No: MC-01

SUBMITTAL COVERSHEET
Nanuet UFSD –Phase 3 Projects

Architect:
KSQ Architects
215 W 40th Street,15th Floor
New York, NY 10018

Owner:
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Nanuet, NY 10954

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School Name: Nanuet Union Free School District Phase 3 Bond Projects @ Barr Middle School & Nanuet High School

Type of Submittal:

Re-submittal: [ ] No [ ] Yes

[ ] Shop Drawings **[ ]** Product Data **[ ]** Schedule **[ ]** Sample **[ ]** ________________
[ ] Test Report **[ ]** Certificate **[ ]** Color Sample **[ ]** Warranty **[ ]** ________________

Submittal Description:

Product Name: GVIBRATION ISOLATION PIPING AND EQUIPMENT

Manufacturer: KINETICS

Subcontractor/ Supplier: KINETICS

References:

Spec. Section No.: 230548

Drawing No(s): ____________________

Paragraph: _________________________

Rm. or Detail No(s): ________________

Architect's/ Engineer's Review Stamp	Contractor Review Statement:
	These documents have been checked for accuracy and coordinated with job conditions and Contract requirements by this office and have been found to comply with the provisions of the Contract Documents. Ronald J. Lombardo 10-10-23 Name: Date: Company Name: Joe Lombardo Plumbing & Heating of Rockland Inc.

Remarks:

The Pitfalls of Combining Internal & External Equipment Isolation

Introduction:

Almost all Make-up Air Units (***MAU***), Air Handling Units (***AHU***), and Rooftop Units (***RTU***) have internal spring-type isolation for the intake and exhaust fans. These fans typically have operating speeds that range from ***400 rpm*** to ***1200 rpm***. Assuming an imbalance in the fan wheel, these operating speeds produce a forcing frequency (***f***) that will range between ***6.67 Hz*** and ***20 Hz***. There are many buildings that have natural frequencies of their structures that lie between ***8 Hz*** and ***12 Hz***.

There are a number of reasons for using internal isolation for the intake and exhaust fans. It may be intended to reduce the excitation of the building structure. It can be a feature added as a sales tool or to assist the passage of noise test requirements prior to shipment. Lastly it may help prevent fatigue failure of the cabinet. In any case, it should be noted that typically the only components that receive spring isolation in the equipment cabinets are these intake and exhaust fans.

There is a trend to use both internal and external isolation with the idea that more isolation will always reduce the transmission of noise and vibration. This is not necessarily true. In fact the use of both internal and external isolation can increase the level of noise and vibration transfer to the building's structure. The purpose of this paper is to demonstrate the conditions under which this might occur.

Traditional Approach to Equipment Isolation:

Traditionally, external equipment isolation has been chosen by assuming that the equipment and spring isolation form a single degree of freedom system in which damping is neglected as shown in Figure G3.12.1-1 below. In this approach, the center of gravity (***C.G.***) of the equipment was assumed to lie at the geometrical center of the equipment. Also, it is usually assumed that all of the forces that would cause oscillation of the equipment act in the vertical direction. Thus, the equipment will experience only vertical motion. The stiffness and mass of the building are not taken into account by the model shown in Figure G3.12.1-1.

In Figure G3.12.1-1, ***M*** refers to the mass of the equipment, and ***K*** refers to the combined stiffness of all of the spring isolators that support the equipment. Normally the vibration isolation industry will refer to the stiffness of the springs in terms of the static deflection of the springs. The term static deflection actually entails more than the just the stiffness of the springs that support a given piece of equipment. The static deflection is a quantity that incorporates the mass of the equipment and the stiffness of the springs that support it.

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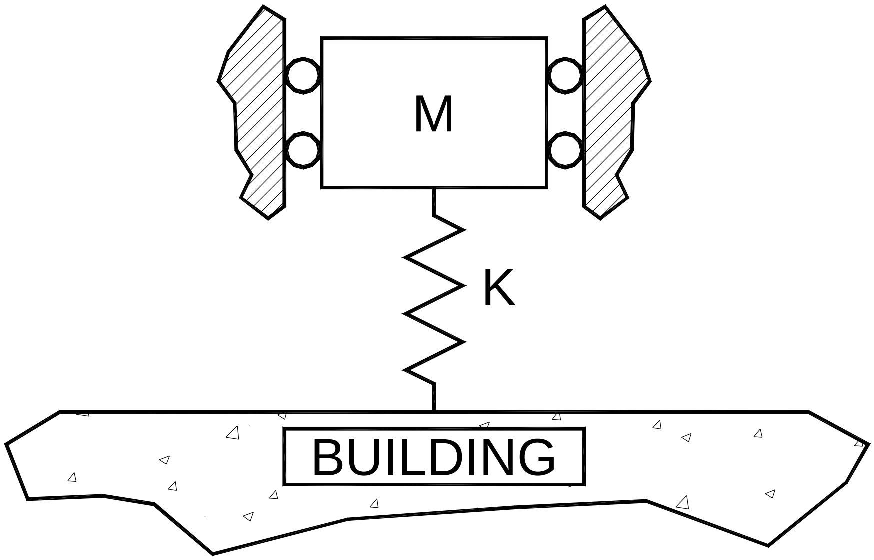

Figure G3.12.1-1: Basic Single Degree of Freedom Vibration Model.

Equation G3.12.1-1 defines the natural frequency of the system shown in Figure G3.12.1-1.

$$f_N = [(M / K)^{1/2}] / (2 * \pi) = [(g / \Delta)^{1/2}] / (2 * \pi) \qquad \text{(Eq. G3.12.1-1)}$$

In Equation G3.12.1-1, f_N is the natural frequency of the system and ***g*** is the acceleration due to gravity, which has a value of ***386.4 in/sec²***. The variable ***Δ*** denotes the ***Static Deflection*** of the mass, ***M***, which represents the equipment and the spring(s).

Unlike internal isolation springs, which are not normally "tuned" to the building structure, manufacturers of external equipment isolation will offer springs that have ***1"***, ***2"***, ***3"***, and ***4" Static Deflections***. The natural frequencies represented by these springs are given in Table G3.12.1-1. The springs chosen for a given application will depend on the type of equipment to be supported, the position of the equipment in/on the building and the stiffness (flexibility) of the supporting building structure. The guidelines used for selection of springs to support equipment of various types are given in the Heating, Ventilating, and Air-Conditioning Applications volume of the **ASHRAE Handbook**. The standard spring families offered by Kinetics Noise Control are ***1"***, ***2"***, and ***4" Static Deflections***. The improvement, over a ***2" Static Deflection*** spring, gained by using a ***3"*** static deflection spring is marginal when compared to that gained by using the ***4" Static Deflection*** spring. Therefore, Kinetics Noise Control chose to not offer the ***3" Static Deflection*** spring family as a standard product family.

If the forcing frequency (***f***) of the rotating components of the equipment is close to the natural frequency of the equipment on the springs, then excess vibration and sound

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energy will be transferred to the building structure. How much vibration and sound energy is transferred is defined by the transmissibility. The transmissibility, T_R, is defined by Equation G3.12.1-2, and is discussed in more detail in Document T1.2.2. The larger the value of the transmissibility, the more vibration is transferred directly to the building structure. As the forcing frequency, f, approaches the natural frequency, f_N, the values of the transmissibility can exceed ***1.0***. This is a situation where more vibration is felt by the structure than is being generated by the equipment.

Table G3.12.1-1: System Natural Frequency vs. Static Spring Deflection.

Static Spring Deflection Δ (in)	System Natural Frequency f_N (Hz)
1	3.13
2	2.21
3	1.81
4	1.56

$$T_R = \left| 1 / \left[(f / f_N)^2 - 1 \right] \right| \qquad \textbf{(Eq. G3.12.1-2)}$$

For the values of static deflection springs supplied by Kinetics Noise Control the transmissibility at fan speeds ranging from ***500 rpm*** to ***1200 rpm*** are plotted in Figure G3.12.1-2. These curves represent the performance of a piece of equipment with external isolation only. These plots assume that the fans are unbalanced, and thus there is one force per revolution of the fan.

Transmissibility, T_R, under ***0.125*** is desirable to minimize the amount of sound and vibration transmitted to the building. Figure G3.12-1-2 shows that this is achieved with external isolation for all instances, except for a ***1" Static Deflection*** at fan speeds below ***600 rpm***. Of course, the building stiffness is not included in this analysis. As the building structure becomes more flexible, ***2"*** and ***4" Static Deflection*** springs would need to be used to "protect" the more sensitive building structure. It should be noted that the ***1" Static Deflection*** and ***2"*** Static Deflection curves in Figure G3.12.1-2 would apply to internal isolation only, as well. In almost any piece of rooftop equipment, it would be impractical to use springs with a static deflection of ***4"*** for internal component isolation.

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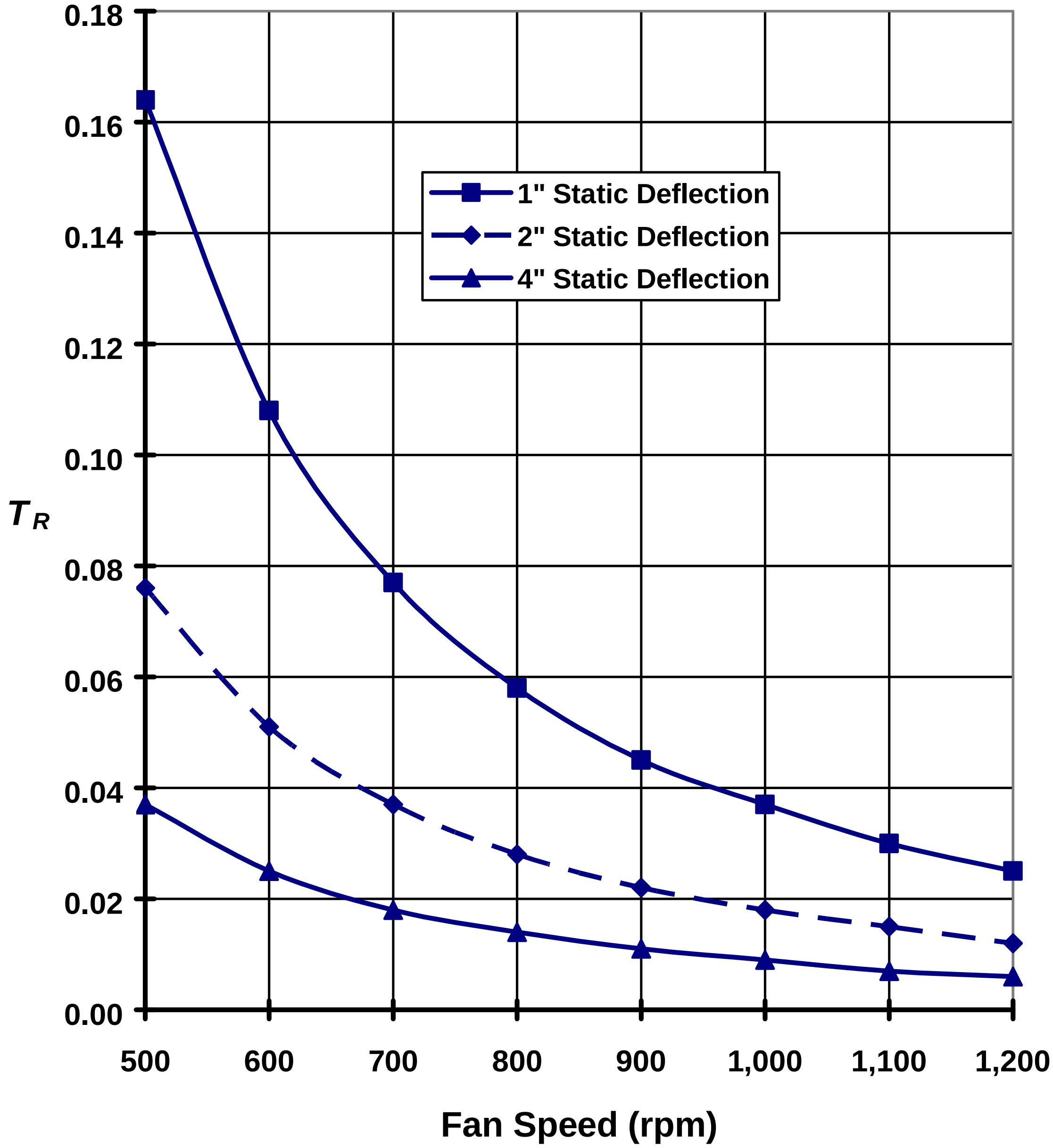
Figure G3.12.1-2: Transmissibility vs. Fan Speed
External Isolation Only



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Using Internal and External Equipment Isolation:

As with the traditional approach, the ***C.G.*** of the equipment is assumed to be at its geometrical center, and damping is neglected. It is also assumed that the forces that would cause the equipment to move will act in the vertical direction only. Thus, as before, the equipment will experience vertical motion only. The stiffness and mass of the building will not be included in the model to be described below. The recommendations that are found in the ASHRAE Handbook should be followed in regard to the building stiffness as it applies to the selection of spring isolation for the various types of equipment.

Equipment with both internal and external isolation may be modeled, in its simplest form, as a two degree of freedom system. The representation of the model is shown in Figure G3.12.1-3. In this model, M_1 is the mass of the internally isolated components. These components are usually the intake and exhaust fans. K_1 is the stiffness of the internal isolation springs and, with the mass, M_1 produces a static deflection of the internal springs equal to Δ_1. M_2 represents the mass of the rest of the equipment; that is, the non-isolated internal components and the cabinet. K_2 is the stiffness of the external isolation springs and with the total mass of the equipment (M_1+M_2) produces a static deflection of the external springs equal to Δ_2.

