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

Vibration problems are usually caused by the moving and rotating mechanical elements that lie inside HVAC equipment. The source vibration, if not properly isolated, can transfer to the structure and connected elements found inside HVAC equipment, piping or ductwork. Sometimes, occupants can sense the vibrational effect as something that’s felt, but inaudible. In many cases, however, the vibration can propagate and radiate as a low frequency humming sound—this is known as structure-borne noise.

Without a careful, methodical approach to the proper selection and application of vibration isolators, problems can arise with significant consequences, including additional costs, extra work, lost time, and damage to professional reputations. Vibration and structure-borne noise problems go hand-in-hand and are common issues that engineers have to deal with in HVAC.

Restraint Requirements

A Are wind load calculations required?  
B Is the equipment adequately attached?  
C Are restraints required for ductwork?  
D Is there thermal expansion?  
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 inflict 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 acceptably high degree of risk and liability may be borne by both.

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.

Our goal is to save you labor.

For vibration isolation and restraint systems, what cost should contractors carry for materials and labor? How can contractors avoid scope and labor creep? These are difficult questions to answer when systems aren’t scheduled, locations aren’t determined, and specifications are vague. It’s up to the contractor to figure it all out.

The cost of labor is estimated to be 10 times the cost of materials and labor. Unfortunately, this labor is also at risk of ballooning over the project timeline. Reducing labor directly impacts the project margin.

At Vibro-Acoustics we have one focus when it comes to vibration isolation and restraint systems—to deliver labor savings to installing contractors. This is our mantra. We have worked extensively on multiple labor-saving programs across all customer facing departments. Our Labor-Savings Timeline (right) illustrates some of the ways we save our customers labor when we partner together on projects.

Labor-Savings Timeline

1 Scope Discussion  
2 Kick Off Meeting  
3 Classroom Training  
4 Project Management  
5 Custom Engineering  
6 Product Installation  
7 Site Visits & Sign Off

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

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<tr>
<th>Isolation products</th>
<th>NH / SH</th>
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<td>Restraint products</td>
<td>BB / BBR / VAC / RRK</td>
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**NH 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.

**RRK Rigid Restraints**

Vibro-Acoustics’ family of spring hangers are available in a variety of rubber configurations and configurations of rubber and springs.

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

**VAC Rod Stiffener Clamp**

To keep hanger rods from bending and buckling due to seismic activity, additional steel angles are clamped to them using Vibro-Acoustics easy-to-install VAC rod stiffener clamps.

**BB BulletBrace™ Adjustable Cable Restraint System**

Utilizing the uniquely designed BulletLock™ (patent pending) securing mechanism, the BulletBrace™ is the fastest adjustable cable restraint system in the market.

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.

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**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.

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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.

**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.

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Vibro-Acoustics’ BulletBrace™ cable restraint system is the fastest adjustable cable restraint system on the market. Thanks to the uniquely designed BulletLock™ (patent pending) cable securing mechanism, our pre-assembled BulletBrace kits can be secured quickly and easily.

Adjustable vs. Non-Adjustable
Unlike non-adjustable cable restraints, adjustable cable restraints allow the installer to correct minor cable tension problems without having to replace or splice installed cable restraints. This saves needless installation time and cost.

Vibro-Acoustics’ SCSR-H Seismic Restraint Spring Isolators
Designed to withstand more than 1g of lateral seismic force, the SCSR-H is available in multiple load ratings with one standard height for installation. The hot-dip galvanized finish provides protection for outdoor applications.

Hot-Dip Galvanized SCSR (for attachment to concrete structure)
Powder-Coated SCSR (for attachment to steel structure)

Just Slide and Secure
With BulletBrace™, the cable length can be adjusted quickly after installation to remove excess sag of the cable. For the contractor, the adjustability eliminates the need for reinstalling the cable, and the time saved reduces the installer’s labor.

Vibro-Acoustics’ SFS-1A and -2A isolators use springs that are precompressed to 2/3 capacity. This reduces labor required to adjust the springs since they are preloaded.
More Non-Suspended Systems

Indoor Chillers

To avoid excessive stress on piping connections during chiller maintenance, restrained isolators should be selected. Factors such as exposure to a seismic/wind 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
Base products: CIB / IFB

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 pad 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: SFS / SCSR
Base products: SB / CIB / IFB

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 restrainers.

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

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 lowered architectural screens. The guaranteed acoustical package corrects excess 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 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.
Non-Suspended Systems & Other Products

More Non-Suspended Systems

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 restraints for suspended vertical inline pumps.

