

# VIBRATION ISOLATION Product Selection Guide for HVAC Equipment



# Table of Contents

Vibration Isolation and Control .....	3
Engineering Services .....	4
<b>EQUIPMENT TYPES</b>	
Refrigeration Machines and Chillers .....	6
Air Compressors and Vacuum Pumps .....	7
Pumps .....	8
Axial, Plenum, Cabinet, and Centrifugal Inline Fans .....	9
Centrifugal Fans .....	10
Cooling Towers .....	11
Boilers .....	11
Propeller Fans .....	12
Ducted Rotating Equipment .....	12
Packaged AH, AC, H and V Units .....	13
Engine-Driven Generators .....	13
Heat Pumps, Fan Coils, Computer Room Units .....	14
Condensing Units .....	14
Packaged Rooftop Equipment .....	14
<b>PRODUCTS</b>	
The Fiberglass Advantage .....	15
ASHRAE TYPE 1: Fiberglass or Neoprene Pad .....	15
KIP Fiberglass Pad   NP / NG, RSP Neoprene Pads, KIP-RT Isolation Rails	
ASHRAE TYPE 2: Floor Isolator or Hanger .....	16
AC Fiberglass Mount   RD, RDS, RQ Neoprene Mounts	
FH Fiberglass Hanger   RH Neoprene Hanger	
ASHRAE TYPE 3: Spring Floor Isolator or Hanger .....	17
FDS Free-Standing Isolator	
SFH Fiberglass Hanger   SRH Neoprene Hanger   SH Hanger	
ASHRAE TYPE 4: Restrained Spring Isolator .....	18
TITAN   FHS/FHSL   FLS/FLSS   FMS   KCI   LDR	
ASHRAE TYPE 5: Thrust Restraints .....	19
HSR	
ASHRAE TYPE 6: Air Mounts .....	19
KAM   CAM	
BASE TYPE A: Direct Isolation .....	20
BASE TYPE B: Structural Rails .....	20
QUIETRAIL   CRFS   SBB   SFB   Pump Stands & Supports	20
BASE TYPE C: Concrete Inertia Base .....	21
CIB	
KINFLEX Flexible Connectors .....	21
BASE TYPE D: Curb-Mounted Base .....	22
KSR 2.0   Z-CLIP   KSCR   ESR	
In Curb Acoustical Treatments .....	23
ESSR Sound and Vibration Curb .....	23
Seismic Restraint .....	24
Riser Supports, Anchors, and Guides .....	25
Piping/Hanger Selection Data (U.S) .....	26
Piping/Hanger Selection Data (SI) .....	27
Isolation Notes for Specific Equipment .....	Back



## Vibration Isolation and Seismic Control Basics:

Mechanical vibration and vibration-induced noise are common sources of occupant complaints in modern buildings. Vibration is caused by reciprocating motion from rotating components within mechanical equipment. All reciprocating, or rotating, equipment should be isolated to reduce transmission of vibration into the structure. Kinetics Noise Control provides technical assistance in the selection and specification of tailor-made isolation systems and vibration isolation products that enable building owners to install complex heating, ventilation, and air-conditioning systems without the worry of vibration problems.

### If you have a Vibration Issue:

Isolator deflections shown in the following pages are based on the data published in the 2015 ASHRAE Handbook. Recommended isolator type, base type, and minimum static deflection are reasonable and safe recommendations for most HVAC equipment installations. Additional assistance from one of our many qualified representatives or acoustical consultants can also be very useful in resolving these problems.

### Engineering Expertise:

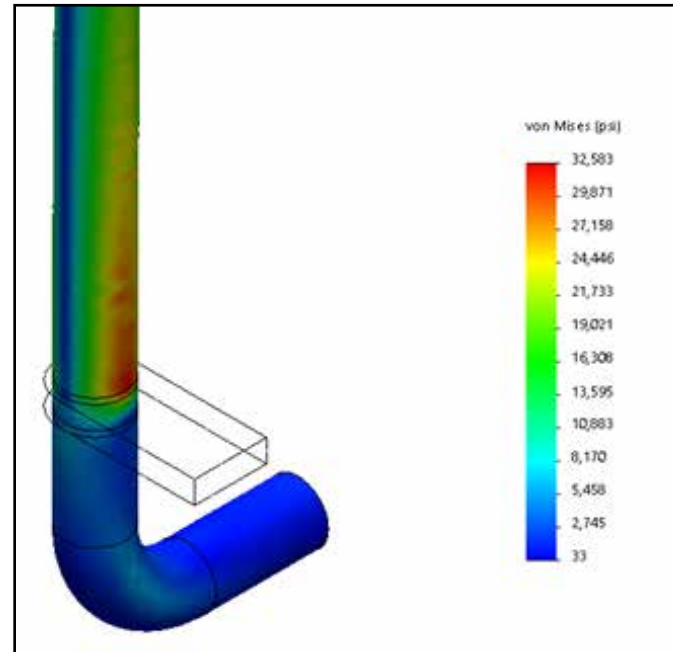
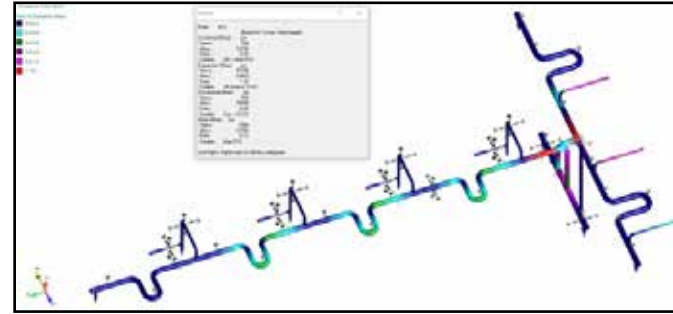
Building codes are constantly updated with stricter requirements for seismic, wind, and blast protection. Kinetics offers a complete line of restrained vibration isolators to satisfy current building code requirements as well as complete engineering support. Our highly skilled engineering staff focus on labor savings and constructability in line with current directions in mechanical construction. We offer streamlined and cost effective engineered solutions along with professional and stamps to meet any specification requirements in all 50 states. Kinetics' unsurpassed expertise will ensure success with highly complex hospital, government, and military projects as well as the unique challenges of design/build projects.



# Engineering Services

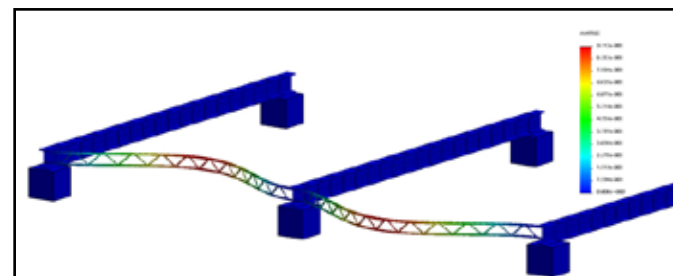
## Pipe Stress Analysis

- B31, ASCE Compliance and Certification
- Optimized Seismic Bracing Layouts
- Thermal Loop/Joint Design



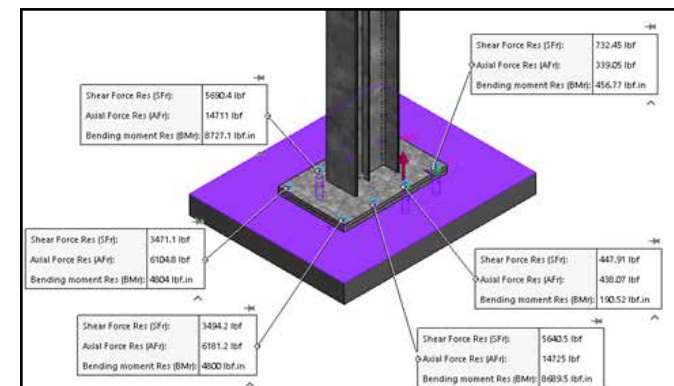
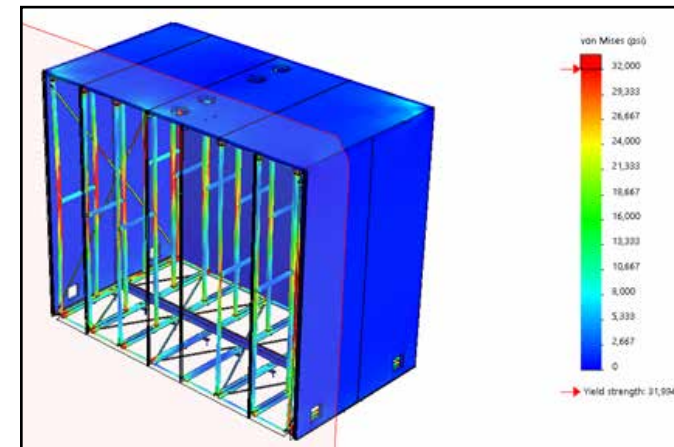
## Riser Support Design and Analysis