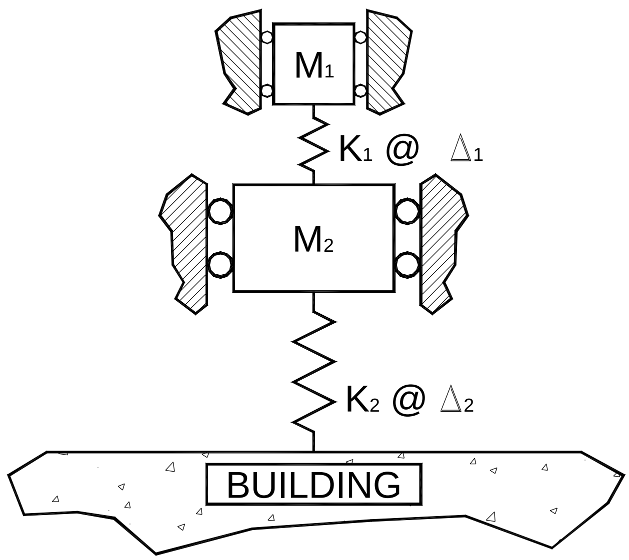

Figure G3.12.1-3: Basic Two Degree of Freedom Vibration Model.

The system shown in Figure G3.12.1-3 has two natural frequencies where resonance will occur if the system is driven at, or close to, one or the other of those natural frequencies. The number of degrees of freedom for a given system is determined by the number of independent variables required to describe the motion of the system. For the system in Figure G3.12.1-1, only one variable will be required to describe the motion of the mass ***M***. For the system shown in Figure G3.12.1-3, one independent variable for each of the

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masses, M_1 and M_2, will be required to completely describe their motions. Thus, this system has two degrees of freedom. The mass M_1 represents the internally isolated component which in our case is the fan. The remainder of the piece of equipment is represented by the mass M_2. The combined stiffness of the internal isolation springs is shown as K_1. The combined stiffness of the external isolation springs is represented by K_2.

The analysis involves determining the equations of motion for each mass. This will result in a system of two simultaneous second order differential equations. The solution for this system of equations is a classic one, and is described and demonstrated in Document T1.1.6.

The natural frequencies for systems with various configurations were determined. Three different types of units were examined. The mass ratio $[M_1/(M_1+M_2)]$ is typically different for each of the three types of equipment. For the ***MAU***, the mass of the isolated components was found to be approximately one-half the total mass of the unit $[M_1=0.5*(M1+M2)]$. The mass of the isolated components in the ***AHU*** were found to be roughly one-fourth the total mass of the unit $[M_1=0.25*(M_1+M_2)]$. Finally, the mass of the isolated components for an ***RTU*** was found to be about one-eighth the total mass of the unit $[M_1=0.125*(M_1+M_2)]$.

The literature for one of the manufacturers of roof top equipment indicates that the standard springs used for the internally isolated components would have a ***2" Static Deflection***. Another manufacturer of roof top equipment used springs with a ***1" Static Deflection*** as the standard selection for the internally isolated components. The optional springs had a ***2" Static Deflection***. The third manufacturer investigated, advertised the use of internal isolation but did not indicate the ***Static Deflection*** produced in the springs by the mass of the internally isolated components. It is possible that in some cases the ***Static Deflection*** of the internal isolation springs may be less than ***1"***.

For each of the units mentioned above, several combinations of internal and external isolation springs were investigated. The cases investigated are listed below in Table G3.12.1-2. The first (f_{N1}) and second (f_{N2}) natural frequencies for these cases following were calculated and are given in Table 3.12.1-3.

In Table G3.12.1-3, the first natural frequency is the higher of the two. It is the one that will cause the most problems from a vibration and sound energy transfer point of view. Examination of the tabulated results above shows that there are several combinations that may experience problems with excessive vibration and/or noise. The problem combinations will show themselves more clearly using transmissibility plots similar to the one in Figure G3.12.1-2.

The transmissibility will be calculated using the first natural frequency for each case and combination. Equipment curves for each case will be plotted on the same graph along

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with the transmissibility curve for the appropriate external isolation spring. These graphs are shown below in Figures G3.12.1-14 through G3.12.1-10.

Table G3.12.1-2: Cases Considered in This Study.

Case No.	Static Deflection of Internal Springs Δ_1 (in)	Static Deflection of External Springs Δ_2 (in)	Applied to Equipment Type
1	2.00	1.00	***MAU***, ***AHU***, and ***RTU***
2	2.00	2.00	***MAU***, ***AHU***, and ***RTU***
3	2.00	4.00	***MAU***, ***AHU***, and ***RTU***
4	1.00	1.00	***MAU***, ***AHU***, and ***RTU***
5	1.00	2.00	***MAU***, ***AHU***, and ***RTU***
6	1.00	4.00	***MAU***, ***AHU***, and ***RTU***
7	0.50	1.00	***MAU***, ***AHU***, and ***RTU***

In Figures G3.12.1-4 through G3.12.1-10, the curve labeled **No Internal** would correspond to the use of external isolation only. Please note that in all cases the transmissibility for external isolation only is lower and, in most instances, much lower than any combination that uses internal and external isolation. The performance of the ***MAU***, ***AHU***, and ***RTU*** with both internal and external isolation approaches the performance of the units with external isolation alone, only as the fan speed increases beyond, say, ***800 rpm***. Also, as the mass of the internally isolated components decreases relative to the mass of the entire unit, the performance of the unit with both internal and external isolation approaches that of the unit with external isolation alone.

Figures G3.12.1-7 and G3.12.1-10 demonstrate conditions that could be potential problems for an ***MAU*** installation. In both cases the external isolation springs have a ***1" Static Deflection***. The ***MAU*** in Figure G3.12.1-7 has internal isolation springs with a ***1" Static Deflection***, and the ***MAU*** in Figure G3.12.1-10 has a ***0.5" Static Deflection*** for the internal isolation springs. Figure G3.12.1-10 represents a possible worst-case scenario. For the case in Figure G3.12.1-4, the transmissibility, T_R, is about ***0.9*** at a fan speed of ***500 rpm***. This means that roughly ***90%*** of the noise and vibration produced by the fan will be transmitted to the structure. For the ***MAU*** in Figure G3.12.1-10, the transmissibility, T_R, at ***500 rpm*** is ***2.85***. This is the potentially dangerous condition of resonance. In this case the vibrations can grow until the ***MAU*** or supporting isolators fail in some manner. Could this latter condition actually occur? If the equipment manufacturer specified the internal isolation springs incorrectly, it is conceivable that the internal isolation springs could

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indeed deflect less than ***1"*** under the weight of the internally isolated components.

Table G3.12.1-3: First and Second Natural Frequencies for Various Types of Equipment with Both Internal & External Isolation.

Case No.	Equipment Type	Static Deflection of Internal Springs Δ_1 (in)	Static Deflection of External Springs Δ_2 (in)	First Natural System Frequency f_{N1} (Hz)	Second Natural System Frequency f_{N2} (Hz)
1	MAU	2.00	1.00	5.06	1.93
1	AHU	2.00	1.00	3.93	2.03
1	RTU	2.00	1.00	3.52	2.11
2	MAU	2.00	2.00	4.09	1.70
2	AHU	2.00	2.00	3.13	1.81
2	RTU	2.00	2.00	2.75	1.91
3	MAU	2.00	4.00	3.59	1.36
3	AHU	2.00	4.00	2.78	1.43
3	RTU	2.00	4.00	2.49	1.49
4	MAU	1.00	1.00	5.78	2.40
4	AHU	1.00	1.00	4.42	2.56
4	RTU	1.00	1.00	3.90	2.70
5	MAU	1.00	2.00	5.07	1.93
5	AHU	1.00	2.00	3.93	2.02
5	RTU	1.00	2.00	3.52	2.10
6	MAU	1.00	4.00	4.42	2.22
6	AHU	1.00	4.00	3.75	1.51
6	RTU	1.00	4.00	3.40	1.53
7	MAU	0.50	1.00	7.17	2.72
7	AHU	0.50	1.00	5.56	2.86
7	RTU	0.50	1.00	4.98	2.98

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Figure G3.12.1-4: Case No. 1 - Transmissibility vs. Fan Speed
Internal Isolation = 2" Static Deflection Springs
External Isolation = 1" Static Deflection Springs

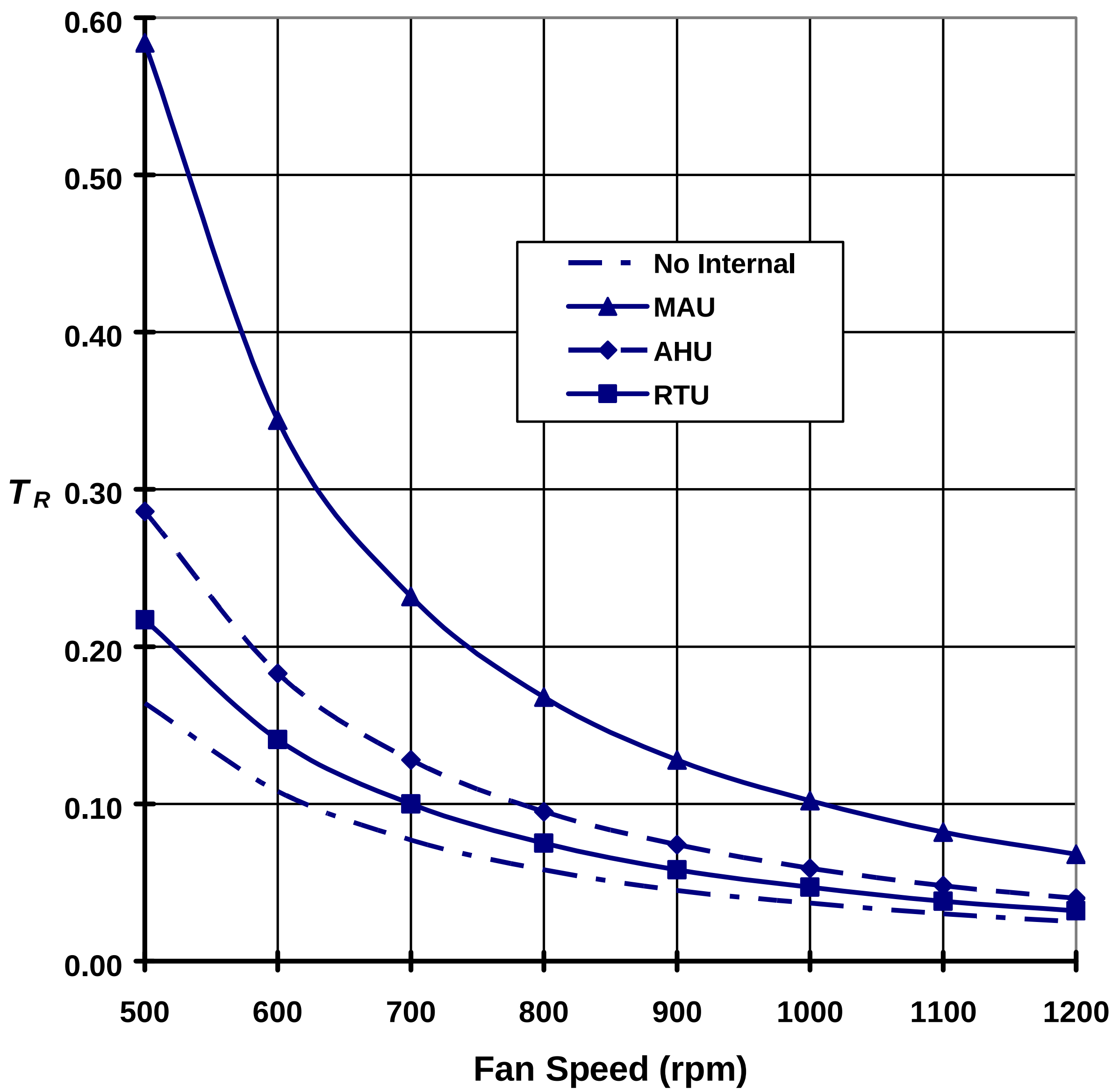

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Figure G3.12.1-5: Case No. 2 - Transmissibility vs. Fan Speed
Internal Isolation = 2" Static Deflection Springs
External Isolation = 2" Static Deflection Springs

