

Modular/Restraint Isolator

Model FMS

U.S. Patent No. 7,028,696

Description

Designed for the latest building codes, the Kinetics Model FMS Seismically Rated Restraint/Vibration Isolator can be used as a restraint device or as a seismically rated vibration isolator assembly. 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. The vibration isolation module uses laterally stable springs compliant with industry guidelines.

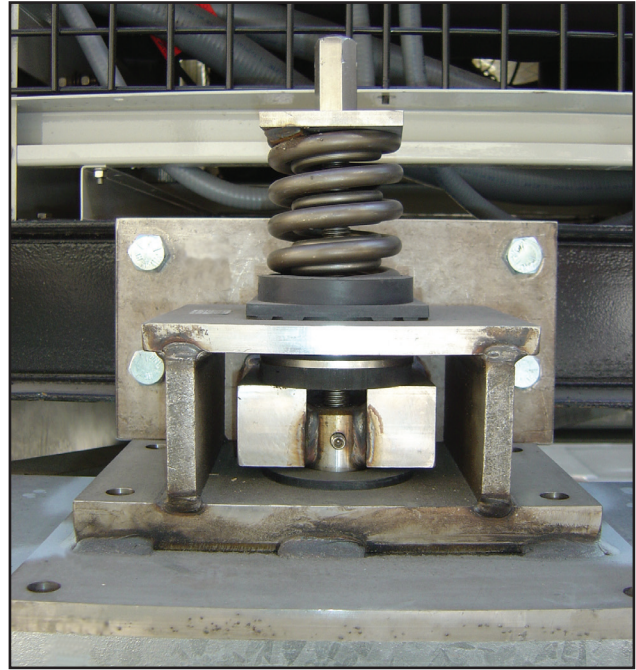
The FMS restraint modules are available in a wide range of capacities. The vibration isolation modules are available in Kinetics' full complement of coil capacities through 4 in. (100 mm) deflection. The ability to select the restraint module independent of the vibration isolator load and deflection requirements ensures a custom, no-compromise fit for restraint and vibration control. This modular feature allows the FMS to be optimized for a wide range of applications. In addition, the isolator can be used in applications requiring constant free and operating height.

The unique design of the Kinetics FMS restraint module minimizes the seismic loads transmitted into the anchors or other attachment hardware. As a result, considerably higher seismic ratings are possible versus conventional designs using similar sized connection hardware.

The Kinetics FMS vibration isolation module offers an open spring design where the spring is completely visible for inspection and totally accessible for adjustment. The top adjustment nut can be accessed with a ratchet or power impact-type tool in addition to conventional open end wrenches, reducing field installation time. The pendulum suspension feature lowers the center of gravity of the applied load and increases the isolator stability. This application is somewhat different on cooling tower installations.

Restraint components are available in 8 sizes with horizontal force capacity ratings ranging to 70,000 lb.

Standard isolation elements are available to 4 in. (100 mm) deflection with support capacities ranging to 23,000 lb.



Application

Because of the extreme design flexibility of the modular concept, Kinetics Model FMS Seismic Restraint/Vibration Isolators can be used effectively for large, heavy pieces of equipment in highly active seismic or wind prone areas as well as for more common applications in less active areas without financial consequence. The FMS is ideal for equipment mounted on structural frame or concrete inertia bases. As with any seismic restraint or vibration isolation device, direct mounting to light pieces of equipment may not be possible without an intermediate frame.

Because of the minimal vertical travel and near constant operating height, the FMS isolator is excellent for use on cooling towers, chillers, boilers or other equipment where the potential for wide weight variations during service is anticipated.

With 4 in. (100 mm) deflection coils, these isolators are ideal for the isolation of sensitive equipment or for use in protecting long span flexible structures from induced vibrations.

FMS Selection Based on Seismic Load Requirements

Dimensions and Restraint Capacity Data (Attached to Steel and Attached to Concrete)

The first step in selecting the FMS is to calculate the forces acting on the equipment using the method indicated by the project specifications or the local building code, whichever is the most severe.