- B31, ASCE Compliance
- Optimized Restraint and Guide Layouts
- Design of Fully Anchored to Fully Floating Systems



## Vibration Analysis

- Fully Dynamic/Transient FEA Capability
- Vibration Isolation Efficiency for Complex Systems
- Provide Input for Structure Design



## Support Design

- 3D Modeling and Analysis
- Linear & Non-linear Capability
- Code Driven Design of Structural Support Systems and Components

## Static and Dynamic Seismic and Wind Analysis on equipment and their attachment details

- Input Response Spectrum
- Peak Stress Plot
- Peak Displacement Plot

## Structural Design Support

- Column Design
- Concrete Pad Design
- Foundation and Anchorage Design

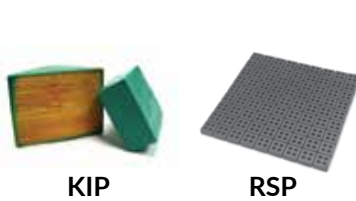


Equipment Type:

Refrigeration Machines and Chillers\*

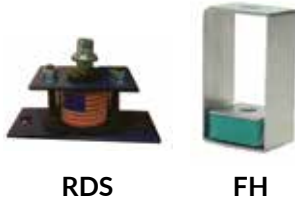
Equipment Location												
Equipment Category	Floor Span											
	Slab on Grade			Up to 20 ft (6 m)			20 to 30 ft (6 - 9 m)			30 to 40 ft (9-12 m)		
	Base Type	ASHRAE Type	Isolator Defl.	Base Type	ASHRAE Type	Isolator Defl.	Base Type	ASHRAE Type	Isolator Defl.	Base Type	ASHRAE Type	Isolator Defl.
Reciprocating	A	2	0.25" (6)	A	4	0.75" (19)	A	4	1.50" (38)	A	4	2.50" (64)
Centrifugal, scroll	A	1	0.25" (6)	A	4	0.75" (19)	A	4	1.50" (38)	A	4	1.50" (38)
Screw	A	1	1.00" (25)	A	4	1.50" (38)	A	4	2.50" (64)	A	4	2.50" (64)
Absorption	A	4	0.25" (6)	A	4	0.75" (19)	A	4	1.50" (38)	A	4	1.50" (38)
Air-cooled recip., scroll	A	1	0.25" (6)	A	4	1.50" (38)	A	4	1.50" (38)	A	4	2.50" (64)
Air-cooled screw	A	4	1.00" (25)	A	4	1.50" (38)	B	4	2.50" (64)	B	4	2.50" (64)

\*Data from 2019 ASHRAE Handbook. See back cover for additional notes on Refrigeration Machines.



ASHRAE TYPE 1:  
Fiberglass or Neoprene Pad  
See page 15 for more details

- KINETICS KIP Fiberglass Pad
- KINETICS NP Neoprene Pad
- KINETICS NG Neoprene Pad
- KINETICS RSP Neoprene Pad



ASHRAE TYPE 2:  
Floor Isolator or Hanger  
See page 16 for more details

- KINETICS AC Fiberglass Mount
- KINETICS RDS Neoprene Mount
- KINETICS RQ Neoprene Mount
- KINETICS FH Fiberglass Hanger
- KINETICS RH Neoprene Hanger



ASHRAE TYPE 4:  
Restrained Spring Isolator  
See page 18 for more details

- KINETICS TITAN
- KINETICS FMS
- KINETICS FLS
- KINETICS FLSS

BASE TYPE A:  
Direct Isolation  
No base, isolators attached directly to equipment.

BASE TYPE B:  
Structural Steel Rails or Base  
See page 20 for more details  
KINETICS SBB Structural Rail Base  
KINETICS SFB Structural Beam Base  
KINETICS QuietRail Cooling Tower Rail

Equipment Type:

Air Compressors and Vacuum Pumps\*

Equipment Location												
Equipment Category	Floor Span											
	Slab on Grade			Up to 20 ft (6 m)			20 to 30 ft (6 - 9 m)			30 to 40 ft (9-12 m)		
	Base Type	ASHRAE Type	Isolator Defl.	Base Type	ASHRAE Type	Isolator Defl.	Base Type	ASHRAE Type	Isolator Defl.	Base Type	ASHRAE Type	Isolator Defl.
Tank-mounted horizontal												
≤10 HP	A	3	0.75" (19)	A	3	0.75" (19)	A	3	1.50" (38)	A	3	1.50" (38)
≥10 HP	C	3	0.75" (19)	C	3	0.75" (19)	C	3	1.50" (38)	C	3	1.50" (38)
Tank-mounted vertical	C	3	0.75" (19)	C	3	0.75" (19)	C	3	1.50" (38)	C	3	1.50" (38)
Base-Mounted	C	3	0.75" (19)	C	3	0.75" (19)	C	3	1.50" (38)	C	3	1.50" (38)
Large Reciprocating	C	3	0.75" (19)	C	3	0.75" (19)	C	3	1.50" (38)	C	3	1.50" (38)

\*Data from 2019 ASHRAE Handbook. See back cover for additional notes on Compressors.

\*\*For seismic & wind applications, use ASHRAE TYPE 4



ASHRAE TYPE 3:  
Spring Floor Isolator or Hanger  
See page 17 for more details

- KINETICS FDS Free-Standing Isolator
- KINETICS SL Housed Isolator
- KINETICS SM Housed Isolator
- KINETICS SFH Fiberglass Hanger
- KINETICS SRH Neoprene Hanger
- KINETICS SH Hanger



ASHRAE TYPE 4:  
Restrained Spring Isolator  
See page 18 for more details

- KINETICS TITAN
- KINETICS FMS
- KINETICS FLS
- KINETICS FLSS
- KINETICS FHS

BASE TYPE A:  
Direct Isolation  
No base, isolators attached directly to equipment.

BASE TYPE C:  
Concrete Inertia Base  
See page 21 for more details  
KINETICS CIB





Equipment Type:

Pumps\*

Equipment Location												
Equipment Category	Floor Span											
	Slab on Grade			Up to 20 ft (6 m)			20 to 30 ft (6 - 9 m)			30 to 40 ft (9-12 m)		
	Base Type	ASHRAE Type	Isolator Defl.	Base Type	ASHRAE Type	Isolator Defl.	Base Type	ASHRAE Type	Isolator Defl.	Base Type	ASHRAE Type	Isolator Defl.
Close-Coupled												
≤7.5 HP	B	2	0.25" (6)	C	3	0.75" (19)	C	3	0.75" (19)	C	3	0.75" (19)
≥7.5 HP	C	3	0.75" (19)	C	3	0.75" (19)	C	3	1.50" (38)	C	3	1.50" (38)
Large Inline												
5 to 25 HP	A	3	0.75" (19)	A	3	1.50" (38)	A	3	1.50" (38)	A	3	1.50" (38)
≥25 HP	A	3	1.50" (38)	A	3	1.50" (38)	A	3	1.50" (38)	A	3	2.50" (64)
End Suction/Split Case												
≤40 HP	C	3	0.75" (19)	C	3	0.75" (19)	C	3	1.50" (38)	C	3	1.50" (38)
50 to 125 HP	C	3	0.75" (19)	C	3	0.75" (19)	C	3	1.50" (38)	C	3	2.50" (64)
≥150 HP	C	3	0.75" (19)	C	3	1.50" (38)	C	3	2.50" (64)	C	3	3.50" (89)
Packaged Pump Systems	A	3	0.75" (19)	A	3	0.75" (19)	A	3	1.50" (38)	C	3	2.50" (64)

\*Data from 2019 ASHRAE Handbook. See back cover for additional notes on **Pumps**.

\*\*For seismic & wind applications, use ASHRAE TYPE 4



RQ



FH

ASHRAE TYPE 2:  
Floor Isolator or Hanger  
See page 16 for more details

- KINETICS AC Fiberglass Mount
- KINETICS RD Neoprene Mount
- KINETICS RQ Neoprene Mount
- KINETICS FH Fiberglass Hanger
- KINETICS RH Neoprene Hanger



FDS



SFH

ASHRAE TYPE 3:  
Spring Floor Isolator or Hanger  
See page 17 for more details

- KINETICS FDS Free-Standing Isolator
- KINETICS SL & SM Housed Isolator
- KINETICS SFH Fiberglass Hanger
- KINETICS SRH Neoprene Hanger
- KINETICS SH Hanger



KSIP



PS

NEW BASE TYPE B OPTIONS  
Inline Pump Support/Stand  
See page 20 for more details

- KINETICS PS Inline Pump Stands
- KINETICS KSIP Suspended Inline Pump Support

BASE TYPE A:  
Direct Isolation

No base, isolators attached directly to equipment.