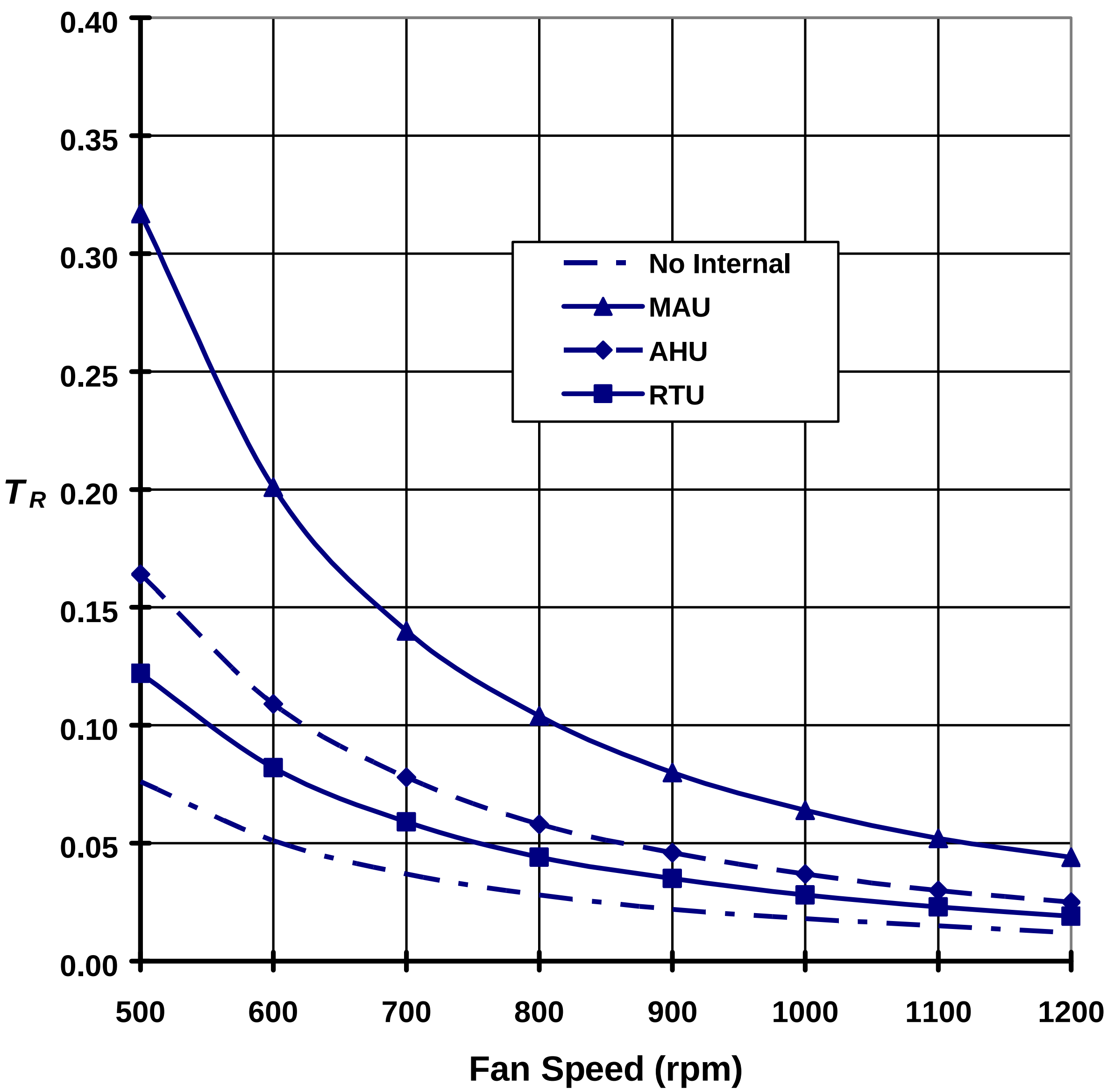

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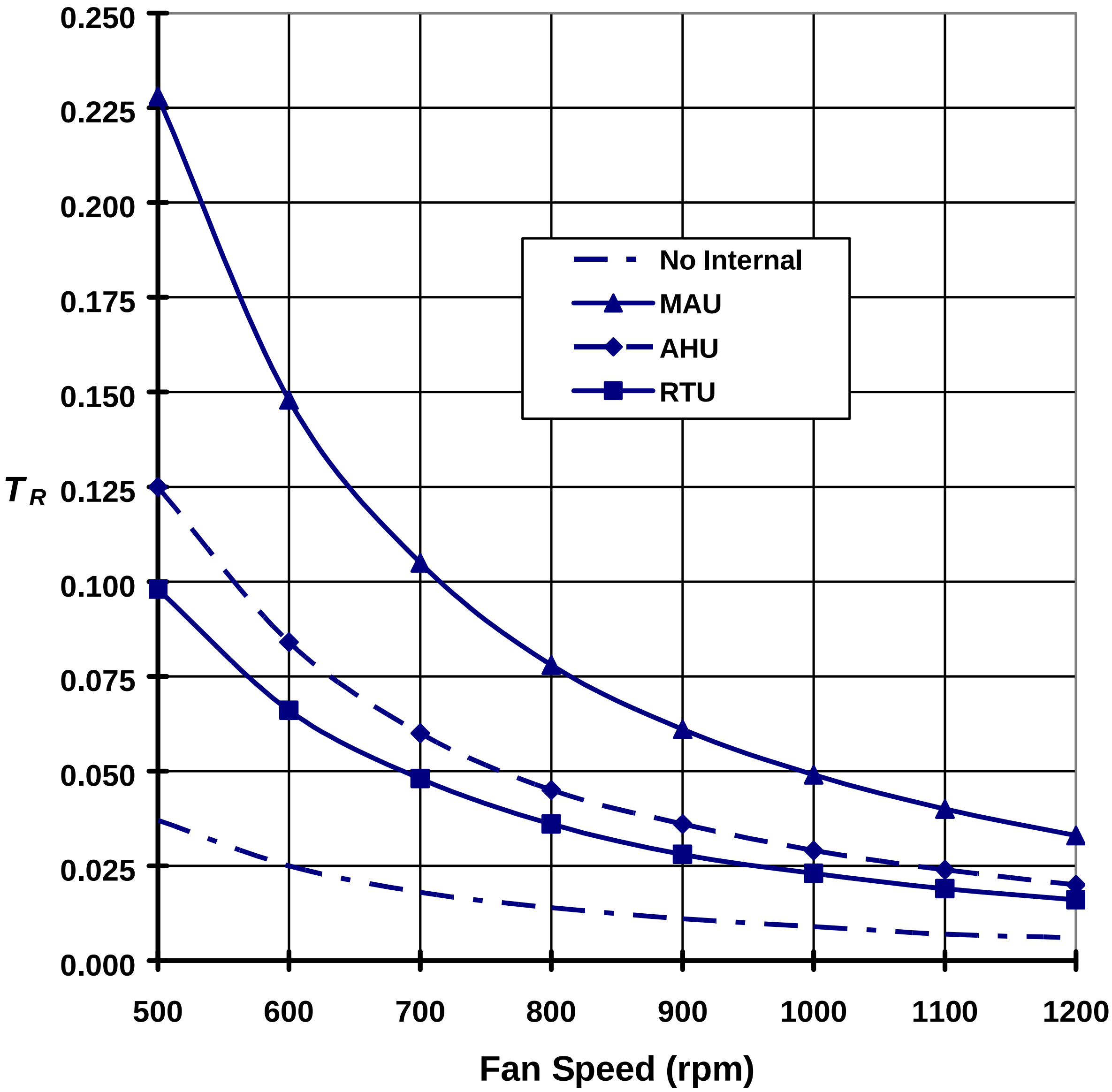
Figure G3.12.1-6: Case No. 3 - Transmissibility vs. Fan Speed
Internal Isolation = 2" Static Deflection Springs
External Isolation = 4" Static Deflection Springs



KINETICS™ Vibration Isolation Manual

PITFALLS OF COMBINING INTERNAL & EXTERNAL EQUIP. ISOLATION

RELEASE DATE: 9/8/04

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G3.12.1
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Figure G3.12.1-7: Case No. 4 - Transmissibility vs. Fan Speed
Internal Isolation = 1" Static Deflection Springs
External Isolation = 1" Static Deflection Springs

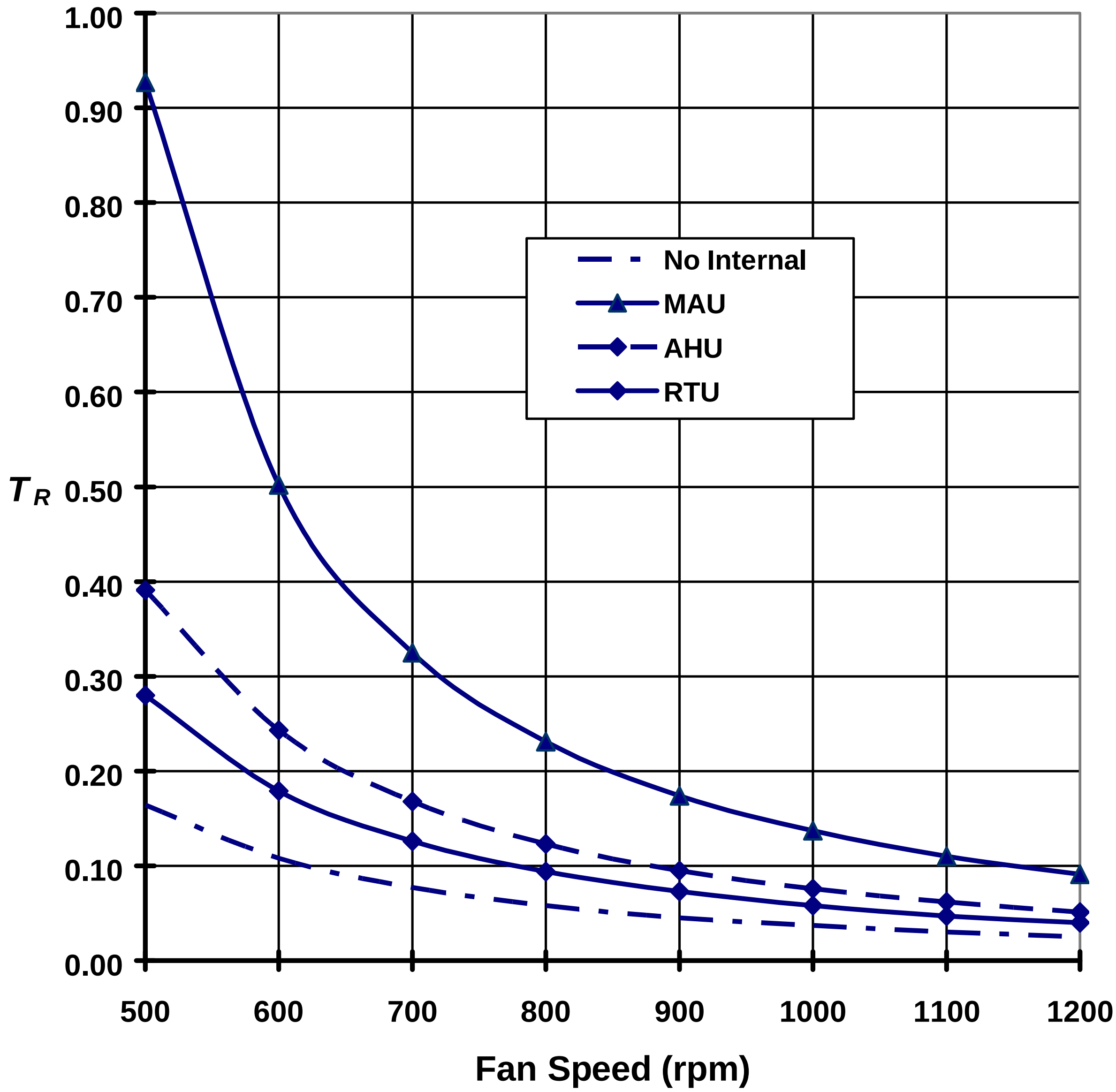

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Figure G3.12.1-8: Case No. 5 - Transmissibility vs. Fan Speed
Internal Isolation = 1" Static Deflection Springs
External Isolation = 2" Static Deflection Springs

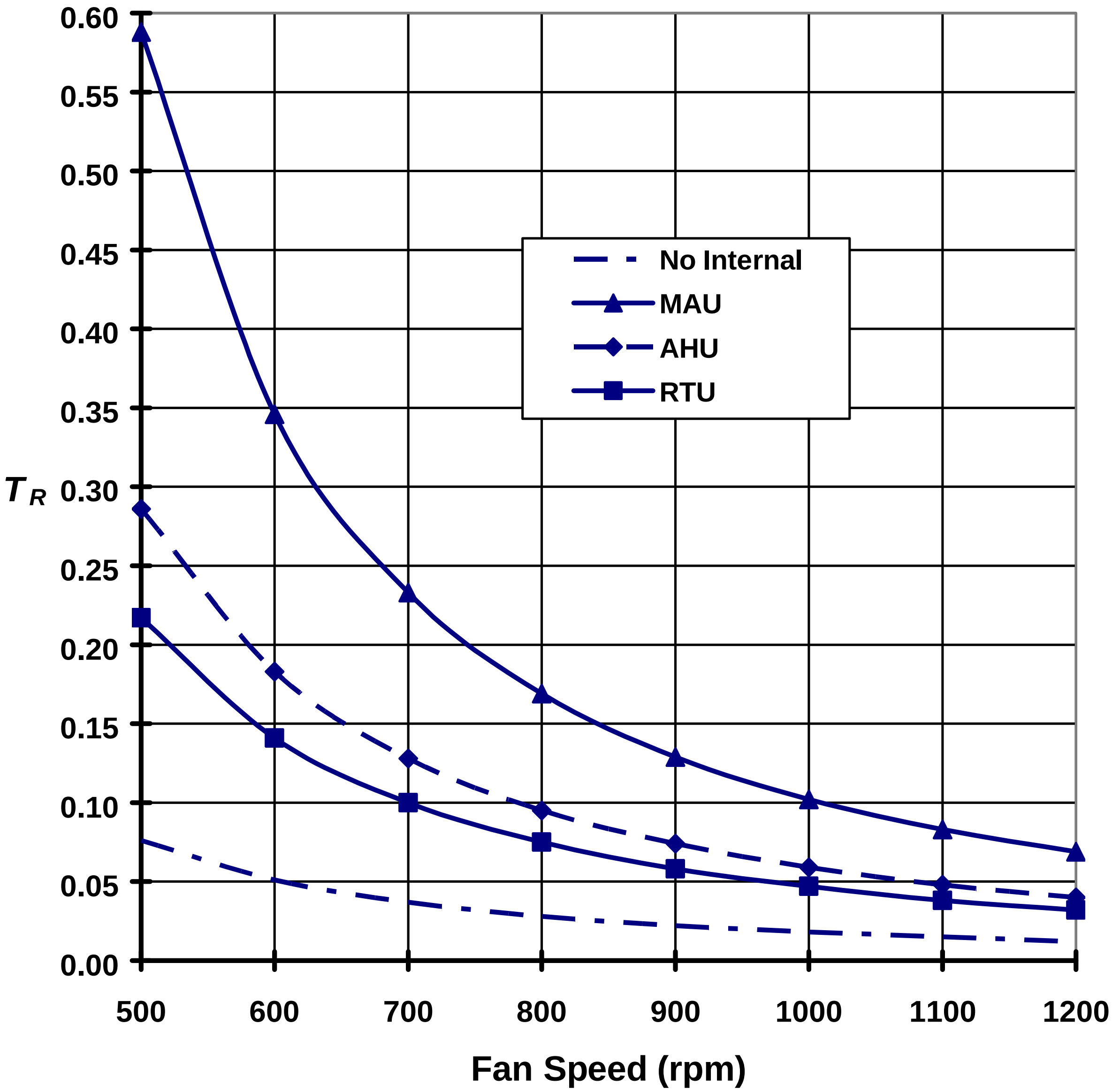

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Figure G3.12.1-9: Case No. 6 - Transmissibility vs. Fan Speed
Internal Isolation = 1" Static Deflection Springs
External Isolation = 4" Static Deflection Springs

