I1.1 – Seismic Restraint Categories and Types:

Seismic restraints for pipe and duct are generally separated into two categories.

1. Transverse Seismic Restraints: These act to keep the pipe or duct from swinging side-to-side. They are normally placed so that they act perpendicular, at right angles, to the pipe or duct, as shown in Figure I1-1. These seismic restraints are located at, or very near, the pipe or duct hangers. If the restraints are not attached directly to the hanger, they may be attached to the pipe or duct with in four (4) inches of the hanger location. This is so that any vertical reaction loads from the restraints go to the structure directly through the hanger and not the pipe or duct.

![Transverse Seismic Restraint Diagram](Figure I1-1; Definition of Transverse and Longitudinal Seismic Restraints)

2. Longitudinal Seismic Restraints: These act to keep the pipe or duct from swinging back-and-forth along the length of the pipe or duct. Typically, they are placed parallel to, or along, the length of the pipe or duct, as shown in Figure I1-1. The seismic restraints are also located at, or very near, the hanger locations of the pipe or duct for the same reason stated above.

Seismic restraints may be further broken down into two basic types based on the way they work.
1. Strut Restraints (Rigid Braces) – these restraints carry both tension (pull) and compression (push) loads along the axis of the strut. Only one strut is required to restrain a pipe or duct in one direction, either transverse or longitudinal. These restraints are normally constructed of a structural member with attachment brackets on either end for the structure and the pipe or duct. The common structural members that are used are, AISI rolled angles, pipe, conduit, and UNISTRUT™ channels. **Caution** must be used when applying this type of restraint. The seismic forces will produce both tensile and compressive reactions in the hanger rod that may equal or exceed the dead load of the pipe or duct. In other words, the seismic forces acting on the strut restraints may be capable of **breaking the hanger rod**, or **pulling the rod anchor out of the structure**. If strut restraints are to be used, the engineer of record needs to be informed. The hanger rods and rod anchors may need to be increased in size and capacity to carry the additional tensile reaction loads in the hanger rod generated by the seismic forces.

2. Cable Restraints (Tension Only Braces) – these restraints can carry only tension (pull) loads along the length of the able. They must be used in pairs where the cables are oriented ~180° apart to keep the pipe or duct from moving back-and-forth. Remember, **you can’t push a rope**, so there must be two cables for each restraint location and direction, transverse and longitudinal. The seismic forces in the restraint cables will produce only compressive reaction loads in the hanger rods.

### I1.2 – Drawing Symbols:

On the drawings provided by Kinetics Noise Control the symbols shown in Figure I1-2 are used to indicate the approximate locations of the seismic restraints required for a run of pipe or duct. For duct or single clevis hung pipe the seismic restraint location is shown as a single large dot. For trapeze supported pipe, the symbol used is an “I” shaped bar centered on a large dot. The “I” shaped bar will extend on either side of the central dot to cover all of the pipes that are assumed to be supported on the trapeze bar.
The category of the restraint indicated for each location along with the restraint kit and the anchorage (structural attachment) hardware kit for the project’s seismic conditions are shown by the symbol in Figure I1-3. The symbol at a location (T) indicates that the restraint is a transverse restraint, the symbol (L) indicates that the restraint is to be a longitudinal restraint, and symbol (TL) indicates that both transverse and longitudinal restraints are required for that location.

Restraint Type Designation:
- T - Transverse Restraint
- L - Longitudinal Restraint
- TL - Both Transverse & Longitudinal
- TT - Two Transverse Restraints -180° Apart & Used Primarily For Riser Applications

KNC Restraint Kit Code:
Restraint Capacity Required At This Location, See Table I1-1.

KNC Anchorage Kit Code:
Anchorage Capacity Required At This Location, See Tables I1-2 & I1-3.
structural member being provided by others. Tables I1-2 and I1-3 list the code designations for the various anchorage kits provided by Kinetics Noise Control for anchorage to concrete/steel and wood/steel respectively. Each anchorage kit will contain enough hardware of the correct size and grade to attach the restraint kit to concrete, steel, or wood. For restraint cable kits the hardware is divided equally between the two cable assemblies. These same hardware kits may also be used with strut restraints that have the same capacity as the cable restraints for which the anchorage kit was recommended.

### Table I1-1; Seismic Restraint Cable Kit vs. Code Cross-Reference

<table>
<thead>
<tr>
<th>KNC Restraint Kit Code</th>
<th>Restraint Kit Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>K2</td>
<td>KSCU-2 Cable Kit – 2 mm or 1/8” Cable &amp; Appropriate Connectors</td>
</tr>
<tr>
<td>K3</td>
<td>KSCU-3 Cable Kit – 3 mm or 1/8” Cable &amp; Appropriate Connectors</td>
</tr>
<tr>
<td>K4</td>
<td>KSCU-4 Cable Kit – 5 mm Cable 3/16” &amp; Appropriate Connectors</td>
</tr>
<tr>
<td>K5</td>
<td>KSCU-5 Cable Kit – 6 mm or 1/4” Cable &amp; Appropriate Connectors</td>
</tr>
<tr>
<td>C1</td>
<td>KSCC-250 Cable Kit – 1/4” Cable &amp; Saddle + U-bolt Connectors</td>
</tr>
<tr>
<td>C2</td>
<td>KSCC-375 Cable Kit – 3/8” Cable &amp; Saddle + U-bolt Connectors</td>
</tr>
<tr>
<td>C3</td>
<td>KSCC-500 Cable Kit – 1/2” Cable &amp; Saddle + U-bolt Connectors</td>
</tr>
<tr>
<td>F</td>
<td>Direct Mounted to Floor or Roof Using Anchor Bolts</td>
</tr>
<tr>
<td>W</td>
<td>Direct Mounted to Wall Using Anchor Bolts</td>
</tr>
</tbody>
</table>

**I1.3 – Seismic Restraint Spacings:**

This part will discuss the seismic restraint spacings typically used by Kinetics Noise Control. First, the following definitions will be helpful.

\[
S_H = \text{the pipe or duct hanger spacing.}
\]

\[
S_L = \text{the calculated spacing for the longitudinal seismic restraints marked as } (L).
\]

\[
S_T = \text{the calculated spacing transverse seismic restraints marked as } (T).
\]
### Table I1-2; Structural Concrete/Steel Anchorage Kit vs. Code Cross-Reference

<table>
<thead>
<tr>
<th>KNC Attachment Kit Code</th>
<th>Anchorage Kit Description per Restraint Cable Kit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Note: Through bolts &amp; nuts of the same size may be used for each kit and code shown below.</td>
</tr>
<tr>
<td>X1</td>
<td>(2) 1/4” Concrete Anchor (with Grommet)</td>
</tr>
<tr>
<td>X2</td>
<td>(2) 3/8” Concrete Anchor (with Grommet)</td>
</tr>
<tr>
<td>X3</td>
<td>(2) 1/2” Concrete Anchor</td>
</tr>
<tr>
<td>Y1</td>
<td>(2) 5/8” Concrete Anchor</td>
</tr>
<tr>
<td>Y2</td>
<td>(2) 3/4” Concrete Anchor</td>
</tr>
<tr>
<td>Y3</td>
<td>(2) 7/8” Concrete Anchor</td>
</tr>
<tr>
<td>Z1</td>
<td>(4) 3/8” Concrete Anchors with Oversized Base Plate</td>
</tr>
<tr>
<td>Z2</td>
<td>(8) 3/8” Concrete Anchors with Oversized Base Plate</td>
</tr>
<tr>
<td>Z3</td>
<td>(4) 1/2” Concrete Anchors with Oversized Base Plate</td>
</tr>
<tr>
<td>Z4</td>
<td>(8) 1/2” Concrete Anchors with Oversized Base Plate</td>
</tr>
</tbody>
</table>

### Table I1-3; Structural Wood/Steel Anchorage Kit vs. Code Cross-Reference

<table>
<thead>
<tr>
<th>KNC Attachment Kit Code</th>
<th>Anchorage Kit Description per Restraint Cable Kit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Note: Through bolts &amp; nuts of the same size may be used for each kit and code shown below.</td>
</tr>
<tr>
<td>W1</td>
<td>(2) 1/4” Lag Screw (with Grommet)</td>
</tr>
<tr>
<td>W2</td>
<td>(2) 3/8” Lag Screw (with Grommet)</td>
</tr>
<tr>
<td>W3</td>
<td>(2) 1/2” Lag Screw</td>
</tr>
<tr>
<td>W4</td>
<td>(2) 5/8” Lag Screw</td>
</tr>
<tr>
<td>W5</td>
<td>(2) 3/4” Lag Screw</td>
</tr>
<tr>
<td>W6</td>
<td>(2) 7/8” Lag Screw</td>
</tr>
<tr>
<td>W7</td>
<td>(4) 3/8” Lag Screws with Oversized Base Plate</td>
</tr>
<tr>
<td>W8</td>
<td>(8) 3/8” Lag Screws with Oversized Base Plate</td>
</tr>
<tr>
<td>W9</td>
<td>(4) 1/2” Lag Screws with Oversized Base Plate</td>
</tr>
<tr>
<td>W10</td>
<td>(8) 1/2” Lag Screws with Oversized Base Plate</td>
</tr>
</tbody>
</table>
As mentioned above, the seismic restraint locations must be at, or very near, the pipe or duct hangers. So, the actual seismic restraint spacing will be some multiple of the actual hanger spacing. The longitudinal seismic restraint spacing may be equal to the transverse seismic restraint spacing, or it may be twice the transverse seismic restraint spacing depending on the seismic conditions and the weight per foot of the pipe or duct that is being restrained. The seismic restraint industry has historically relied on the recommendations of SMACNA for specifying the proper seismic restraint spacings. Table I1-4 shows the typical seismic restraint spacings used by Kinetics Noise Control when creating the drawings showing the seismic restraints and their approximate locations for a run of pipe or duct.

Table I1-4; Typical Seismic Restraint Spacings Used by Kinetics Noise Control

<table>
<thead>
<tr>
<th>Transverse Seismic Restraint Spacing (S_T) (ft.)</th>
<th>Longitudinal Seismic Restraint Spacing (S_L) (ft.)</th>
<th>Comments on Maximum Allowable Restraint Spacings</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 (S_T)</td>
<td>10 (S_L)</td>
<td>Maximum Allowable Spacings for Low Deformability (Brittle) Piping.</td>
</tr>
<tr>
<td>10 (S_T)</td>
<td>20 (S_L)</td>
<td>Other Optional Spacings Used to Extend the Useful Range of Application for Specific Restraints.</td>
</tr>
<tr>
<td>15 (S_T)</td>
<td>30 (S_L)</td>
<td>Maximum Allowable Restraint Spacings for Hazardous Gas Piping.</td>
</tr>
<tr>
<td>20 (S_T)</td>
<td>40 (S_L)</td>
<td>Maximum Allowable Restraint Spacings for Ductwork.</td>
</tr>
<tr>
<td>30 (S_T)</td>
<td>60 (S_L)</td>
<td>Maximum Allowable Restraint Spacings for HVAC &amp; Plumbing Piping.</td>
</tr>
<tr>
<td>40 (S_T)</td>
<td>80 (S_L)</td>
<td>Maximum Allowable Restraint Spacings for HVAC &amp; Plumbing Piping.</td>
</tr>
</tbody>
</table>

Kinetics Noise Control makes every possible effort to ensure that their drawings are to the scale indicated, so the approximate restraint locations make be determined on the job site by scaling the drawing. The locations are approximate because the engineers at Kinetics Noise Control have no way of knowing the exact location of the hangers, other components, and structure not shown on the drawings provided to them. As long as the illustrated restraint spacings are not exceeded, the exact location of the restraints along the run of pipe or duct is not critical as long as the restraints coincide with a hanger. This means that in some instances (when restraint spacing is not an even
multiple of the support spacing), one or two extra restraint kits may be required for a run of pipe or duct.

Many project specifications call for standard hanger spacings of 5 ft. or 10 ft. for all pipe and duct. These hanger spacings work very well with those recommended by SMACNA and Kinetics Noise Control. There are some instances where a different hanger spacing may be required or specified. If for instance the specified hanger spacing was 8 ft. and the transverse and longitudinal restraint spacing specified by Kinetics Noise Control was 20 ft. and 40 ft. respectively, the transverse restraint spacing for the project would be 16 ft. and the project longitudinal spacing would be 32 ft. For this case, extra restraint kits would be required for any pipe or duct runs where the hangers were spaced at 8 ft.

I1.4 – Examples of How Kinetics Noise Control Drawing Symbols are used:

For single clevis hung pipe, a typical run of pipe will be marked for seismic restraint and anchorage kits as shown in Figure I1-4. Notice that every location with a longitudinal seismic restraint will also have a transverse seismic restraint. This is true for virtually all cases of seismic restraint for pipe and duct. The two restraint callouts at the corner are for transverse seismic restraints. If these transverse seismic restraints can be located within 24 in. (2 ft.) of the corner, the transverse restraint in on one leg will serve as the longitudinal restraint on the other leg. Kinetics Noise Control will always assume that a hanger can be placed within 24 in. of the corner and mark the drawings accordingly. If these restraints can not be located close enough to the corner, additional kits may be required to provide restraint in the longitudinal direction for each leg. Note that in all cases the seismic restraint kits will all be K3, KCSU-3. These kits have 1/8” or 3mm cables with connectors provided by Kinetics Noise Control. The anchorage kits will all be X2, 3/8 in. concrete anchors and 3/8-16 UNC bolts.
A typical run of trapeze supported pipe is shown with the approximate locations and callouts for the seismic restraint is shown below in Figure I1-5.

The “I” bars indicate that these three pipes are assumed to be supported on the same set of trapeze bars. Unless otherwise instructed, Kinetics Noise Control assumes that runs of pipes that lie parallel and very close together are supported on the same set of trapeze bars. If the actual pipe runs are single clevis hung, more restraints will be required. Note that the restraint kits are
K4, KSCU-4. These kits contain 5 mm or 3/16" cables and appropriate connectors. The anchorage kits are X3, 1/2 in. concrete anchors and 1/2-13 UNC bolts. The seismic restraint kits and anchorage kits have much higher capacities than the ones called out for the previous example in Figure I1-4. Assuming the two figures are of similar scale and that the pipe sizes are similar, this makes sense. The seismic restraint and anchorage requirements are based on the weight of the pipe or duct that is being restrained, and all other things being equal, three pipes will weight much more than one pipe of a similar size, and will require larger cable and anchors to keep them from swinging side-to-side, or back-and-forth.

For pipe runs supported by trapeze bars, the longitudinal restraints must be arranged to prevent the pipes from being twisted by the seismic forces. In some instances, an extra restraint kit may be required per longitudinal restraint location. This will be discussed further in the next section.

Figure I1-7 shows the seismic restraint callouts and approximate locations for a typical run of duct.