BASE TYPE B:  
Structural Steel Rails or Base  
See page 20 for more details

- KINETICS SBB Structural Rail Base
- KINETICS SFB Structural Beam Base
- KINETICS Inline Pump Stands
- KINETICS Suspended Inline Pump Support

BASE TYPE C:  
Concrete Inertia Base  
See page 21 for more details

- KINETICS CIB



Equipment Type:

Axial, Plenum, Cabinet, and Centrifugal Inline Fans\*

Equipment Location													
Equipment Category	Floor Span												
	Slab on Grade			Up to 20 ft (6 m)			20 to 30 ft (6 - 9 m)			30 to 40 ft (9-12 m)			
	Base Type	ASHRAE Type	Isolator Defl.	Base Type	ASHRAE Type	Isolator Defl.	Base Type	ASHRAE Type	Isolator Defl.	Base Type	ASHRAE Type	Isolator Defl.	
Up to 22 in. diameter	A	2	0.25" (6)	A	3	0.75" (19)	A	3	0.75" (19)	C	3	0.75" (19)	
24 in. diameter and up													
≤2.0 in. SP													
RPM	Up to 300	B	3	2.50" (64)	C	3	3.50" (89)	C	3	3.50" (89)	C	3	3.50" (89)
	301 to 500	B	3	0.75" (19)	B	3	1.50" (38)	C	3	2.50" (64)	C	3	2.50" (64)
	500 and up	B	3	0.75" (19)	B	3	1.50" (38)	B	3	1.50" (38)	B	3	1.50" (38)
≥2.1 in. SP													
RPM	Up to 300	C	3	2.50" (64)	C	3	3.50" (89)	C	3	3.50" (89)	C	3	3.50" (89)
	301 to 500	C	3	1.50" (38)	C	3	1.50" (38)	C	3	2.50" (64)	C	3	2.50" (64)
	500 and up	C	3	0.75" (19)	C	3	1.50" (38)	C	3	1.50" (38)	C	3	2.50" (64)

\*Data from 2019 ASHRAE Handbook.

\*\*For seismic & wind applications, use ASHRAE TYPE 4



RDS



FH

ASHRAE TYPE 2:  
Floor Isolator or Hanger  
See page 16 for more details

- KINETICS AC Fiberglass Mount
- KINETICS RD Neoprene Mount
- KINETICS RDS Neoprene Mount
- KINETICS RQ Neoprene Mount
- KINETICS FH Fiberglass Hanger
- KINETICS RH Neoprene Hanger

BASE TYPE A:  
Direct Isolation

No base, isolators attached directly to equipment.



FDS



SFH

ASHRAE TYPE 3:  
Spring Floor Isolator or Hanger  
See page 17 for more details

- KINETICS FDS Free-Standing Isolator
- KINETICS SL Housed Isolator
- KINETICS SM Housed Isolator
- KINETICS SFH Fiberglass Hanger
- KINETICS SRH Neoprene Hanger
- KINETICS SH Hanger

BASE TYPE B:  
Structural Steel Rails or Base  
See page 20 for more details

- KINETICS SBB Structural Rail Base
- KINETICS SFB Structural Beam Base



HSR

ASHRAE TYPE 4/TYPE 5:  
Restrained Spring Isolator  
See pages 18-19 for more details

- KINETICS TITAN
- KINETICS FMS
- KINETICS FLSS
- KINETICS FHS
- KINETICS HSR (TYPE 5)

BASE TYPE C:  
Concrete Inertia Base  
See page 21 for more details

- KINETICS CIB







## Propeller Fans and Ducted Rotating Equipment\*

\*Data from 2019 ASHRAE Handbook.



**KINETICS** TITAN  
**KINETICS** FMS  
**KINETICS** FLS  
**KINETICS** FLSS  
**KINETICS** FHS  
**KINETICS** HSR (TYPE 5)

## Packaged AH, AC, H and V Units; Engine-Driven Generators\*

\*Data from 2019 ASHRAE Handbook. See Back for additional notes on ***Air-Handling Equipment***.  
 \*\*For seismic & wind applications, use ASHRAE TYPE 4  
 \*\*\*For rooftop mounted equipment use BASE TYPE D

**KINETICS** QuietRail

13





Equipment Type:

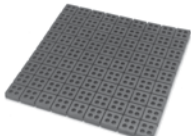
Heat Pumps, Fan-Coils, Computer Room Units;  
Condensing Units; Packaged Rooftop Equipment\*

Equipment Type	Equipment Location											
	Floor Span											
	Slab on Grade			Up to 20 ft (6 m)			20 to 30 ft (6 - 9 m)			30 to 40 ft (9-12 m)		
	Base Type	ASHRAE Type	Isolator Defl.	Base Type	ASHRAE Type	Isolator Defl.	Base Type	ASHRAE Type	Isolator Defl.	Base Type	ASHRAE Type	Isolator Defl.
Heat Pumps, Fan-Coils, Computer Room Units	A	3	0.75" (19)	A	3	0.75" (19)	A	3	0.75" (19)	A/D	3	1.50" (38)
Condensing Units	A	1	0.25" (6)	A	4	0.75" (19)	A	4	1.50" (38)	A/D	4	1.50" (38)
Packaged Rooftop Equipment	A/D	1	0.25" (6)	D	3	0.75" (19)	N/A	N/A	N/A	N/A	N/A	N/A

\*Data from 2019 ASHRAE Handbook. See back for additional notes on *Packaged Rooftop Equipment*.



KIP-RT



RSP



FDS



SFH



KCI



LDR

ASHRAE TYPE 1:  
Fiberglass or Neoprene Pad  
See page 15 for more details

- KINETICS KIP-RT Rooftop Equipment Pads
- KINETICS KIP Fiberglass Pad
- KINETICS NP Neoprene Pad
- KINETICS NG Neoprene Pad
- KINETICS RSP Neoprene Pad

ASHRAE TYPE 3:  
Spring Floor Isolator or Hanger  
See page 17 for more details

- KINETICS FDS Free-Standing Isolator
- KINETICS SL Housed Isolator
- KINETICS SM Housed Isolator
- KINETICS SFH Fiberglass Hanger
- KINETICS SRH Neoprene Hanger
- KINETICS SH Hanger

ASHRAE TYPE 4:  
Restrained Spring Isolator  
See page 18 for more details

- KINETICS LDR
- KINETICS KCI (NEW! 2021)
- KINETICS FHSL

BASE TYPE A:  
Direct Isolation

No base, isolators attached directly to equipment.

BASE TYPE B:  
Structural Steel Rails or Base  
See page 20 for more details

- KINETICS CRFS Computer Room Floor Stand

BASE TYPE D:  
Curb-Mounted Base  
See page 22 for more details

- KINETICS KSR Isolation Rail
- KINETICS KSCR Isolation Curb
- KINETICS ESR Isolation Curb

The Fiberglass Advantage

Kinetics Noise Control manufactures both fiberglass and neoprene isolators. Fiberglass isolators offer the following advantages:

- Varying densities and sizes to suit a variety of load requirements
- Constant pad performance, unaffected by age or high temperatures
- UV resistant for outdoor use constant location performance through seasonal temperature changes
- Ask local rep for fiberglass advantage demonstration



Vibration Isolation Demo

ASHRAE TYPE 1: Fiberglass and Neoprene Pads



KINETICS KIP-RT  
Rooftop Equipment Pads

Description: KIP-RT fiberglass pads are used to control vibration that is being transmitted from rooftop equipment. KIP-RT is 1.75" wide x 48" long and is installed between roof-mounted equipment and the supporting curb.

Application: Packaged Rooftop Equipment

Dimensions: 1.75" wide x 0.5" thick x 48" long

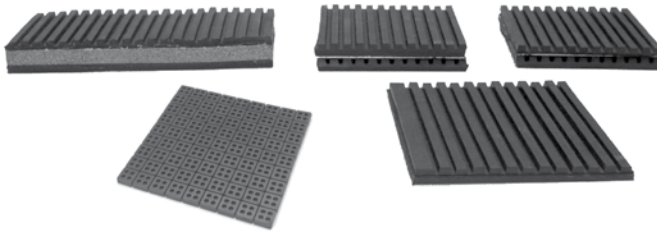


KINETICS KIP  
Fiberglass Isolation Pad

Description: A high-density matrix of compressed molded fiberglass; individually coated with a flexible, moisture-impervious elastomeric membrane, designed to allow controlled air movement in the fiber media.