Roof Piping and Duct
Site scheduling is critical when coordinating installation of roof piping with pipe stands. The building code requires the 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 pre-designed for over 1g of lateral seismic force and are available in both fixed and adjustable-height models.

SPS/SPSA: Seismic Pipe Stands
Vibro-Acoustics' SPS/SPSA pipe stands are pre-designed for over 1g of lateral seismic force and are available in both fixed and adjustable-height models.

This patented design saves contractors more than 40% compared to field-fabricated solutions. The pre-engineered solution provides capacity of more than 1g of lateral seismic force and includes pre-drilled holes for ANSI 125# flanges.

SPS: Seismic Inline Pump Stands
Vibro-Acoustics' SPS seismic inline pump stands are pre-designed for over 1g of lateral seismic force and are available in both fixed and adjustable-height models.

This patented design saves installing contractors more than 40% compared to field-fabricated solutions. The pre-engineered solution provides capacity of more than 1g of lateral seismic force and includes pre-drilled holes for ANSI 125# flanges.

SRB: Seismic Restraint Bracket
Vibro-Acoustics' series of pre-engineered seismic brackets provide a bracing solution for tanks, AHUs, and other HVAC equipment.

N/NSN: Neoprene Pads
This isolation pad with integral load distribution plate provides high-frequency vibration isolation and is designed to fit the system.

Fit-the-System Solutions
Not enough room to install a standard product? Does the standard product not solve the problem? Has the site conditions changed last minute? Need to save labor on installations? If you encounter any of these situations, you can contact Vibro-Acoustics for fit-the-system solutions.

VCR: Noise Control Curb
Rooftop units, primary sources of vibration problems, are often subjects of non-compliance with background sound criteria. To avert a vibration or structure-born noise problem, engineers should specify Vibro-Acoustics' noise control curb, which provides external vibration 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/Eng.

VCR: Noise Control Curb
Vibro-Acoustics offers a fully integrated noise and vibration control curb, engineered for the specific project requirements and criteria. To learn more, visit our website to view the brochure on this solution.

Other available curb types: Standard Curbs (RC) and Isolated Rails (RTR)

Fit-the-System Solutions
Height-saving bracket for chiller isolation
Support for exhaust muffler to accommodate thermal contraction and expansion

Rooftop Units & Curb Mounted Fans
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Floating Riser Solutions

Vibro-Acoustics’ floating riser solutions are designed to address thermal growth and vibration issues for vertical piping systems in a building.

Pipe risers undergo changes in temperature as chilled or heated water enters the pipe. As the temperature changes, the pipe expands or contracts. If the piping system is anchored to the structure, the thermal growth or shrinkage will apply stress on the pipe riser support points, potentially damaging the building structure and pipe. It is also important to isolate the pipe from the building structure in order to eliminate unwanted noise and vibration paths. If required, seismic considerations need to be taken into account to ensure the piping system can withstand a seismic event.

Vibro-Acoustics is an expert in designing thermal and seismic solutions for vertical piping systems. Our spring riser supports provide complete noise and vibration control and are designed to allow controlled expansion and contraction of pipe risers. Floating riser solutions fully isolate the piping system from the structure with the use of spring isolators, eliminating high pipe anchor loads at the floor supports. Vibro-Acoustics will also specify the final load at the structure during the submittal phase for each floor mount. For seismic applications, we will consider lateral seismic loads in the design of the floating riser system to achieve optimal performance.

Seismic Inline Pump Stands

Save up to 40% cost over field-fabricated solutions with Vibro-Acoustics’ SIPS. Seismic Inline Pump Stands, which offer a more convenient solution to support and restrain vertical inline pumps.

SIPS: Seismic Inline Pump Stands

Vertical inline (VIL) pumps are increasingly popular with design engineers and contractors, as they tend to take up less space in mechanical rooms. Since these pumps are typically located close to the floor, floor-mounted seismically-restrained supports are ideal when a seismic restraint solution is required.

Vibration Isolation Pads

Neoprene pads with steel distribution plates are available as an option for vibration isolation.

Bolt Holes

Cutouts are sized to accommodate standard class 150 flanges.

Low-Profile SIPS Seismic Inline Pump Stands

Seismic Inline Pump Stands with two SCSR seismically-restrained spring isolators

SIPS Seismic Inline Pump Stands with neoprene pads

Powder-Coated

Pump stands are powder-coated enamel for corrosion protection

Free Spring Isolator with Top Plate

Restrained Spring Isolator

Spring Hanger
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.

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.