![Figure I1-6; Typical Kinetics Noise Control Seismic Restraint Kit and Anchorage Kit, and Location Callouts for Duct](image)

Rectangular duct is normally supported on some type of trapeze bar arrangement. As with the trapeze supported pipe runs, this may require some special arrangements and potentially extra...
cable kits per longitudinal restraint location to keep the duct from being twisted by the seismic forces. See the next part for a more complete discussion of this issue.

I1.5 – Typical Seismic Restraint Arrangements for Single Clevis Hung Pipe:

In this section the basic installation arrangements for pipe and duct will be discussed. This is by no means a complete treatment of the subject. There are many different arrangement for supporting and restraining pipe and duct, and whenever it appears that all of them have been covered a new situation develops that requires new and innovative ways for supporting and restraining the runs of pipe and duct. This section will show just the basic arrangements. More arrangements are shown in a set of drawings, SS-20070950 Sheets A through G, that are sent out with each order shipment of seismic restraint and anchorage kits. If the drawings are not part of the order shipment, or available from the authorized representative of Kinetics Noise Control, they are available directly from Kinetics Noise Control.

Figures I1-7 through I1-9 show single clevis hung pipes with transverse cable restraints. The installation shown in Figure I1-7 is typical for cable restraints. The recommended installation angle for the cable restraints is 45° when measured against the horizontal. Note that a clear distance on either side of the hanger rod approximately equal to the hanger rod length will be required to make the attachment to the roof or floor structure above. Also, between the pipe run attachment and the structural attachment, the cable restraint cannot touch any other component or structure. In normal practice, the installation angle is allowed to vary down to 30° and up to a maximum of 60°. Figure I1-8 is a typical single clevis hung pipe with transverse seismic cable restraints that are installed at 30°. Note that twice as much space on either side of the hanger rod is required for seismic restraints with a 30° installation angle as those seismic restraints which have a 45° installation angle. Installation angles greater than 30° will require increasingly more clear room for installation; which is not normally available in most buildings.
Figure I1-7; Single Clevis Hung Pipe with Typical Transverse Seismic Cable Restraints @ 45°

Figure I1-8; Single Clevis Hung Pipe with Typical Transverse Seismic Cable Restraints @ 30°
Figure I1-9 is a typical single clevis hung pipe with transverse seismic cable restraints that are installed at 60°. Here, half as much space on either side of the hanger rod is required for seismic restraints with a 60° installation angle as those seismic restraints which have a 45° installation angle. No installation angles greater than 60° are permitted as there will be almost no restraint benefit from the cables; the pipe will simply swing side-to-side on the cables and hanger rod with little or no resistance.

Figure I1-9; Single Clevis Hung Pipe with Typical Transverse Seismic Cable Restraints @ 60°

All three of the cases shown in Figures I1-7 through I1-9 assume that the structural anchorage will be made to the roof or floor structure above. The structural attachment may also be made to walls, beams, and or columns. These attachments will need to be approved by the structural engineer since the roof, floor, walls, columns, and beams were designed without knowledge of the exact placement of the seismic restraints. The use of strut restraints can cut the space required along side the pipe or duct for installing these restraints basically in half, which is probably their one big benefit.
For single clevis hung pipe, the longitudinal restraints may be installed similar to that shown in Figure I1-10. A more detailed set of views for this arrangement is shown in Figure I1-11.

Figure I1-10; Single Clevis Hung Pipe with Typical Longitudinal Seismic Cable Restraints

These two figures show the longitudinal seismic restraints attached directly to the pipe with in 4 inches of the hanger location. The longitudinal restraints may also be attached to the clevis hanger, but some physical means to keep the pipe from sliding back-and-forth in the hanger must be used. Figure I1-11 shows that the pipe clamp is to be rotated slightly to allow the restraints to miss the hanger rod and any rod stiffener that may be in its path. Strut type longitudinal restraints may also be attached to the pipe with a pipe clamp. As with the transverse restraints, the installation angle may vary from 30° up to a maximum of 60°.

If the pipe is insulated it is good practice to clamp directly to the pipe and insulate over the clamp. Clamping seismic restraints to the pipe over the insulation could damage the insulation during installation, and will typically not remain secure during an earthquake.
I1.6 – Typical Seismic Restraint Arrangements for Trapeze Supported Pipe and Duct:

Typical transverse seismic restraint arrangements for trapeze supported pipe and duct are shown in Figures I1-12 and I1-13 respectively. Many more potential arrangements are shown in drawing SS-20070957 Sheets A1 and A2 provided by Kinetics Noise Control.

How the longitudinal restraints are applied to trapeze supported pipe and duct will determine whether additional restraints are required beyond those indicated in the Material Required List provided by Kinetics Noise Control. As much as practical Kinetics Noise Control design restraint installations that will require the fewest number of restraint kits. The longitudinal restraints for trapeze supported pipe and duct must be installed to balance the loads on the trapeze bar, and pipe or duct. This condition is best illustrated using plan views of the trapeze supported pipe and duct. Figures I1-14 and I1-15 show three plan views each for trapeze supported pipe and duct, respectively, with restraint locations requiring both transverse and longitudinal seismic restraints.
Figure I1-12; Typical Transverse Seismic Restraint Arrangement for Trapeze Supported Pipe

Figure I1-13; Typical Transverse Seismic Restraint Arrangement for Trapeze Supported Duct
Figure I1-14; Balanced Longitudinal Seismic Restraints for Trapeze Supported Pipe

Figure I1-15; Balanced Longitudinal Seismic Restraints for Trapeze Supported Duct
In Figures I1-14 A & B and Figures I1-15 A & B, the restraint of the trapeze supported pipe and duct may be made with the cable restraint kits which are normally called out and supplied by Kinetics Noise Control. If the installation issues require that arrangements such as the ones shown in Figures I1-14 C and I1-15 C be used, then an extra restraint and anchorage kit will be required for each such location.

I1.7 – Isolated Pipe & Duct:

All of the restraint schematics shown in this manual depict non-isolated pipe and duct. For isolated pipe and duct, the restraints are installed in the same fashion as they are detailed for non-isolated pipe and duct. However, there are special treatments for the isolation hangers that must be followed during the installation to ensure the seismic performance of the system. These treatments are detailed in Figure I1-16.

![Figure I1-16; Treatments for Isolation Hangers at Seismic Restraint Locations](image-url)
The most important treatment from a seismic point of view, see Figure I1-16, is an uplift limit stop applied to the hanger rod just below the isolation hanger. Typically this consists of a nut and washer, as shown, which are adjusted to provide a gap not to exceed one quarter inch between the washer and the bottom of the isolation hanger. When top mounted cushions of neoprene or fiberglass are provided, a gap, not to exceed one eighth inch is required at the top of the isolation hanger. These treatments are valid for all isolated pipe and duct.

For isolated pipe and duct, it is good practice to use only cable type restraints. They provide flexibility and are not as likely to “short out” the isolation hangers. Strut type restraints provide a rigid load path in both tension and compression from the pipe or duct directly to the structure. This will for a continuous transmission path for sound and vibration to travel from the pipe or duct to the structure.

I1.8 – Important Things to Note and Remember:

1. There are two basic categories of seismic restraints.
   a. Transverse Seismic Restraints – perpendicular to the run of pipe or duct.
   b. Longitudinal Seismic Restraints – parallel to the run of pipe or duct.

2. There are two commonly used types of restraints.
   a. Strut Restraints (Rigid Braces) – carry both tension and compression loads along the length of the brace.
      i. **One strut restraint** is required at each transverse restraint and each longitudinal restraint.
      ii. Strut restraints will increase tensile loads in the hangers and anchors, and may exceed the allowable capacity of the hangers and anchors. Co-ordinate the use of strut restraints with the engineers of record.
      iii. Strut restraints will also create compressive loads in the hangers. Hangers at restraint locations must be capable of carrying compressive (buckling) loads, and may required hanger stiffeners.
b. Cable Restraints (Tension Only Braces) – carry only tension loads along the length of the cable.
   i. **Two cable restraints** 180° apart are required for each transverse restraint and each longitudinal restraint.
   ii. Cable restraints load the hangers only in compression. The hangers at the restraint locations must be capable of carrying compressive load (buckling) loads and may require hanger stiffeners.

3. Seismic restraints must be located at or very near (within 4 inches) of the pipe and duct hanger locations to directly transfer the compressive reaction loads from the seismic forces to the structure of the building, rather than through the pipe and duct.

4. The recommended installation angle for seismic restraints is 45°, as measured from the horizontal.
   a. The maximum allowable installation angle is 60°. Seismic restraints with installation angles greater than 60° will have little or no horizontal restraint capacity.
   b. Normally the minimum allowable installation angle is 30°. This is primarily due to space considerations. Smaller installation angles may be used for special cases when required.

5. Anchorage of the seismic restraints to the building structure must be made at locations where the structure is strong enough to carry the seismic loads plus the normal working loads. Coordinate the locations and anchorage of all seismic restraints with the structural engineer of record and/or the architect.

6. The seismic restraints **must not** touch or interfere with any other component or structure between their attachment point on the pipe or duct run, and their anchorage point on the building structure.

7. Cable restraints and strut restraints **can not** be mixed on the same run of pipe or duct. They must all be cable restraints, or they must all be strut restraints.

8. **For all** restraint locations and directions, there **must be** a hard connection between the pipe or duct and the seismic restraint to prevent movement of the pipe or duct during an
earthquake. Trapeze supported pipe and duct must be rigidly attached to the trapeze bar if the seismic restraints are attached to the hangers or trapeze bar.

9. For trapeze supported pipe and duct, the longitudinal seismic restraints must be balanced across the trapeze bar.

10. For isolated pipe and duct special treatments including uplift control are required. These treatments are detailed in Section I1.7.
I2.1 – The Need for a Plan:

The need for seismic restraints on a run of pipe or duct will impact many trades and building design professionals. Typically, the first trade on a project will have little or no trouble installing their pipe or duct and the seismic restraints that may be required. They basically have all of the available space to work with. As the project progresses it becomes more and more difficult to install the various pipe and duct runs, and especially more difficult to install the required seismic restraints. Many times, the last contractor on the project is just plain out-of-luck. If there is enough space to install the pipe or duct, it may be impossible to install the seismic restraints. Heaven forbid that the first contractor on the project find out that seismic restraint will be required for their pipe or duct after everything is installed. They may not be able to even see their pipe or duct from the floor, much less be able to get to it to install the restraints.

So, a plan is needed by the MEP (Mechanical, Electrical, and Plumbing) coordinator for the scheduling of the trades so that the installation of the pipe and duct along with the seismic restraints will be more possible. Also, before each contractor begins the installation of their pipe or duct, they need to walk each run of pipe or duct and determine where the pipe or duct is to be installed relative to other components already in place, what type of seismic restraint will be required for each run, and where the anchorage for the seismic restraint to the building structure will be possible.

This section will provide the MEP coordinator and contractors with guidelines for planning the installation of the seismic restraints for the pipe and duct. These guidelines are in the form of a checklist. They are general and are by no means complete for every project. Since every project has its own special issues that must be dealt with, these guidelines may not address all conditions, but they should be a good start.
I2.2 – What the MEP Coordinator Needs to Consider:

1. Determine which runs of pipe and duct will require seismic restraint, and which ones won’t.
   a. For Seismic Design Categories A and B seismic restraint for pipe and duct is not required by the code.
   b. For Seismic Design Category C, if the pipe or duct has a Component Importance Factor of 1.0, seismic restraint is not required by the code.
   c. For all other cases there may be certain pipe and duct runs that fall under a code exemption or a local jurisdictional exemption. A detailed breakdown of other code based exemptions can be found in Section S-4.0 of the manual.

2. Assume that seismic restraint will be required for the project, there may be instances where a run of pipe or duct that would normally be exempt from the need for restraints would need to be restrained because of its close proximity to equipment or other runs of pipe or duct that do require seismic restraint. A run of pipe or duct that would normally be exempt from seismic restraint will require seismic restraints if;
   a. If it can swing back and for and impact and damage a critical piece of equipment or run of pipe or duct that is seismically restrained.
   b. If a run of pipe or duct that has a Component Importance Factor of 1.0 is installed above a run of pipe or duct that has a component Importance Factor of 1.5, then it must be seismically restrained as thought it had a Component Importance Factor of 1.5.

3. When coordinating between different MEP professionals and trades, give careful consideration to the following.
   a. Position pipe and duct in elevation to allow seismic restraints of adjacent pipe, duct and components to be placed without interference.
   b. Position suspended equipment so that seismic restraints do not interfere with adjacent pieces of equipment, pipe, and duct.
   c. Seismic restraints must be attached directly to building structure that has sufficient capacity to resist the expected seismic loads plus the design service loads.
d. Equipment in-line with the ductwork may be restrained as part of the ductwork if the following are true.
   i. The in-line equipment weighs 75 lbs, or less.
   ii. At least one end of the in-line equipment is rigidly attached to the duct.
   iii. Piping or other services attached to the in-line equipment are done so with connections that can allow any relative motion to occur without damage.

   e. **Exception to “d.” for duct in buildings assigned to Seismic Design Categories D, E, and F, with a Component Importance Factor equal to 1.0, a cross-sectional area less than 6 ft² and in-line equipment weighing more than 20 lbs: Any restraint exemption that is applicable to the duct is NOT applicable to the in-line equipment which must still be individually restrained!**

4. The following issues must be considered when anchoring the seismic restraints to the building structure.
   a. Component attachments must be connected to the building structure by bolting, welding, or other positive attachment means. The frictional resistance due to the dead weight of the component may not be considered as part of the attachment means.
   b. Post installed concrete anchors should be prequalified in accordance with ACI 355.2. The post installed anchors should have an ICC-ES Report issued for them stating that they are for use with the code that is in force, and in the proper Seismic Design Category.
   c. Power actuated fasteners, such as powder shot pins, may not be used for tension loadings in Seismic Design Categories D, E, or F, unless approved by the code official, Authority having jurisdiction, for those applications.
   d. Friction clips are not permitted for seismic anchorage attachment.
   e. Beam clamps that are used for seismic anchorage attachments must be equipped with retaining straps, also known as retainer straps or safety straps capable of resisting the expected seismic loads.
I2.3 – What the Contractor Needs to Consider:

By the time the contractor has the final set of plans for the piping and ductwork, the following issues should be decided.

1. The runs of pipe and duct that require seismic restraint.
2. The approximate restraint locations and types, either longitudinal, transverse, or both.
3. The restraint capacity required at each location, and a possible anchorage to the building structure.

Before the pipe or duct is installed, the contractor should walk the run to see if there are any locations where a strut restraint will be required in place of a set of cable restraints. This decision will set the type of restraint for rest of the run. Some of the things that will require the use of strut over cable restraints are;

1. Other pipe or duct runs in the path of one of the restraint cables.
2. Suspended equipment in the path of one of the restraint cables.
3. No competent structure for the attachment of one of the restraint cables to the building.

It is absolutely imperative that seismic restraint cables do not come in to contact with any other pipe, duct, piece of equipment, or structural component in the path between the component being restrained and the attachment point on the building structure. This is because any seismic activity would place tremendous forces on the component that the seismic restraint cable had been wrapped around, potentially damaging it or the restraint.