If the FMS is to be used as a restraint only, do the following:

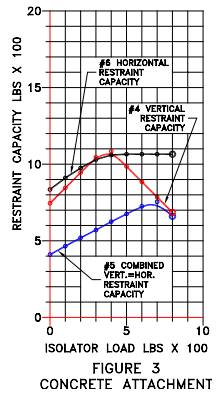
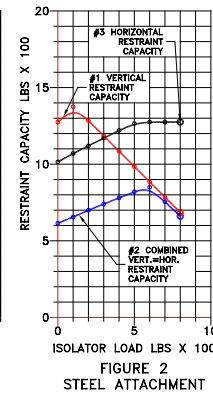
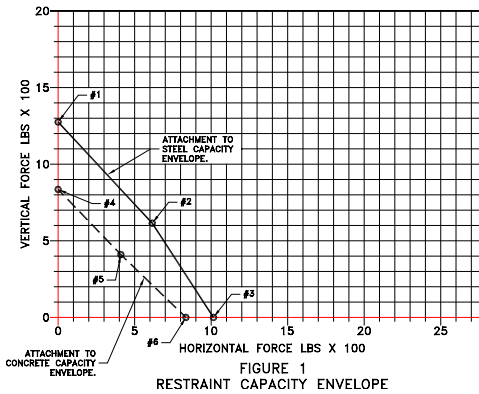
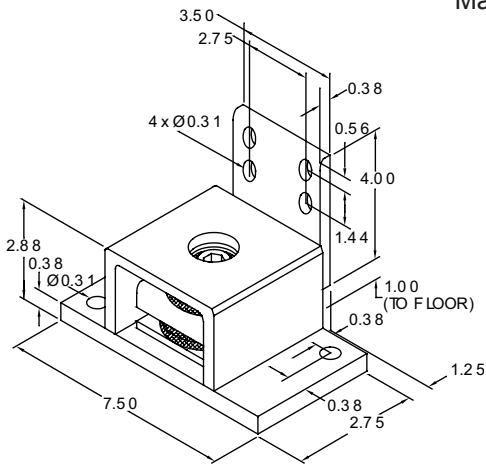
1. Determine if the restraint will be attached to steel or anchored to concrete.
2. Using the forces calculated above, go to figure 1, Restraint Capacity Envelope, and plot the vertical and horizontal forces.
3. Select a restraint where the forces fall within the envelope for the appropriate attachment method (attached to steel or attached to concrete).

If the FMS is to be used as a restraint/vibration isolator, follow these steps:

1. Determine the maximum equipment load to be supported by the isolator.
2. Refer to Figure 2 for Steel Attachment or Figure 3 for Concrete Attachment.
3. Using the forces calculated in step 1, plot the vertical restraint capacity on curve 1 of figure 2 or curve 4 of figure 3 on the vertical axis of figure 1.
4. Plot the horizontal restraint capacity from curve 3 or curve 6 on the horizontal axis of figure 1.
5. Plot the combined restraint capacity from curve 2 or curve 5 at the point on figure 1 where the vertical and horizontal forces both match this value.
6. Connecting these points creates an envelope that shows the capacity of the restraint when subjected to equipment support and seismic loads simultaneously.
7. All worst case seismic loads

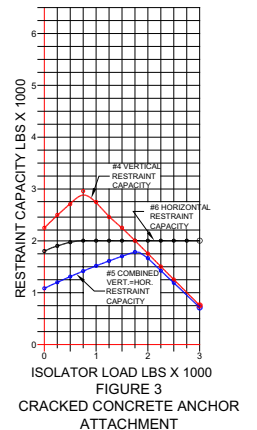
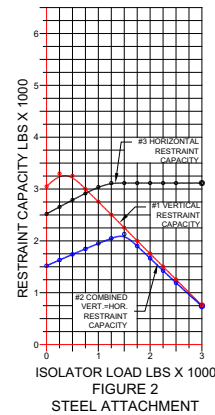
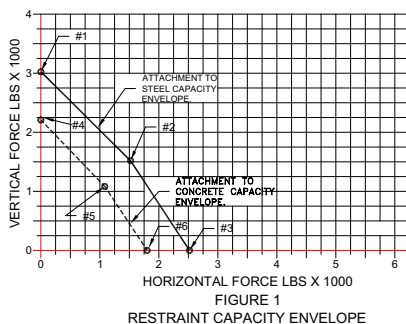
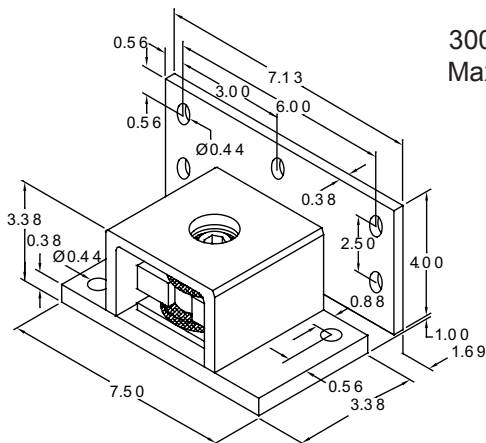
FMSAA

