Kinetics Noise Control is experienced in providing the healthcare industry with innovative solutions to noise, vibration and seismic issues. These solutions are a product of quality engineering and manufacturing at Kinetics since 1958.

Dublin Methodist Hospital
Dublin, Ohio

Seismic Restraint and Vibration Isolation Solutions for Healthcare Construction

- Piping and Ductwork
- HVAC and Electrical Equipment
- Fire Protection

KINETICS
Noise Control

Why Is Seismic Restraint Needed?

For hospitals and healthcare facilities, the damaging effects of earthquakes are of significant concern throughout North America and in many areas of the world. In the U. S., the International Building Code mandates the use of seismic restraint for hospital and healthcare facilities even in areas with relatively low seismic activity. Earthquake damage to inadequately restrained piping, mechanical and electrical systems within and on buildings can be extensive even when there is no structural damage to the actual building. Piping, mechanical and electrical equipment knocked off of its supporting structure due to earthquake-related building movement can threaten life, property and the ability of a hospital to operate. The cost of properly restraining your equipment is insignificant when compared to the costs associated with repair, replacement and system downtime as a result of seismic damage.

This brochure presents Kinetics' approach to designing and applying seismic restraint systems. These systems serve to limit the movement of equipment and to keep the equipment captive during a seismic event.

A thorough analysis of seismic restraint hardware and seismically rated vibration isolators requires the consideration of four (4) aspects of the system:

1) **Attachment of the Equipment to the Restraint:**
   The equipment must be securely attached to the Kinetics restraint system. This attachment must demonstrate sufficient strength to withstand the imposed seismic forces.

2) **Restraint Design:**
   The strength of Kinetics' seismic restraint systems are designed to withstand the equipment imposed seismic forces.

3) **Attachment of Restraint to the Building Structure:**
   This attachment is typically via bolts, welds, or concrete anchors. In addition, the building attachment interface must be reviewed by the structural engineer of record to ensure that it is capable of withstanding the imposed seismic forces. Typically, this attachment is the 'weakest link' of the overall design, especially when post installed concrete anchors are used.

4) **Equipment Fragility:**
   The ability of the equipment to continue to operate after being subjected to seismic force. Fragility information must be obtained from the equipment manufacturer and is not covered in this brochure.

The photos on this page are examples of properly restrained HVAC equipment surviving the 1994 Northridge earthquake unscathed. The photo above is of a rooftop unit installed directly next to a collapsed parking garage in Northridge. On the left is a rooftop installation across from the I-10 collapse.

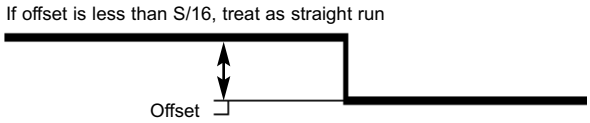
Seismic Restraint of Suspended Equipment, Piping and Ductwork

In hospitals and healthcare facilities, the International Building Code, IBC, requires some pipe and duct systems to remain in operation for life-safety purposes following an earthquake. These systems are assigned a Component Importance Factor of 1.5. Life-safety systems typically include but are not limited to fire sprinkler and fire suppression systems, smoke removal and fresh air ventilation systems, infectious disease control systems, medical gas lines, ventilation and humidity control for surgical suites and clean rooms. Pipe and duct systems not considered life-safety whose failure could cause failure of life-safety systems operating near by also needs to be restrained.

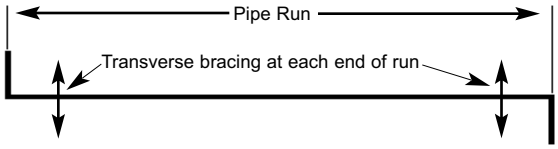
The most frequent occurrence of these failures has been in systems that were not restrained to the standards set forth in the building codes or the guidelines issued by SMACNA (Sheet Metal and Air Conditioning Contractors National Association).

