Vibration Isolation and Restraint Systems
Vibration, Structure-Borne Noise, & Seismic/Wind Effects

Vibration and noise problems go hand-in-hand and are common issues that engineers have to deal with in HVAC.

Traditional Practices

Traditional practices in vibration isolation selection don’t always allow for the best solutions. One traditional approach is to rely on vibration isolation products that are supplied by the HVAC equipment manufacturer. The downside to this approach is that engineers can’t be sure that the end result will meet the design criteria. Proper isolator selection and application depend greatly on the driving frequencies of the equipment (especially equipment with variable speed drives), location and supporting structure deflection, and surrounding and connected elements such as piping and ductwork.

When selecting isolators, the standard approach is to refer to the ASHRAE table; however, industry knowledge is necessary in order to use this table to arrive at the best solution for the system.

Restrainment Requirements

A  Are wind load calculations required?
B  Is the equipment adequately attached?
C  Are restraints required for ductwork?
D  Is thermal expansion required?
E  Which anchors are required?
F  What embedment and edge distance is required?

Achieving code compliance (e.g., IBC or NBC) is critical. Seismic and wind events can induce damage from a building’s non-structural components, creating life-safety issues and devastating loss of revenue. If neither the design nor the construction teams have adequate expertise in extreme event engineering, an unacceptably high degree of risk and liability may be borne by both.

The Integrated Systems Approach

Instead of choosing products based solely on their performance data in an ideal test setup, Vibro-Acoustics uses the Integrated Systems Approach to select the right products and ensure they are applied properly. The Integrated Systems Approach considers how the products will integrate with the systems, and how the integration will affect the actual installed performance.

Drawing on over 50 years of experience, Vibro-Acoustics focuses chiefly on providing the application engineering expertise and product solutions needed to achieve the desired sound criteria. This requires our Application Engineers to address both structure-borne and airborne noise. Vibro-Acoustics writes project-specific specifications for vibration isolation, seismic/wind restraint and airborne noise to save engineers time when reviewing submittals and to help avoid vibration problems post-design. Vibro-Acoustics also serves as a single point of contact for meeting sound criteria and for ensuring solutions are code compliant.

In the following pages you will learn how our isolation and restraint products can be applied to the systems listed below.

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What is the load?

How stiff is the structure?

What are the criteria?

What is the natural frequency?

Rubber or spring? Or both?

Seismic or non-seismic?

The application of the wrong vibration isolation or restraint product can lead to vibration and noise problems, an inability to achieve code compliance, and even life-safety issues.
**Suspended Systems**

A key factor in effective piping and ductwork isolation and restraint is site planning and coordination before installation. For restraints, the first step is choosing between cable or rigid. Selecting the proper restraint system requires a study of piping or ductwork placement, an examination of site conditions—including wall and ceiling location and construction—and an understanding of the vibration isolation needs. If vibration isolation is required, then cable restraints should be used instead of rigid restraints.

**Ductwork**

Vibro-Acoustics offers a variety of standard and custom isolation and restraint solutions for duct systems. These solutions, combined with our seismic engineering capabilities, give contractors and engineers the advantage of single-source responsibility.

**Isolation products**: NH / SH

**Restraint products**: SRK / VAC / RRK

Vibro-Acoustics Neoprene Hanger

This advanced element design, which includes 12 unique neoprene extrusions, achieves desired deflections at the rated loads. This results in better acoustic performance of the product.

**VAC Rod Stiffener Clamp**

To keep hanger rods forced into compression from bending and buckling, additional clamps are clamped to them using Vibro-Acoustics' easy-to-install VAC rod clamps.

**SRK Seismic-Cable Restraint**

Vibro-Acoustics' SRK cable kits are available for various loads. Depending on size, the kits are supplied with either wire rope, PPS or compression sleeves. Clamps are provided in configurations that meet the installing contractor's preference.

**SH Spring Hangers**

Vibro-Acoustics' family of spring hangers are available in a variety of load capacities and configurations of rubber and spring.

**SHRB Spring Hanger**

Spring hangers are also available with and without rubber elements (SHR and SH), bottom cups (SHB), both elements and cups (SHRB), and precompressed versions for all four options (PSH, PSHR, PSHB, and PSHRB). Uplift stopwashers are provided for seismic applications.

**Piping**

Restraining piping can pose a challenge due to limited room, high ceilings, and a web of ductwork, piping, and electrical conduit. Vibro-Acoustics provides on-site trade coordination and custom pipe stand designs that help installing contractors achieve code compliance with minimal labor costs. Piping systems have unique parameters to consider when selecting vibration isolation and seismic restraints, most notably different pipe materials and thermal expansion and contraction.

**Isolation products**: SH

**Restraint products**: RRK / VAC / SRK

No matter what the site conditions require (single clevis hung, trapeze, pipe stands, etc.), Vibro-Acoustics can apply a vibration isolation and restraint system that fits with the preferred installation method.

**Fan Coil Units, Heat Pumps & Terminal Units**

In some cases, restraint of small suspended equipment can be unnecessary or handled by alternative means. Our design and engineering staff can help specifying engineers create clear project-specific specifications and help contractors determine the most cost-effective methods to ensure code compliance, especially on projects with many terminal units.

**Isolation products**: NH / SH

**Restraint products**: SRK / VAC

Fan units, heat pumps, and terminal units often require a solution for both airborne and structure-borne noise.

**Fans**

Duct-mounted or suspended fans vary in size, configuration, and horsepower. These variables, coupled with location and application, will help determine the correct isolation and restraint solution. Fans will often require a solution for both airborne and structure-borne noise.