Application: Recommended as support mounts for high speed fans, pumps, and chillers, on grade, having operating speeds of 1750 RPM and higher.

Capacity: Provide load-bearing capacities from 5 to 500 PSI (0.35 to 35 kg per sq. cm) of pad surface area.



KINETICS NP / NG, RSP  
Neoprene Isolation Pads

Description: Single-ribbed or crossed, double-ribbed elastomer-in-shear pads, in combination with steel shims when required, having minimum static deflections as tabulated.

Application: Isolate noise, shock, and high frequency vibration, generated by mechanical equipment and industrial machinery located on a grade-supported structural slab.

Capacity:  
NP/NG: Designed to permit 60 or 120 PSI (4.2 or 8.4 kg/cm<sup>2</sup>) loading at maximum rated deflections.

RSP: Designed to permit 60 psi (4.2 kg/cm<sup>2</sup>) loading at a maximum rated deflection of 0.15" (4 mm)

Dimensions:  
NP/NG pads are available in 4", 6", or 9" (102, 152, 228 mm) squares with capacities from 400 to 9,700 lbs. (181 to 4400 kg), or in full 18" (457 mm) square sheets which can be cut or drilled to meet field requirements.

RSP: 18" x 18" x 3/4" (457 mm x 457 mm x 19 mm) thick sheets, scored into 2" x 2" x 3/4" (51 mm x 51 mm x 19 mm) thick pads

Deflection: NP Pads 0.04" to 0.09" (1 mm to 2 mm)  
NG Pads 0.13" to 0.19" (3 mm to 5 mm)



# ASHRAE TYPE 2: Floor Isolator or Hanger

## KINETICS AC Fiberglass Isolation Mount

**Description:** A molded inorganic fiberglass isolation pad bonded to a steel load transfer plate, and to a formed steel bolt-down bracket. AC mount includes an equipment anchor bolt with a neoprene grommet to prevent metal-to-metal contact.

**Application:** Recommended for the isolation of vibration produced by utility ventilating fans, vane axial fans, high speed motors, roof-mounted exhaust fans, and similar mechanical equipment.

**Capacity:** 40 to 900 lbs. (18 kg to 409 kg)

**Deflection:** 0.18 in. to 0.70 in. (4 mm to 18 mm)



## KINETICS RD, RDS and RQ Neoprene Isolation Mounts

**Description:** One-piece molded neoprene mounts with encapsulated metal inserts. Available in a housed seismic version.

**Application:** Recommended for the isolation of vibration produced by small pumps, vent sets, and low pressure packaged air-handling units.

**Capacity:** 55 lbs. to 4,000 lbs. (25 kg to 1814 kg)

**Deflection:** RD up to 0.5" (13 mm)  
RQ up to 0.13" (3 mm)



## KINETICS FH Fiberglass Isolation Hanger

**Description:** A coded, molded, inorganic fiberglass isolation pad attached to a steel load transfer plate and to a stamped or welded hanger bracket.

**Application:** Recommended for the isolation of vibration produced by suspended mechanical or electrical equipment, in-line and exhaust fans, ductwork, or piping.

**Capacity:** 250 lbs. to 900 lbs. (18 kg to 409 kg)

**Deflection:** 0.18" to 0.27" (4 mm to 7 mm)



## KINETICS RH Neoprene Isolation Hanger

**Description:** A coded elastomer in-shear insert with a load plate, assembled into a stamped or welded hanger bracket.

**Application:** Recommended for the isolation of vibration produced by suspended mechanical or electrical equipment, in-line and exhaust fans, ductwork, or piping.

**Capacity:** up to 2,000 lbs (907 kg)

**Deflection:** 0.20" to 0.57" (5mm to 15 mm)



# ASHRAE TYPE 3: Spring Floor Isolator or Hanger

## KINETICS FDS Free-Standing Spring Isolator

**Description:** A high deflection, free-standing, unboxed, large diameter, laterally stable steel springs assembled into an upper load plate and leveling assembly.

**Application:** Recommended for control of both high and low frequency vibration produced by reciprocating air or refrigeration compressors, pumps, packaged air-handling and air-conditioning equipment, centrifugal and axial fans, and internal combustion engines.

**Capacity:** 35 lbs. to 23,200 lbs. (16 kg to 10,523 kg)

**Deflection:** 1" to 4" (25 mm to 102 mm)



## KINETICS SFH, SRH, SH Spring Isolation Hangers

**Description:** Free-standing, laterally stable steel spring, in series with a pre-compressed molded fiberglass insert (SFH), elastomer-in-shear insert (SRH), or elastomeric washer (SH) complete with a load plate (SFH/SRH only) and assembled in a stamped or welded steel bracket.

Hangers will allow support rod misalignment through a 30° arc without short-circuiting. Isolation brackets will carry a 500% overload without failure.

**Application:** Recommended for the isolation of vibration produced by suspended mechanical equipment, in-line fans, exhaust fans, cabinet fans, pumps, ductwork, and piping.

**Capacity:** 35 lbs. to 3,850 lbs. (16 kg to 1,747 kg)

**Deflection:** 1" to 2.40" (25 mm to 61 mm), and 4.05" to 4.75" (104 mm to 112 mm)

**Patented No-Short Self-Centering Cap:**  
(U.S. Patent No. 5,653,426)  
Featured on 1" and 2" spring isolation hangers. Indexed steps in spring cap keep the washer and rod centered in the cap.



# ASHRAE TYPE 4: Restrained Spring Isolator



## KINETICS TITAN (U.S. Patent No. 9,316,279) Vibration Isolator/Restraint

**Description:** Comprised of two interfacing but independent elements; two or more high deflection, free-standing, housed, large diameter, laterally stable steel springs, and a seismically rated housing.

The steel springs and elastomeric snubber element are each replaceable without having to lift or otherwise remove the supported equipment.

**Application:** Recommended for equipment mounted on a structural frame, or concrete inertia base where the top plate of the isolator can be fully utilized.

**Capacity:** up to 23,200 lbs. (10,523 kg)  
**Deflection:** up to 4" (102 mm)

## KINETICS FHS/FHSL Restrained Spring Isolator

**Description:** FHS Free-Standing Isolator with a steel housing assembly to limit lateral and vertical movement of the supported equipment during an earthquake without degrading the vibration isolation of the spring during normal equipment operating conditions.

**Application:** Recommended for mechanical equipment located near critically quiet areas when there is a possibility that the equipment to be isolated will be subjected to the external forces associated with an earthquake.

**Capacity:** up to 5,800 lbs. (2,631 kg)  
**Deflection:** up to 4" (102 mm)



## KINETICS FLS/FLSS Restrained Spring Isolators

**Description:** FLS/FLSS Free-standing, large diameter, laterally stable steel springs assembled into welded steel housing assemblies fabricated to limit vertical movement of the isolated equipment. The housings provide a constant free and operating height to facilitate installation.

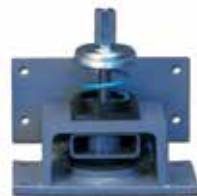


**Application:** Recommended for the isolation of vibration produced by equipment carrying a large fluid load which may be drained, such as boilers and chillers, and for the isolation of outdoor components such as cooling towers and air-cooled condensers.

**Capacity:** up to 23,200 lbs. (10,523 kg)  
**Deflection:** up to 4" (102 mm)

## KINETICS FMS (U.S. Patent No. 7,028,969) Modular Restraint/Isolator

**Description:** The unit is comprised of a restraint module and an optional vibration isolation module. This modular design allows the engineer to design for seismic or wind forces independent of the load and deflection requirements of the vibration isolator.



**Application:** Ideal for cooling towers, chillers, boilers or other equipment where the potential for wide weight variations during service is anticipated.

**Capacity:** up to 23,200 lbs. (10,523 kg)  
**Deflection:** up to 4" (102 mm)

# ASHRAE TYPE 4: Restrained Spring Isolator

## KINETICS KCI Spring Isolator



**Description:** Compact lightweight small restrained spring isolator, Plated Steel assembly to limit lateral and vertical movement of the supported equipment during an earthquake or wind storm. Angle top plate or threaded bolt options available for equipment attachment.

**Application:** Recommended for small to medium mechanical equipment near critically quiet areas when there is also need for Wind or Seismic restraint. Can also be used with strut to isolate equipment farms.

**Deflection:** up to 2" (51mm)

## KINETICS LDR Light Duty Rail System



**Description:** A low-cost solution designed to isolate residential style condensing units and other light weight equipment.