1200 lb Vert / 1000 lb Horiz Steel
Max Isolator Rating 805 lb



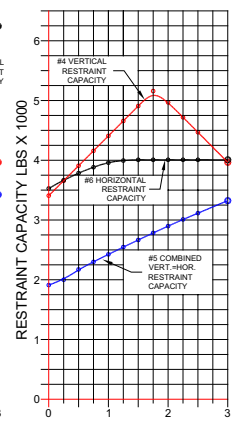
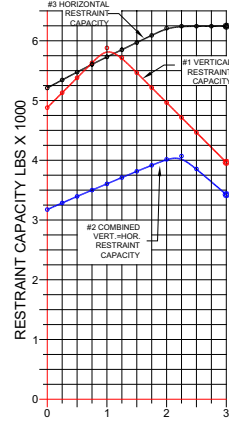
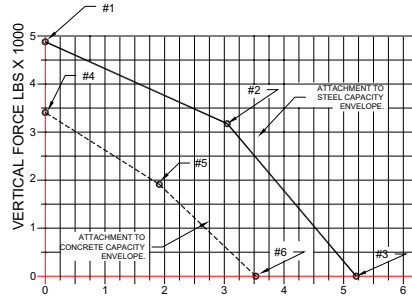
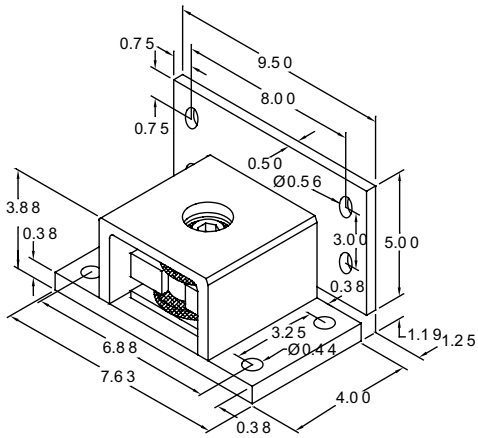
FMSA

3000 lb Vert / 2500 lb Horiz
Max Isolator Rating 2500 lb



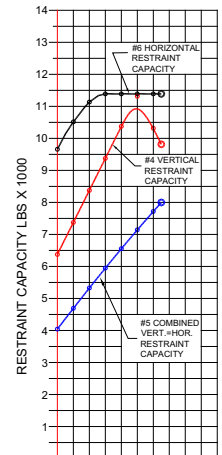
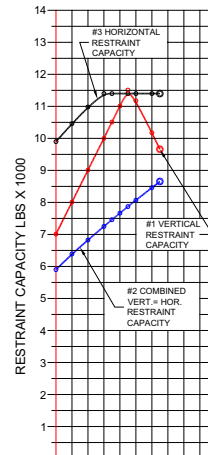
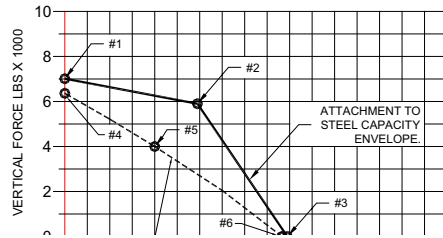
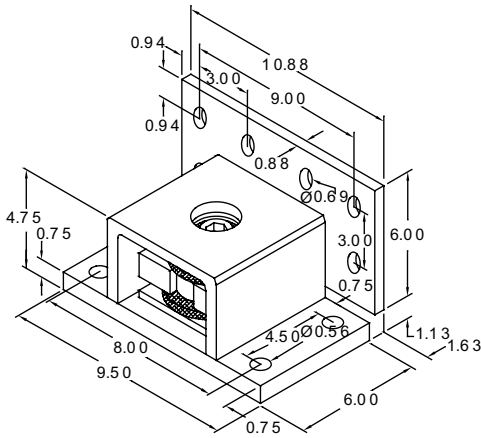
FMSB