2006 IBC requires that there be a clear and well defined load path from the pipe or duct being restrained to the building structure. In general, it is not acceptable to attach seismic restraints to stud walls unless the installation has been approved by the architect and/or structural engineer of record. Some of the stud walls may be load bearing and not have enough extra capacity to handle...
the design seismic loads from a run of pipe or duct. Other stud walls may be non-load bearing walls and not be adequately attached to the load bearing portion of the structure at the top of the wall, and thus not be capable of carrying large loads perpendicular to the wall.

It may be a good idea to install the seismic restraints as the run of pipe or duct is being installed to be sure that the seismic restraints can be placed in the locations that were planned, and that the types of restraints planned for are used. On some jobs, if the contractor waits until the entire pipe or duct run is up to install the restraints, other components may be in the path of the planned restraints, or the building structure may be completely inaccessible.

I2.4 – Final Word on the Use of Strut Type Restraints:

In general the use of strut type restraints over cable type restraints will call for a decrease in the restraint spacing and/or an increase in hanger rod size and hanger rod anchor capacity. Be aware that, if a previously installed run of pipe or duct is being fitted with seismic restraints, and some of the restraint locations require the use of struts rather than cables, all of the existing restraints will need to be changed out to struts and the hanger rod and anchors most likely will need to be increased in size and capacity. Therefore, it is very important to plan ahead to avoid costly surprises.

I2.5 – Summary:

Proper prior planning will indeed lead to the best possible outcome for any project. This planning must be done, not only by the contractor and MEP coordinator, but also by all of the design professionals responsible for the pipe, duct and structure.

It is the close co-ordination of all disciplines and trades that will lead to a smoother execution of a building design. This planning co-ordination is implied in the code, and must be driven from the top down by the building owner and architect.
CABLE RESTRAINT SCHEMATICS FOR PIPING

I3.1 – Introduction:

This section will present several basic schematics for the seismic cable restraints for single clevis supported pipe. The figures and descriptions in this section will be based on the Kinetics Noise Control drawing SS-20070950 titled Cable Restraint Schematics for Piping – Sheet A. There are several drawings in this specific series. They have been designed to aid the installing contractor with the installation of seismic cable restraints for pipe and duct. Each drawing has a number designation ranging from SS-20070950 through SS-20070959. Also each drawing is also identified by a particular letter designation ranging from Sheet A though Sheet H. Each of the drawings in this series has several views on each sheet designated by a specific letter. Where the figures in this section correspond with those views on the Kinetics Noise Control drawings SS-20070950 through SS-20070959 they will be cross referenced by sheet letter and figure letter, for instance Sheet A – View D.

The schematics in this section are intended to be a quick guide for planning and inspection purposes. The details on making structural connections and pipe attachments for the seismic restraint cables and components are covered in Sections I5.0 and I6.0 respectively. Hanger rod stiffeners may be required at some seismic restraint locations to prevent buckling of the hanger rod when the combination of seismic uplift loads and the reaction forces to the horizontal seismic loads generated at the restraint locations exceed the weight load. They are not addressed in this section, but are covered in Section I8.0. Also, piping supported on isolation hangers is not shown in this document. The seismic restraint schematics and attachments for isolated and non-isolated pipe are identical. However, the isolation hangers must receive special treatments that are described in Section I1.7 of this manual.
I3.2 – Transverse (T) Cable Restraint Schematics for Clevis Supported Pipe:

Figure I3-1; Transverse (T) Cable Restraint Schematic Arrangement for Single Clevis Supported Pipe – Cable Restraints Attached to Clevis Hanger

The type of clevis hanger that is represented in Figure I3-1 is a standard adjustable clevis hanger that is typified by the MSS Type-1 detail. This type of hanger is shown in a little more detail in Figure I3-9. This schematic arrangement may also be applied to an adjustable roller hanger MSS Type-43, which is pictured in more detail in Figure I3-10.
Occasionally, it makes sense to have the transverse seismic restraints attached to the hanger rod immediately above the clevis hanger. Sometimes there can be access or clearance issues with the clevis hanger. Sometimes the seismic restraints are being retrofitted to piping that is already in place. The Kinetics Noise Control Model KSCA brackets will allow seismic restraints to be retrofit to the hanger rods of clevis supported and trapeze supported pipe. The KSCA brackets must be attached tightly to the rod and tight against the top nut on the clevis hanger or the trapeze support hanger as shown in Section I6.3 of this manual, to prevent bending of the hanger rod.

Figure I3-2; Transverse (T) Cable Restraint Schematic Arrangement for Single Clevis Supported Pipe – Cable Restraints Attached to Hanger Rod Immediately Above Clevis Hanger
Figure I3-3; Transverse (T) Cable Restraint Schematic Arrangement for Single Clevis Supported Pipe – Cable Restraints Attached to a Pipe Riser Clamp Immediately Adjacent to the Clevis Hanger

For non-insulated pipe, this makes a convenient way to retrofit seismic restraints to piping that is already in place. The clevis hanger and hanger rod are not disturbed by the installation of the seismic restraints. Except in cases where the hanger rods may need to be reinforced with rod stiffeners to resist the seismic uplift forces.

The NFPA requires that the seismic restraints for fire protection piping systems be attached directly to the pipe itself. The pipe riser clamp provides an excellent means of making that attachment to steel pipe.
Figure I3-4; Transverse (T) Cable Restraint Schematic Arrangement for Single Clevis Supported Pipe – Cable Restraints Attached Weld to Tabs Immediately Adjacent to the Clevis Hanger

Weld tabs provide a secure means of attaching the seismic restraints to the pipe, especially in high seismic areas where the piping engineer will not allow attachment to the clevis hanger or hanger rod.

The use of weld tabs must be planned for before the pipe is installed and filled. Otherwise, obtaining good welds is nearly impossible due to the heat dissipating properties of the fluid, and the potential orientation of the weld.
I3.3 – Longitudinal (L) Cable Restraint Schematics for Clevis Supported Pipe:

In order for longitudinal seismic restraints to be attached to the clevis hanger or the hanger rod directly above the clevis hanger, the clevis hanger itself must be a clamping type hanger that firmly secures the pipe in order to transfer the seismic loads from the pipe to the restraints. These are commercially available, but are not provided by Kinetics Noise Control as part of the standard restraint package.
For this type of installation, a commercially available pipe riser clamp is used to secure the cable restraints to the pipe. The clamp may be rotated slightly to allow the one cable to clear the hanger rod and rod stiffener and clamps, if required. Note that the restraint cables **must not** touch the hanger rod, rod stiffener, or the rod stiffener clamps. This could lead to a dangerous overload condition for the hanger rod or damage to the cable during an earthquake.
As for the transverse restraints, weld tabs provide a secure means of attaching the seismic restraints to the pipe, especially in high seismic areas. The use of weld tabs must be planned for before the pipe is installed and filled. Otherwise, obtaining good welds is nearly impossible due to the heat dissipating properties of the fluid, and the potential orientation of the weld. As with the riser clamps, the restraint cables must not touch the hanger rod, rod stiffener, or the rod stiffener clamps. This could lead to a dangerous overload condition for the hanger rod or damage the cable during an earthquake.
I3.4 – Combined Transverse & Longitudinal (TL) Cable Restraint Schematics for Clevis Supported Pipe:

Figure I3-8; Combined Transverse & Longitudinal (TL) Cable Restraint Schematic Arrangement for Single Clevis Supported Pipe – Cable Restraints Attached to a Clamp Type Clevis Hanger
In order for longitudinal seismic restraints to be attached to the clevis hanger or the hanger rod directly above the clevis hanger, the clevis hanger itself must be a clamping type hanger that firmly secures the pipe in order to transfer the seismic loads from the pipe to the restraints. These are commercially available, but are not provided by Kinetics Noise Control as part of the standard restraint kit.

Figure I3-9: Combined Transverse & Longitudinal (TL) Cable Restraint Schematic Arrangement for Single Clevis Supported Pipe – Cable Restraints Attached to Pipe Riser Clamps Immediately Adjacent to the Clevis Hanger
It is not uncommon to want to use both, the transverse and longitudinal seismic restraints at the same location. The use of riser clamps allows them to be easily attached to the pipe close to a hanger location. The riser clamps can also be replaced with weld tabs as shown in Figure I3-7 above. As with the independent longitudinal restraints, the restraint cables must not touch the hanger rod, rod stiffener, or the rod stiffener clamps.

Figure I3-10; Combined Transverse & Longitudinal (TL) Cable Restraint Schematic Arrangement for Single Clevis Supported Pipe – Cable Restraints Attached to Weld Tabs Adjacent to the Clevis Hanger
I3.5 – Some Common Types of Clevis Hangers:

**Figure I3-11; Standard Adjustable Clevis Hanger**

- **Adjustable Clevis Hanger MSS Type-1**
  - Bolt Limits Upward Movement of Pipe in Clevis Bracket at Restraint Locations

**Figure I3-12; Roller Type Clevis Hanger Used for Hot and Cold Fluid Lines**

- **Adjustable Roller Hanger MSS-Type 43**
  - Protection Saddle for Seismic Uplift Control at Restraint Locations
  - Protection Saddle
  - Pipe Insulation
  - Hanger Rod
  - Maximum 1/4" movement
  - Steam, Hot or Chilled Water Pipe
Seismic Uplift Control at Restraint Locations Provided by Hanger Clamp Design

Figure I3-13; Commercially Available Clamp Type Clevis Hanger

Adjustable Swivel Ring Band Hanger MSS Type-10

Screw Hanger Rod Down Tight to Pipe for Seismic Uplift Control at Restraint Locations

Figure I3-14; Adjustable Swivel Ring Band Pipe Clevis Hanger – Typically Used for Fire Protection Piping
I3.6 – Transverse (T) Cable Restraint Schematics for Trapeze Supported Pipe:

Figure I3-15; Transverse (T) Cable Restraint Schematic Arrangement for Trapeze Supported Pipe – Cable Restraints Attached to Both Ends, or Hanger Rods, of the Trapeze Bar and Directed Outside the Trapeze.
Figure I3-16; Transverse (T) Cable Restraint Schematic Arrangement for Trapeze Supported Pipe – Cable Restraints Attached to One End, or Hanger Rod, of the Trapeze Bar
Figure I3-17; Transverse (T) Cable Restraint Schematic Arrangement for Trapeze Supported Pipe – Cable Restraints Attached to Both Ends, or Hanger Rods, of the Trapeze Bar and Directed Inside the Trapeze.
Figure I3-18; Transverse (T) Cable Restraint Schematic Arrangement for Trapeze Supported Pipe – Cable Restraints Attached to Both Ends, or Hanger Rods, of the Trapeze Bar and Directed Inside the Trapeze with a Second Tier Trapeze Support for Additional Pipes.
Figure I3-19; Transverse (T) Cable Restraint Schematic Arrangement for Trapeze Supported Pipe – Cable Restraints Attached to Both Ends, or Hanger Rods, of the Trapeze Bar and Directed Outside the Trapeze for Use in Tight Space Situations.
Figure I3-20; Transverse (T) Cable Restraint Schematic Arrangement for Trapeze Supported Pipe – Trapeze Bar Is Too Close to a Wall to Allow a Normal Restraint Arrangement – Obtain Permission from the Structural Engineer and Architect Before Penetrating the Wall
I3.7 – Longitudinal (L) Cable Restraint Schematics for Trapeze Supported Pipe:

Figure I3-21: Longitudinal (L) Cable Restraint Schematic Arrangement for Trapeze Supported Pipe – Restraint Forces are Balanced Side-to-Side – Requires One (1) Extra Restraint Cable Kit beyond KNC Material Required List per Longitudinal Restraint Location
Figure I3-22; Longitudinal (L) Cable Restraint Schematic Arrangement for Trapeze Supported Pipe – Restraint Forces are Balanced Side-to-Side – Requires No Addition Cable Kits Other Than Those on the KNC Material Required List per Longitudinal Restraint Location
I3.8 – Transverse (T) Cable Restraint Schematics for Floor or Roof Mounted Pipe:

Figure I3-23; Transverse (T) Cable Restraint Schematic Arrangement for Floor or Roof Mounted Pipe – One Restraint Attached to Each Side of the Cross Bar at the Vertical Legs Directed Outward from the Floor Stand
Figure I3-24; Transverse (T) Cable Restraint Schematic Arrangement for Floor or Roof Mounted Pipe – Both Restraints Attached to One Side of the Cross Bar at the Vertical Leg
Figure I3-25; Transverse (T) Cable Restraint Schematic Arrangement for Floor or Roof Mounted Pipe – One Restraint Attached to Each Side of the Cross Bar at the Vertical Legs Directed Inward
Figure I3-26; Transverse (T) Cable Restraint Schematic Arrangement for Floor or Roof Mounted Pipe – Two Restraints Attached to the Vertical Legs Acting as Cross Braces – The Anchors Attaching the Stand to the Floor Must be Seismically Rated Cracked Concrete Anchors with a Current ICC-ESR Number
I3.9 – Longitudinal (L) Cable Restraint Schematics for Floor or Roof Mounted Pipe:

![Diagram showing Longitudinal Cable Restraint Schematic](image)

Figure I3-27; Longitudinal (L) Cable Restraint Schematic Arrangement for Floor or Roof Mounted Pipe – Restraints Attached to the Floor Stand or Support
Figure I3-28; Longitudinal (L) Cable Restraint Schematic Arrangement for Floor or Roof Mounted Pipe – Restraints Attached to the Pipe – Each Pipe Must be Individually Restained
I3.10 – Combined Transverse & Longitudinal (TL) Cable Restraint Schematics for Trapeze Supported Pipe:

Figure I3-29; Combined Transverse & Longitudinal (TL) Cable Restraint Schematics for Trapeze Supported Pipe – All of the Options Shown Offer Balanced Longitudinal Restraint Forces Side-to-Side – Options #2 and #3 Do Not Require Extra Cable Restraint Kits While Option #1 Does Require One (1) Extra Restraint Cable Kit Beyond Those Listed in the KNC Material Required List per Combined Transverse & Longitudinal Seismic Restraint Location
I3.11 – Some Common Trapeze Bar Configurations:

The design of trapeze bars used in the support of pipe is varies by trade, the standard used for designing the piping, engineering company, and design requirements. There are no “off the shelf” trapeze bars available as there are clevis hangers. Each trapeze bar is designed for the specific application, and the design of the trapeze bar structural members from which it is constructed are generally specified by the design professional of record for the system being installed.