The code bodies have revised their focus in these areas, ensuring that the current Code and Guideline information is followed. Broadly stated, in applications where significant motion can occur, the restraint requirements for piping and ductwork systems are to be adequately sized in both the lateral and axial directions. These restraints must be used with spacings short enough to prevent local failures in the pipe/duct runs between restraints. In the field, seismic restraint systems must attach and interface with numerous piping, ductwork, and electrical systems. It is difficult if not impossible to specify locations for these restraints prior to completion of the runs since the routes of these systems frequently changes over the course of construction. It is recommended that the seismic restraint be installed after the installation of the mechanical and electrical systems. The SMACNA Seismic Restraint Manual offers general guidance for field installation of these restraints. It includes tables with maximum spacing and restraint component sizes for various sizes of piping and ductwork in the various seismic zones. The SMACNA manual is easily understood and can be effectively used by installation contractors on systems already in place. The value listed as “S” in the drawings to the right comes from tabulated data from SMACNA and computation sheets provided by Kinetics Noise Control for case specific applications. *(continued on next page)*

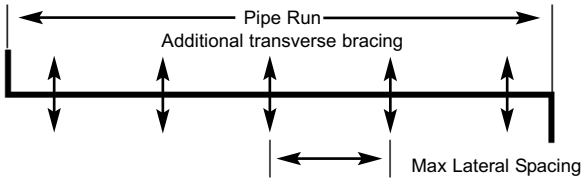
A) Definition of a pipe “run”



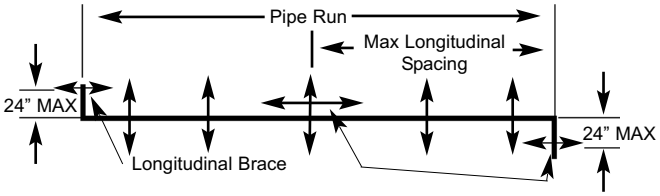
B) Minimum number of lateral restraints on a “run”



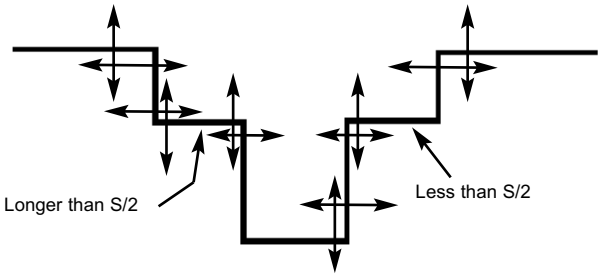
C) Additional lateral restraints



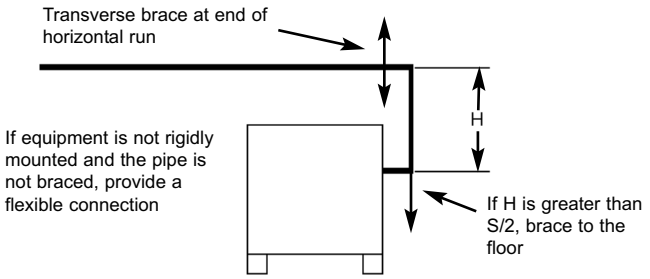
D) Minimum number of lateral restraints on a “run”



E) Restraining a series of short jogs



F) Restraints at termination points



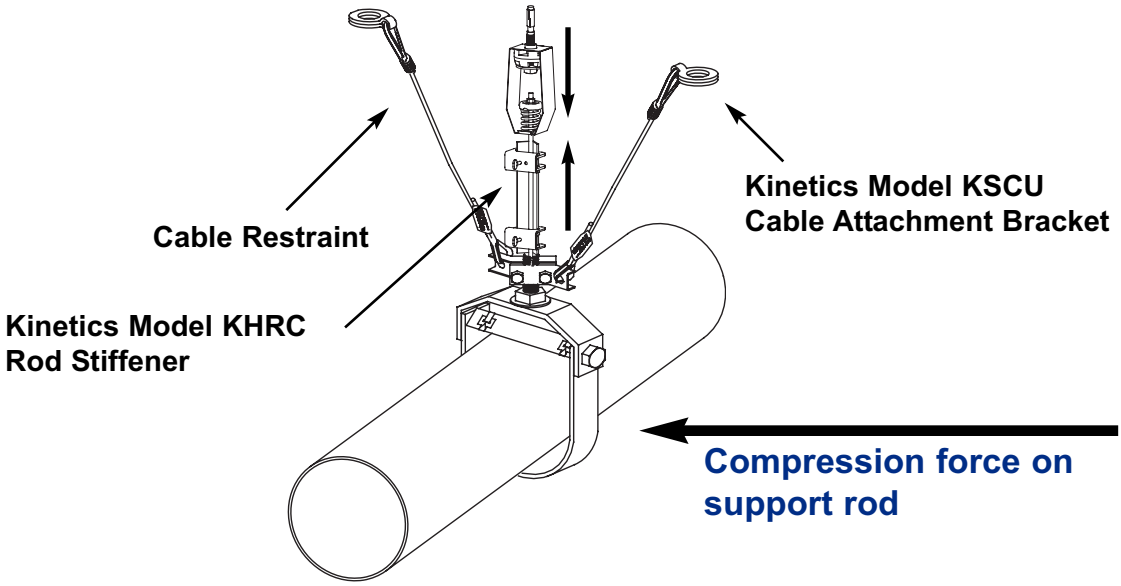
Seismic Restraint of Suspended Equipment, Piping and Ductwork