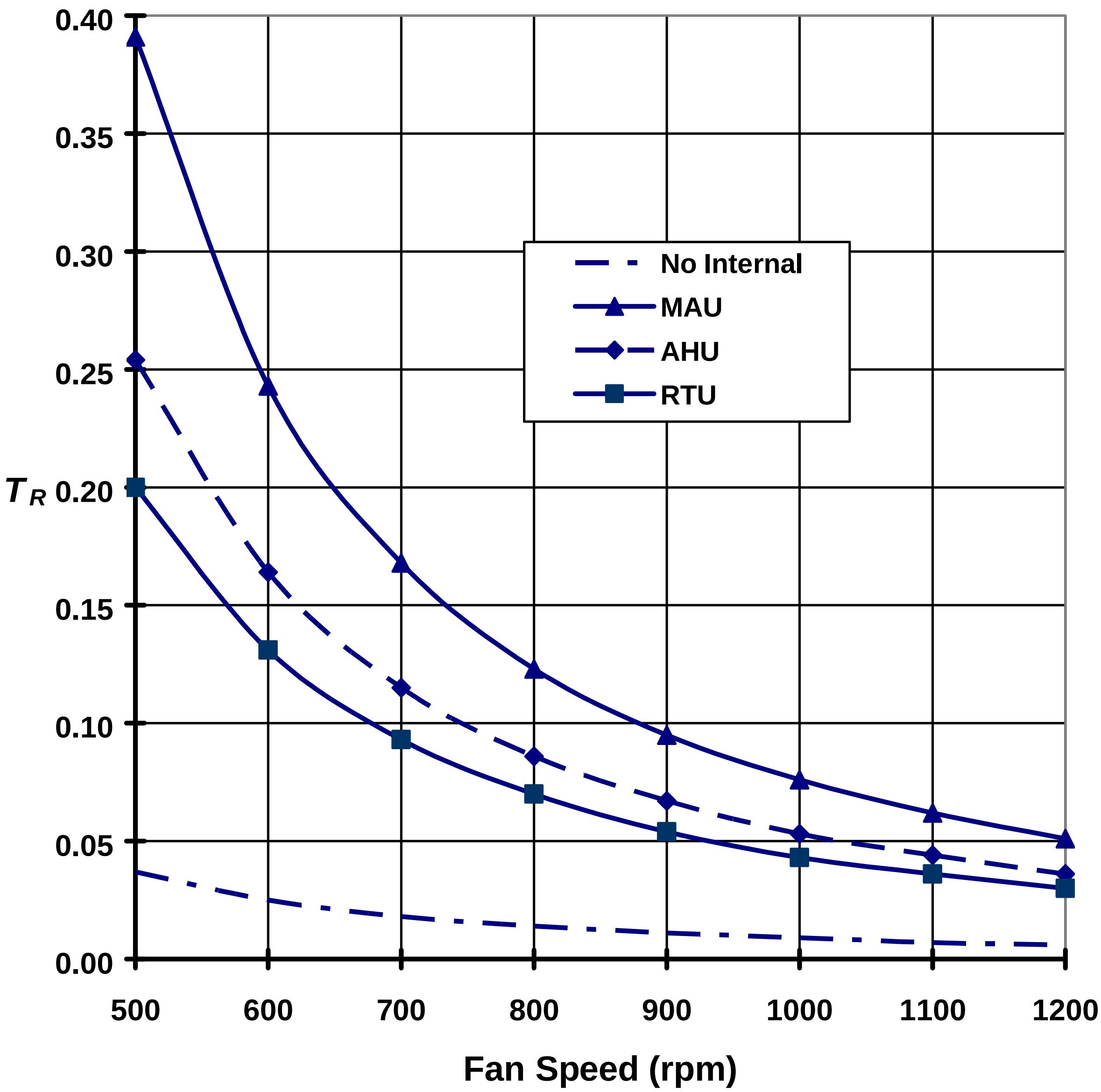

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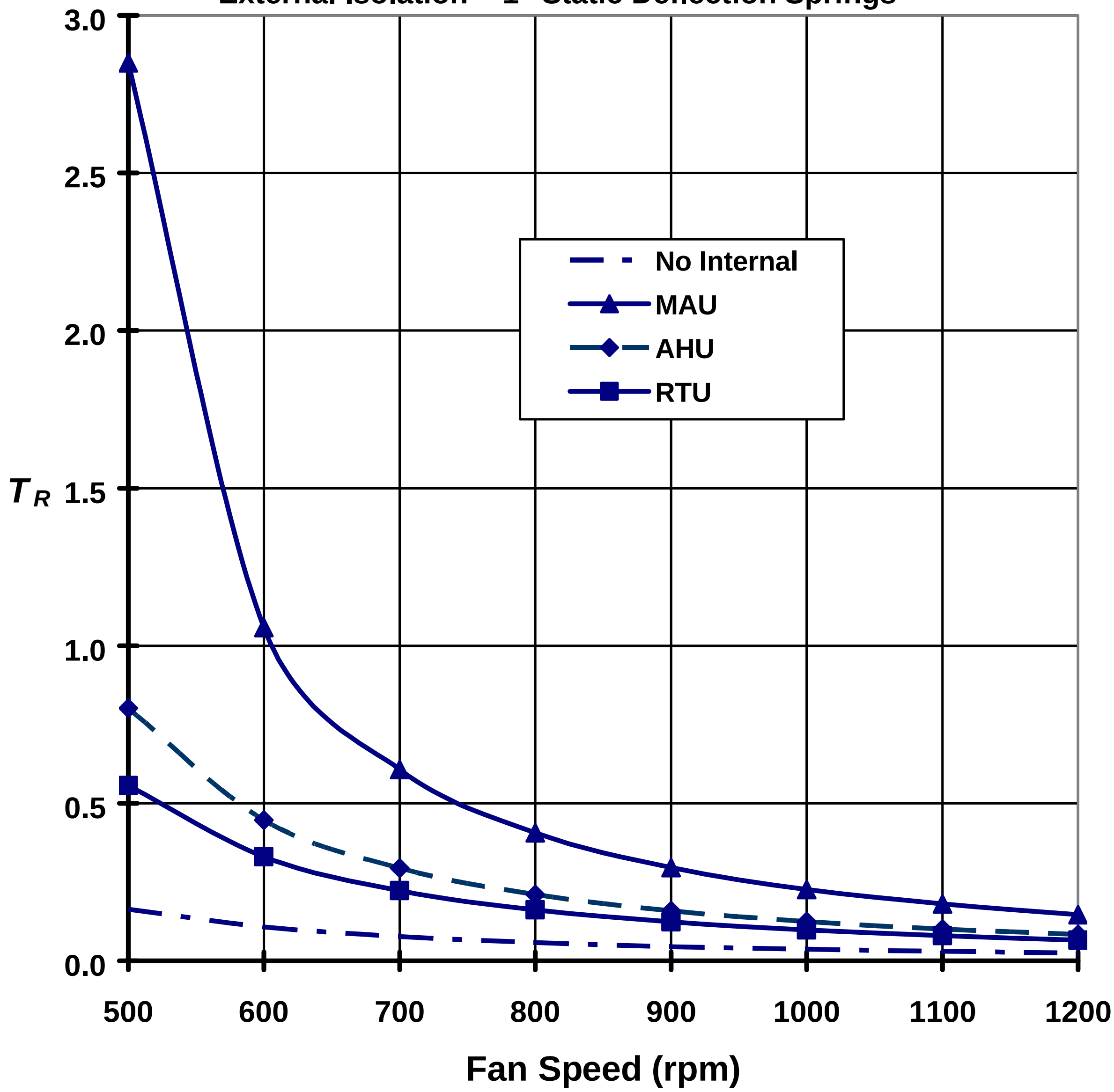
Figure G3.12.1-10: Case No. 7 - Transmissibility vs. Fan Speed
Internal Isolation = 0.5" Static Deflection Springs
External Isolation = 1" Static Deflection Springs



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Figures G3.12.1-4 through G3.12.1-10 clearly demonstrate that the use of external equipment isolation alone will always produce results that will be superior to those achieved by having both internal and external isolation on the same piece of equipment. That is, the external isolation when used by it self will always have a lower value for the transmissibility, T_R, than when used in conjunction with internal isolation. This means that less sound and vibration will be transferred to the building structure when just the external equipment isolation is used. Care should be taken to ensure that the internal isolation springs are "blocked out" before operating the equipment if external equipment isolation has been installed.

Using Only Internal Equipment Isolation:

Many acoustical and vibration isolation consultants feel that the internal isolation provided with the rooftop unit will hold the transmitted vibration and noise to acceptable levels, and sometimes, depending on the application, this may be true. However, keep in mind that there are many instances that will require that the entire cabinet be isolated. These cases will be discussed shortly. First we should examine the curves for the transmissibility for the use of internal equipment isolation alone. Four sets of isolation springs were chosen, ***0.25" Static Deflection***, ***0.50" Static Deflection***, ***1" Static Deflection***, and ***2" Static Deflection***. The ***0.25" Static Deflection*** case is included because this is the deflection range expected for a neoprene isolator. It is possible that some smaller units may in fact use this type of isolator due to space restrictions in the equipment cabinet. The ***0.50" Static Deflection*** case is included to show what can happen if the internal isolation springs are not properly selected. The Transmissibility vs. Fan Speed curves for these four cases are shown in Figure G3.12.1-11.

The use of ***1"*** and ***2" Static Deflection*** springs will produce the same values for the transmissibility, T_R, as seen in Figure G3.12.1-2 for external isolation only. Thus, if the fans are the only source of noise and vibration, the rooftop unit would be adequately isolated for most applications. However, if there are other sources of sound and vibration in the equipment cabinet, they would not be isolated. Also, if the walls of the cabinet were to be excited by the fan, any other internal component, or by the action of the wind, then this sound or vibration would not be isolated from the building.

Internal isolation springs not properly selected will cause sound and vibration issues at fan speeds below ***800 rpm*** or so. The use of neoprene isolators for the fans should be avoided. They will allow excessive noise and vibration to pass on to the building. Below ***600 rpm*** the neoprene springs may even amplify the effects of the sound and vibration that are transmitted to the building.

Finally, for buildings where perceptible transmission of excess sound and vibration is absolutely unacceptable, the use of ***4" Static Deflection*** external isolation springs alone is recommended for rooftop units.

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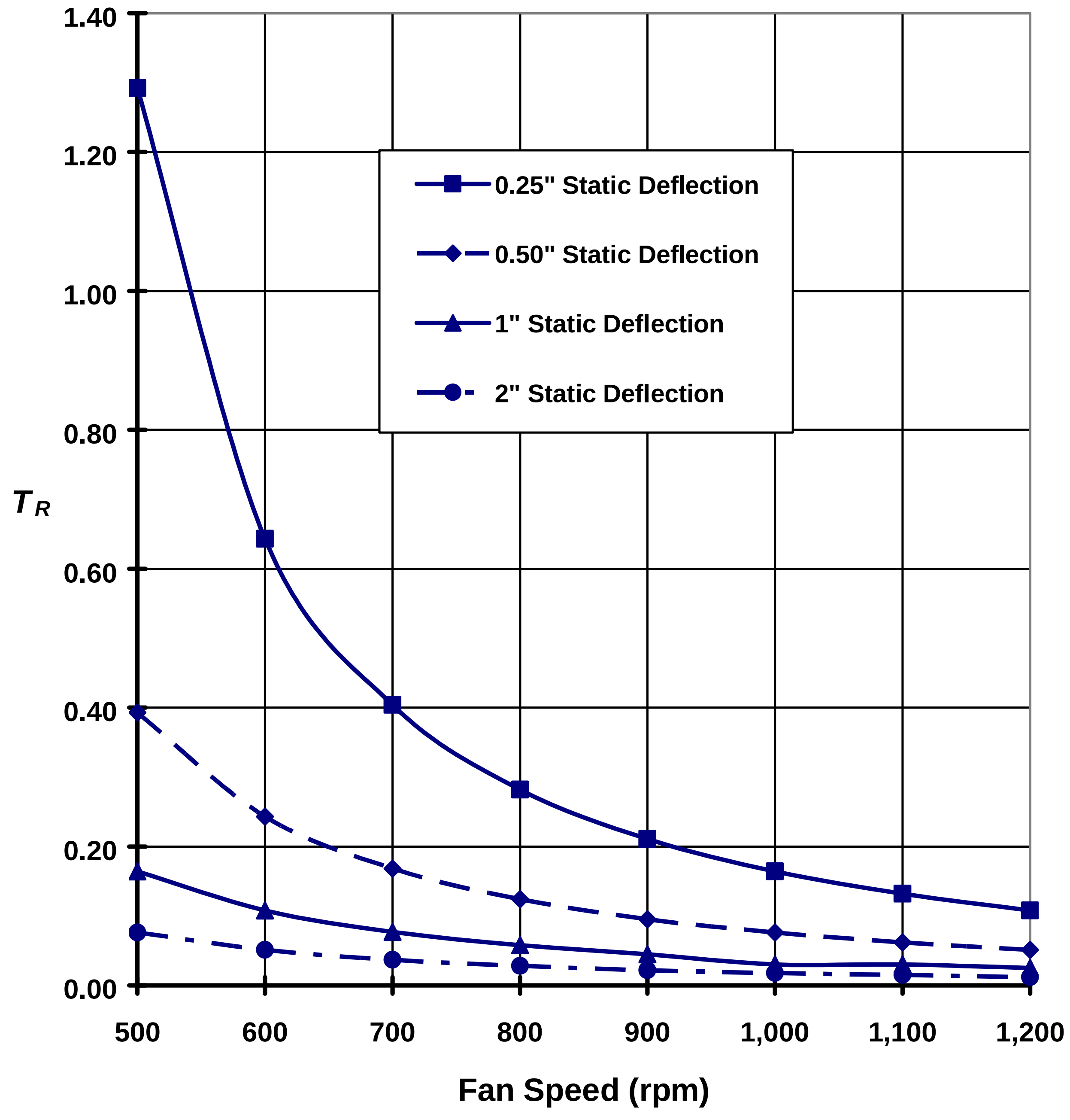
Figure G3.12.1-11: Transmissibility vs. Fan Speed
Internal Isolation Only