3000 lb Vert / 5200 lb Horiz
Max Isolator Rating 3000 lb



FMSC

7000 lb Vert / 9900 lb Horiz
Max Isolator Rating 6500 lb



FMSD

10,300 lb Vert / 16,000 lb Horiz
Max Isolator Rating 10,000 lb

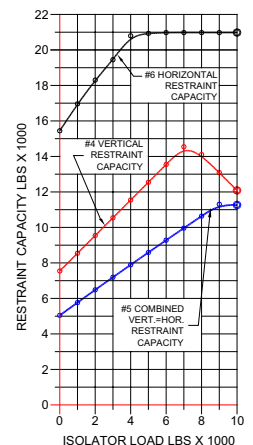
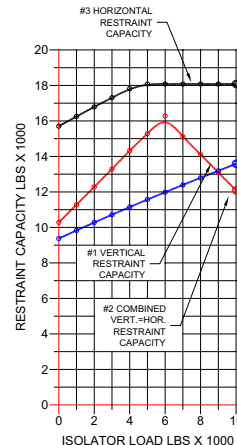
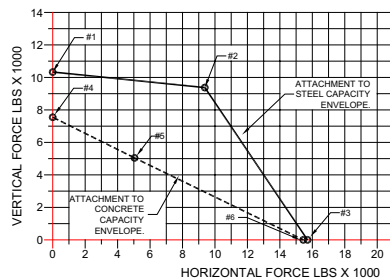
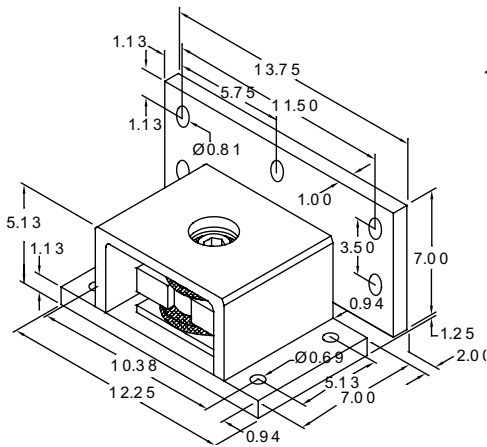
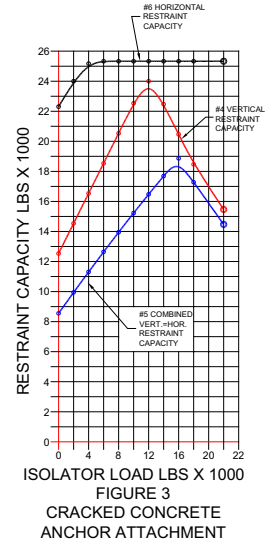
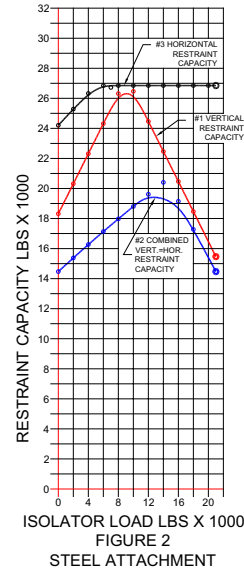
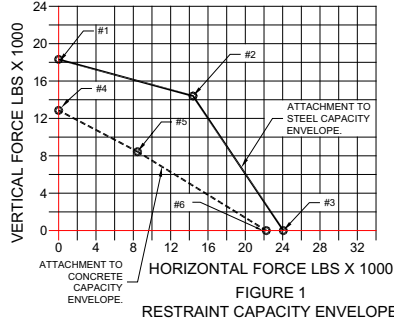
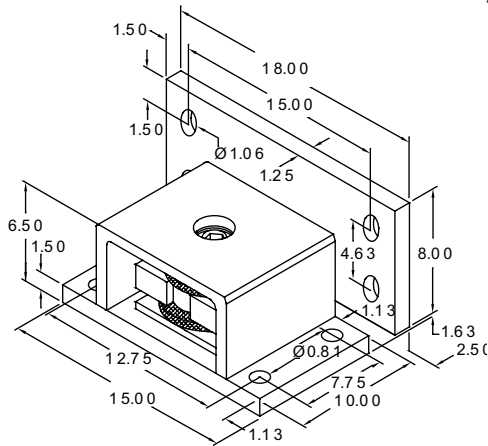