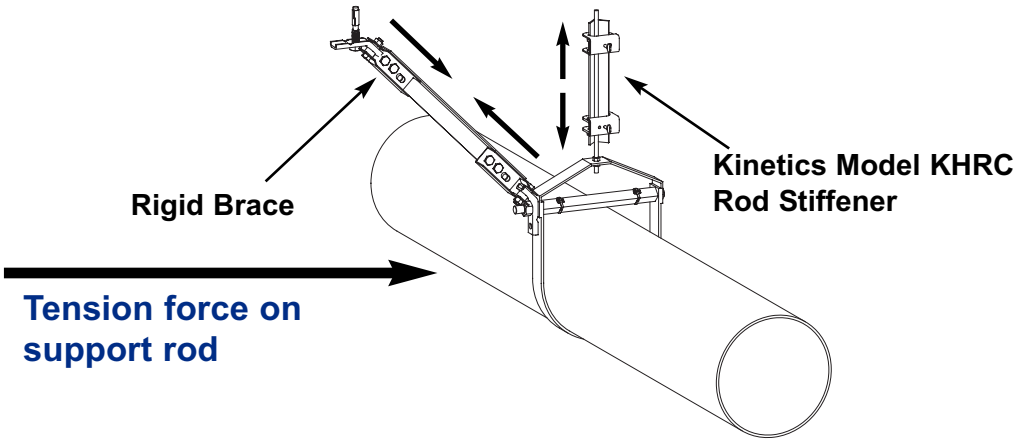
(Continued from previous page)

Typically piping/ductwork systems are restrained either with cable restraints or rigid braces that run upward at an angle from the pipe/duct to the ceiling. Because these links run at an angle, the application of a horizontal load generates a vertical load component on the hanger rod which supports the pipe or duct. This vertical component can frequently be as large as double the horizontal force. This vertical force needs to be taken into account when designing the anchorage.

When using cable restraint systems, the secondary vertical force component generated by the horizontal load is always directed upward, loading the support hanger rod in compression. With rigid braces, the vertical force component can be either in compression or tension, depending on the direction of the seismic load. To resist the compressive load, a stiffener is required on the hanger rod when the critical buckling length of the hanger rod is exceeded. This dimension is tabulated in the SMACNA guidelines for various piping configurations. Where a rigid brace is used, not only does the long hanger rod require a stiffener, the anchor itself must also be capable of taking a downward load comprised of both the weight load of the pipe and the downward force generated by the seismic event.

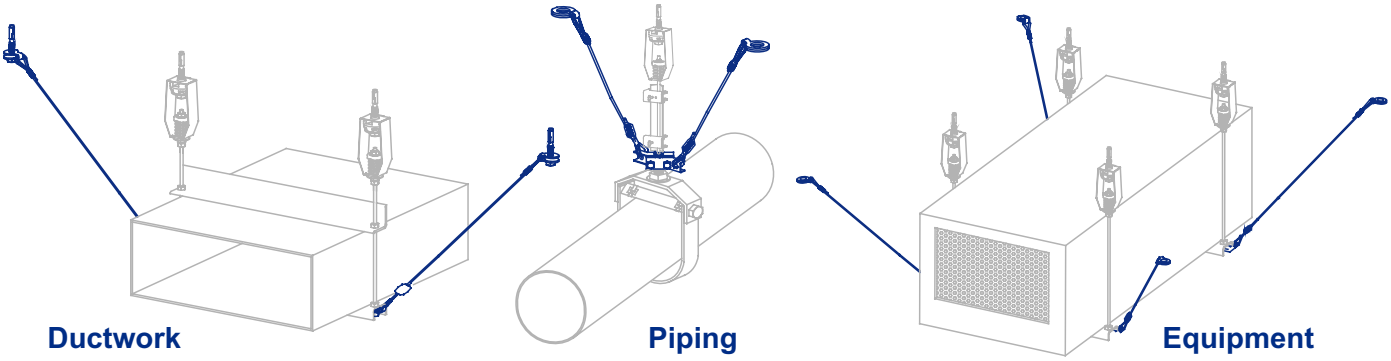
It has been found that piping or ductwork that is hung on rods such that the dimension from the top of the pipe/duct to the underside of the supporting surface is 12" or less will not be excessively excited by a seismic event. It has also been found that pipes under 2-1/2" in diameter are sufficiently small and ductile such that they will flex and not be damaged by an earthquake. The same holds true for ducts that are under 6 ft in cross-sectional area. Most of the codes exclude such systems from seismic restraint requirements.