KINETICS Noise Control
DUBLIN, OHIO, USA • MISSISSAUGA, ONTARIO, CANADA

Toll Free (USA only): 800-959-1229
International: 614-889-0480
Fax: 614-889-0540
World Wide Web: www.kineticsnoise.com
Email: sales@kineticsnoise.com

Conclusions:

1.) In all cases investigated, equipment that had external isolation only had lower transmissibility values than equipment with both internal and external isolation.
2.) The harmful effects of using both internal and external isolation are amplified as the operating speed of the internally isolated components decreases. The reason for this is shown in the first natural frequency indicated in Table G3.12.1-3. They are, in some instances, very close to the forcing frequency of a ***500 rpm*** fan which is ***8.33 Hz***.
3.) As the mass of the internally isolated components increases relative to the mass of the entire unit, the harmful effects of the internal and external isolation become more pronounced. When the mass of the internally isolated components becomes a significant percentage of the whole mass of the unit, the use of internal and external isolation could have disastrous results when combined with the lower fan speeds.
4.) In some of the cases in Table G3.12.1-3, the first natural frequency of the internally and externally isolated equipment approached the natural frequency of some buildings. In these cases, significant transmission of low frequency noise and vibration could be expected.
5.) Any condition that moves the ***C.G.*** of the internally isolated components and/or the entire piece of equipment off of the geometric center of the equipment will introduce additional degrees of freedom to the system. This will result in additional natural frequencies, resonance conditions, which must be avoided. Thus it behooves the owner to reduce the number of resonance conditions by eliminating the internal or the external isolation. However, as demonstrated above, external isolation performs better than internal isolation.
6.) If both internal and external isolation are specified, choose external isolation springs with a set of either ***2"*** or ***4" Static Deflection*** springs based on the entire mass of the equipment. The external isolation springs with the ***4" Static Deflection*** are preferable.
7.) If the equipment installation is sensitive to the transmission of vibration and noise, internal isolation should not be used. The use of external isolation alone always produces better results than the use of both internal and external isolation. The external isolation springs recommended most often for sound and vibration sensitive applications have a ***4" Static Deflections***. Springs with such high static deflections are not usually applicable for internal isolation. This is primarily due to the limited space available inside the equipment cabinet.
8.) For applications with external isolation only, any internal isolation springs on the fans should be "blocked out". The exceptions would be neoprene mounting grommets that are used on high speed components such as screw-type compressors, and fans with operating speeds over ***1200 rpm***.
9.) If internal isolation is to be used rather than external isolation, the "blocking" used to immobilize the fan during shipment and installation of the rooftop unit must be removed.

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Email: sales@kineticsnoise.com

DWG # MS-M-601 K13 EQUIMENT RAILS

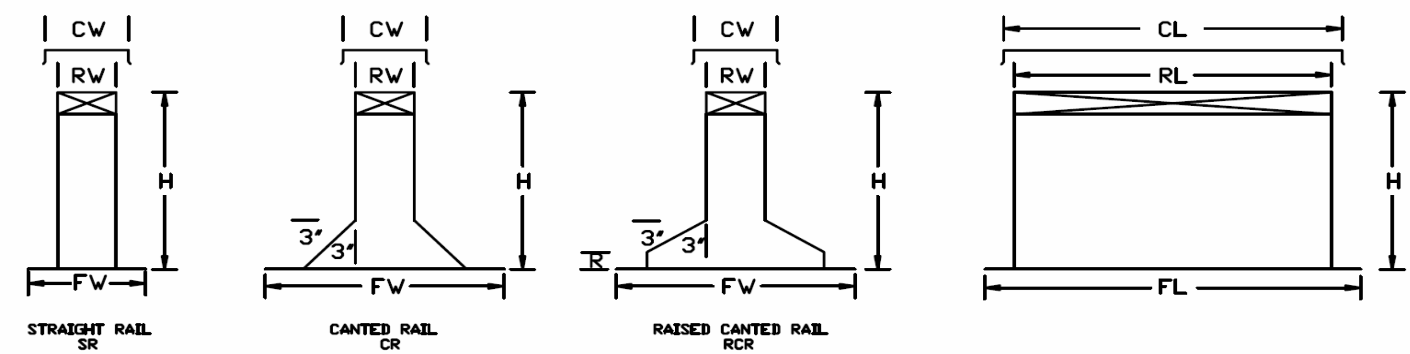
HRANEC SHEET METAL INC., ROOF CURBS **EQUIPMENT RAILS** **724-437-2211**

Standard Construction

- 18 GAUGE GALVANIZED
- FULLY WELDED CONSTRUCTION
- 2" FLANGE OUT
- 2" x 4" WOOD NAILER

Optional Features

- ☐ ALUMINUM CONSTRUCTION
- ☐ 2X6 WOOD NAILER
- ☐ ______________________



Tag	Type	Qty	RW	RL	FW	FL	H	CW	CL
HP-MS-3,4,5,6,7,8,9	SR	14	8"	60"	12"	64"	18"	9"	62"
HP-HS-ACCU-2	ATTACHED	AS	PER	D&B	SUBMITTAL				

Hranec Sheet Metal, Inc.
763 Route 21
Uniontown, PA 15401
Phone: (724) 437-2211
Fax: (724) 437-2233

P.O. Number : ______________________

Customer: ______________________

Project: ______________________

Location: ______________________

Architect: ______________________

HP- MS-3,4,5,6,7,8,9 weigh 528 lbs

NOTE ATTACHED KINETICS REPORT NOT TO USE EXTERNAL VIBRATION ISOLATION ON INTERNALLY ISOLATED EQUIPMENT. ALSO NOT RECOMMENED ON BY DAIKIN WITH REGARDS TO THE REFRIGERANT CONNECTED PIPING

LDR 1" DEFLECTION ISOLATION RAIL SET

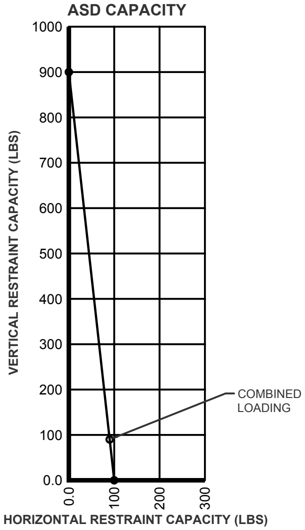
IP UNITS (INCHES AND POUNDS)

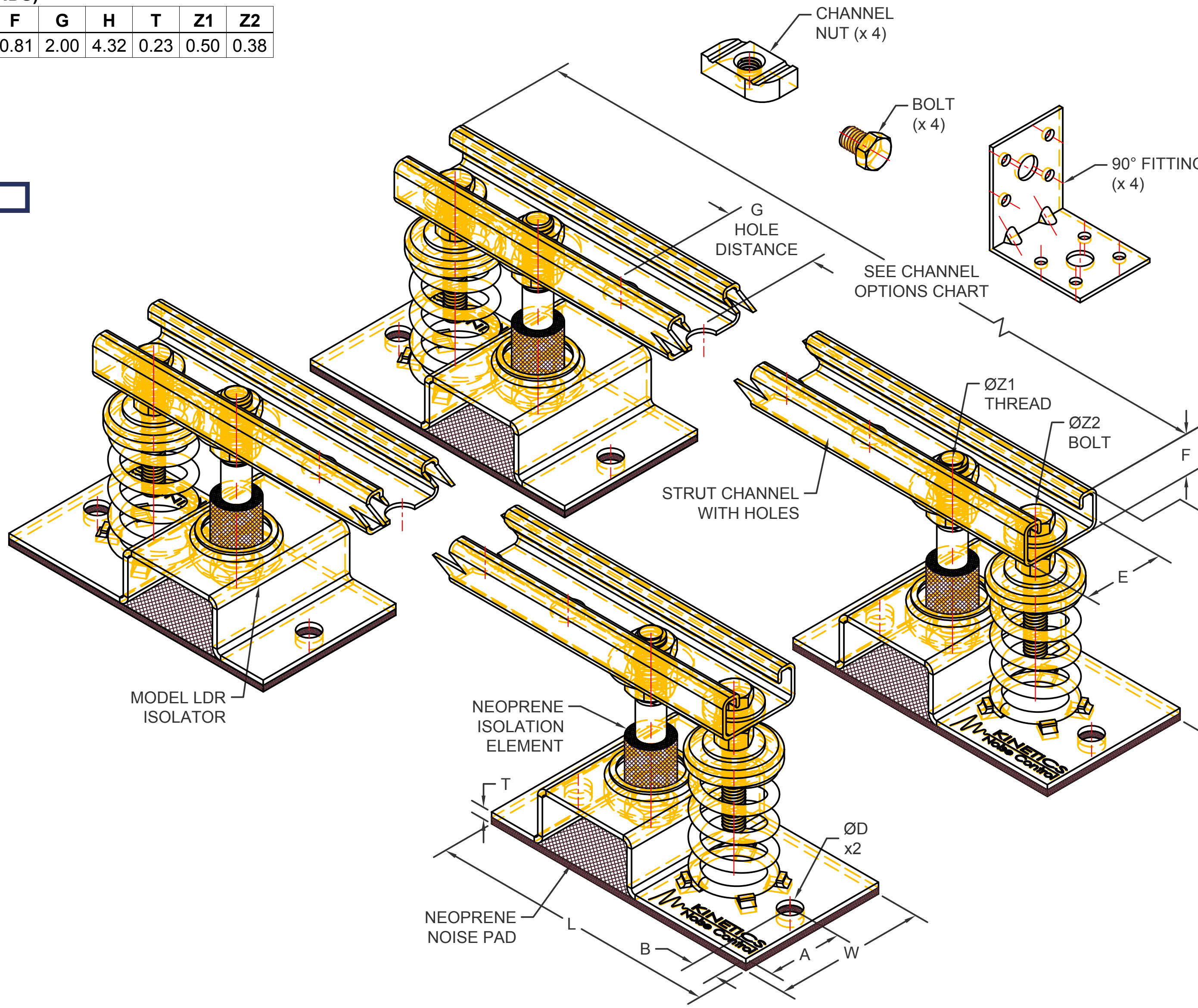
TYPE	L	W	A	B	D	E	F	G	H	T	Z1	Z2
1-120/820	5.75	3.00	1.50	0.50	0.44	1.63	0.81	2.00	4.32	0.23	0.50	0.38

STANDARD RATINGS		SPRING COIL			SYSTEM RATED	
TYPE	SIZE	COLOR	FREE HT.	O.D.	LOAD	DEFL.
LDR	1-120	BLUE	2.50	1.46	120	1.00
LDR	1-260	GREEN	2.50	1.46	260	1.00
LDR	1-480	GRAY	2.50	1.46	480	0.95
LDR	1-820	BROWN	2.50	1.46	820	0.95

STRUT CHANNEL OPTIONS	
OPTION	LENGTH (IN)
B	24.00
C	48.00

LDR SINGLE ISOLATOR ASD CAPACITY





SPECIFICATIONS:

- ALL HARDWARE IS BRIGHT ZINC PLATED.
- HOUSING IS ZINC PLATED STEEL.
- SPRING COILS ARE POWDER COATED STEEL.
- ALL ELEMENTS ARE SAFE AT SOLID LOADING.
- LDR ISOLATION RAILS ARE TYPICALLY SOLD IN PAIRS.
- LDR ISOLATORS ARE DESIGNED TO BE USED WITH STANDARD UNISTRUT P4100 HS CHANNEL OR EQUAL.
- STRUT CHANNEL USES STANDARD CHANNEL NUTS WHICH CAN BE PURCHASED SEPARATELY.

KINETICS Noise Control

VISCMA VIBRATION ISOLATION & SEISMIC CONTROL MANUFACTURERS ASSOCIATION

KINETICS NOISE CONTROL, INC
6300 IRELAN PL,
DUBLIN, OH 43017 USA
Ph: 614 889-0480, Fax: 614 889-0540
www.kineticsnoise.com

Model:	By: BB	Drawing No:
LDR-1-120/820 ISOLATION SET	Date: 01/23/17	S-01.19-10
	Revised: 02/05/18 / BB	

KINETICS® LDR

LIGHT DUTY EQUIPMENT ISOLATION RAIL

Features

- Cost effective isolation solution for light weight rooftop isolation
- Zinc plated steel housing
- Bright zinc plated hardware
- Seismic and wind restraint certifications available
- Currently available in 1" deflection. 2" deflection coming soon.
- Shipped assembled with four (4) isolators, two (2) lengths of strut, and four (4) equipment attachment clip assemblies. All hardware is provided to mount the equipment to the rail.
- Load capacities up to 820 lbs per set of four (4) isolators (up to 205 lbs per isolator)
- Can be used on a single unit or multiple units farmed together using longer strut and custom quantities of isolators

Description

Kinetics® LDR light duty rail isolation system is a low-cost solution designed to isolate residential style condensing units and other light weight equipment (small fans, mini split systems, etc.). LDR eliminates vibration from penetrating into the structure and occupants below.

Standard LDR isolation system orders will include four (4) seismic isolators with snubbers, two (2) pieces of 24" or 48" Unistrut (custom sizes available), and four (4) equipment attachment clip assemblies (clips, strut nuts, and clip bolts).

Application

LDR light duty rail isolation system is recommended for the isolation of rooftop condensing units to eliminate vibration from penetrating into the structure below and disturbing the occupants. LDR is used to isolate an individual condensing unit and is fully customized into long lengths of strut with custom quantities of isolators for large numbers of units in a single area.