Figure I3-30; Some Common Trapeze Bar Design Configurations Used for Supporting Pipe
Some common structural members used to construct trapeze bars used for pipe supports are shown in Figure I3-30. Figure I3-30 A is a typical trapeze bar constructed from AISI structural angle that is cut and drilled in the field for the hanger rods and pipe clamps. Figure I3-30 B is a single structural channel that mounted horizontally, and is cut and drilled in the field for the hanger rods and pipe clamps. Figure I3-30 C is a strut channel similar to a UNISTRUT® P5000 which is also cut in the field. Strut channels may be purchased pre-pierced with holes and/or slots to aid in mounting the hanger rods and clamps for the piping. Strut manufacturers also have special pipe clamps that are design to work in the open slot of the strut channel. Figure I3-30 D is a trapeze bar that is made of a weldment consisting of two standard channels back-to-back. In this configuration two drilled plates on welded on each end provide the mounting locations for the hanger rods. Pipe clamps would need to have drilled plates welded to the tops of the channels, or have holes drilled in the flanges of the channels. If the flange holes are used to mount the pipe clamps tapered structural washers should be used against the bottom of the flange to prevent bending of the clamp bolts. This design is used to carry very large and heavy pipes such as chilled water supply and return lines.

I3.12 – Trapeze Bar Design Loads:

Typically trapeze bars are designed to carry the dead weight loads of the pipes that they are supporting, and for non-seismic applications this is more than sufficient. However with the introduction of significant seismic loads, the trapeze bars at the seismic restraint locations may need to become more “beefy” to carry the horizontal seismic loads generated by the pipes they are supporting.

At transverse (T) seismic restraint locations, the seismic loads will act along the trapeze bar, which is its strong direction. The trapeze bar will only need to be strong enough to support the dead weigh load of the pipes, and to not buckle under the transverse seismic loads generated by the pipes that it is supporting.
At longitudinal (L) and combined transverse & longitudinal (TL) seismic restraint locations, the situation is very different. The longitudinal restraints may be resisting the seismic loads generated by as much as eight times the length of pipe as they are supporting. The longitudinal seismic forces will act perpendicular to the trapeze bar and will place it in bending. Typically the strong bending direction for a trapeze bar is chosen to resist the dead weight load of the pipe which is acting vertically against the bar. As a result, the longitudinal seismic forces are typically applied in the weak bending direction of the trapeze bar. Since the dead weight loads and the longitudinal seismic restraint loads can act concurrently (at the same time), those trapeze bars located at longitudinal seismic restraint locations may require a stronger section to resist the expected load combination. This is a situation that should be addressed before the installing contractor is confronted by it in the field!

Note for Installing Contractors: If a similar trapeze bar design is being used throughout a project, the following situations will warrant a question back to the design professional of record for the system being installed.

1. The project is located in a high seismic area such as;
   a. Los Angeles, CA
   b. San Francisco, CA
   c. Seattle, WA
   d. Portland, OR
   e. Salt Lake City, UT
   f. Memphis, TN
   g. Charleston, SC

2. Large piping is being supported on trapeze bar designs that are also used for smaller pipes.

3. The same trapeze bar design is being used on the top floor and in the basement to carry the same number and size of pipes.
The seismic design forces acting on the pipe, and the seismic restraint locations and spacings are discussed in the Sections S5.0 and S7.0 respectively. It is the responsibility of the design professional of record for the system being installed to ensure that the trapeze bars at each seismic restraint location are capable of carrying the dead weight loads of the pipe as well as the design seismic loads specified by the code for the project.

I3.13 – “Clamping” the Pipe to the Trapeze Bar – When and How:

When the seismic restraints are attached to either the trapeze bar or the hanger rod(s), the pipes themselves must be clamped, or otherwise positively attached to the trapeze bar to ensure that the seismic loads from the pipes is indeed passed through to the seismic restraints. There can be no relative motion between the pipe and the trapeze bar. Clamps such as U-bolt clamps do rely on friction to hold the pipe in place, but the normal force depends on the torque applied to the nuts rather than the gravity load from the dead weight of the pipe. Therefore, the clamping force may be increased to the point where slippage between the pipe and the trapeze bar is not possible. There are many other types of clamps that may be employed such as the strut type clamps made to work with strut channels such as those manufactured by UNISTRUT® and Cooper B-Line. It is the responsibility of the design professional of record responsible for the system to determine if the clamps specified will be adequate to transmit the expected seismic loads, and to specify the proper torque values required.

When working with steam lines, hot or chilled HVAC water lines, and domestic hot water lines a means to deal with the thermal growth and shrinkage of the pipes must be used that will properly limit the relative movement between the pipe and the trapeze bar at the restraint locations. Pipes such as steam lines and hot or chilled HVAC lines typically are insulated to maintain system thermal efficiency. The insulation presents some particular issues when the relative motion between the pipe and trapeze bar must be kept to zero. Figure I3-31 shows one means of allowing thermal growth or shrinkage while preventing transverse movement of the pipe, and
providing uplift control. Note, some means of protecting the insulation such as protection saddles must be used to prevent it from being crushed during an earthquake.

Figure I3-31; Transverse (T) Cable Restraint Location for Trapeze Supported Steam Line – Insulated Steam Pipe Is Trapped in the Transverse Direction and Uplift Is Prevented, While Thermal Growth Is Allowed by a Double Roll Pipe Support

Figure I3-32 shows a hot or chilled HVAC water line supported by a trapeze bar at a transverse seismic restraint location. Here the pipe is loosely restrained to the trapeze bar by a U-Bolt that is slightly wider than the insulation, and is not tightened down. The clearance between the pipe and the U-Bolt must not exceed 1/4". This arrangement will allow the pipe to grow or shrink without affecting the trapeze bar, or overloading the pipe. Here again, some means of protecting the insulation must be used. Shown in Figure I3-32 are protection saddles, however in lighter seismic conditions, insulation protection shields may serve just as well. Figure I3-33 shows a steam line, or a hot or chilled HVAC water line supported by a trapeze bar at a longitudinal seismic restraint location. Here the pipe is clamped to the trapeze bar firmly enough to prevent slippage between the pipe and the trapeze bar in the longitudinal direction. Great care must be taken that the insulation, and in some cases, the pipe are not crushed when the U-Bolt is tightened down. Typically, there will be only one longitudinal seismic restraint location for this type of pipe per run.
If more longitudinal seismic restraints are required, expansion/contraction joints will be needed between adjacent longitudinal restraints, see Section S9.0 of this manual.

Figure I3-32; Transverse (T) Cable Restraint Location for Trapeze Supported Hot or Chilled Water Line – Insulated Water Pipe Is Trapped in the Transverse Direction and Uplift Is Prevented, While Thermal Growth Is Allowed by a U-Bolt which is Slightly Wider than the Insulation, and which Is Not Tightened Down

Figure I3-33; Longitudinal (L) Cable Restraint Location for Trapeze Supported Steam Line, or Hot or Chilled Water Line – Insulated Pipe Is Trapped in the Longitudinal Direction and Uplift Is Prevented by a U-Bolt which Fits the Insulation Snuggly, and which Is Tightened Down Sufficiently to Prevent Longitudinal Motion of the Pipe Relative to the Trapeze Bar
Figures I3-34 and I3-35 show the clamping arrangements for domestic hot water lines to a trapeze bar at the transverse and longitudinal seismic restraint location respectively. Extra care must be taken with domestic hot water piping because the pipes are usually thin wall copper tubing, or are PVC or CPVC. These pipes are easily crushed; therefore, torque values for tightening the U-Bolt clamps on the pipes supported by trapeze bars at longitudinal seismic restraint locations must be closely monitored.

There will probably be only one longitudinal seismic restraint location per run for domestic hot water pipes, and it will typically be located in the middle of the run to balance the thermal growth in the pipe. Also, the last transverse seismic restraint location must be far enough away from a corner so that the pipes do not fail in bending when they grow in service, see Section S9.0 of this manual.

Figure I3-34; Transverse (T) Cable Restraint Location for Trapeze Supported Domestic Hot Water Line – Water Pipe Is Trapped in the Transverse Direction and Uplift Is Prevented, While Thermal Growth Is Allowed by a U-Bolt which is Slightly Wider Than the Pipe, and which Is Not Tightened Down
I3.14 – Summary for Seismic Cable Restraints for Piping:

1. The schematics and arrangements presented in this section are intended to be used as guidelines for the installation of seismic restraints for piping. They do not represent fully engineered designs for specific projects. The specific design details of each installation are the responsibility of the design professional of record for the systems that are being installed.

2. A minimum of two seismic restraint cables acting 180° apart are required for each transverse and each longitudinal seismic restraint location.

3. When locating and specifying seismic restraints for a project, Kinetics Noise Control will list the minimum required number of seismic restraint kits required under ideal conditions for the project. The actual installation circumstances may require additional restraint kits at certain locations.
4. Clevis hangers, trapeze bars, and hanger rods at seismic restraint locations must be properly sized and specified by the design professional of record for the system to handle the expected seismic forces as well as the dead weight loads from the pipe.

5. Attachment of seismic restraints to the piping, clevis hangers, trapeze bars, and hanger rods must be approved by the design professional of record for the system.

6. For floor or roof mounted pipe where the restraints are installed as shown in Figure I3-26, the anchors attaching the stand or support to the building structure form part of the seismic load path. As such, these anchors must be seismically rated anchors for use in cracked concrete, and must have a current ICC-ESR number.

7. Attachment of seismic restraints to the building structure must be approved by the structural engineer and/or the architect or record.
I4.1 – Introduction:

This section will present several basic schematics for the seismic cable restraints for duct. The figures and descriptions in this section will be based on the Kinetics Noise Control drawings SS-20070957 and SS-20070958 titled Cable Restraint Schematics for Duct – Sheets A1 and A2 respectively. There are several drawings in this specific series. They have been designed to aid the installing contractor with the installation of seismic cable restraints for pipe and duct. Each drawing has a number designation ranging from SS-20070950 through SS-20070959. Also each drawing is specified by a particular letter designation ranging from Sheet A though Sheet H. The drawing numbers are in no particular order. However, the letter designations are in strict alphabetical order. Each of the drawings in this series has several views on each sheet designated by a specific letter. Where the figures in this section correspond with those views on the Kinetics Noise Control drawings SS-20070950 through SS-20070959 they will be cross referenced by sheet letter and figure letter, for instance Sheet A1 – View H.

The schematics in this section are intended to be a quick guide for planning and inspection purposes. The details on making structural connections and duct attachments for the seismic restraint cables and components are covered in Sections I5.0 and I6.0 respectively. Hanger rod stiffeners may be required at for hanger rods at seismic restraint locations to prevent buckling of the hanger rod under the seismic uplift conditions. They not addressed in this section, but are covered in Section I8.0. Also, duct supported on isolation hangers is not shown in this document.

The seismic restraint schematics and attachments for isolated and non-isolated duct are identical. However, the isolation hangers must receive special treatments that are described in Section I1.7 of this manual.
I4.2 – Transverse (T) Cable Restraint Schematics for Rectangular and Square Duct:
Figure I4-1; Transverse (T) Cable Restraint Schematic Arrangement for Trapped Rectangular Duct – One Restraint at Each Hanger Location Directed Outward from the Top Trapeze Bar
Figure I4-2; Transverse (T) Cable Restraint Schematic Arrangement for Trapped Rectangular Duct – One Restraint at Each Hanger Location Directed Inward & Crossing Over the Top of the Duct from the Top Trapeze Bar
Figure I4-3; Transverse (T) Cable Restraint Schematic Arrangement for Trapped Rectangular Duct – Two Restraints at One Hanger Location with One Restraint Directed Inward & One Restraint Directed Outward from the Top Trapeze Bar
Figure I4-4; Transverse (T) Cable Restraint Schematic Arrangement for Trapped Rectangular Duct – One Restraint at Each Hanger Location Directed Outward from the Bottom Trapeze Bar.
Figure I4-5; Transverse (T) Cable Restraint Schematic Arrangement for Supported Rectangular Duct – One Restraint at Each Hanger Location Directed Outward from the Trapeze Bar.
Figure I4-6; Transverse (T) Cable Restraint Schematic Arrangement for Suspended Rectangular Duct – One Restraint at Each Hanger Location Directed Outward from the Trapeze Bar
Figure I4-7: Transverse (T) Cable Restraint Schematic Arrangement for Suspended Rectangular Duct – Two Restraints at One Hanger Location with One Restraint Directed Inward & One Restraint Directed Outward from the Trapeze Bar.
Figure I4-8; Transverse (T) Cable Restraint Schematic Arrangement for Suspended Rectangular Duct – Four Restraints Connected Through an Intermediate Trapeze Bar and Directed Inward from the Intermediate Trapeze Bar – *An Extra Restraint Kit Is Required*
Figure I4-9: Transverse (T) Cable Restraint Schematic Arrangement for Suspended Rectangular Duct – Four Restraints Connected Through an Intermediate Trapeze Bar and Directed Outward from the Intermediate Trapeze Bar – **An Extra Restraint Kit Is Required**
Figure I4-10: Transverse (T) Cable Restraint Schematic Arrangement for Supported Rectangular Duct – Restrained with an Angle Strut Passing Through a Non-Structural Wall Using One Pair of Restraint – Obtain Permission from the Structural Engineer & Architect before Penetrating the Wall.
Figure I4-11; Transverse (T) Cable Restraint Schematic Arrangement for Suspended Rectangular Duct – Two Restraints Directed Outward and Attached At or Near the Center of the Trapeze Bar
I4.3 – Longitudinal (L) Cable Restraint Schematics for Rectangular and Square Duct:

Figure I4-12: Longitudinal (L) Cable Restraint Schematic Arrangement for Rectangular Duct – Restraints Located on Each Side of the Bottom Trapeze Bar – *An Extra Restraint Kit Is Required*
Figure I4-13; Longitudinal (L) Cable Restraint Schematic Arrangement for Trapped Rectangular Duct – 1.) Restraints Located in the Center of the Top Trapeze Bar or 2.) Restraints Located on Each Side of the Top Trapeze Bar – *An Extra Restraint Kit Is Required*
I4.4 – Transverse (T) Cable Restraint Schematics for Round Duct:

Figure I4-14; Transverse (T) Cable Restraint Schematic Arrangement for Round Duct Supported by Two Hanger Rods – One Restraint at Each Hanger Location Directed Outward
Figure I4-15; Transverse (T) Cable Restraint Schematic Arrangement for Round Duct Supported by One Hanger Rod – Two Restraints Adjacent to Hanger Rod Attached to Band Clamps
I4.5 – Longitudinal (L) Cable Restraint Schematics for Round Duct:

Figure I4-16; Longitudinal (L) Cable Restraint Schematic Arrangement for Round Duct Supported by Two Hanger Rods – Two Restraints at Each Hanger Location – *An Extra Restraint Kit Is Required*
Figure I4-17; Longitudinal (L) Cable Restraint Schematic Arrangement for Round Duct Supported by One Hanger Rod – Two Restraints Adjacent to and on Each Side of the Hanger Rod Attached to Band Clamps – *An Extra Restraint Kit Is Required*
I4.6 – Transverse (T) Cable Restraint Schematics for Floor or Roof Mounted Duct:

Figure I4-18; Transverse (T) Cable Restraint Schematic Arrangement for Floor or Roof Mounted Duct – One Restraint Attached to Each Side of the Cross Bar at the Vertical Legs and Directed Outward from the Floor Stand.
Figure I4-19; Transverse (T) Cable Restraint Schematic Arrangement for Floor or Roof Mounted Duct – One Restraint Attached to Each Side of the Top of the Duct and Directed Outward from the Floor Stand.
Figure I4-20; Transverse (T) Cable Restraint Schematic Arrangement for Floor or Roof Mounted Duct – Both Restraints Attached to One Side of the Cross Bar at the Vertical Leg
Figure I4-21; Transverse (T) Cable Restraint Schematic Arrangement for Floor or Roof Mounted Duct – One Restraint Attached to Each Side of the Cross Bar at the Vertical Legs and Directed Inward.
Figure I4-22; Transverse (T) Cable Restraint Schematic Arrangement for Floor or Roof Mounted Duct – Two Restraints Attached to the Vertical Legs Acting as Cross Braces – The Anchors Attaching the Stand to the Floor Must be Seismically Rated Cracked Concrete Anchors with a Current ICC-ESR Number
I4.7 – Longitudinal (L) Cable Restraint Schematics for Floor and Roof Mounted Duct:

Attachment of Duct to Cross Bar. Sections A3.4, A3.5, & A3.6

Cable Restraint Attachment Section I6.0

KNC Cable Restraint Sections S7.0 & I1.0

Structural Attachment (Orientation #1) Section I5.0

Install Angle See KNC Data Sheet

Building Structure

Figure I4-23; Longitudinal (L) Cable Restraint Schematic Arrangement for Floor or Roof Mounted Duct – Restraints Attached to the Floor Stand or Support
Figure I4-24; Longitudinal (L) Cable Restraint Schematic Arrangement for Floor or Roof Mounted Duct – Restraints Attached to the Duct
I4.8 – Transverse (T), Longitudinal (L), and Combined (TL) Restraint Plan View Arrangements for Ducts:

Figure I4-25; Transverse (T) and Longitudinal (L) Basic Plan View Restraint Arrangements for Duct – Note: The Longitudinal (L) Restraint Cables in Longitudinal Restraint Options #1 & #2 are Arranged to Prevent Twisting of the Duct – *An Extra Restraint Kit Is Required for Longitudinal (L) Restraint Option #1*
Figure I4-26; Combined Transverse and Longitudinal (TL) Basic Plan View Restraint Arrangements for Duct – Note: The Restraint Cables in Options #1, #2, & #3 are Arranged to Prevent Twisting of the Duct – An Extra Restraint Kit Is Required for Combined Transverse and Longitudinal (TL) Restraint Options #1 & #2
I4.9 – Attachment of Seismic Restraints to Ducts and Trapeze Bars:

It is necessary to have a verifiable positive load path between the duct and the building structure. Duct that is restrained in accordance with the SMACNA “Seismic Restraint Manual – Guidelines for Mechanical Systems” will have this verifiable load path. The methods recommended in this manual by SMACNA are compatible with most forms of sheet metal duct construction techniques, and the seismic requirements of many locations. However, there will be some projects whose seismic requirements exceed the limits published by SMACNA. For these situations, fasteners used to attach the duct to the trapeze bars which are restrained, or the seismic restraints to the duct may be selected based on the information found in Appendices A3.4, A3.5, and A3.6. These fastener selections are based on the Horizontal Force Class for the duct being restrained. This system of Horizontal Force Classes is discussed in Section S7.0 of this manual.

I4.10 – Summary for Seismic Cable Restraints for Duct:

1. The schematics and arrangements presented in this section are intended to be used as guidelines for installation of seismic restraints for duct. They do not represent fully engineered designs for specific projects. The specific design details of each installation are the responsibility of the design professional of record for the systems that are being installed.

2. A minimum of two seismic restraint cables acting 180° apart are required for each transverse and each longitudinal seismic restraint location.

3. When locating and specifying seismic restraints for a project, Kinetics Noise Control will always list the minimum required number of seismic restraint kits for each restraint location. The actual installation circumstances may require additional restraint kits at certain locations particularly for trapeze supported duct or round duct supported by two hanger rods to balance the restraint forces from side-to-side on the duct.

4. Hangers and/or hanger rods at seismic restraint locations must be rigid members such as all thread rods in order to be able to transmit seismic uplift reaction forces from the duct to the building structure.
5. Hangers, trapeze bars, and hanger rods at seismic restraint locations must be properly sized and specified by the design professional of record for the system to handle the expected seismic forces as well as the dead weight loads from the duct.

6. Attachment of seismic restraints to the duct, hangers, trapeze bars, and hanger rods must be approved by the design professional of record for the system.

7. For floor or roof mounted duct where the restraints are installed as shown in Figure I4-22, the anchors attaching the stand or support to the building structure form part of the seismic load path. As such, these anchors must be seismically rated anchors for use in cracked concrete, and must have a current ICC-ESR number.

8. Attachment of seismic restraints to the building structure must be approved by the structural engineer and/or the architect or record.
5.1 – Introduction:

This section will present several basic arrangements for attaching seismic cable restraints to the building structure. The figures and descriptions in this section will be based on the Kinetics Noise Control drawings SS-20070951, SS-20070952, and SS-20070953 titled Concrete/Masonry Attachment – Sheet B, Steel Attachment – Sheet C, and Wood Attachment – D respectively. There are several drawings in this specific series. They have been designed to aid the installing contractor with the installation of seismic cable restraints for pipe and duct. Each drawing has a number designation ranging from SS-20070950 through SS-20070959. Also each drawing is specified by a particular letter designation ranging from Sheet A though Sheet H. The drawing numbers are in no particular order. However, the letter designations are in strict alphabetical order. Each of the drawings in this series has several views on each sheet designated by a specific letter. Where the figures in this section correspond with those views on the Kinetics Noise Control drawings SS-20070950 through SS-20070959 they will be cross referenced by sheet letter and figure letter, for instance Sheet C – View M.

Kinetics Noise Control provides attachment kits for their seismic restraint cable kits for pipe and duct. Kinetics Noise Control will, when requested to do so, provide a certification for the products that they sell. This certification will state that the seismic restraint cable and attachment kits will meet the seismic design requirements for the project in question when properly installed at the correct spacing. It is important to keep in mind that this certification does not extend to the building structure. Kinetics Noise Control is a manufacturer of vibration isolation and seismic restraint devices for the HVAC industry, and as such has no control over the design of the building structure. It is the responsibility of the structural engineer of record, and in some cases the architect of record, to approve the structural connections for the seismic restraints for pipe and duct.
I5.2 – KSUA Attachment Brackets:

I5.2.1 – KSUA Brackets – Basic Sizes & Installation:

Kinetics Noise Control provides several different attachment brackets that can be used for making the structural attachment for the seismic cable restraints. Figure I5-1 shows the two KSUA brackets.

![KSUA-1 and KSUA-2 brackets diagram]

Figure I5-1; Kinetics Noise Control Model KSUA Seismic Restraint Cable Attachment Brackets

Primarily, the KSUA attachment brackets are used with the Kinetics Noise Control Model KSCU Seismic Restraint Cable Kits, which are described in Appendix A1.1. A KSCU seismic restraint cable kit consists of two restraint cables with a loop swaged on one end, two Kinetics provided end connectors, two Kinetics Model KSCA attachment brackets (which will be described in detail in the Section I5.3.1). For OSHPD applications thimbles are required for both ends of the restraint cables.
The KSUA attachment brackets were designed to be used with the pre-swaged end of the restraint cable, although they can be used on the end of the cable where the loop is made with the Kinetics provided end connector. Figure I5-2 shows the basic installation of the KSUA brackets. The particular installation shown is for attachment to the building structural concrete, although the basic procedure is the same regardless of whether the bracket is being attached to structural steel, concrete, or wood.

1. The pre-swaged end loop of the restraint cable is slipped over one of the legs of the open KSUA bracket; see View #2 Side KSUA – Open in Figure I5-2.
2. The open KSUA bracket is placed over the fastener, with or without a flat washer, and the nut is run down finger tight on the bracket. See View #2 Side KSUA – Open in Figure I5-2 above.
3. Tighten the nut with a wrench to the proper torque specified for the fastener being used. The two legs of the KSUA bracket should be squeezed completely shut as shown in View #3 Side KSUA – Closed as shown in Figure I5-2. Squeezing the legs of the KSUA bracket shut
will form a loop for the restraint cable. The cable should be loose and free to move inside the loop of the KSUA bracket.

I5.2.2 – KSUA Brackets – Attachment to Steel:

In general, attaching the KSCU seismic restraint cable kits to structural steel will maximize the capacity of the KSCU restraint installation. Figure I5-3 and Table I5-1 illustrate how the KSUA bracket may be welded to structural steel. A rolled structural W shape is shown; however, this scheme may be applied to any structural shape with the approval of the building structural engineer. An ASTM A307, SAE Grade 2, bolt of the proper size is located on the structural steel and welded as shown in Figure I5-3. Then the cable and KSUA bracket are installed a described in Section I5.2.1.

![KSUA Bracket Typical](image)

**Sheet C - Views F, K, M, and N**

**Figure I5-3; Welding KSUA Brackets to Structural Steel**

**Table I5-1; Bolt and Weld Size for KSUA Bracket Weld Attachment to Structural Steel**

<table>
<thead>
<tr>
<th>KSUA Bracket</th>
<th>Bolt Size $D_B$</th>
<th>Weld Size $h$ (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KSUA-1</td>
<td>3/8-16 UNC</td>
<td>3/16</td>
</tr>
<tr>
<td>KSUA-2</td>
<td>1/2-13 UNC</td>
<td>1/4</td>
</tr>
</tbody>
</table>
Kinetics Noise Control supplies Models KSBC-1 and -2 Seismic Beam Clamps that may be used to attach the KSUA brackets to structural steel AISC W, M, S, or HP shapes without welding. This method of attachment to structural steel is shown in Figure I5.4. Here also, the use of the seismic beam clamps to attach the KSUA brackets to the structural steel must be approved by the building structural engineer.

KSUA Brackets may be attached to steel open web joists as shown in Figures I5-5, I5-6, and I5-7. These structural elements are normally designed to be as efficient as possible which means that they are designed to carry primarily vertical loads, and are sized to carry just the code mandated loads. If seismic restraints for pipe and duct are to be attached to these open web steel joists as shown in Figures I5-5, I5-6, and I5-7 below, it is absolutely necessary for the building structural engineer to approve each attachment point.
Use at Cross-Brace Location Only!
Otherwise Follow Figure I5-6.

KSUA Bracket

Sheet C - View A

Figure I5-5; Attaching KSUA Brackets to Cross-Braced Open Web Steel Joists

KSUA Bracket

Sheet C - View G

Figure I5-6; Attaching KSUA Brackets to Un-Braced Open Web Steel Joists
Figure I5-7; Attaching KSUA Brackets to Un-Braced Open Web Steel Joists – Aligned to Joists

1. 13/16 Strut Channel for KSUA-1
2. 1-5/8 Strut Channel for KSUA-2
3. Strut Channel to Span at least 2 V's as Shown

Use Channel Nuts with Serrated Teeth

Both Sides Typ.

Sheet C - View B
I5.2.3 – KSUA Brackets – Attachment to Concrete:

The typical attachment of seismic cable restraints to concrete using KSUA brackets is shown in Figure I5-8. The critical installation dimensions are listed in Table I5-2.

Figure I5-8; Typical KSUA Bracket Installation in Concrete
Table I5-2; Critical KCCAB Concrete Anchor Installation Dimensions for KSCU Restraint Cable Kits

<table>
<thead>
<tr>
<th>Anchor &amp; Pilot Hole Size $D_o$ (in)</th>
<th>Pilot Hole Depth $H_o$ (in)</th>
<th>Effective Anchor Embedment $H_{ef}$ (in)</th>
<th>Minimum Concrete Thickness $H_{min}$ (in)</th>
<th>Minimum Anchor Spacing $S_{min}$ (in)</th>
<th>Minimum Anchor Edge Distance $C_{min}$ (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8</td>
<td>2-5/8</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>4-3/8</td>
</tr>
<tr>
<td>1/2</td>
<td>4</td>
<td>3-1/4</td>
<td>6</td>
<td>9-3/4</td>
<td>7-1/2</td>
</tr>
</tbody>
</table>

The installation dimensions listed in Table I5-2 are the minimum required to achieve the listed capacities for the Model KSCU Seismic Restraint Cable Kits listed in Appendix A1.1, Tables A1.1-3 and A1.1-4.

Figure I5-9 shows a KSUA bracket attached to concrete which has been poured over a corrugated metal deck. Thickest concrete section at the ribs of the decking must meet the Minimum Concrete Thickness from Table I5-2 above. Figure I5-10 shows a KSUA bracket mounted to a strut channel which spans at least two ribs. This arrangement is used when there is not enough concrete thickness for a 1/2" anchor to be used with a KSUA-2 bracket, or the concrete is a lightweight concrete that produces a lower anchor capacity that what would be expected with normal weight concrete, see Table I5-3 for anchor substitutions for lightweight concrete over metal decking.

Table I5-3; Anchor Substitution for Lightweight Concrete over Metal Decking for KSCU Cable Kits

<table>
<thead>
<tr>
<th>KNC Anchor Kit Code</th>
<th>Standard Anchor Size (in)</th>
<th>Used With KNC Restraint Kit Code</th>
<th>Cable Size</th>
<th>For Lightweight Concrete over Metal Decking</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td></td>
<td></td>
<td>Required Anchor Size (in)</td>
<td>Required Embedment Depth (in)</td>
</tr>
<tr>
<td>X2 3/8</td>
<td>X2 3/8 K2</td>
<td>2 mm</td>
<td>3/8</td>
<td>2</td>
</tr>
<tr>
<td>X2 3/8</td>
<td>X2 3/8 K3</td>
<td>3 mm</td>
<td>3/8</td>
<td>2</td>
</tr>
<tr>
<td>X2 3/8</td>
<td>X2 3/8 K4</td>
<td>4 mm</td>
<td>3/8</td>
<td>2</td>
</tr>
<tr>
<td>X3 1/2</td>
<td>X3 1/2 K5</td>
<td>5 mm</td>
<td>5/8</td>
<td>4</td>
</tr>
</tbody>
</table>

1 For use in lightweight concrete poured over metal decking, the KSUA-2 bracket supplied with the K5 (KSCU-5) cable restraint kit will need to be replaced with the Kinetics Noise Control Model KSCC-1 bracket, order P/N 9036608.
Locate Anchor in Center of Thickest Concrete Section at the Ribs

KSUA Bracket

Sheet B - View C

Figure I5-9; KSUA Bracket Attached to Concrete Poured on Corrugated Metal Decking

$S_{\text{min}}$ or Greater

Locate Anchors in Center of Thickest Concrete Sections at the Ribs

KSUA Bracket Mid-Way Between Anchors

1. 13/16 Strut Channel for KSUA-1
2. 1-5/8 Strut Channel for KSUA-2
3. Use Channel Nuts with Serrated Teeth

Sheet B - View G

Figure I5-10; KSUA Bracket Attached to Strut Channel Anchored to Concrete Poured on Corrugated Metal Decking
I5.2.4 – KSUA Brackets – Attachment to CMU Walls:

The concrete used for CMU components is usually a lightweight concrete, and often has fillers and aggregates such as fly ash and bottom ash. Therefore, the strength of this concrete does not match that of normal weight concrete, and may not match that of poured in place lightweight concrete. For this reason, **attachments for seismic restraints made to CMU walls must be approved by the building structural engineer in advance of installation of the restraints.**

When solid masonry blocks are used, the best way to make these attachments is to use through bolts with load plates on both sides of the wall as shown in Figure I5-11. The capacity of the attachment will be whatever the building structural engineer says that the point load limit for the wall will be. (Up to but not exceeding the cable kit capacity as published by Kinetics Noise Control.)