**Application:** Recommended for the isolation of rooftop condensing units to eliminate vibration from penetrating into the structure below and disturbing the occupants.

**Capacity:** up to 810 lbs. (10,523 kg)  
**Deflection:** 1" (25 mm)

# ASHRAE TYPE 5: Thrust Restraint

## KINETICS HSR Thrust Restraint



**Description:** A high deflection, large diameter, laterally stable steel coil spring assembled into a threaded rod and bracket assembly.

**Application:** Used to counteract the discharge force created by fans during operation. Recommended for all fan heads, suspended fans, and all base-mounted and suspended air-handling equipment operating at 2 inches or greater total static pressure (TSP). HSR Thrust Restraints are always installed in pairs and often work in conjunction with inertia bases for floor-mounted fans to counteract fan thrust.

**Capacity:** 35 lbs to 1,975 lbs. (16 to 896 kg)

**Deflection:** 1" to 2" (25 mm to 51 mm)

# ASHRAE TYPE 6: Air Springs

## KINETICS KAM and CAM Air Vibration Isolation Mounts



**Description:** Pneumatic, elastomeric vibration mounts. The CAM is available in four (4) sizes supporting loads up to 7,500 lbs. The KAM is available in seven (7) sizes with capacities from 500 to 22,000 lbs. per mount.

**Application:** Recommended for mechanical equipment and industrial process equipment requiring low natural frequency isolation, as well as protecting sensitive equipment from disturbing floor-borne vibration.



## BASE TYPE A: Direct Isolation

Used when equipment is unitary and rigid and does not require additional support. Direct isolation can be used with large chillers, some fans, packaged air-handling units, and air-cooled condensers. If there is any doubt that the equipment can be supported directly on isolators, use structural bases (type B) or inertia bases (type C), or consult the equipment manufacturer.

## BASE TYPE B: Structural Rails or Bases

### KINETICS QUIETRAIL Cooling Tower Rail

**Description:** Specifically designed and engineered to support cooling towers and chillers requiring a supplemental mounting frame.

**Application:** Designed to provide a wind and seismic rated vibration isolation frame without the need for additional equipment support steel. The frames provide a means by which the equipment can be stabilized and motion reduced by lowering the equipment center of gravity.

### KINETICS SBB Structural Beam Base

**Description:** Structural steel beam sections, with welded-on isolator support brackets, and pre-located and drilled anchor bolt holes for bolting to equipment to be supported.

**Application:** Recommended for support and isolation of absorption chillers, hermetic centrifugal chillers, package boilers, cooling towers, and similar types of equipment.

### KINETICS PS Seismic Inline Pump Stand

**Description:** Provide seismic restraint for vertical inline pumps without the need for intermediate support, delivering significant labor savings for contractors in the field.

**Application:** The stands utilize a structural design that supports and restrains the inline pump and the associated piping to meet the latest seismic and wind restraint requirements.

### KINETICS CRFS Computer Room Floor Stand

**Description:** Structural steel floor stands provide rigid mounting for seismic restraint and/or isolation of computer room air conditioning units (CRAC).

**Application:** Specifically designed and engineered to support computer room A/C units requiring seismic restraint and/or vibration isolation.

### KINETICS SFB Structural Frame Base

**Description:** Welded structural frame bases with channels, angles, or WF beams, which are complete with outboard height-saving isolator brackets and prelocated equipment anchor bolts.

**Application:** Recommended for support and isolation of reciprocating chillers, close coupled pumps, vent sets, packaged air handling units, centrifugal fans, evaporative condensers, and similar types of equipment.

### KINETICS KSIP Suspended Inline Pump Support

**Description:** Provides a bracket for suspended vertical inline pumps without the need for intermediate support, delivering significant labor savings for contractors in the field and ease of installation.

**Application:** Engineered to carry the weight of a suspended inline pump.

## BASE TYPE C: Concrete Inertia Base



### KINETICS CIB Concrete Inertia Base

**Description:** A unique structural design which integrates perimeter channels, isolator support brackets, reinforcing rods, anchor bolts, and concrete fill into a controlled load transfer system, utilizing steel in tension and concrete in compression, resulting in high strength and stiffness with minimum steel frame weight.

**Application:** Recommended for use with open-type centrifugal chillers, reciprocating air and refrigeration compressors, chillers, and heat pumps, close-coupled and base-mounted pumps, centrifugal fans, internal combustion engines, and similar types of equipment.

### KINETICS KINFLEX Flexible Connectors

**Description:** Prevent stresses due to expansion and contraction, isolate against the transfer of noise and vibration, and compensate for misalignment.

**Application:** Used on both hot and chilled water circulation lines, suction and discharge sides of pumps, and header connections.



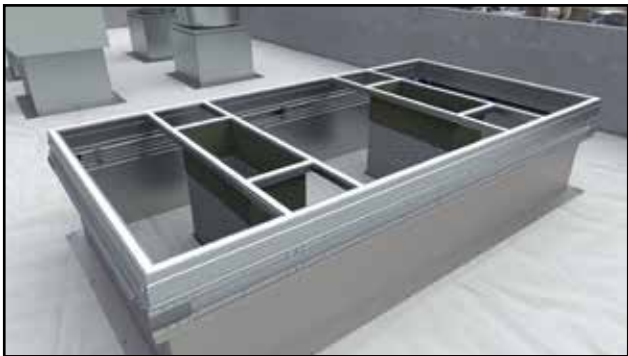
**KINFLEX Seismic V-Loops** solve the problems of pipe motion caused by thermal pipe growth and the movements associated with seismic activity. Seismic V-loops limit amount of space required for installation and hold in more heat than to traditional large pipe loops.



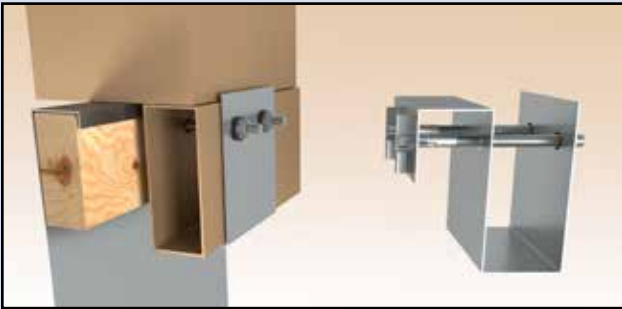
# BASE TYPE D: Curb-Mounted Base

## KINETICS KSR 2.0 Vibration Isolation Roof Curb Rail

KSR 2.0 equipment isolation rail is engineered to isolate packaged rooftop equipment from the roof structure. KSR 2.0 vibration isolation rails are specifically designed and engineered for use as a noise and vibration isolation system for roof curb-mounted mechanical equipment.



- The 2.0 Advantage**
- Improved design with fewer components than the previous KSR
  - Extremely easy installation with factory assembled parts
  - Pre-installed weather strip
  - Integrated seismic and wind restraints that do not require additional labor to install
  - Adjustable height to adapt to a multitude of curb mounted equipment designs
  - Isolation rail is engineered to meet the latest building code requirements



- KINETICS Z-CLIP  
Wind Restraint Bracket**
- Designed to secure attachment of unit to the roof curb. Each bracket is engineered to fit specific application. Bolt toggle design allows for a secure through bolt attachment without needing access to the inside of the curb, reducing number of clips required and field labor.

## KINETICS KSCR and ESR Vibration Isolation Curbs



- Complete assemblies designed to resiliently support equipment at the specified elevation and constitute a fully enclosed air and weather-tight system.
- Standard Features**
- Seismic and wind restraint
  - Up to 4" (102 mm) deflection, powder-coated steel springs with 50% overload capacity
  - Supply and return flexible connector support
  - Environmentally inert elastomeric seal for an air and water-tight closure between the curb and rail
  - High profile, non-interference aluminum rail (only KSCR)
  - Accessible ports for each isolator to inspect, level, or change springs after equipment placement (only ESR)
- Options**
- Deflections over 4" (102 mm)
  - Interface for sloped or multi-pitched roofs
  - Additional height for plenums & silencers
  - Exterior thermal insulation
  - Acoustical treatments
  - Certification of seismic and wind load engineering

# In Curb Acoustical Treatments

Add an "in curb" acoustical treatment to control breakout noise from equipment fans and compressors into the space below.



## KINETICS RT-7 RT-7 Acoustical Treatment

- STC 37**
- Exclusively from Kinetics Noise Control, specially designed to control breakout noise from rooftop equipment in curbs, RT-7 is a cost-effective solution and a contractor favorite due to its light weight and overall ease of installation.