Model KSCU Cable Restraint Kit

- All-in-one cable restraint kit designed to meet your application in the field
- Available in 15' lengths and up to 1/4" cable diameter
- Installation time is a fraction of what it takes to install conventional systems



Model KHRC Hanging Rod Stiffener Clamp

- Required to brace threaded rod when rod is used to suspend piping, ductwork, and/or hanging equipment in a seismic zone.
- Designed to easily and securely attach steel stiffening bracing angles to the threaded rod, using common hand tools.
- Unique design allows the installation of the angle bracing without disassembling the hanging rod.
- Reference seismic building codes to determine the size and thickness of the bracing angle and quantity of attachment clamps required.

Model FHS
Seismic Control Spring Isolator

- Combination coil spring isolator and seismic restraint for indoor and outdoor floor mounted fans, pumps, air compressors and other mechanical equipment.
- All-directional restraint with vertical limit stops
- Field interchangeable spring coils
- Galvanized housing and epoxy powder coated coils
- Constant free height and operating height
- Equipment motion limited to 0.2" in all directions, at the isolator
- Provides seismic and wind restraint required by current building codes*
- Available static deflection from 1" to 4"

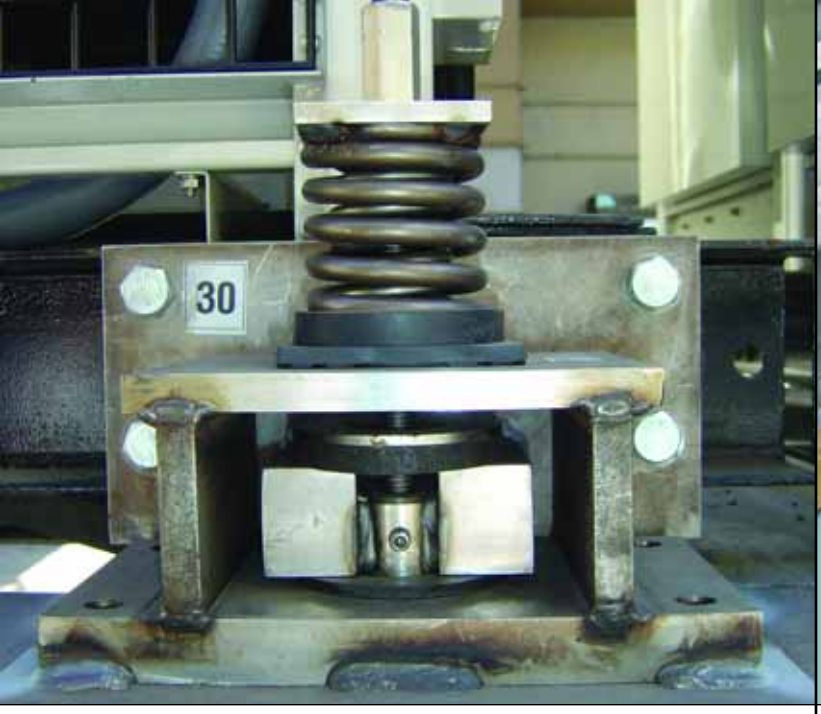
Model FLSS
Restrained Spring Isolator

- Combination coil spring isolator and seismic restraint for indoor and outdoor floor mounted cooling towers, chillers and boilers.
- All-directional restraint with vertical limit stops
- Field interchangeable spring coils
- Galvanized housing and epoxy powder coated coils
- Constant free height and operating height
- Equipment motion limited to 0.2" in all directions, at the isolator
- Provides seismic and wind restraint required by current building codes*
- Available static deflection from 1" to 4"

*Equipment geometry, attachment and anchorage may affect restraint capacity.