![Sheet B - View F](image)

**Figure I5-11; KSUA Through Bolt Attachment to a Solid CMU Wall**
Figures I5-12 and I5-13 show attachment methods for hollow CMU walls. **Here again, the building structural engineer must approve the attachment prior to installation, and indicate the point load limit for the wall.** (Note: In the case of the umbrella type anchor, Figure I5-13, the peak capacity is limited to that of the 3/8" anchor.)

![Figure I5-12; KSUA Through Bolt Attachment to a Hollow CMU Wall](image)

**KSUA Bracket**

Backer Plates Both Sides

Minimum Size

KSUA-1: $\frac{3}{16} \times \frac{5}{8} \times \frac{5}{8}

KSUA-2: $\frac{1}{4} \times \frac{71}{2} \times \frac{71}{2}$
Figure I5-13; KSUA “Umbrella” Type Adhesive Anchor Attachment to a Hollow CMU Wall

Finally, for filled CMU walls, standard wedge type anchors can be used with reduced capacities as shown in Figure I5-14. **Here also, the building structural engineer must approve the attachment prior to installation, and indicate the point load limit for the wall.**
Anchor Capacity Will Depend Upon the Fill & Masonry Unit Used.

Figure I5-14; KSUA Wedge Type Anchor Attachment to a Filled CMU Wall
I5.2.5 – KSUA Brackets – Attachment to Wooden Structures:

Attachment of seismic or wind restraints to a wooden structure requires careful coordination with the building structural engineer. While wooden structures tend to perform better during an earthquake than their concrete, masonry, or steel counterparts, individual restraint attachments and point loads can adversely affect the strength and performance of the building structure. This is because the location of grain irregularities, knots, splits and checks cannot be controlled. The building structural engineer can indicate the proper locations and load capacity limits for each restraint attachment type and location.

Figure I5-15 and Table I5-4 show the typical installation dimensions that will apply to lag screw attachments. For more detailed lag screw data see Appendix A4.4.

![Figure I5-15; Typical Lag Screw Installation Dimensions](image)
Table I5-4: Lag Screw and Through Bolt Installation Data for Model KSCU Restraint Cable Kits

<table>
<thead>
<tr>
<th>Lag Screw &amp; Through Bolt Size</th>
<th>Lag Screw Pilot Hole Size d (in)</th>
<th>Screw &amp; Bolt Minimum Spacing S (in)</th>
<th>Screw &amp; Bolt Minimum End Distance E1 (in)</th>
<th>Screw &amp; Bolt Minimum Edge Distance E2 (in)</th>
<th>Lag Screw Embedment Does Not Include Screw Point E3 (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D (in)</td>
<td>Soft Wood</td>
<td>Hard Wood</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/4</td>
<td>1/8</td>
<td>5/32</td>
<td>1</td>
<td>1</td>
<td>3/8</td>
</tr>
<tr>
<td>3/8</td>
<td>3/16</td>
<td>1/4</td>
<td>1-1/2</td>
<td>1-1/2</td>
<td>9/16</td>
</tr>
<tr>
<td>1/2</td>
<td>15/64</td>
<td>21/64</td>
<td>2</td>
<td>2</td>
<td>3/4</td>
</tr>
</tbody>
</table>

KSUA brackets installed in Orientation 1 to structural wood are shown in Figure I5-16 for a lag screw attachment and Figure I5-17 for a through bolted attachment.

![Diagram of KSUA bracket installation](image)

Keep Restraint Cable Parallel to 2x Joist or Truss for Maximum Capacity.

Sheet D - View A

Figure I5-16; KSUA Attached to Wood in Orientation 1 Using a Lag Screw
Special Note: Seismic and wind restraints are not to be attached to the end grain of structural wood!!

KSUA brackets installed in Orientation 2 to structural wood are shown in Figure I5-18 for a lag screw attachment and Figure I5-19 for a through bolted attachment.
Keep Restraint Cable Parallel to Stud for Maximum Capacity.

Sheet D - View K

Figure I5-18; KSUA Attached to Wood in Orientation 2 Using a Lag Screw

Clearance Hole

$D + \frac{1}{32}'' \text{ to } D + \frac{1}{16}''$

Keep Restraint Cable Parallel to Stud for Maximum Capacity.

Sheet D - View K

Figure I5-19; KSUA Attached to Wood in Orientation 2 Using a Through Bolt
The KSUA bracket may be attached to the sides of wooden joists and beams in Orientation 2 as shown in Figure I5-20 for lag screw attachment and Figure I5-21 for through bolt attachment.

**Figure I5-20; KSUA Attached to a Wooden Joist or Beam in Orientation 2 Using a Lag Screw**

**Figure I5-21; KSUA Attached to a Wooden Joist or Beam in Orientation 2 Using a Through Bolt**
I5.3 – KSCA Attachment Brackets:

I5.3.1 – KSCA Brackets – Basic Sizes & Installation:

The Kinetics Noise Control Model KSCA bracket was originally designed to be a part of a clamp assembly that would allow the restraint cables to be attached to hanger rods. More will be said about this application in Section I6.0 of this manual. However, over time, the KSCA bracket has proven to be useful for attaching the restraint cables to the building structure. The KSCA bracket as part of a bolted or anchored structural attachment is shown in Figures I5-22 and I5-23. Notice in Figure I5-22, that the single hole beyond the bend is used for attaching the cable to the bracket. Depending on the angle of the cable when installed, a thimble may be need in this loop to prevent damage to the cable. All OSHPD applications require the use of thimbles on both ends of the cable.

![Diagram of KSCA Bracket](image)

**DO NOT Use This Hole for Structural Attachments!!**

Structural Fastener Hole

\[
\frac{1}{4} \text{ in. thru } \frac{1}{2} \text{ in. Bolt or Anchor Sizes}
\]

Cable Attachment Hole

\[
\frac{3}{32} \text{ in. (2 mm) thru } \frac{1}{4} \text{ in. (6 mm) Cable Sizes}
\]

Figure I5-22; General Information for the KSCA Bracket Used for Structural Attachment
I5.3.2 – KSCA Brackets – Attachment to Steel:

KSCA brackets are most easily attached to structural steel by welding, see Figures I5-24 and I5-25. Most structural engineers do not want clearance holes drilled in the structural elements. Figure I5-26 shows the KSCA bracket attached to structural steel AISC W, M, S, or HP shapes without welding.
Both Sides

Rod Goes in Hole Closest the Bend in the Long Leg of the KSCA Bracket!

Use Neoprene Grommet as Shown in Figure I5-23 for Model KSBC-1 Seismic Beam Clamp.

Figure I5-25; KSCA Bracket Welded to Structural Steel in Orientation 2

Figure I5-26; Using Model KSBC Seismic Beam Clamps to Attach KSCA Brackets to Structural Steel
I5.3.3 – KSCA Brackets – Attachment to Concrete:

KSCA brackets should not be attached directly to light weight concrete. This is due to the fact that the contact area of a KSCA bracket is small enough that the light weight concrete may be crushed when tightening the fasteners. This will lead to the bracket being loose and increased shock loads during an earthquake. KSCA brackets may be attached directly to normal weight concrete as shown in Figure I5-27.

![Figure I5-27; Typical KSCA Bracket Installation in Normal Weight Concrete](image)

There may be certain instances where a single anchor with a KSUA bracket or a KSCA bracket will not have enough capacity. Then the KSCUZ2, two concrete anchor, and KSCUZ4, four concrete anchor, kits may be used, shown in Figures I5-28, I5-29, I5-30, and I5-31.
Figure I5-28; Model KSCUZ2 Attachment Kit to Concrete Using the KSCA Bracket – (2) 3/8 Anchors
Figure I5-29; Model KSCUZ4 Attachment Kit to Concrete Using the KSCA Bracket – (4) 3/8 Anchors
Figure I5-30: Models KSCUZ2 and KSCUZ4 Concrete Attachment Kits for KSCA Brackets in Orientation 1 and Orientation 2

Figure I5-31; Anchor Hole Drill Template for Models KSCUZ2 and KSCUZ4
I5.3.4 – KSCA Brackets – Attachment to CMU Walls:

The concrete used for CMU components is usually a lightweight concrete, and often has fillers and aggregates such as fly ash and bottom ash. Therefore, the strength of this concrete does not match that of normal weight concrete, and may not match that of poured in place lightweight concrete. For this reason, **attachments for seismic restraints made to CMU walls must be approved by the building structural engineer in advance of installation of the restraints.** All of the schemes for attaching the KSCA bracket to CMU walls will require the use of a backer plate beneath the KSCA bracket to protect the CMUs. When solid masonry blocks are used, the best way to make these attachments is to use through bolts with load plates on both sides of the wall as shown in Figure I5-32. The capacity of the attachment will be whatever the building structural engineer says that the point load limit for the wall will be. (Up to but not exceeding the cable kit capacity as published by Kinetics Noise Control.)

![Diagram of KSCA Through Bolt Attachment to a Solid CMU Wall](image)

Sheet B - View F

Figure I5-32; KSCA Through Bolt Attachment to a Solid CMU Wall
Figures I5-33 and I5-34 show attachment methods for hollow CMU walls. Here again, the building structural engineer must approve the attachment prior to installation, and indicate the point load limit for the wall. Also, backer plates beneath the KSCA bracket will be required to protect the CMU. (Note: In the case of the umbrella type anchor, Figure I5-13, the peak capacity is limited to that of the 3/8” anchor.)
Finally, for filled CMU walls, standard wedge type anchors can be used with reduced capacities as shown in Figure I5-35. **Here also, the building structural engineer must approve the**

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**Figure I5-34; KSCA “Umbrella” Type Adhesive Anchor Attachment to a Hollow CMU Wall**
attachment prior to installation, and indicate the point load limit for the wall. As with the other KSCA attachments to CMU walls, a backer plate beneath the KSCA bracket will be required.

Anchor Capacity Will Depend Upon the Fill & Masonry Unit Used.

For 3 Anchors Use Neoprene Grommet as Shown in Figure I5-23

Figure I5-35; KSCA Wedge Type Anchor Attachment to a Filled CMU Wall
I5.3.5 – KSCA Brackets – Attachment to Wooden Structures:

Attachment of seismic or wind restraints to a wooden structure requires careful coordination with the building structural engineer. While wooden structures tend to perform better during an earthquake than their concrete, masonry, or steel counterparts, individual restraint attachments and point loads can adversely affect the strength and performance of the building structure. This is because the location of grain irregularities, knots, splits and checks can not be controlled. The building structural engineer can indicate the proper locations and load capacity limits for each restraint attachment type and location. Figure I5-15 and Table I5-4 show the typical installation dimensions that will apply to lag screw attachments. For more detailed lag screw data see Appendix A4.4. **KSCA brackets used fro attachment to wood applications will require steel backer plates beneath the KSCA bracket to prevent damage to the wood!**

KSCA brackets installed in Orientation 1 to structural wood are shown in Figure I5-36 for a lag screw attachment and Figure I5-37 for a through bolted attachment.

---

**Figure I5-36; KSCA Attached to Wood in Orientation 1 Using a Lag Screw**

**Backer Plate Minimum Size**

For $\frac{1}{4}$ in. & $\frac{3}{8}$ in. Lag Screws See Figure I5-23

Keep Restraint Cable Parallel to 2x Joist or Truss for Maximum Capacity.
**Special Note: Seismic and wind restraints are not to be attached to the end grain of structural wood!!**

KSCA brackets installed in Orientation 2 to structural wood are shown in Figure I5-38 for a lag screw attachment and Figure I5-39 for a through bolted attachment.

The KSCA bracket may be attached to the sides of wooden joists and beams in Orientation 2 as shown in Figure I5-40 for lag screw attachment and Figure I5-41 for through bolt attachment.
Keep Restraint Cable Parallel to Stud for Maximum Capacity.

Figure I5-38; KSCA Attached to Wood in Orientation 2 Using a Lag Screw

Backer Plate Minimum Size
\[ \frac{3}{16} \times 1\frac{1}{2} \times \frac{5}{8} \]

Clearance Hole
\[ D + \frac{1}{32} \text{ to } D + \frac{1}{16} \]

For \( \frac{1}{4} \) in. & \( \frac{3}{8} \) in. Lag Screws
See Figure I5-23

Figure I5-39; KSCA Attached to Wood in Orientation 2 Using a Through Bolt

Backer Plate Minimum Size
\[ \frac{3}{16} \times 1\frac{1}{2} \times \frac{5}{8} \]

Keep Restraint Cable Parallel to Stud for Maximum Capacity.
Figure I5-40; KSCA Attached to a Wooden Joist or Beam in Orientation 2 Using a Lag Screw

For $\frac{1}{4}$ & $\frac{3}{8}$ Lag Screws
Use Neoprene Grommet as Shown in Figure I5-23

Backer Plate Minimum
$\frac{3}{16} \times 1 \frac{1}{2} \times \frac{5}{8}$

Figure I5-41; KSCA Attached to a Wooden Joist or Beam in Orientation 2 Using a Through Bolt

For $\frac{1}{4}$ & $\frac{3}{8}$ Bolts
Use Neoprene Grommet Shown in Figure I5-23

Clearance Hole
$D + \frac{1}{16''}$ to $D + \frac{1}{16''}$

Backer Plate Minimum
$\frac{3}{16} \times 1 \frac{1}{2} \times \frac{5}{8}$

H/2 Min. But Greater Than 3''
The KSCUZ2 and KSCUZ4 attachment kits will allow the KSCA bracket to be mounted to a wooden structural member using two or four lag screws. Figures I5-42 and I5-43 show the KSCUZ2 and KSCUZ4, respectively, mounted to a wooden column.