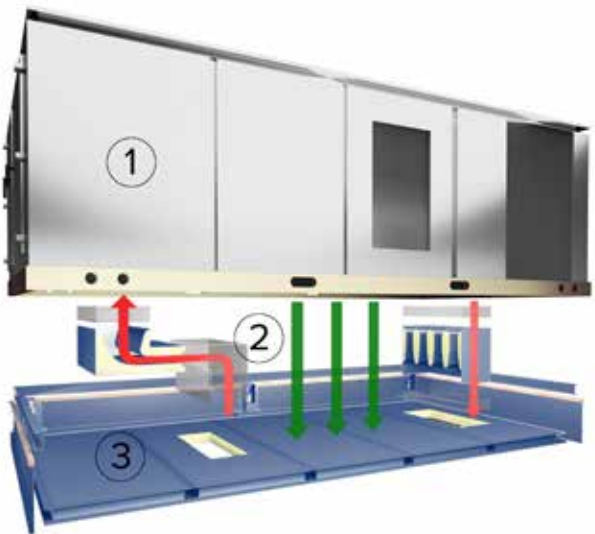


- KINETICS NOISEBLOCK  
Acoustical Panels**
- STC 40 / 43 / 48 / 52**
- Kinetics versatile NOISEBLOCK acoustical panels are double-walled perforated metal panels. For rooftop equipment, Kinetics specifies 22-gauge perforated panels that are manufactured to fit and laid into the bottom of the curb delivering superior sound absorption (noise reduction) and transmission loss (noise blocking).

## KINETICS ESSR Sound and Vibration Isolation Curb

Kinetics ESSR vibration isolated curb system addresses all noise sources associated with packaged rooftop equipment. Here is how:

1. Vibration from fans and compressors (source 1) and vibration from casing radiated noise caused by duct turbulence and the airborne noise of the fans and compressors (source 2) are controlled with Kinetics high deflection, laterally stable coil spring isolators and high frequency neoprene noise pads.
2. Duct-borne noise from the supply and return air fans (source 3) are controlled using an aerodynamic acoustical silencer on the supply fan and an acoustical plenum on the return air side - both with minimal pressure drop.
3. Breakout noise through the bottom of the rooftop unit (source 4) is controlled by the NOISEBLOCK STL acoustical panel located in the floor of the ESSR.





# Seismic Restraint

Seismic restraint systems limit movement and keep equipment captive during a seismic event. Proper utilization of these systems can reduce the threat to life and minimize long-term costs due to equipment damage and associated loss of service. Additional seismic restraint products can be found within ASHRAE Type 4 (page 15) and Base Type D (page 18).



## KINETICS QuakeLoc™ Seismic Cable Restraint Kits

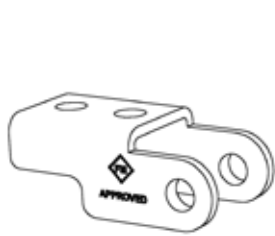
Piping, duct, electrical cable trays, and suspended equipment

- Reduces Installation Time and Cost
- Contractor Friendly Design
- IBC Code Compliant

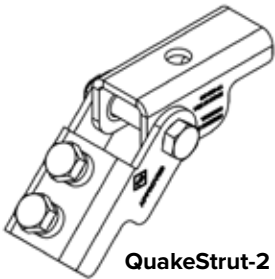
### Accessories

**KHRC Adjustable Angle Rod Stiffeners:** Securely attach a length of steel angle to a conventional hanging threaded rod.

**KSBC Seismic Beam Clamp:** Attach seismic restraints to roof or floor support I-beams.



QuakeStrut-1



QuakeStrut-2

## KINETICS QuakeStrut™ Rigid Seismic Bracing

FM Approved Class 1950

QuakeStrut-1 is used when you are through bolting to the strut and offers an economical rigid bracing option. QuakeStrut-2 is the full assembly with all of the hardware to connect the strut.



## KINETICS HS Series Seismic Snubbers

**Description:** Heavy structural steel assemblies designed to minimize equipment motion within the product's design capabilities without failing.

Seismic Snubbers are designed to be used in pairs and serve to keep supported equipment contained when the equipment is subjected to lateral or vertical forces along any axis.

## Seismic Mounting Brackets

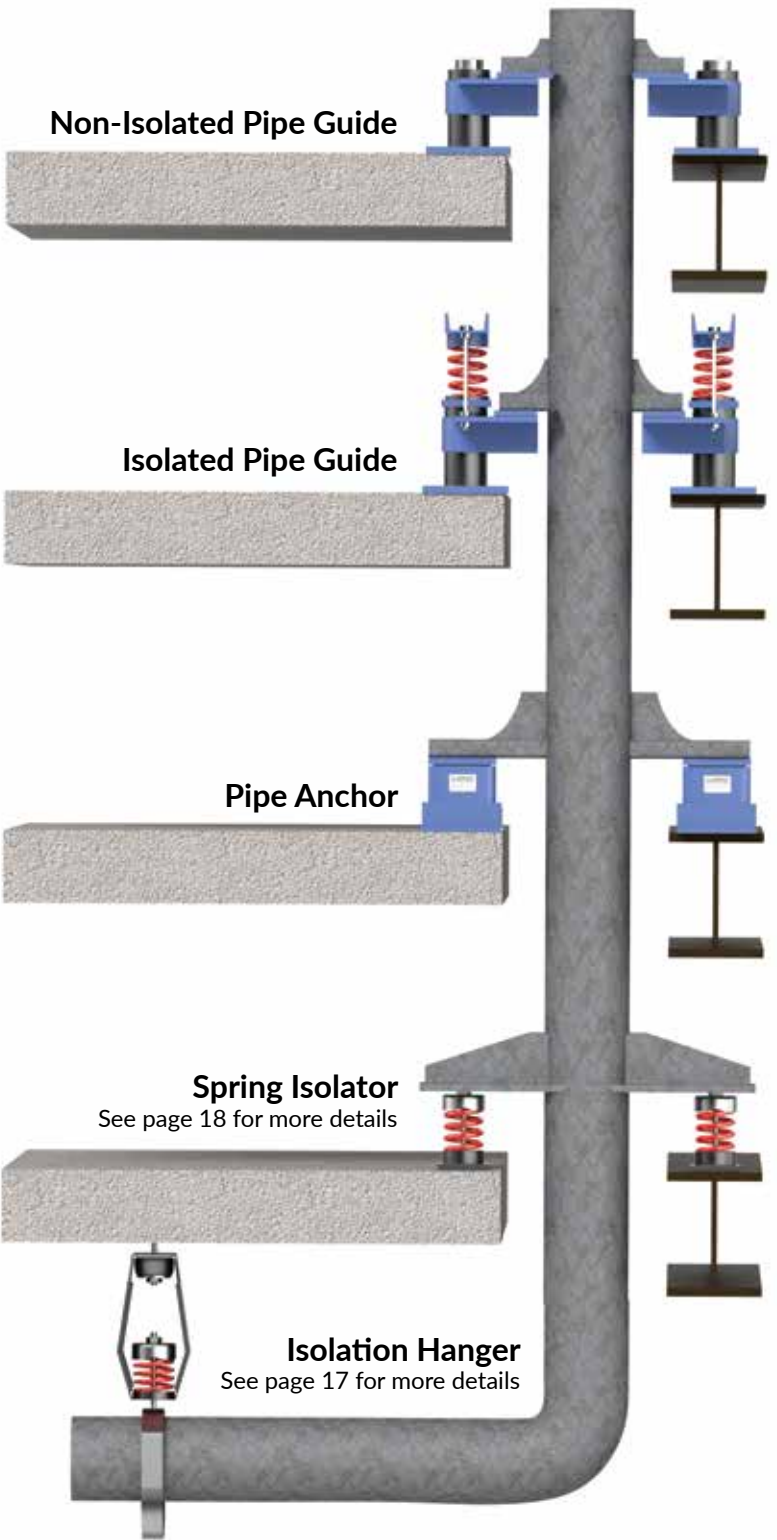
**KINETICS KSMS:** Solid-mount equipment to the building structure

**KINETICS KSMG:** Resiliently mount and restrain equipment to the building structure

**KINETICS KSMF:** Solid-mount mushroom fans to the curb

# Riser Supports, Anchors, and Guides

**KINETICS®** riser supports, anchors, and guides isolate the pipe from the structure to minimize noise and vibration transmission, while also allowing the pipe to expand and contract with minimal change in the support forces. Kinetics offers custom engineering services to assist in the design of your riser system. Please see Kinetics Pipe Riser Selection Guide for details.