FIGURE 4

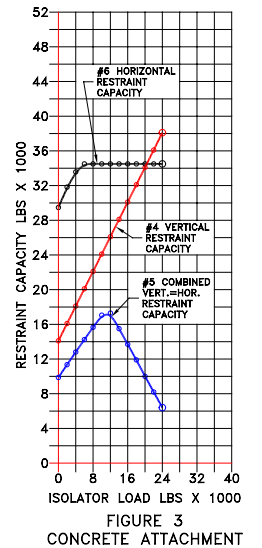
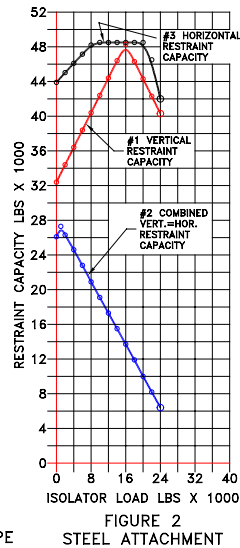
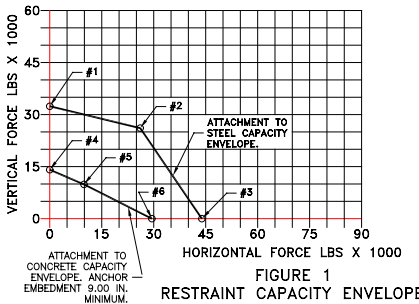
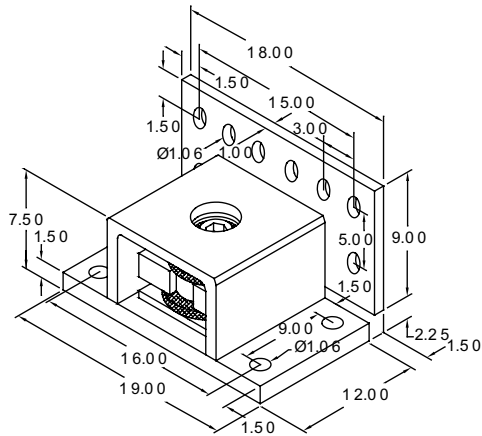
FMSE

18,200 lb Vert / 24,200 lb Horiz
Max Isolator Rating 21,000 lb



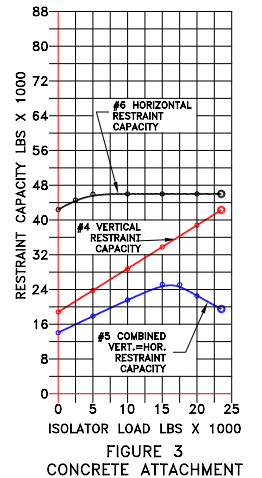
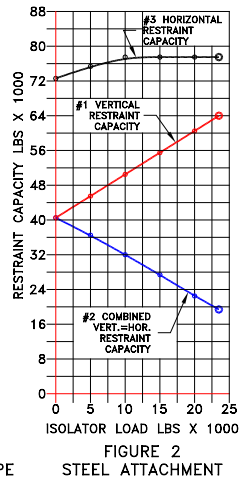
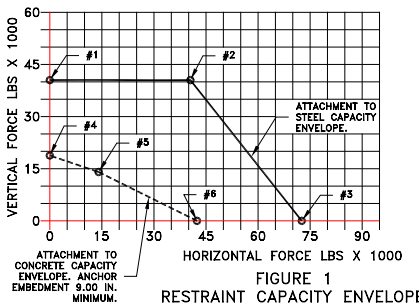
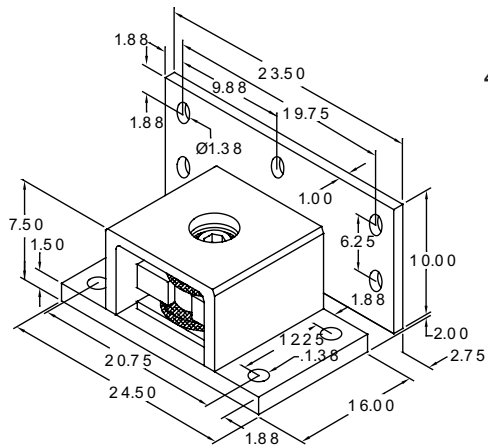
FMSF