KINETICS Noise Control®

Specification

Isolation system shall be comprised of two (2) independent support rails with adjustable equipment mounting clips each supported by two (2) seismic and wind resistant housed spring isolators. The springs shall have all of the characteristics of free standing coil spring isolators per section D below. Isolators shall consist of a single laterally stable steel coil spring assembled into steel housings designed to limit movement of the supported equipment in all directions.

Housing assembly shall be a steel member that includes provisions for attachment to structural or elevated roof island elements. It shall interface with a coil spring leveling assembly and a 3-axis restraint snubbing element that shall bolt directly to the underside of the equipment support rail. The housing shall be fitted with integral non-skid isolation pads and holes for anchoring the housing to the supporting structure. Housing shall be zinc plated for outdoor corrosion resistance. Housing shall be designed to provide a constant free and operating height within 1/8" (3 mm).

The isolator housing shall be designed to withstand the project design seismic forces in all directions.

Coil spring elements shall be selected to provide static deflections of either 1 or 2 inches as shown on the vibration isolation schedule or as indicated or required in the project documents. Spring elements shall be color coded or otherwise easily identified. Springs shall have a lateral stiffness greater than 1.1 times the rated vertical stiffness and shall be designed to retain a minimum of 0.75 inch travel beyond the rated capacity to accommodate overloads. Non-welded spring elements shall be epoxy powder coated and shall have a minimum of a 1000 hour rating when tested in accordance with ASTM B-117.

Spring rail assembly shall be model LDR as manufactured by Kinetics Noise Control.

STANDARD RATINGS		SPRING COIL (SINGLE ISOLATOR)				
					RATED	
TYPE	SIZE	COLOR	FREE HT.	O.D.	LOAD lbs (kg)	DEFL. in (mm)
LDR	1-120	BLUE	2.50 (64)	1.46 (37)	120 (54)	1.00 (25)
LDR	1-260	GREEN	2.50 (64)	1.46 (37)	260 (118)	1.00 (25)
LDR	1-480	GRAY	2.50 (64)	1.46 (37)	480 (218)	0.90 (24)
LDR	1-820	BROWN	2.50 (64)	1.46 (37)	820 (372)	0.90 (24)

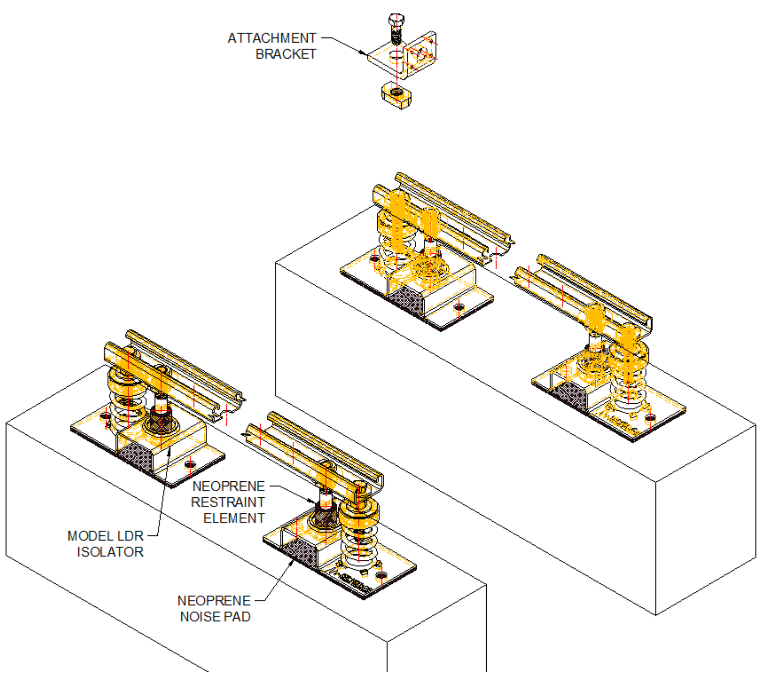
KINETICS Noise Control®

kineticsnoise.com
sales@kineticsnoise.com
1-800-959-1229

LDR Installation Guidelines

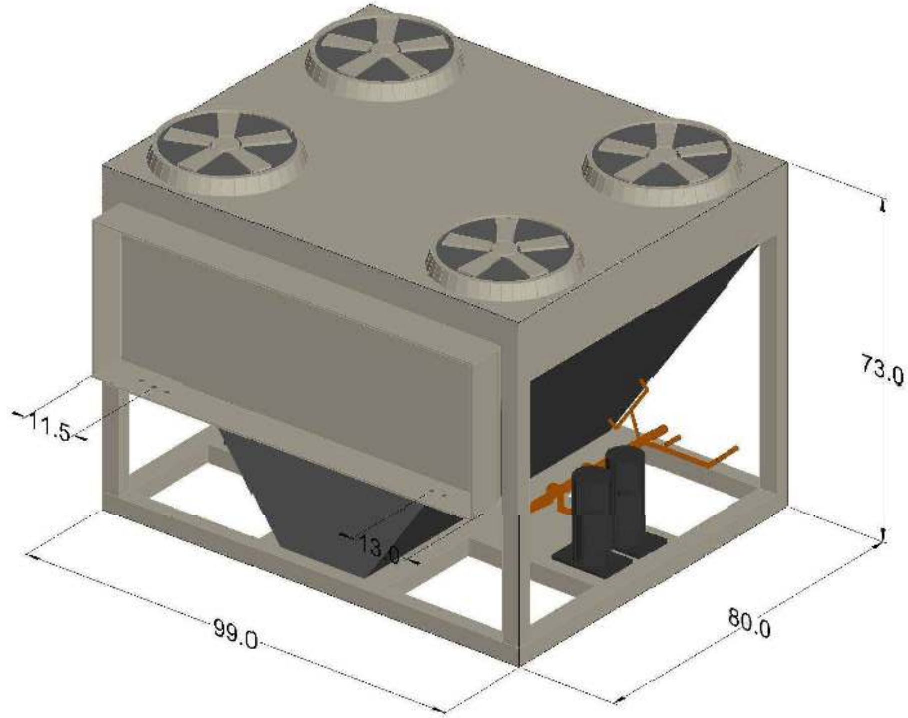
Model LDR is comprised of two (2) side-by-side rail assemblies, each supported by two (2) Isolator/restraint components. These are intended to be mounted on either a single platform or on side-by-side islands.

1) Layout the rails in the approximate final desired location, ensure that the spacing between them is compatible with the attachment points and/or geometry of the equipment to be supported and that the center of gravity of the equipment is approximately midway between the support channels.
2) Center the neoprene restraint elements in the isolator bracket holes allowing approximately equal clearance all the way round at all 4 locations.
3) Ensure that the isolator bases are square and aligned with the support channels.
4) Mark holes and install the attachment hardware for the LDR isolators.
5) Install the isolated equipment on channels using the equipment attachment brackets, channel bolts and nuts. Ensure that it is at operating weight.
6) Attach the equipment to the attachment brackets using #10 self-tapping screws or the bolts holes provided. Fully tighten the channel bolts and nuts.
7) Adjust the coils by turning their leveling screws one turn at a time in sequence as you move around the unit. When the vertical snubber in 1 corner lifts off the load pad, stop adjusting that location but continue with the remainder. Repeat the process until all locations are loose.
8) Turn each leveling screw 3 more turns to achieve approx. 1/4-inch clearance between the restraint bolt head and the neoprene noise pad.



Kinetics Noise Control, Inc., 6300 Irelan Place, Dublin, Ohio, 43017
Telephone: 614-889-0480 | Fax: 614-889-0540
www.kineticsnoise.com | sales@kineticsnoise.com

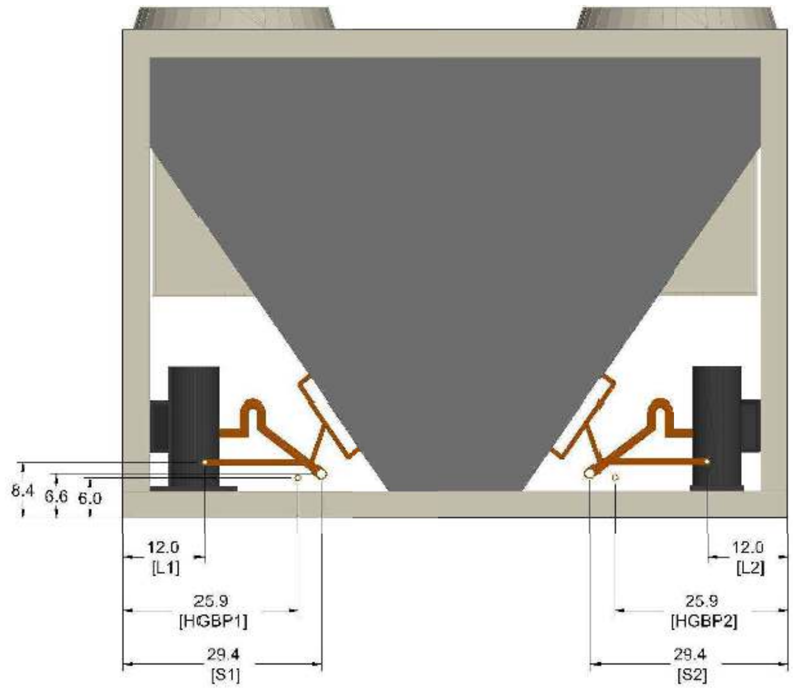
HS-HP- ACCU-2



Product Drawing	Unit Tag: ACCU-HS-2			Sales Office: D&B Building Solutions LLC	
Product:	Project Name: Nanuet & Barr Bond			Sales Engineer:	
Model: RCS045D	Aug. 23, 2023	Ver/Rev:	Sheet: 1 of 1	Scale: NTS	Tolerance: +/- 0.25"	Dwg Units: in [mm]

DAIKIN
13600 Industrial Park Blvd. Minneapolis, MN 55441
www.DaikinApplied.com Software Version: 09.40

No change to this drawing may be made unless approved in writing by Daikin Applied. Purchaser must determine that the equipment is fit and sufficient for the job specifications.

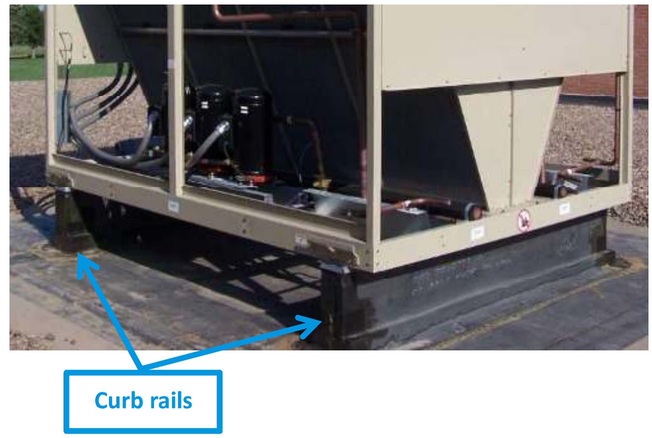


ELEVATION VIEW - PIPE CONNECTION DETAILS

Product Drawing	Unit Tag: ACCU-HS-2			Sales Office: D&B Building Solutions LLC			DAIKIN 13600 Industrial Park Blvd. Minneapolis, MN 55441
Product:	Project Name: Nanuet & Barr Bond			Sales Engineer:			
Model: RCS045D	Aug. 23, 2023	Ver/Rev:	Sheet: 1 of 1	Scale: NTS	Tolerance: +/- 0.25"	Dwg Units: in [mm]	www.DaikinApplied.com Software Version: 09.40

RCS-D Vintage Curb Rails

Part Number: 500518001



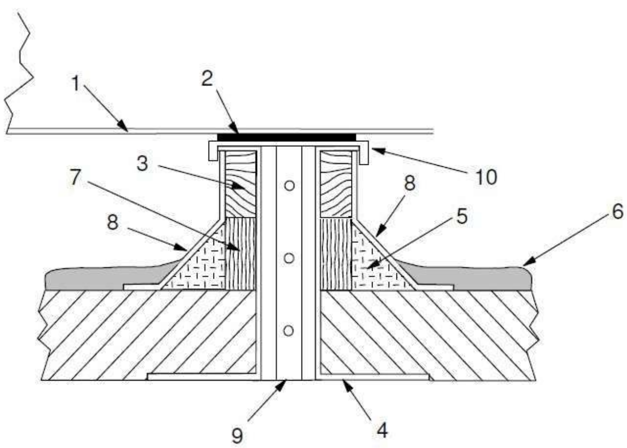
Description

Daikin's curb rails provide support for the RCS condensing unit with two 'floating' rails. These rails are spaced apart to properly support the unit at four corners. These rails are rigid and do not carry any wind or seismic certifications.

Components

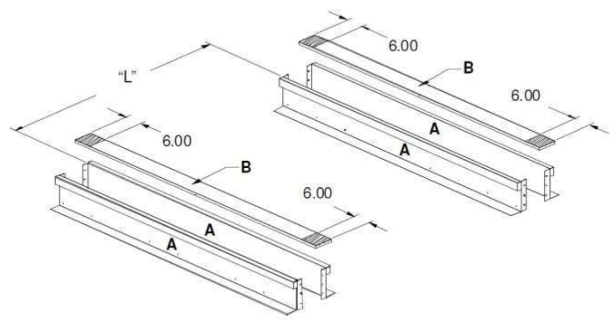
1. Unit Base
2. Curb gasketing
3. 2 x 4 nailer strip
4. Galvanized curb
5. Cant strip*
6. Roofing material*
7. Rigid insulation*
8. Flashing*
9. Insulation between galvanized curb*
10. Galvanized curb cover

** NOT FURNISHED*



Rail Dimensions

Model	"L" in.
015D, 020D, 025D	45
030D, 035D, 040D, 045D, 050D, 060D, 062D, 068D	58
042D, 070D, 072D, 075D, 080D, 085D, 090D, 092D, 100D, 105D	81
110D, 120D, 125D, 130D, 140D	114



Assembly Instructions

1. Set curbing parts “A” in place making sure that the orientation agrees with the assembly instructions. Check alignment of all mating bolt holes.
2. Bolt curbing parts together using fasteners provided. Securely tighten all bolts.
3. Curb must be level within .50” from side to side and .50” over its length.
4. Weld curb assembly in place. Caulk all seams watertight and insulate between channels.
5. Flash curbing into roof as shown in roof detail “A”.
6. Set curbing part “B” into place. Remove backing from .25” thick x 1.50” wide gasketing and apply to surface shown by crosshatching.