Figure I5-42; Model KSCUZ2 Attachment Kit to a Wooden Column Using the KSCA Bracket – (2) 3/8 Lag Screws
The KSCUZ2 and KSCUZ4 attachment kits will also allow the KSCA bracket to be mounted to a wooden structural beam using two or four lag screws. Figures I5-44 and I5-45 show the KSCUZ2 and KSCUZ4, respectively, mounted to a wooden beam. Figure I5-31 provides the dimensional information to layout the drill pattern for the pilot holes. The pilot drill size is given in Table I5-3 for both hard and soft woods.
Figure I5-44; Model KSCUZ2 Attachment Kit to a Wooden Beam Using the KSCA Bracket – (2) 3/8 Lag Screws

(1) KSCA Bracket
(1) 1/2-13 UNC Flat Socket Head Cap Screw
(1) 3/8-13 UNC Hex Nut
(1) 1/2 Flat Washer
(2) 3/8 x 4 Lag Screws
(1) KSCUZ 4 Bolt Base Plate
(1) KSCUZ Cable Kit

Lag Screws in Opposite Corners as Shown. When Lag Screws are Arranged as Shown, Plates May Touch. 15/16 Min. End Distance

H Min. But Greater Than 3"
Figure I5-45; Model KSCUZ4 Attachment Kit to a Wooden Beam Using the KSCA Bracket – (4) 3/8 Lag Screws
I5.4 – KSCC Attachment Brackets:

I5.4.1 – KSCC Brackets – Basic Sizes & Installation:

The Kinetics Noise Control Model KSCC brackets have been designed for use with the larger wire ropes and U-bolt, “Crosby®”, type clips. There are currently two KSCC brackets which are described in Figure I5-46.

A typical KSCC Restraint Cable using a KSCC bracket is shown in Figure I5-47. The details for the U-bolt clip installation may be found in the submittal package or in Appendix A1.1. All OSHPD applications require the use of thimbles on both ends of the cable.
I5.4.2 – KSCC Brackets – Attachment to Steel:

Typically, structural engineers do not want bolt clearance holes drilled in structural members that were not sized and selected for this application. So, the KSCC clips may be most readily attached to structural steel by welding as shown in Figures I5-48 and I5-49. Figure I5-50 shows the KSCC brackets attached to structural steel AISI W, M, S, or HP shapes without welding. The pertinent weld information is given in Table I5-5. Figures I5-51, I5-52, and I5-53 show the KSCC brackets attached to steel open web joists.
Sheet C - View E

Figure I5-48; KSCC Brackets Welded to Structural Steel in Orientation 1

Sheet C - Views H, P, and Q

Figure I5-49; KSCC Brackets Welded to Structural Steel in Orientation 2
Table I5-5; Weld Size and Length for KSCC Bracket Weld Attachment to Structural Steel

<table>
<thead>
<tr>
<th>KSCC Bracket</th>
<th>Weld Size $h$ (in)</th>
<th>Weld Length Both Sides $L$ (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KSCC-1</td>
<td>1/4</td>
<td>2</td>
</tr>
<tr>
<td>KSCC-2</td>
<td>5/16</td>
<td>3-1/4</td>
</tr>
</tbody>
</table>

Figure I5-50; Using Model KSBC-2 Seismic Beam Clamps to Attach KSCC Brackets to Structural Steel

Sheet C - View R
Figure I5-51; Attaching KSCC Brackets to Cross-Braced Open Web Steel Joists

Sheet C - View C

Use at Cross-Brace Location Only!
Otherwise Follow Figure I5-52.

Figure I5-52; Attaching KSUA Brackets to Un-Braced Open Web Steel Joists

Sheet C - View D

STRUCTURAL ATTACHMENTS FOR PIPE AND DUCT RESTRAINTS
PAGE 43 of 65

Toll Free (USA Only): 800-959-1229
International: 614-889-0480
FAX: 614-889-0540
World Wide Web: www.kineticsnoise.com
E-mail: sales@kineticsnoise.com

KINETICS™ Pipe & Duct Seismic Application Manual
Dublin, Ohio, USA • Mississauga, Ontario, Canada

SECTION – I5.0
RELEASED ON: 09/04/2009

Member
Figure I5-53; Attaching KSCC Brackets to Un-Braced Open Web Steel Joists – Aligned to Joists

1. Locate KSCC Bracket Mid-way Between Anchors
2. Use Channel Nuts with Serrated Teeth

Both Sides Typ.

3/16
I5.4.3 – KSCC Brackets – Attachment to Concrete:

Model KSCC brackets may be attached to normal weight concrete as shown in Figure I5-54. The installation dimensions indicated in Figure I5-54 are listed in Table I5-6.

![Diagram of KSCC Bracket Installation in Normal Weight Concrete](image)

Figure I5-54; Typical KSCC Bracket Installation in Normal Weight Concrete

The installation dimensions listed in Table I5-6 are the minimum requirements to achieve the listed capacities the Model KSCC Seismic Restraint Cable Kits listed in Appendix A1.1, Tables A1.1-3 and A1.1-4 for normal weight concrete.
Figures I5-55 and I5-56 show schemes for attaching the KSCC brackets to concrete which has been poured over corrugated steel decking. The thickest section at the ribs of the decking must meet the Minimum Concrete Thickness from Table I5-6. In the arrangement shown in Figure I5-56, the strut channel must span at least two ribs as shown, see Table I5-7 for anchor substitutions for lightweight concrete over metal decking.

![Diagram of anchor installation](image)

**Sheet B - View C**

**Figure I5-55; KSCC Bracket Attached to Concrete Poured on Corrugated Metal Decking**
Table I5-7; Anchor Substitution for Lightweight Concrete over Metal Decking for KSCC Cable Kits

<table>
<thead>
<tr>
<th>KNC Anchor Kit Code</th>
<th>Standard Anchor Size (in)</th>
<th>Used With KNC Restraint Kit Code</th>
<th>Cable Size</th>
<th>For Lightweight Concrete over Metal Decking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Required Anchor Size (in)</td>
<td>Required Embedment Depth (in)</td>
</tr>
<tr>
<td>Y1</td>
<td>5/8</td>
<td>K2</td>
<td>1/4 in.</td>
<td>5/8</td>
</tr>
<tr>
<td>Y2</td>
<td>5/8</td>
<td>K3</td>
<td>1/4 in.</td>
<td>5/8</td>
</tr>
<tr>
<td>Y2</td>
<td>5/8</td>
<td>K5</td>
<td>3/8 in.</td>
<td>5/8</td>
</tr>
</tbody>
</table>

There may be certain instances where the KSCC bracket with a single anchor will not have the required capacity. In those cases, the KSCCZ2, two concrete anchors, or the KSCCZ4, four concrete anchor, kits may be used. These installations, orientations and required bolt template are shown in Figures I5-57, I5-58, I5-59, and I5-60 respectively. Minimum edge distances and spacings must be maintained to generate the full rated capacity of the attachment kits.
When Two Anchors are Used They Must be Placed in Opposite Corners!

When Anchors are Arranged as Shown KSCCZ 4 Bolt Base Plates May Touch

Min. 6 7/8

Min. 6 7/8

When Two Anchors are Used They Must be Placed in Opposite Corners!

Figure I5-57; Model KSCCZ2 Attachment Kit to Concrete Using the KSCC Brackets – (2) 1/2 Anchors
Figure I5-58; Model KSCCZ4 Attachment Kit to Concrete Using the KSCC Brackets – (4) 1/2 Anchors
Figure I5-59; Models KSCCZ2 and KSCCZ4 Concrete Attachment Kits for KSCC Brackets in Orientation 1 and Orientation 2

Figure I5-60; Anchor Hole Drill Template for Models KSCCZ2 and KSCCZ4
I5.4.4 – KSCC Brackets – Attachment to CMU Walls:

The concrete used for CMU components is usually a lightweight concrete, and often has fillers and aggregates such as fly ash and bottom ash. Therefore, the strength of this concrete does not match that of normal weight concrete, and may not match that of poured in place lightweight concrete. For this reason, **attachments for seismic restraints made to CMU walls must be approved by the building structural engineer in advance of installation of the restraints.**

When solid masonry blocks are used, the best way to make these attachments is to use through bolts with load plates on both sides of the wall as shown in Figure I5-61. The capacity of the attachment will be what ever the building structural engineer says that the point load limit for the wall will be. (Up to but not exceeding the cable kit capacity as published by Kinetics Noise Control.)

![Figure I5-61; KSCC Through Bolt Attachment to a Solid CMU Wall](image)

Sheet B - View F

Figure I5-61; KSCC Through Bolt Attachment to a Solid CMU Wall
Figures I5-62 and I5-63 show attachment methods for hollow CMU walls. *Here again, the building structural engineer must approve the attachment prior to installation, and indicate the point load limit for the wall.* (Note: In the case of the umbrella type anchor, Figure I5-13, the peak capacity is limited to that of the 3/8" anchor.)
Finally, for filled CMU walls, standard wedge type anchors can be used with reduced capacities as shown in Figure I5-64. *Here also, the building structural engineer must approve the attachment prior to installation, and indicate the point load limit for the wall.*
Anchor Capacity Will Depend Upon the Fill & Masonry Unit Used.

Figure I5-64: KSCC Wedge Type Anchor Attachment to a Filled CMU Wall
I5.4.5 – KSCC Brackets – Attachment to Wooden Structures:

Attachment of seismic or wind restraints to a wooden structure requires careful coordination with the building structural engineer. While wooden structures tend to perform better during an earthquake than their concrete, masonry, or steel counterparts, individual restraint attachments and point loads can adversely affect the strength and performance of the building structure. This is because the location of grain irregularities, knots, splits and checks cannot be controlled. The building structural engineer can indicate the proper locations and load capacity limits for each restraint attachment type and location. Figure I5-15 and Table I5-8 show the typical installation dimensions that will apply to lag screw attachments. For more detailed lag screw data see Appendix A4.4.

Table I5-8; Lag Screw and Through Bolt Installation Data for Model KSCC, Restraint Cable Kits

<table>
<thead>
<tr>
<th>Lag Screw &amp; Through Bolt Size $D$ (in)</th>
<th>Lag Screw Pilot Hole Size $d$ (in)</th>
<th>Screw &amp; Bolt Minimum Spacing $S$ (in)</th>
<th>Screw &amp; Bolt Minimum End Distance $E_1$ (in)</th>
<th>Screw &amp; Bolt Minimum Edge Distance $E_2$ (in)</th>
<th>Lag Screw Embedment Does Not Include Screw Point $E_3$ (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft Wood</td>
<td>1/2</td>
<td>15/64</td>
<td>2</td>
<td>2</td>
<td>3/4</td>
</tr>
<tr>
<td>Hard Wood</td>
<td>5/8</td>
<td>19/64</td>
<td>2-2/12</td>
<td>2-1/2</td>
<td>15/16</td>
</tr>
<tr>
<td></td>
<td>3/4</td>
<td>23/64</td>
<td>3</td>
<td>3</td>
<td>1-1/8</td>
</tr>
</tbody>
</table>

Model KSCC brackets installed in Orientation 1 to structural wood using lag screws and through bolts are shown in Figures I5-65 and I5-66 respectively. KSCC brackets attached to structural wood in Orientation 2 using lag screws and through bolts are shown, respectively, in Figures I5-67 and I5-68.

Special Note: Seismic and wind restraints are not to be attached to the end grain of structural wood!!
Figure I5-65; KSCC Attached to Wood in Orientation 1 Using a Lag Screw

Figure I5-66; KSCC Attached to Wood in Orientation 1 Using a Through Bolt
Figure I5-67; KSCC Attached to Wood in Orientation 2 Using a Lag Screw

Keep Restraint Cable Parallel to Stud for Maximum Capacity

Sheet D - View J

Clearance Hole

\[ D + \frac{1}{32} \text{" to } D + \frac{1}{16} \text{"} \]

Figure I5-68; KSCC Attached to Wood in Orientation 2 Using a Through Bolt

Keep Restraint Cable Parallel to Stud for Maximum Capacity

Sheet D - View J
The KSCC bracket may be attached to the sides of wooden joists and beams in Orientation 2 as shown in Figure I5-69 for lag screw attachment and Figure I5-70 for through bolt attachment.

Figure I5-69; KSCC Attached to a Wooden Joist or Beam in Orientation 2 Using a Lag Screw

Figure I5-70; KSCC Attached to a Wooden Joist or Beam in Orientation 2 Using a Through Bolt
The KSCCZ2 and KSCCZ4 attachment kits will allow the KSCC bracket to be mounted to a wooden structural member, such as a column, using two or four lag screws, as shown in Figures I5-71 and I5-72 respectively.

![Diagram showing attachment kit installation](image)

Sheet B - View G

Figure I5-71; Model KSCCZ2 Attachment Kit to a Wooden Column Using KSCC Brackets – (2) 1/2 Lag Screws
Figure I5-72; Model KSCCZ4 Attachment Kit to a Wooden Column Using KSCC Brackets – (4) 1/2 Lag Screws

The KSCCZ2 and KSCCZ4 attachment kits will also allow the KSCC bracket to be mounted to a wooden structural beam using two or four lag screws. Figures I5-73 and I5-74 show the KSCCZ2 and KSCCZ4, respectively, mounted to a wooden beam. Figure I5-60 provides the dimensional information to layout the drill pattern for the pilot holes. The pilot drill size is given in Table I5-6 for both hard and soft woods.
Figure I5-73; Model KSCCZ2 Attachment Kit to a Wooden Beam Using KSCC Brackets – (2) 1/2 Lag Screws
Figure I5-74; Model KSCCZ4 Attachment Kit to a Wooden Beam Using KSCC Brackets – (4) 1/2 Lag Screws
I5.5 – Finishing Touches:

1. Make sure all restraints have two restraint cables 180° apart. Remember: *You can’t push a rope!*

2. Be sure all restraint locations have the proper restraints, transverse (T) and/or Longitudinal (L) and/or (TL), installed per the drawings provided by Kinetics Noise Control or the responsible engineer of record.

3. Make sure all longitudinal (L) restraints on trapeze supported pipe and duct are *balanced.* Seismic forces acting through the longitudinal (L) restraints should not twist the pipe or duct through the trapeze bar.

4. All seismic restraints cable must be hand tight as shown in Figure I5-75, and the pipe(s) or duct must be centered.

![Diagram showing correct and incorrect cable tension](image)

*Figure I5-75; All Seismic Restraint Cables must be Hand Tight*
5. Excess seismic restraint cable may be coiled and tied off with tape, plastic or metal wire ties, or tie wire in a fashion that is compatible with the installed environment. For corrosive and damp environments use stainless steel wire ties and tie wire. Excess Cable may be coiled as shown in Figures I5-76 and I5-77 for KSCU and KSCC Seismic Restraint Cable Kits respectively.

6. Finally, if the excess cable is to be removed, **do not cut off the excess until after the final inspection and approval of the system.**
Figure I5-77; Coiling Excess Seismic Restraint Cables for KSCC Cable Kits
I6.1 – Introduction:

This section will present several basic arrangements for attaching seismic cable restraints to the building structure. The figures and descriptions in this section will be based on the Kinetics Noise Control drawings SS-20070954, SS-20070955 and SS20070956 titled Attachment to Pipe, Component Attachment Details, and Fire System Restraint Details respectively. There are several drawings in this specific series. They have been designed to aid the installing contractor with the installation of seismic cable restraints for pipe and duct. Each drawing has a number designation ranging from SS-20070950 through SS-20070959. Also each drawing is specified by a particular letter designation ranging from Sheet A though Sheet H. The drawing numbers are in no particular order. However, the letter designations are in strict alphabetical order. Each of the drawings in this series has several views on each sheet designated by a specific letter. Where the figures in this section correspond with those views on the Kinetics Noise Control drawings SS-20070950 through SS-20070959 they will be cross referenced by sheet letter and figure letter, for instance Sheet C – View M.