32,000 lb Vert / 43,000 lb Horiz
Max Isolator Rating 24,000 lb



FMSG

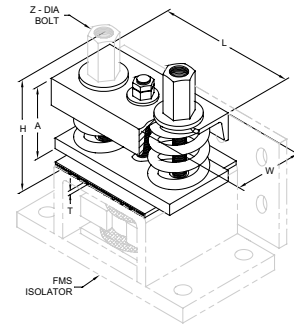
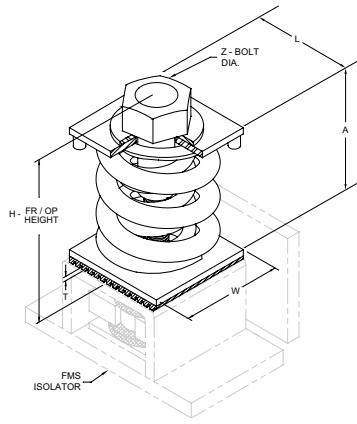
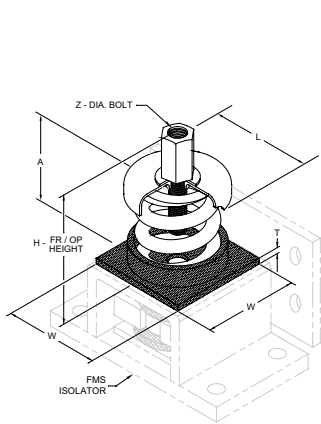
41,000 lb Vert / 72,000 lb Horiz
Max Isolator Rating 24,000 lb



FMS Coil Assemblies

COIL TYPE	A	H (free)	H (op)	L	W	Z
1-35/805	3.55	5.38	4.38	2.07	2.63	0.38
1-250/3500	4.81	6.63	5.63	3.45	3.88	0.75
1-740/1400	3.72	5.56	4.56	5.25	2.63	0.38
1-3400/7000	5.56	7.94	6.94	8.25	4.00	0.75
1-3750/10500	5.56	7.94	6.94	10.38	4.00	0.75
1-9860/14000	5.56	7.94	6.94	15.50	4.00	0.75
2-100/1975	6.63	8.09	6.09	3.94	4.38	0.38
2-2000/4500	8.43	9.18	7.18	5.00	5.00	0.75
2-1990/4000	9.18	9.93	7.93	10.00	5.00	0.75
2-5000/9000	8.88	9.88	7.88	13.38	7.00	1.00