## KRG Pipe Guide

Isolated or non-isolated. Required in shaft-mounted risers. Typically excluded on core-drilled risers. Isolated version recommended for use guide is required at same location as an isolated support, unless isolation can be overhead.



## KPA Pipe Anchor

Recommended to anchor pipe to structure to set thermal origin.

PIPING/HANGER SELECTION DATA (U.S.)

Piping Weight and Spacing - Water

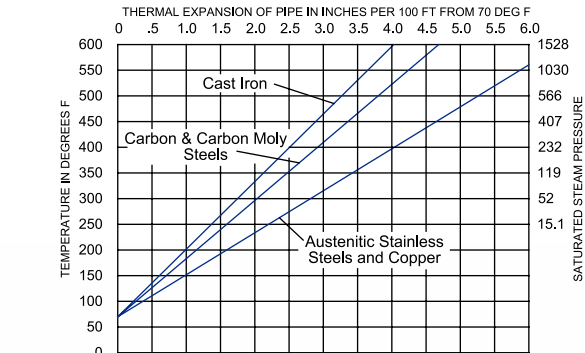
Pipe Size (in.)	1	1.25	1.5	2	2.5	3	4	5	6	8	10	12	14	16	18	20	24
Pipe Schedule	40	40	40	40	40	40	40	40	40	40	40	40	30	30	30	20	20
Max. Spacing (ft.)	7	7	9	10	11	12	14	16	17	19	20	23	25	27	28	30	32
Insulation (in.)*	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Wt. per Lin. Ft. (lb.)																	
Pipe	1.7	2.3	2.7	3.7	5.8	7.6	10.8	14.7	19.0	28.6	40.6	53.7	54.7	62.7	82.2	78.8	94.9
Water	0.4	0.6	0.9	1.5	2.1	3.2	5.5	8.7	12.5	21.7	34.2	48.5	59.8	79.2	99.8	126.1	184.0
Insulation	0.6	0.7	0.8	0.9	1.1	1.3	1.5	3.0	3.4	4.2	5.1	6.0	6.5	7.3	8.2	9.0	10.7
Total	2.7	3.6	4.4	6.1	9.0	12.1	17.8	26.4	34.9	54.5	79.9	108.2	121.0	149.2	190.2	213.9	289.6
Wt. @ 10 ft. Spacing (lb.)	-	-	-	61	90	121	178	264	349	545	799	1082	1210	1492	1902	2139	2896
KNC Hanger Model No.																	
SH/SRH/SFH -1	-	-	-	70	125	125	245	370	370	600	800	1250	1250	1700	2200	2200	3500
SH/SRH/SFH -2	-	-	-	70	120	120	220	465	465	720	850	1025	1200	2000	2000	2500	-
SH/SRH/SFH -4	-	-	-	100	100	100	250	250	500	500	750	1000	1250	1600	2250	2250	3000
Recommended Rod Size (in.)**	-	-	-	0.38	0.38	0.38	0.50	0.50	0.50	0.50	0.62	0.62	0.75	0.75	0.88	0.88	1.00
Wt. @ 20 ft. Spacing (lb.)	-	-	-	-	-	-	-	-	-	-	1598	2163	2419	2984	-	-	-
KNC Hanger Model No.																	
SH/SRH/SFH -1	-	-	-	-	-	-	-	-	-	-	1700	2200	2465	3500	-	-	-
SH/SRH/SFH -2	-	-	-	-	-	-	-	-	-	-	2000	2500	2500	-	-	-	-
SH/SRH/SFH -4	-	-	-	-	-	-	-	-	-	-	1600	2250	2500	3000	-	-	-
Recommended Rod Size (in.)**	-	-	-	-	-	-	-	-	-	-	0.75	0.88	0.88	1.00	-	-	-
Max. Spacing (ft.)	7	7	9	10	11	12	14	16	17	19	20	23	25	27	28	30	32
Wt. @ Max. Spacing (lb.)	19	26	40	61	99	145	250	421	594	1036	1598	2487	3024	-	-	-	-
KNC Hanger Model No.																	
SH/SRH/SFH -1	35	35	70	70	125	245	370	500	600	1000	1700	2865	3500	-	-	-	-
SH/SRH/SFH -2	35	35	70	70	120	220	465	465	720	1200	2000	2500	-	-	-	-	-
SH/SRH/SFH -4	-	-	-	100	100	250	250	500	750	1250	1600	2500	3500	-	-	-	-
Recommended Rod Size (in.)**	0.25	0.38	0.38	0.38	0.38	0.38	0.50	0.50	0.50	0.62	0.75	0.88	1.00	-	-	-	-

Piping Weight and Spacing - Steam

Pipe Size (in.)	1	1.25	1.5	2	2.5	3	4	5	6	8	10	12	14	16	18	20	24
Pipe Schedule	40	40	40	40	40	40	40	40	40	40	40	40	30	30	30	20	20
Insulation (in.)*	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Wt. per Ft. (lbs.)	1.7	2.3	2.7	3.7	5.8	7.6	10.8	14.7	19.0	28.6	40.6	53.7	54.7	62.7	82.2	78.8	94.9
Pipe																	
Insulation	1.2	1.3	1.4	1.6	1.8	2.1	2.5	4.2	4.8	5.9	7.1	8.2	8.9	10.1	11.2	12.3	14.5
Total	2.9	3.6	4.1	5.3	7.6	9.7	13.3	18.9	23.8	34.6	47.7	61.9	63.6	72.8	93.4	91.1	109.4
Wt. @ 10 ft. Spacing (lb.)	-	36	41	53	76	97	133	189	238	346	477	619	636	728	934	911	1094
KNC Hanger Model No.																	
SH/SRH/SFH -1	-	35	35	70	70	125	125	245	245	370	500	625	625	800	1000	1000	1250
SH/SRH/SFH -2	-	35	35	70	70	120	120	220	220	465	720	720	720	720	1025	1025	1200
SH/SRH/SFH -4	-	-	-	100	100	100	100	250	250	500	500	750	750	750	1000	1000	1250
Recommended Rod Size (in.)**	-	0.38	0.38	0.38	0.38	0.38	0.38	0.50	0.50	0.50	0.50	0.62	0.62	0.62	0.62	0.62	0.62
Wt. @ 20 ft. Spacing (lb.)	-	-	-	-	-	-	-	-	477	691	954	1238	1273	1456	1867	1822	2187
KNC Hanger Model No.									500	625	1000	1250	1250	1700	2200	2200	2200
SH/SRH/SFH -1	-	-	-	-	-	-	-	-	720	720	1025	2000	2000	2000	2000	2000	2500
SH/SRH/SFH -2	-	-	-	-	-	-	-	-	500	750	1000	1250	1600	1600	2250	2250	2250
SH/SRH/SFH -4	-	-	-	-	-	-	-	-	0.50	0.62	0.62	0.75	0.75	0.75	0.88	0.88	1.00
Recommended Rod Size (in.)**	-	-	-	-	-	-	-	-	0.50	0.62	0.62	0.75	0.75	0.75	0.88	0.88	1.00
Max. Spacing (ft.)	9	10	12	13	14	15	17	19	21	24	26	30	32	35	37	39	39
Wt. @ Max. Spacing (lb.)	26	36	50	69	107	145	227	359	501	829	1240	1857	2036	2548	3454	3552	4266
KNC Hanger Model No.																	
SH/SRH/SFH -1	35	35	70	70	125	245	245	370	500	1000	1250	2200	2200	2865	-	-	-
SH/SRH/SFH -2	35	35	70	70	120	220	220	465	720	850	2000	2000	2200	2500	-	-	-
SH/SRH/SFH -4	-	-	-	100	100	100	250	500	500	1000	1250	2250	2250	2750	-	-	-
Recommended Rod Size (in.)**	0.25	0.38	0.38	0.38	0.38	0.38	0.50	0.50	0.50	0.62	0.75	0.88	1.00	1.00	-	-	-

\*Insulation weight based on industry standard insulation

\*\*Rod size recommendation and max. hanger spacing based on MSS SP-69



Approximate Flanged Fitting Weights (lb.)

