder during a series of decaying oscillations. The maximum force experienced by the equipment through the shock mounting is considerably less than if the unit had been solidly supported and in consequence the support system provides a level of shock reduction.
In general this is the basis of shock protection, the greater the shock deflection the better the shock protection achieved. By incorporating high levels of damping or constant force displacement devices very efficient shock protection can be achieved.

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THE DESIGN PROCESS

As outlined in the basic theory section, experience has shown that for many practical applications, by considering the vertical direction only and applying certain guidelines, it is possible to design an acceptable AVM suspension system.

The process can be summarized in five basic steps outlined below but the following points should be considered before commencing:

Typically, mountings are fitted under equipment, using support brackets or “feet”, at positions calculated to achieve similar deflections at all mountings, when installed.

If the application involves a “driving” unit, e.g. a diesel/petrol engine or motor and a “driven” unit, e.g. a compressor, with flexible coupling , or belts and pulleys, it is recommended that both units be mounted onto a common base , or sub – frame. This will ensure the assembly moves as a single unit when in operation. Belt and pulley drives between separate ‘drive’ and ‘driven’ units can experience belt slip and/or breakage resulting in loss of drive, inefficient operation and at times no vibration isolation, so avoid this set-up wherever possible.

Isolation support systems can be designed for installations using belt and pulley drives between separate isolated ‘drive’ and isolated ‘driven’ units, but these require careful design and mounting selection and are best avoided.
When an application dictates separate ‘drive’ and belt or coupling ‘driven’ units, then it is advisable to complete the standard design questionnaire and consult Vibracoustics for advice before proceeding.

On any application with or without a common base-frame it is necessary to establish the loads required to be carried by each mounting position.

Where the supported unit produces or is subjected to forces or applied torques, then these additional loadings to the mountings, must be considered when selecting the appropriate mounting.

The five step design process to isolation design by considering the vertical direction only:

STEP 1:

1. Cat Ref: 04-S-20. Selection of appropriate Vibracoustics product groups.
From the particular application criteria, i.e. the site location and equipment details, use the Static and Mobile application matrices on page 04-S-21 to filter the AVM product groups to ensure only appropriate types are considered.

STEP 2:

Cat Ref:04-S-40. Stage 2.1. Calculate or measure the equipment Centre of Gravity (C.o.G.) position.

Cat Ref:04-S-40. Stage 2.2. Determine the optimum number of AVM’s required.

Cat Ref:04-S-40. Stage 2.3. Select the support positions to be used and determine the imposed loading at each mounting:

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using either,

a) All similar mountings selectively positioned to balance the static stiffness moments about the equipment center of gravity and so achieve equal mounting loads.

Or,

b) Where all support positions are pre-determined, select each individual mounting by stiffness to balance stiffness moments as accurately as possible and achieve similar deflections at all mountings, under the imposed load of the equipment.

STEP 3:

Cat Ref:04-S-30. Stage 3.1.Identifying the lowest excitation frequency that will disturb the system.

Stage 3.2. Using the Isolation Calculator, input the target isolation and excitation frequency to determine the minimum mounting deflection required.

STEP 4:

Cat Ref: 04-S-50. Worked Example and Environmental factors that introduce the need for special materials or treatment.

STEP 5:

Cat Ref: 04-S-60. Check and define suitable service and external connections.

By following this selection procedure, the types and sizes of AVM selected, will meet all defined criteria. If in any doubt consult Vibracoustics Ltd.

N.B. A good system design can be rendered ineffective by poor installation!

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