**Isolation products**: SH / AHCS Thrust Restraints / NH

**Restraint products**: SRK
Non-Suspended Systems

When calculating the applicable loads, identifying the correct mount type for the application, and choosing the right deflection for the isolator, it is critical that engineers understand the exact details of the following: (a) the equipment required to be isolated or restrained; (b) the supporting structure; and (c) the noise and vibration criteria in the building.

Indoor Chillers

To avoid excessive stress on piping connections during chiller maintenance, restrained isolators should be selected. Factors such as exposure to a seismic/event, location in the building, the noise/vibration criteria, the rotating speed(s) of the equipment, quantity of mounting locations, attachment method, and weight distribution are all required to correctly select the appropriate mount.

- Isolation products: FLEX / CSR / RD
- Isolation/restraint products: SCSR / SFS

Base-Mounted Pumps

Base-mounted pumps normally require a concrete inertia base. Selection and sizing of the base should ensure that the range of motion is limited and provide the appropriate vibration isolation for the system. Housekeeping and depth and size, exposure to extreme events, pump type, horsepower, rpm, size, location in the building, and weight distribution are contributing factors in selecting the appropriate isolator.

- Isolation products: FLEX / CSR / FS / RD
- Isolation/restraint products: SCSR / SFS / CSR / RD
- Base products: SB / CIB

Base-Mounted Fans

Depending on the application and type of base-mounted fan, either a concrete or steel base could be required. A typical isolation solution is a Vibro-Acoustics steel base in combination with FS isolators and thrust restraints.

- Isolation products: FS / HCS Thrust Restraint / CSR
- Isolation/restraint products: SCSR / SFS
- Base products: SB / CIB / FS

Cooling Towers, Outdoor Chillers & Condensing Units

Avoid point loading and multiple roof penetrations. Vibro-Acoustics' cooling tower isolation platform is uniquely engineered to save significant project cost, with lessened architectural footprint. The Guaranteed acoustic package provides customers with single-source responsibility for noise and vibration control, as well as cooling tower support.

- Isolation products: CSR
- Isolation/restraint products: SCSR
- Base products: Cooling Tower Platform / CTB / Steel Base

Vibro-Acoustics can perform calculations for and provide seismically-rated, perimeter base rail supporting steel frames for cooling towers and other outdoor equipment.

Vibro-Acoustics has a full line of isolation and restraint mounts for all HVAC equipment. More importantly, we have the expertise to apply these products and provide solutions that achieve both the desired noise and vibration control as well as code compliance.
More Non-Suspended Systems

Roof Piping and Duct

Site scheduling is critical when coordinating installation of roof piping with pipe stands. The building code requires pipe stands to be connected directly to the structure, and this can be a labor-intensive and costly task if the roof membrane is already installed. Vibro-Acoustics' seismic pipe stands are designed with a removable pipe support head to allow for quick and easy roof membrane installation.

Vertical Inline Pumps

Since many vertical inline pumps are not installed on a concrete inertia base, restraining them for extreme events can be a challenge. Utilizing Vibro-Acoustics' pre-engineered pump stands eases installation and ensures code requirements are met. These pump stands are also used with spring hangers and cable restrainers for suspended vertical inline pumps.

Tanks (expansion, hot water, fuel, etc.)

Tanks such as expansion tanks often do not have allocated mounting "feet" for extreme event applications. Vibro-Acoustics' seismic mounting brackets should be utilised at three to four locations around the base. Depending on the tank location and size, wall straps and custom tank cages could be required.

Rooftop Units & Curb Mounted Fans

Rooftop units, primary sources of vibration problems, are often culprits of non-compliance with background sound criteria. To avoid a vibration or structure-borne noise problem, engineers should specify Vibro-Acoustics’ noise control curb, which provides external external isolation, not just isolation of the usual suspects inside the unit (fan, compressor, etc.). Rooftop units with curbs require additional calculations and bracing for extreme events to secure the two attachment planes: the unit to the curb, and the curb to structure. The Vibro-Acoustics VCR curb for extreme event applications comes with the necessary calculations, stamped by a PE/P.Eng.

Fit-the-System Solutions

Not enough room to install a standard product?
Standard product doesn’t solve the problem?
Site conditions have changed last minute?
Need to save labor on installation?

Contact Vibro-Acoustics for Fit-the-System Solutions
Our Services

Vibro-Acoustics complements its full line of vibration isolation and restraint products with our three-stage extreme event engineering and application engineering service.

Step 1: At the Design Stage

Our Lay-in Service saves consultants, on average, 16 hours per project. We work with consultants as an extension of their design team and provide them with a complete set of customized bid documents for noise and vibration control solutions (specifications, schedules, and sectional drawings).

Step 2: Order and Submittal Coordination

Between our Project Managers and Design staff, Vibro-Acoustics will provide:

- Order coordination
- Kick-off meetings (if required)
- Submittal and product scheduling
- Seismic & wind overturn calculations
- Mark-up of piping and ductwork for cable/rigid restraint locations
- Structural analysis and design of custom restraint solutions such as pipe stands, duct stands, racks, and supports
- On-site training for installation teams and cost savings
- Vibration isolation selection
- Vibration analysis
- Custom product design
- Riser isolation
- Thermal expansion calculations
- PE/P.Eng. professional engineering stamps

Step 3: On-Site Coordination

Our numerous field service staff will work with contractors to provide labor saving solutions and training, coordinate between multiple trades, help installers improvise and adapt to field conditions, and provide sign-off letters that are required for occupancy permits.

Vibro-Acoustics is able to provide stamped calculations for seismic and wind restraint selections in all 50 U.S. states and all 10 provinces plus 3 territories of Canada.