Pipe Size (In.)	Bonnet Check Valve	Bonnet Gate Valve	Elbow	Tee	Flange
1	-	9	8	11	4
1.5	-	27	12	18	4
2	26	37	18	24	5
2.5	36	50	27	35	7
3	46	66	33	40	9
4	80	109	56	74	15
5	120	140	78	91	19
6	155	170	97	117	23
8	300	250	160	182	32
10	450	470	260	290	52
12	675	690	390	400	70
14	900	950	520	600	93
16	1200	1250	725	750	120
18	1371	1650	980	930	140
20	1772	2000	1300	1100	175
24	3000	3100	1850	1850	250

PIPING/HANGER SELECTION DATA (SI)

Piping Weight and Spacing - Water

Pipe Size (mm)	25	32	38	51	64	76	102	127	152	203	254	305	356	406	457	508	610
Pipe Schedule	40	40	40	40	40	40	40	40	40	40	40	40	30	30	30	20	20
Max. Spacing (m)	2.1	2.1	2.7	3.0	3.4	3.7	4.3	4.9	5.2	5.8	6.1	7.0	7.6	8.2	8.5	9.1	9.8
Insulation (mm)*	25	25	25	25	25	25	25	38	38	38	38	38	38	38	38	38	38
Wt. per M (kg)																	
Pipe	2.5	3.4	4.0	5.5	8.6	11.3	16.1	21.9	28.3	42.6	60.5	80.0	81.4	93.3	122.4	117.3	141.3
Water	0.6	0.9	1.3	2.2	3.1	4.8	8.2	12.9	18.6	32.3	50.9	72.1	89.0	117.9	148.6	187.8	274.0
Insulation	0.9	1.0	1.2	1.3	1.6	1.9	2.2	4.5	5.1	6.2	7.6	9.0	9.7	10.9	12.2	13.4	15.9
Total	4.0	5.3	6.5	9.0	13.3	18.0	26.5	39.3	52.0	81.1	119.0	161.1	180.1	222.1	283.2	318.5	431.2
Wt. @ 3 m Spacing (kg)	-	-	-	27	40	54	80	118	156	243	357	483	540	666	850	955	1294
KNC Hanger Model No.																	
SH/SRH/SFH -1	-	-	-	70	125	125	245	370	370	600	800	1250	1250	1700	2200	2200	3500
SH/SRH/SFH -2	-	-	-	70	120	120	220	465	465	720	850	1025	1200	2000	2000	2500	-
SH/SRH/SFH -4	-	-	-	100	100	100	250	250	500	500	750	1000	1250	1600	2250	2250	3000
Recommended Rod Size (mm)**	-	-	-	10	10	10	13	13	13	13	16	16	19	19	22	22	25
Wt. @ 6 m Spacing (kg)	-	-	-	-	-	-	-	-	-	-	714	966	1080	1332	-	-	-
KNC Hanger Model No.																	
SH/SRH/SFH -1	-	-	-	-	-	-	-	-	-	-	1700	2200	2465	3500	-	-	-
SH/SRH/SFH -2	-	-	-	-	-	-	-	-	-	-	2000	2500	2500	-	-	-	-
SH/SRH/SFH -4	-	-	-	-	-	-	-	-	-	-	1600	2250	2500	3000	-	-	-
Recommended Rod Size (mm)**	-	-	-	-	-	-	-	-	-	-	19	22	22	25	-	-	-
Max. Spacing (m)	2.1	2.1	2.7	3.0	3.4	3.7	4.3	4.9	5.2	5.8	6.1	7.0	7.6	8.2	8.5	9.1	9.8
Wt. @ Max. Spacing (kg)	8.6	11.8	18.1	27.7	44.9	65.8	113.4	190.9	269.4	469.9	724.8	1128.1	1371.7	-	-	-	-
KNC Hanger Model No.																	
SH/SRH/SFH -1	35	35	70	70	125	245	370	500	600	1000	1700	2865	3500	-	-	-	-
SH/SRH/SFH -2	35	35	70	70	120	220	465	465	720	1200	2000	2500	-	-	-	-	-
SH/SRH/SFH -4	-	-	-	100	100	250	250	500	750	1250	1600	2500	3500	-	-	-	-
Recommended Rod Size (mm)**	6	10	10	10	10	10	13	13	13	16	19	22	25	-	-	-	-



# Isolation Notes for Specific Equipment\*

Kinetics Noise Control strongly recommends 2019 ASHRAE Handbook, Chapter 49 Noise and Vibration Control as a companion to this product selection guide.

## Refrigeration Machines

Large centrifugal, screw, and reciprocating refrigeration machines may generate very high noise levels; special attention is required when such equipment is installed in upper-story locations or near noise-sensitive areas. If equipment is located near extremely noise-sensitive areas, follow the recommendations of an acoustical consultant.

## Compressors

The two basic reciprocating compressors are (1) single- and double-cylinder vertical, horizontal or L-head, which are usually air compressors; and (2) Y, W, and multihead or multicylinder air and refrigeration compressors. Single- and double-cylinder compressors generate high vibratory forces requiring large inertia bases (type C) and are generally not suitable for upper-story locations. If this equipment must be installed in an upper-story location or at-grade location near noise-sensitive areas, the expected maximum unbalanced force data must be obtained from the equipment manufacturer and a vibration specialist consulted for design of the isolation system.

When using Y, W, and multihead and multicylinder compressors, obtain the magnitude of unbalanced forces from the equipment manufacturer so the need for an inertia base can be evaluated.

Base-mounted compressors through 5 hp and horizontal tank-type air compressors through 10 hp can be installed directly on spring isolators (type 3) with structural bases (type B) if required, and compressors 15 to 100 hp on spring isolators (type 3) with inertia bases (type C) weighing 1 to 2 times the compressor weight.

## Pumps

Concrete inertia bases (type C) are preferred for all flexible-coupled pumps and are desirable for most close-coupled pumps, although steel bases (type B) can be used. Close-coupled pumps should not be installed directly on individual isolators (type A) because the impeller usually overhangs the motor support base, causing the rear mounting to be in tension. The primary requirements for type C bases are strength and shape to accommodate base elbow supports. Mass is not usually a factor, except for pumps over 75 hp, where extra mass helps limit excess movement due to starting torque and forces. Concrete bases (type C) should be designed for a thickness of one-tenth the longest dimension with minimum thickness as follows: (1) for up to 30 hp, 6 in.; (2) for 40 to 75 hp, 8 in.; and (3) for 100 hp and up, 12 in. Pumps over 75 hp and multistage pumps may exhibit excessive motion at start-up ("heaving"); supplemental restraining devices can be installed if necessary. Pumps over 125 hp may generate high starting forces; consult a vibration specialist.

## Cooling Towers

These are normally isolated with restrained spring isolators (type 4) directly under the tower or tower dunnage. High deflection isolators proposed for use directly under the motor-fan assembly must be used with extreme caution to ensure stability and safety under all weather conditions.

## Packaged Rooftop Air-Conditioning Equipment

This equipment is usually installed on lightweight structures that are susceptible to sound and vibration transmission problems. The noise problems are compounded further by curb-mounted equipment, which requires large roof openings for supply and return air.

The table shows type D vibration isolator selections for all spans up to 20 ft, but extreme care must be taken for equipment located on spans of over 20 ft, especially if construction is open web joists or thin, lightweight slabs. The recommended procedure is to determine the additional deflection caused by equipment in the roof. If additional roof deflection is 0.25 in. or less, the isolator should be selected for up to 10 times the additional roof deflection. If additional roof deflection is over 0.25 in., supplemental roof stiffening should be installed to bring the roof deflection down below 0.25 in., or the unit should be relocated to a stiffer roof position.

For mechanical units capable of generating high noise levels, mount the unit on a platform above the roof deck to provide an air gap (buffer zone) and locate the unit away from the associated roof penetration to allow acoustical treatment of ducts before they enter the building.

Some rooftop equipment has compressors, fans, and other equipment isolated internally. This isolation is not always reliable because of internal short-circuiting, inadequate static deflection, or panel resonances. It is recommended that rooftop equipment over 300 lb be isolated externally, as if internal isolation was not used.

## Fans and Air-Handling Equipment

Consider the following in selecting isolation systems for fans and air-handling equipment:

1. Fans with wheel diameters of 22 in. and less and all fans operating at speeds up to 300 rpm do not generate large vibratory forces. For fans operating under 300 rpm, select isolator deflection so the isolator natural frequency is 40% or less than the fan speed. For example, for a fan operating at 275 rpm,  $0.4 \times 275 = 110$  rpm. Therefore, an isolator natural frequency of 110 rpm or lower is required. This can be accomplished with a 3 in. deflection isolator (type 3).
2. Flexible duct connectors should be installed at the intake and discharge of all fans and air-handling equipment to reduce vibration transmission to air duct structures.
3. Inertia bases (type C) are recommended for all class 2 and 3 fans and air handling equipment because extra mass allows the use of stiffer springs, which limit heaving movements.
4. Thrust restraints (type 5) that incorporate the same deflection as isolators should be used for all fan heads, all suspended fans, and all base-mounted and suspended air-handling equipment operating at 2 in. or more total static pressure. Restraint movement adjustment must be made under normal operational static pressures.

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