Model HS Series
Seismic Snubbers

- Single and double axis horizontal and vertical seismic restraint models available
- Standard capacities of up to 6,500 pounds force
- Restraint capacities to meet all building code requirements
- May be bolted or welded in place
- Replaceable neoprene elements
- Easily inspected for short circuits



Model FMS
Modular Restraint/Isolator

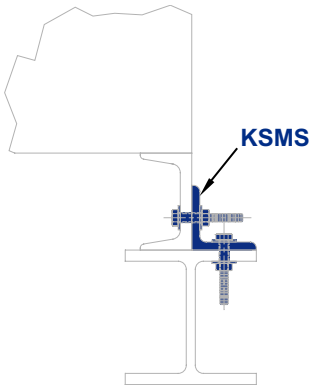
- The unique design of the Patented Kinetics FMS restraint module minimizes the seismic loads transmitted into the anchors or other attachment hardware. As a result, considerably higher seismic ratings are possible versus conventional designs using similar sized connection hardware.
- Restraint capacities to meet all building code requirements for seismic and wind loads*
- Optional isolation with deflection from 1" to 4"
- Horizontal force capacity ratings ranging to 70,000 lbs
- Easy to install, adjust and inspect

Model ESR
Vibration Isolation Curb

- Structural steel isolated curb with wood nailer
- Provides seismic and wind restraint required by current building codes*
- Access ports for each coil spring isolator
- Available static deflection from 1" to 4"
- Options: Sloped Roof
  Acoustical Insulation
  External Thermal Insulation

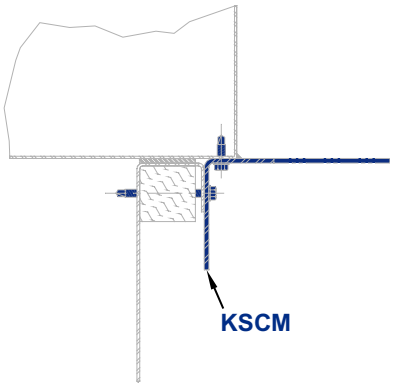
*Equipment geometry, attachment and anchorage may affect restraint capacity.

Model KSMS and KSCM
Seismic Restraint Brackets for floor and curb mounted equipment



Model KSMS (detail left) seismic and wind restraint brackets are used to solid-mount equipment to the building structure. It can be bolted or welded to the equipment, and is attached to the structure by anchoring to concrete or bolting to steel.

Model KSCM (detail right) seismic and wind restraint brackets are used to solid-mount equipment to a roof curb. It can be bolted to the equipment and the roof curb. Attachment of the curb to the structure is the responsibility of others.



Seismic Engineering Capabilities

Kinetics offers extensive practical experience in both design and application. The experienced staff of over twenty (20) technically trained individuals includes ten (10) licensed Professional Engineers, five (5) holding Master's degrees and three (3) who have earned Ph.D.'s spread across Engineering and Manufacturing centers located in Columbus, Ohio (USA) and Toronto, Ontario (Canada); the combined technical experience exceeds 400 years with over 250 years directly related to sound, vibration control, and seismic issues. In addition, Kinetics employees hold PE licenses in 30 States or Canadian Provinces.

St. Anthony's Medical Center
St. Louis, Missouri

Healthcare Facility Projects

- Arkansas State Hospital, Little Rock, AK
- Tucson Medical Center, Tucson, AZ
- Emory University Hospital, Atlanta, GA
- Good Samaritan Hospital, Downers Grove, IL
- Casey County Hospital, Liberty, KY
- St. John's Hospital Tower B, Springfield, MO
- St. Anthony's Medical Center, St. Louis, MO
- Washington University 4th Floor Lab, St. Louis, MO
- Delta Regional Medical Center, Greenville, MS
- Marcus Daly Hospital, Hamilton, MT
- VA Medical Center, Las Vegas, NV
- Cancer Research Center, University of New Mexico
- Columbia Orthopedics, New York, NY
- Dublin Methodist Hospital, Dublin, OH
- Marietta Hospital, Marietta, OH
- Middletown Regional Hospital, Middletown, OH
- Baptist Memorial Hospital, Memphis, TN
- Jackson Madison Tower, Jackson, TN
- Cardiac Care Center, St Croix, U.S. Virgin Islands

Visit us Online at www.kineticsnoise.com/healthcare/

Visit this site for detailed information about our seismic restraint products, and to download three-part specifications, installation guidelines and submittal drawings.

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KINETICS Noise Control

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