THIS IS WHATS CALLED FOR BUT EXTERNALL INSOLATION IS NOT REQUIRED ON INTERNALLY ISOLATED EQUIPMENT MOUNTED ON EQUIPMENT RAILS AND HAS A NEGITIVE IMPACT ON REFRIGERANT LINES CONNECTED

DAIKIN AND LOMBARDO DO NOT RECOMMEND EXTERNAL VIBRATION ISOLATION

Vibration Isolation Kit

Description

Vibration isolation kits come with springs for installation on each corner of the RCS condensing unit. Each kit has different springs for the different unit weights. For ease of installation the springs go in the same spots for the 15-25 ton models and in the same location for the 30-140 ton models.

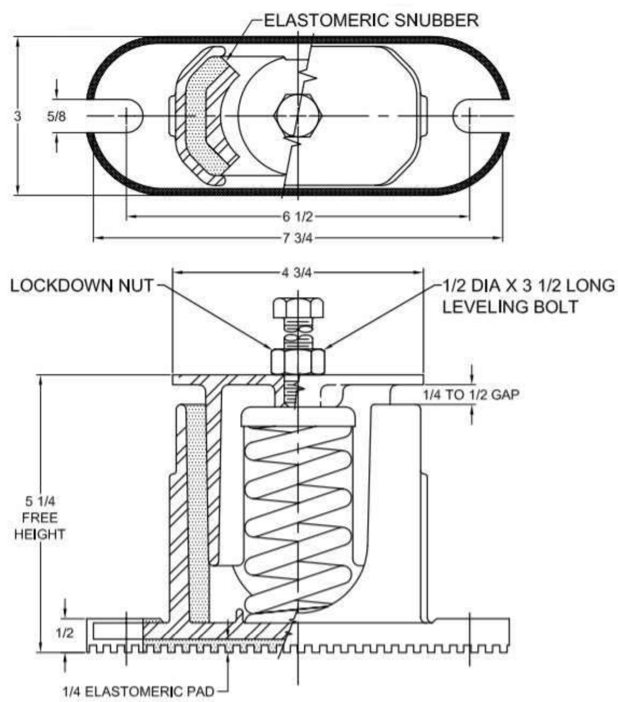
Application

Vibration isolation kits are used to help absorb shocks or tremors generated by the unit (compressors coming on, fans, etc.) reducing the energy transferred to the building structure. Each unit has its own vibration kit per the weight of the unit frame, compressors, and fan arrangements.

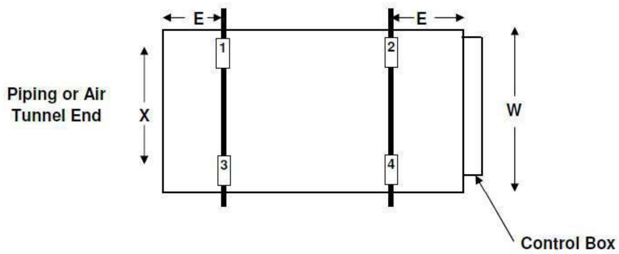
Photos courtesy of The VMC Group, vendor may vary.

Multiple thickness and colors

Dimensions



Spring Placement

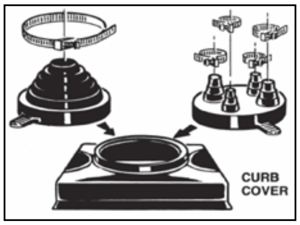


Dimension	Measurement
E	9.5”
W	99”
X	94”

Spring Specifications

TYPE CE-1D CAST IRON SPRING-FLEX ISOLATORS WITH EXTERNAL ADJUSTMENT				
MODEL	MAX LOAD (LBS)	DEFLECTION (IN)	SPRING RATE (LB/IN)	SPRING COLOR CODE
CE-1D-85	85	1.35	60	LT PURPLE
CE-1D-120	120	1.20	100	DK YELLOW
CE-1D-175	175	1.17	150	DK BLUE
CE-1D-250	250	1.40	179	YELLOW
CE-1D-340	340	1.13	300	RED
CE-1D-510	510	1.02	500	BLACK
CE-1D-675	675	1.32	513	DK PURPLE
CE-1D-900	900	1.02	881	DK GREEN
CE-1D-1200	1200	0.90	1327	GRAY
CE-1D-1360	1360	0.77	1758	WHITE
CE-1D-1785N[1]	1785	0.88	2029	GRAY/RED

pipe portals - i could not find a spec to submitt them under.



Standard Construction

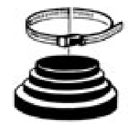
- 18 GAUGE GALVANIZED
- FULLY WELDED CONSTRUCTION
- 1.5", 3LB. DENSITY INSULATION
- 2" FLANGE OUT
- 2" x 2" WOOD NAILER

*RP-481
4 - 3/8" to 1"

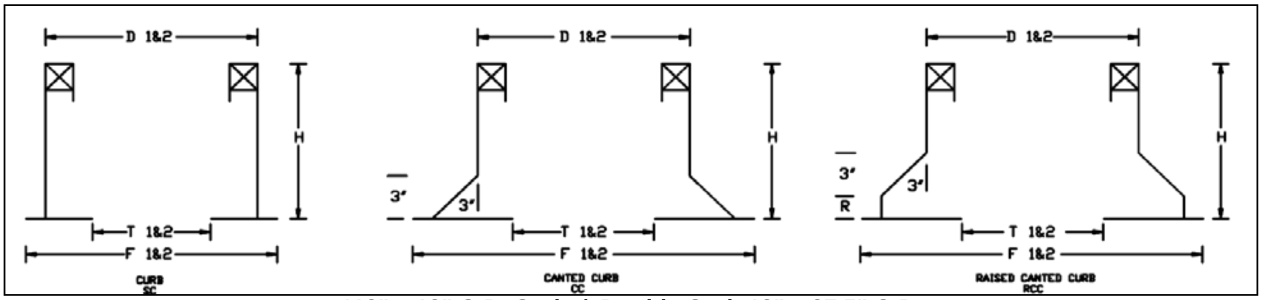
*RP-412
4 - 1" to 2"

*RP-212
2 - 3/8" to 1"
2 - 1" to 2"

*RP-126
1 - 2" to 6"



**N - 182
1 - 8" to 12"



***12" x 12" O.D. Curb / Double Curb 12" x 27.5" O.D.**
****20" x 20" O.D. CURB**

Tag	Cap Model	Curb Type	W (O.D.)	D (O.D.)	H	R	Quantity	Notes
HP-MS-	RP-212	SC	12	12	18"	-	7	
3,4,5,6,7,8.9								
ACCU-HS-2	RP-212	SC	12	12	18"	-	3	

Hranec Sheet Metal, Inc.
763 Route 21
Uniontown, PA 15401
Phone: (724) 437-2211
Fax: (724) 437-2233
www.hraneccurbs.com

P.O. Number : ______________________

Customer: ______________________

Project: ______________________

Location: ______________________

Architect: ______________________

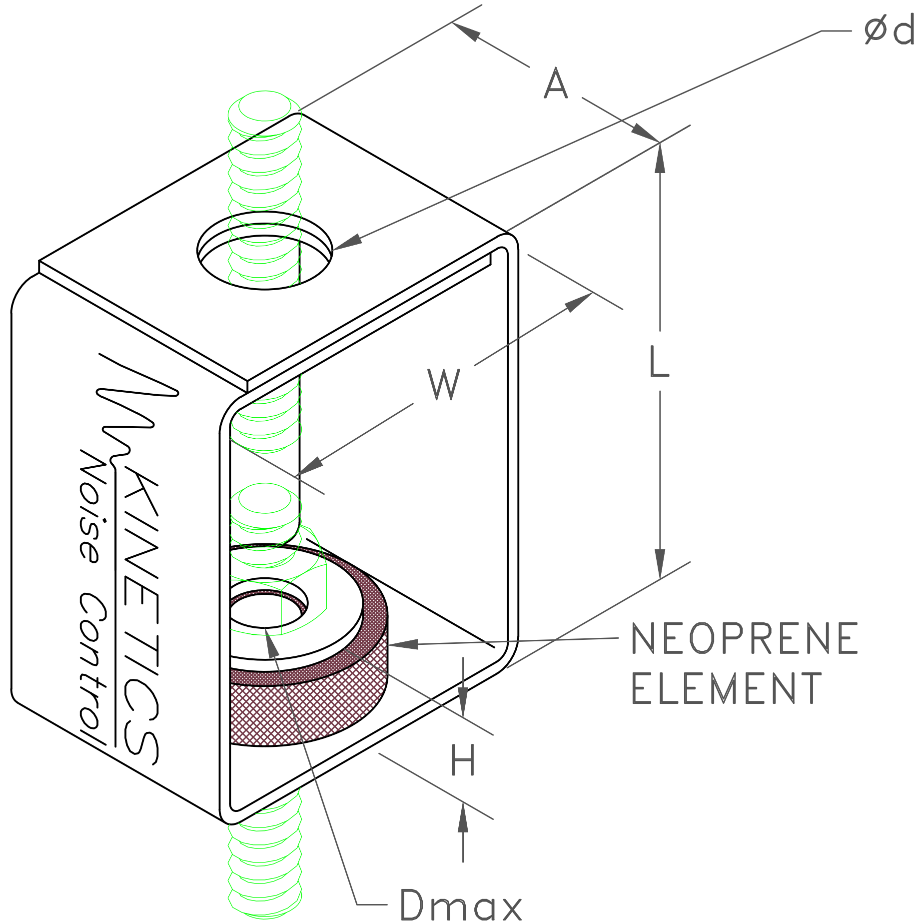
3.3 - b - 1 72 UNIT HEATERS AND CABINET HEATERS HUNG IN CIELING

RH-A HANGER

IP UNITS (INCHES AND POUNDS)

TYPE	L	W	A	Dmax	H	Ød
RH-75A/125A	2.72	2.15	1.50	0.38	0.45	0.69

STANDARD RATINGS			
		RATED	
TYPE	SIZE	LOAD	DEFL.
RH	75A	75	0.09
RH	125A	125	0.04



SPECIFICATIONS:

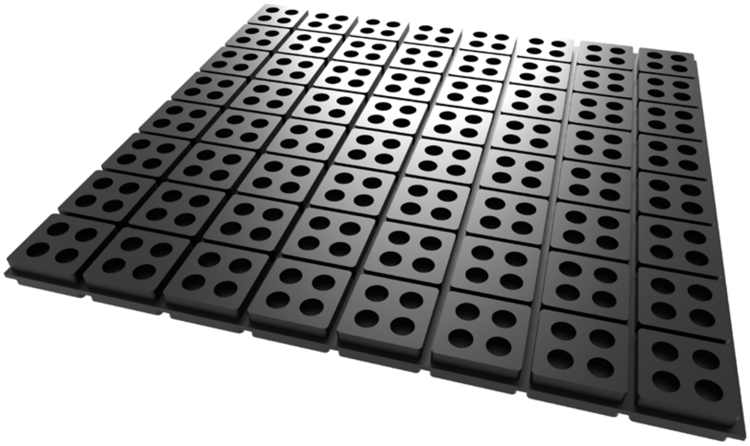
- HANGER BRACKETS ARE BRIGHT ZINC PLATED.
- RATED LOADS ARE MAXIMUM CONTINUOUS OPERATING LOADS.
- HANGER BRACKETS WILL CARRY (5) TIMES OVERLOAD WITHOUT FAILURE.
- HANGER BRACKETS WILL ALLOW 30° ROD MISALIGNMENT WITHOUT SHORT CIRCUITING.

KINETICS Noise Control	TITLE	LAST DATE REVISED	REVISED BY	DRAWING NO.
	RH-75A/125A	07/25/23	CRU3	S-03.39-11

KINETICS®

Elastomeric Isolators

Model RSP



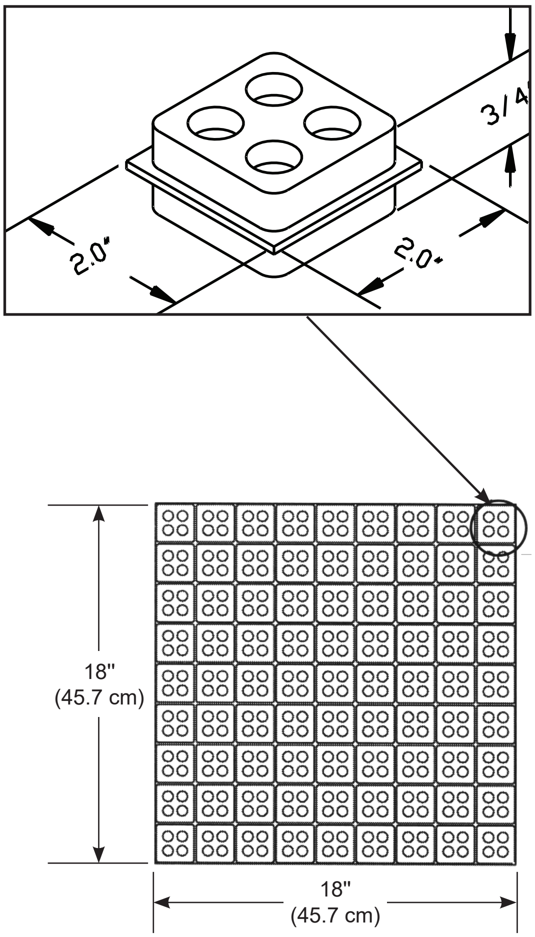
Application and Description

Kinetics RSP pads are produced from a high quality EPDM elastomer. Pads are 50 durometer and are designed for a maximum of 60 psi (4.2 kg. / sq. cm) loading. Pads are designed for a maximum deflection of approximately 20% of its unloaded thickness, 0.15" (0.38 cm). The elastomer is oil and water resistant, offers a long life expectancy consistent with neoprene compounds, and has been designed to operate within the safe stress limits of the material. RSP pads are available up to 18" x 18" x 3/4" (457 mm x 457 mm x 19 mm) thick sheets and are pre-scored into 2" x 2" (51 mm x 51 mm) squares and can be easily cut-to-fit as needed. All pads shall be elastomer in-shear and shall be molded using 2500 psi minimum tensile strength, oil resistant EPDM compounds with no color additives.