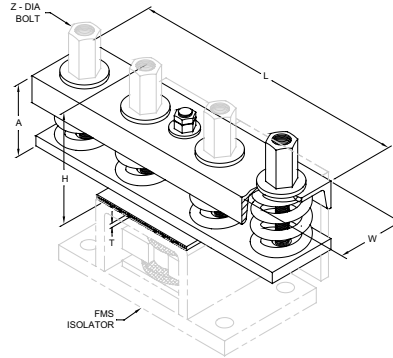
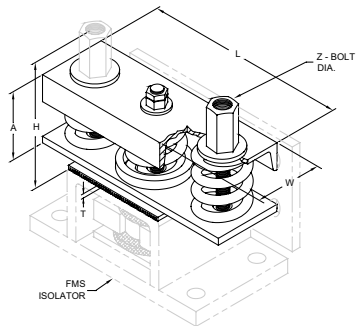
COIL TYPE	A	H (free)	H (op)	L	W	Z
2-9100/13500	8.88	9.88	7.88	17.50	7.00	1.00
2-14000/18000	8.88	10.21	8.21	24.00	7.00	1.00
4-100/1600	11.55	12.30	8.30	6.00	6.00	1.00
4-2250/5800	13.18	13.84	9.84	8.00	8.00	1.00
4-1500/3200	11.55	12.80	8.80	13.75	7.00	1.00
4-3000/4800	11.55	12.80	8.80	18.50	10.00	1.00
4-5500/11600	13.18	14.44	10.44	19.00	5.00	1.00
4-5000/6400	11.55	12.80	8.80	26.00	7.00	1.00
4-11700/17400	13.18	14.44	10.44	27.00	10.00	1.00
4-17800/23200	13.18	14.44	10.44	36.00	10.00	1.00



1-35/805 used on AA,A,B	2-100/1975 used on B,C,D
1-250/3500 used on A,B,C,D,E	

2-2000/4500 used on C,D,E	4-100/1600 used on C,D
	4-2250/5800 used on E,F,G

1-740/1400 used on A,B	2-1990/4000 used on B,C,D,E	4-1500/3200 used on C,D,E
1-3400/7000 used on C,D,E,F,G	2-5000/9000 used on C,D,E,F,G	4-5500/11600 used on E,F,G



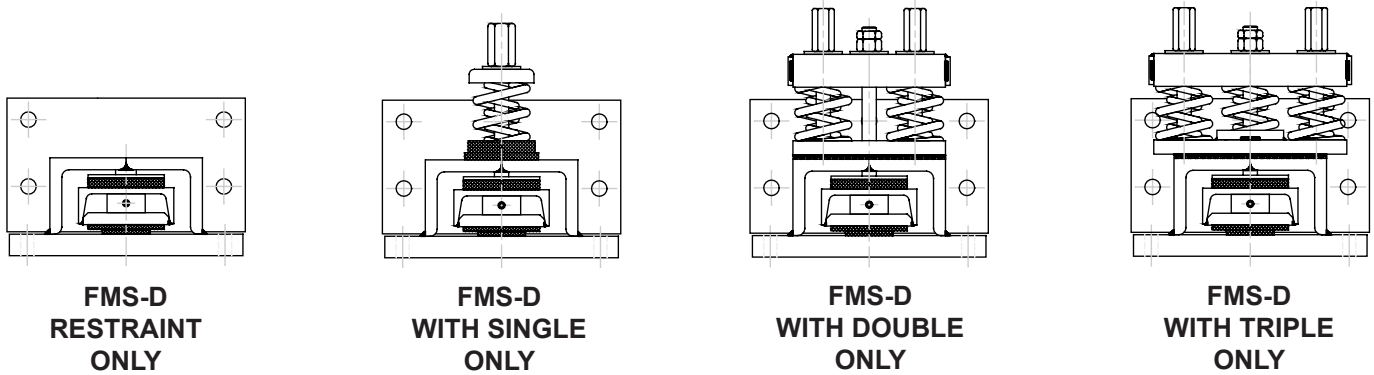
1-3750/10500 used on C,D,E,F,G	2-9100/13500 used on D,E,F,G	4-3000/4800 used on C,D,E,F,G
		4-11700/17400 used on E,F,G

1-9860/14000 used on E,F,G	2-14000/18000 used on E,F,G	4-5000/6400 used on C,D,E,F,G
		4-17800/23200 used on E,F,G