Kinetics RSP elastomer in-shear isolation pads are suitable for the isolation of noise, shock, and high frequency vibration produced by mechanical, industrial, or process equipment located on grade, structural slab, or in other noncritical areas.

Features

- 50 durometer neoprene pads
- Designed for maximum 60 psi
- 18” x 18” x 3/4” with 2” x 2” scores
- Oil, water, and corrosion resistant

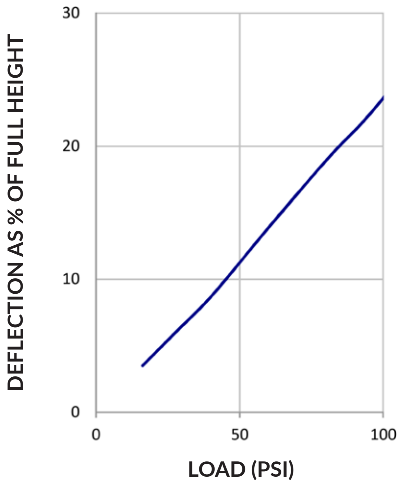


Full Sheet: 18" x 18" x 3/4"
Contains: 81, 2" x 2" pads
Max. Load Rating: 240 lbs. (109 Kg) for each 2" x 2" pad

Specifications

Isolation pads shall be elastomer in-shear pads, used in conjunction with steel shims where required, having static deflections as tabulated. Kinetics RSP pads are produced from a high quality EPDM elastomer. Pads are 50 durometer and are designed for a maximum of 60 psi (4.2 kg. / sq. cm) loading. Pads are designed for a maximum deflection of approximately 20% of its unloaded thickness, 0.15" (0.38 cm). Several layers of waffle pad pads can be stacked for additional deflection when steel separation shim stock is used. The elastomer is oil and water resistant, offers a long life expectancy consistent with neoprene compounds, and has been designed to operate within the safe stress limits of the material. RSP pads are available up to 18" x 18" x 3/4" (457 mm x 457 mm x 19 mm) thick sheets and are pre-scored into 2" x 2" (51 mm x 51 mm) squares and can be easily cut-to-fit as needed. All pads shall be elastomer in-shear and shall be molded using 2500 psi minimum tensile strength, oil resistant EPDM compounds with no color additives. Waffle pad vibration isolators shall have minimum operating static deflections as shown on the Vibration Isolation Schedule, or as indicated on the project documents, but not exceeding published load capabilities. Waffle pad vibration isolators shall be Model RSP as manufactured by Kinetics Noise Control, Inc.

RSP Pad Load vs. Deflection

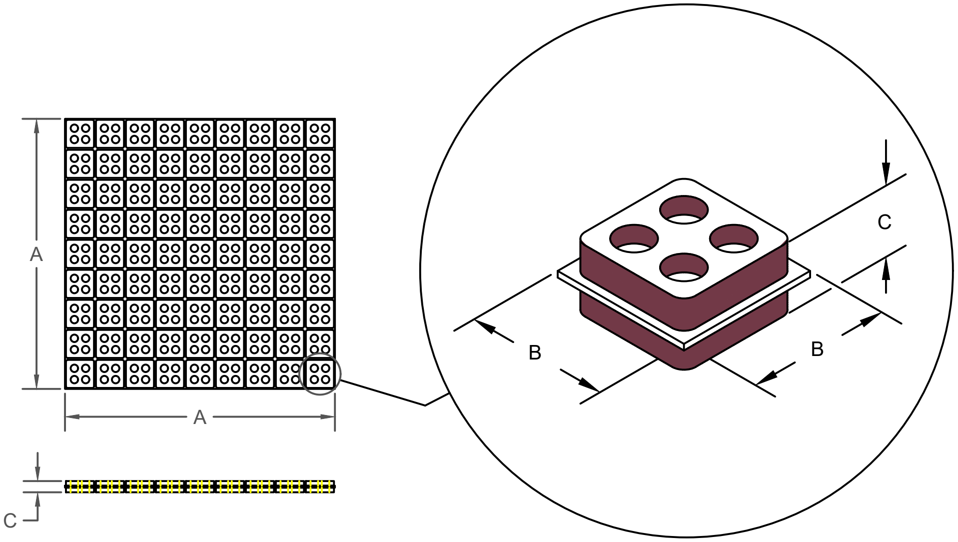


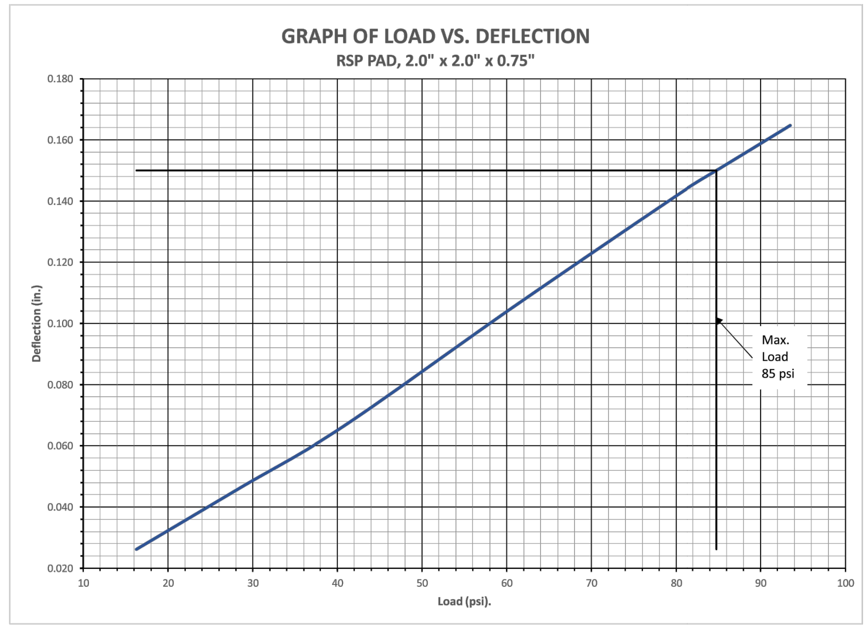
kineticsnoise.com
sales@kineticsnoise.com
1-800-959-1229

RSP ISOLATION PAD

TYPE	A	B	C
RSP	18.00	2.00	0.75

I-P UNITS (INCHES AND POUNDS)





SPECIFICATIONS:

- FULL SHEET IS 18 X 18 X 0.75.
- CONTAINS (81) 2 X 2 PADS.
- MAX LOAD RATING FOR EACH 2 X 2 PAD IS 340 LBS.
- RAW MATERIAL 55 DURO NEOPRENE BLEND.

KINETICS Noise Control®	VISCMA VIBRATION ISOLATION & SEISMIC CONTROL MANUFACTURERS ASSOCIATION	KINETICS NOISE CONTROL, INC 6300 IRELAN PL, DUBLIN, OH 43017 USA Ph: 614 889-0480, Fax: 614 889-0540 www.kineticsnoise.com	Model: RSP PAD	By: JMJ Date: 05/16/03 Revised: 4/24/23 / AHD	Drawing No: S-02.04-11

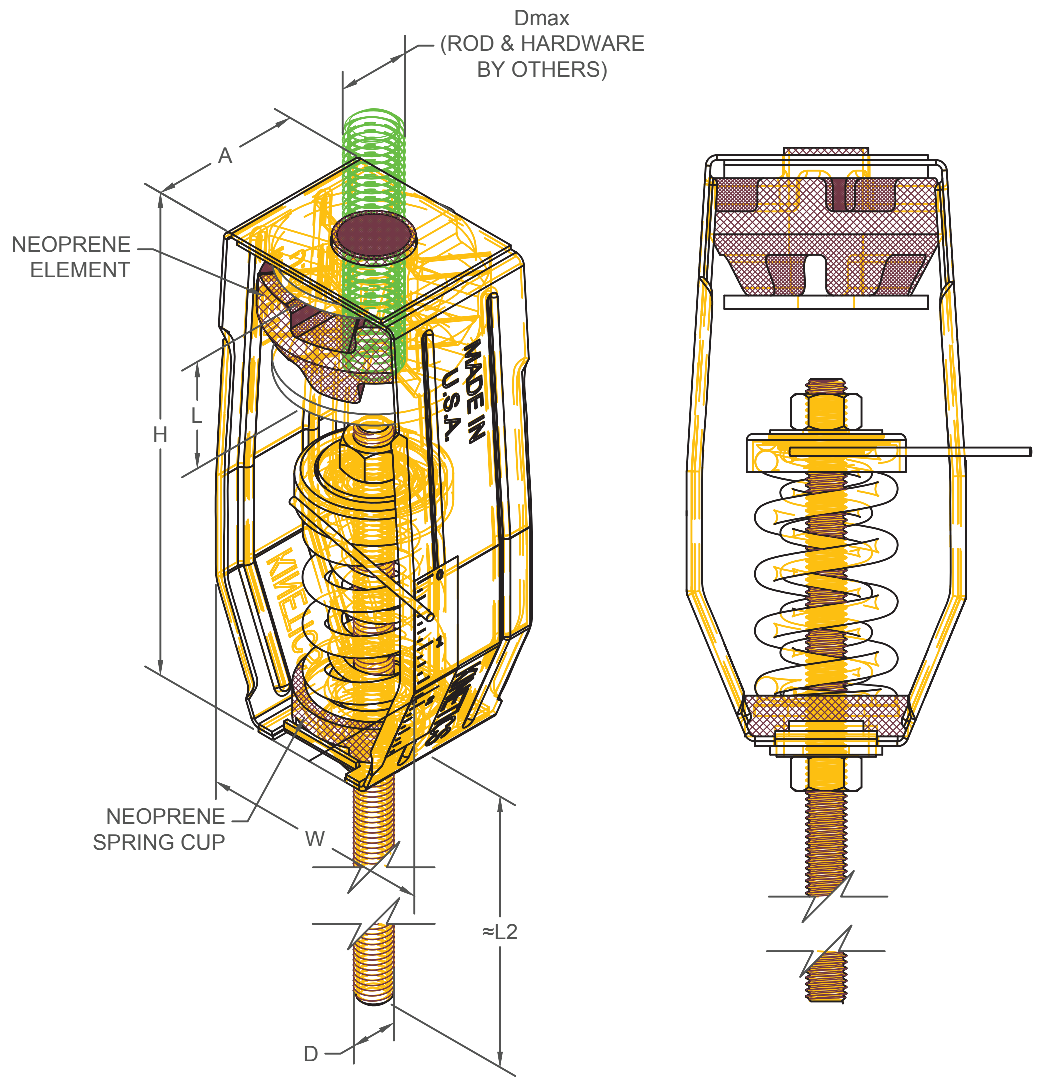
SRPH 1" DEFLECTION ISOLATION HANGERS

IP UNITS (INCHES AND POUNDS)

TYPE	L	L2	H	W	A	D	D_{MAX}
1-35/370	1.72	7.50	7.38	3.69	2.25	0.50	0.63
1-500/805	1.89	7.00	7.38	3.69	2.25	0.63	0.63

3.3 - A - PIPE ISULATION HANGERS

STANDARD RATINGS				SPRING COIL				INSERT COLOR
				COLOR		FREE HT.	O.D.	
TYPE	SIZE	LOAD	DEFL.	OUTER	INNER			
SRPH	1-35	35	1.61	BLUE		3.19	1.75	BLACK
SRPH	1-70	70	1.55	GREEN		3.19	1.75	BLACK
SRPH	1-125	125	1.56	GRAY		3.19	1.75	BLACK
SRPH	1-245	245	1.52	BROWN		3.19	1.75	GREEN
SRPH	1-370	370	1.29	ORANGE		3.19	1.75	WHITE
SRPH	1-500	500	1.45	BEIGE		3.19	1.75	WHITE
SRPH	1-600	600	1.35	CHROME		3.19	1.75	PURPLE
*SRPH	1-700	700	1.40	BEIGE	WHITE	3.19	1.75	PURPLE
*SRPH	1-805	805	1.25	CHROME	WHITE	3.19	1.75	YELLOW



SPECIFICATIONS:

- SPRING ELEMENTS AND BRACKETS ARE POWDER COATED.
- LOAD PLATES ARE BRIGHT ZINC PLATED.
- ISOLATION HANGERS HAVE A TYPICAL OVERLOAD OF 50%.
- ISOLATION HANGERS HAVE A MINIMUM Kx/Ky RATIO OF 1.0.
- SPRING ELEMENTS ARE SAFE AT SOLID LOADING.
- HANGER BRACKETS WILL CARRY AT LEAST (5) TIMES OVERLOAD WITHOUT FAILURE.
- HANGER BRACKETS WILL ALLOW 30° ROD MISALIGNMENT WITHOUT SHORT CIRCUITING, EXCEPT AS NOTED. (*)
- "NO SHORT" STEP CAP.

KINETICS Noise Control

Member VISCMA Vibration Isolation and Seismic Control Manufacturers Association

KINETICS NOISE CONTROL, INC
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Model:	By: BB	Drawing No:
SRPH-1-35/805	Date: 09/05/14	S-03.47-11
	Revised: /	