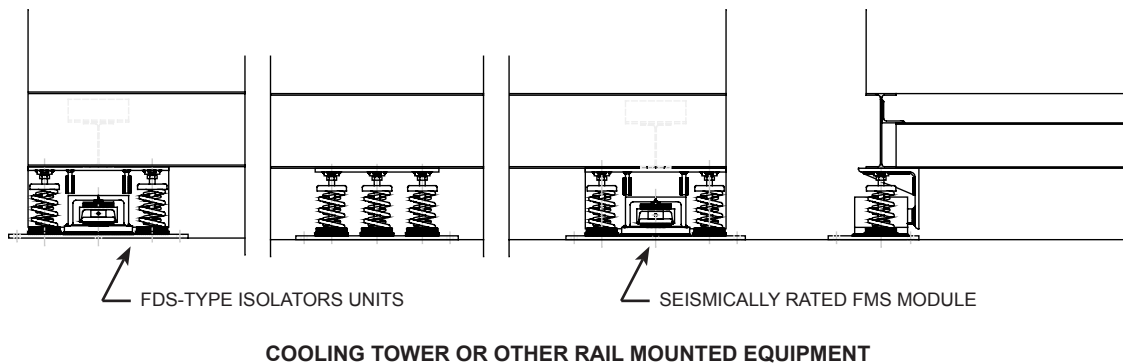
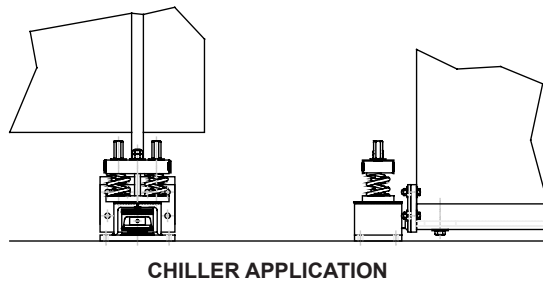
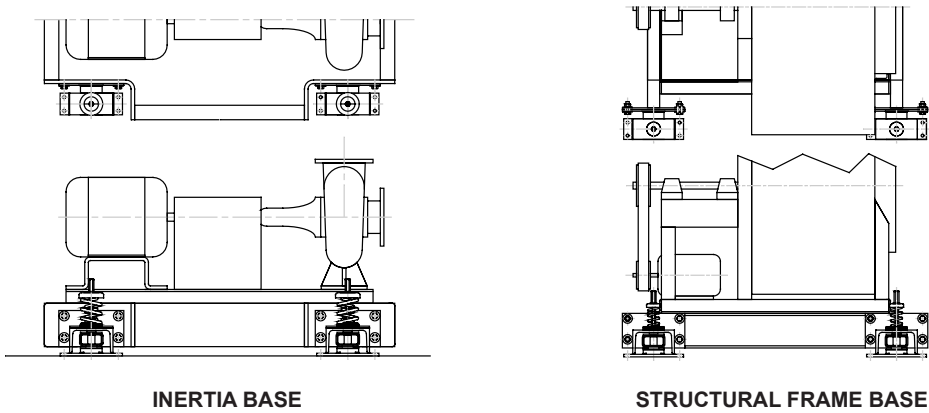
Installation Options

Typical restraint element showing optional coil configurations

In a similar fashion, coils with 1-, 2-, and 4-in. deflection can be fitted to the same restraint element, or different restraint elements can be substituted.



Typical Application Details



Specifications

Spring isolators shall be comprised of two interfacing but independent elements; a coil spring element and a seismically rated housing. The spring coil element shall be comprised of one or more coil assemblies having all of the characteristics of freestanding coil spring isolators as specified in the vibration isolation portion of the specification. The seismically rated housing shall be sized to meet or exceed the force requirements applicable to the project and have the capability of accepting coils of various sizes, capacities, and deflections as required to meet the desired isolation criteria.

All spring forces will be contained within the coil/housing assembly and under no seismic load condition shall the restraint anchoring hardware be exposed to spring-generated forces.

The restraint element shall incorporate a steel housing with elastomeric elements at all dynamic

contact points. The restraint will allow 1/4 in. (25 mm) motion in any direction from the neutral position. All elastomeric elements shall be replaceable.

To ensure the optimum anchorage capacity, the restraint will have an overturning factor (the ratio of the effective lateral snubber height to the short axis anchor spacing) of 0.33 or less.

The leveling nut or screw shall be accessible for adjustment with the use of a pneumatic or electric impact wrench.

The spring element shall be replaceable without having to lift or otherwise remove the supported equipment.

The isolator/restraint shall be Model FMS as manufactured by Kinetics Noise Control.



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