Kinetics Noise Control provides attachment kits for their seismic restraint cable kits for pipe and duct. Kinetics Noise Control will, when requested to do so, provide a certification for the products that they sell. This certification will state that the seismic restraint cable and attachment kits will meet the seismic design requirements for the project in question when properly installed at the correct spacing. It is important to keep in mind that this certification does not extend to the building structure. Kinetics Noise Control is a manufacturer of vibration isolation and seismic restraint devices for the HVAC industry, and as such has no control over the design of the building structure. It is the responsibility of the structural engineer of record, and in some cases the architect of record, to approve the structural connections for the seismic restraints for pipe and duct.
I6.2 – KSUA Attachment Brackets:

I6.2.1 – KSUA Brackets – Basic Sizes & Installation:

Kinetics Noise Control provides several different attachment brackets that can be used to attach the restraint cables to pipe clevises, pipes, duct, and trapeze bar. Figure I6-1 shows the two KSUA brackets.

Figure I6-1; Kinetics Noise Control Model KSUA Seismic Restraint Cable Attachment Brackets

Primarily, the KSUA attachment brackets are used with the Kinetics Noise Control Model KSCU Seismic Restraint Cable Kits, which are described in Appendix A1.1. A KSCU seismic restraint cable kit consists of two restraint cables with a loop swaged on one end, two Kinetics provided end connectors, two Kinetics Model KSCA attachment brackets (which will be described in detail in the Section I6.3.1). For OSHPD applications thimbles are required for both ends of the restraint cables.
The KSUA attachment brackets were designed to be used with the pre-swaged end of the restraint cable, although they can be used on the end of the cable where the loop is made with the Kinetics provided end connector. Figure I6-2 shows the basic installation of the KSUA brackets. The particular installation shown is for attachment to a pipe clevis, although the basic procedure is the same regardless of whether the bracket is being attached to the pipe clevis, the hanger rod, a pipe clamp, or a trapeze bar.

1. The KSUA bracket can be loosely mounted to the clevis hanger as shown in Figure I6-2 End View #1 KSUA – Open.
2. The free end of the restraint cable may be passed through the open loop of the KSUA bracket.
3. Complete the loop in the restraint cable using the Kinetics provided end connector.
4. Tighten the nut with a wrench to the proper torque specified for the fastener being used. The two legs of the KSUA bracket should be squeezed completely shut as shown in Figure I6-2 End View #3 KSUA – Closed and Side View KSUA – Installed.

If the pre-swaged end loop of the restraint cable is to be used, the cable loop must be slipped over one of the legs of the KSUA bracket before doing Step 1 above.

I6.2.2 – KSUA Brackets – Attachment to a Clevis or Hanger Rod:

For transverse (T) restraints only, the KSUA brackets may be attached to the side of a standard, MSS Type 1, clevis hanger or to the hanger rod for a standard clevis hanger as shown in Figures I6-3 and I6-4.
Figure I6-2: Installation of Model KSUA Attachment Bracket

Figure I6-3: KSUA Brackets Attached to the Side of a Standard Clevis Hanger – Transverse (T) Restraints Only

Sheet E - View B
Sheet E - View C

Figure I6-4; KSUA Brackets Attached to the Hanger Rod of a Standard Clevis Hanger – *Transverse (T) Restraints Only*

The commercially available clamp type clevis hangers shown in Figure I3-13 may be used with the KSUA brackets. Figure I6-5 shows this type of clevis hanger with transverse (T) seismic restraints. Figure I6-6 shows the use of this hanger type with longitudinal (L) restraints and Figure I6-7 shows have combined transverse and Longitudinal (TL) restraints may be attached to this type of clevis hangers.
Figure I6-5; KSUA Brackets Attached to a Commercially Available Clamp Type Clevis Hanger – Transverse (T) Restraints

Figure I6-6; KSUA Brackets Attached to the Hanger Rod of a Commercially Available Clamp Type Clevis Hanger – Longitudinal (L) Restraints
Figure I6-7; KSUA Brackets Attached to a Commercially Available Clamp Type Clevis Hanger – Combined Transverse and Longitudinal (TL) Restraints
I6.2.3 – KSUA Brackets – Attachment to the Pipe (Fire Protection Piping):

NFPA-13 Section 9.3.5.11.1 requires that all seismic restraints for all feed and cross mains be attached directly to the pipe. Seismic restraints are not to be attached to the clevis hangers for fire protection piping unless the clevis hangers are specifically listed for this type of application. These types of connections may be made using the KSUA-2 bracket and the Kinetics model KFPC Clamp. Figure I6-8 shows the KSUA-2 bracket and KFPC clamp used for a transverse (T) restraint, Figure I6-9 shows a longitudinal (L) restraint, and Figure I6-10 shows a combination transverse and longitudinal (TL) restraint.
Rotate Clamp for Cables to Clear the Hanger Rod!

Figure I6-9; KSUA Brackets Attached to a KFPC Clamp (May be Used for Fire Protection Piping) – Longitudinal (L) Restraints
Figure I6-10; KSUA Brackets Attached to a KFPC Clamp (May be Used for Fire Protection Piping) – Combined Transverse and Longitudinal (TL) Restraints

Sheet G - View A
I6.2.4 – KSUA Brackets – Attachment to Trapeze Bars:

KSUA brackets may be attached to trapeze bars constructed of rolled structural shapes as shown in Figures I6-11 (transverse (T) restraints), I6-12 (longitudinal (L) restraints, and I6-13 (Combined transverse and longitudinal (TL) restraints). When one of the bolting surfaces on the structural shape has a taper such the inner leg surface of a C-channel, use a tapered structural washer against this surface to prevent bending in the hanger rods, or bolts.

Figure I6-11; KSUA Brackets Attached to a Rolled Structural Trapeze Bar – Transverse (T) Restraints
Option #1 Longitudinal Restraint (L)
Typical - Both Ends of Trapeze Bar

Option #2 Longitudinal Restraint (L)
Typical - Both Ends of Trapeze Bar

Option #3 Longitudinal Restraint (L)
At Center of Trapeze Bar

Figure I6-12; KSUA Brackets Attached to a Rolled Structural Trapeze Bar – Longitudinal (L) Restraints
Option #1 Combined Restraint (TL)
Typical - Both Ends of Trapeze Bar

Option #2 Combined Restraint (TL)
Typical - Both Ends of Trapeze Bar

Option #3 Combined Restraint (TL)
Typical - Both Ends of Trapeze Bar

Option #4 Combined Restraint (TL)
Typical - Both Ends of Trapeze Bar

Figure I6-13; KSUA Brackets Attached to a Rolled Structural Trapeze Bar – Combined Transverse and Longitudinal (TL) Restraints
KSUA-2 brackets may be attached to trapeze bars constructed of strut channel as shown in Figures I6-14 (transverse (T) restraints), I6-15 (longitudinal (L) restraints, and I6-16 (Combined transverse and longitudinal (TL) restraints). When using strut nuts for making seismic attachments to strut channel trapeze bars, use the strut nuts with serrated teeth for extra holding ability. Make sure strut channel and strut nuts selected match the restraint capacity of the cable and attachment kits recommended and provided by Kinetics Noise Control.

Figure I6-14; KSUA-2 Brackets Attached to a Strut Channel Trapeze Bar – Transverse (T) Restraints
Option #1 Longitudinal Restraint (L)  
Typical - Both Ends of Trapeze Bar

Option #2 Longitudinal Restraint (L)  
Typical - Both Ends of Trapeze Bar

Option #3 Longitudinal Restraint (L)  
At Center of Trapeze Bar

Figure I6-15; KSUA-2 Brackets Attached to a Strut Channel Trapeze Bar –  
Longitudinal (L) Restraints
Option #1 Combined Restraint (TL)
Typical - Both Ends of Trapeze Bar

Use Channel Nuts with Serrated Teeth!

Option #2 Combined Restraint (TL)
Typical - Both Ends of Trapeze Bar

Option #3 Combined Restraint (TL)
Typical - Both Ends of Trapeze Bar

Option #4 Combined Restraint (TL)
Typical - Both Ends of Trapeze Bar

Use Channel Nuts with Serrated Teeth!

Figure I6-16; KSUA-2 Brackets Attached to a Strut Channel Trapeze Bar –
Combined Transverse and Longitudinal (TL) Restraints
I6.3 – KSCA Attachment Brackets:

I6.3.1 – KSCA Brackets – Basic Sizes & Installation:

The Kinetics Noise Control Model KSCA bracket was originally designed to be a part of a clamp assembly that would allow the restraint cables to be attached to hanger rods using either two KSCA brackets or one KSCA bracket and a U-Bolt. Figure I6-17 shows the KSCA Bracket. Figure I6-18 shows how the KSCA bracket may be used to clamp the restraint cable kits to hanger rods. Depending on the angle of the cable when installed, a thimble may be needed in this loop to prevent damage to the cable. **All OSHPD applications require the use of thimbles on both ends of the cable.**

![Diagram of KSCA Bracket](image)

**Figure I6-17; Kinetics Noise Control Model KSCA Bracket**
Figure I6-18; Hanger Rod Clamping Options for the KSCA Bracket

- **Option #1**
  - 3/8 in. Minimum Hanger Rod
  - 1 in. Maximum Hanger Rod

- **Option #2**
  - 3/8 in. Minimum Hanger Rod
  - 1 in. Maximum Hanger Rod

- **Option #3**
  - 3/8 in. Minimum Hanger Rod
  - 1 in. Maximum Hanger Rod
  - U-Bolt by Kinetics
I6.3.2 – KSCA Brackets – Attachment to a Clevis or Hanger Rod:

For transverse (T) restraints only, the KSCA brackets may be attached to the hanger rod of a standard, MSS Type 1, or to the side of a standard clevis hanger as shown in Figures I6-19 and I6-20.

Figure I6-19; KSCA Brackets Attached to the Hanger Rod of a Standard Clevis Hanger – Transverse (T) Restraints Only

Sheet E - View A
Figure I6-20; KSCA Brackets Attached to the Side of a Standard Clevis Hanger –
**Transverse (T) Restraints Only**

The commercially available clamp type clevis hangers shown in Figure I3-13 may be used with the KSCA brackets. Figure I6-21 shows this type of clevis hanger with transverse (T) seismic restraints. Figure I6-22 shows the use of this hanger type with longitudinal (L) restraints. Figure I6-23 shows have combined transverse and Longitudinal (TL) restraints may be attached to this type of clevis hangers.
Figure I6-21; KSCA Brackets Attached to the Hanger Rod of a Commercially Available Clamp Type Clevis Hanger – Transverse (T) Restraints
Figure I6-22; KSUA Brackets Attached to the Hanger Rod of Commercially Available Clamp Type Clevis Hanger – Longitudinal (L) Restraints
Figure I6-23; KSCA Brackets Attached to the Hanger Rod of a Commercially Available Clamp Type Clevis Hanger – Combined Transverse and Longitudinal (TL) Restraints
I6.3.3 – KSCA Brackets – Attachment to Trapeze Bars:

KSCA brackets may be attached to trapeze bars constructed of rolled structural shapes as shown in Figures I6-24 (transverse (T) restraints), I6-25 (longitudinal (L) restraints, and I6-26 (Combined transverse and longitudinal (TL) restraints).

Figure I6-24; KSCA Brackets Used with a Rolled Structural Trapeze Bar & a Strut Channel Trapeze Bar – Transverse (T) Restraints
Figure I6-25: KSCA Brackets Used with a Rolled Structural Trapeze Bar & a Strut Channel Trapeze Bar – Longitudinal (L) Restraints
Option #1 Combined Restraint (TL)
Typical Both Ends of Trapeze Bar

Option #2 Combined Restraint (TL)
Typical Both Ends of Trapeze Bar

KSCA Brackets Tight Against Trapeze Bar or Trapeze Bar Nut!

Figure I6-26; KSCA Brackets Used with a Rolled Structural Trapeze Bar & a Strut Channel Trapeze Bar – Combined Transverse & Longitudinal (TL) Restraints
I6.4 – KSCC Attachment Brackets:

I6.4.1 – KSCC Brackets – Basic Sizes & Installation:

The Kinetics Noise Control Model KSCC-1 and KSCC-2 brackets were designed to be used with the Kinetics Noise Control Model KSCC Seismic Restraint Cable Kits, which are described in Appendix A1.1. These kits contain two of the KSCC brackets, bulk cable, and the appropriate number of U-Bolt, “Crosby”, clips. These brackets are shown in Figure I6-27, which also indicates the appropriate fasteners and cables that are to be used with each bracket. Depending on the angle of the cable when installed, a thimble may be needed in this loop to prevent damage to the cable. **All OSHPD applications require the use of thimbles on both ends of the cable.**

![Figure I6-27; Kinetics Noise Control Model KSCC Seismic Restraint Cable Attachment Brackets](image-url)

**Figure I6-27; Kinetics Noise Control Model KSCC Seismic Restraint Cable Attachment Brackets**
I6.4.2 – KSCC Brackets – Attachment to a Clevis or Hanger Rod:

For transverse (T) restraints only, the KSCC brackets may be attached to the side of a standard, MSS Type 1, clevis hanger or to the hanger rod for a standard clevis hanger as shown in Figures I6-28 and I6-29 respectively.

Figure I6-28; KSCC Brackets Attached to the Side of a Standard Clevis Hanger – *Transverse (T) Restraints Only*
The commercially available clamp type clevis hangers shown in Figure I3-13 may be used with the KSCC brackets. Figure I6-30 shows this type of clevis hanger with transverse (T) seismic restraints. Figure I6-31 shows the use of this hanger type with longitudinal (L) restraints and...
Figure I6-32 shows how combined transverse and Longitudinal (TL) restraints may be attached to this type of clevis hangers.

Figure I6-30; KSCC Brackets Attached to a Commercially Available Clamp Type Clevis Hanger – Transverse (T) Restraints
Figure I6-31; KSCC Brackets Attached to the Hanger Rod of a Commercially Available Clamp Type Clevis Hanger – Longitudinal (L) Restraints
Figure I6-32; KSCC Brackets Attached to a Commercially Available Clamp Type Clevis Hanger – Combined Transverse and Longitudinal (TL) Restraints
I6.4.3 – KSCC Brackets – Attachment to the Pipe (Fire Protection Piping):

NFPA-13 Section 9.3.5.11.1 requires that all seismic restraints for all feed and cross mains be attached directly to the pipe. Seismic restraints are not to be attached to the clevis hangers for fire protection piping unless the clevis hangers are specifically listed for this type of application. These types of connections may be made using KSCC brackets and the Kinetics model KFPC Clamp. Figure I6-33 shows the KSCC brackets and KFPC clamp used for a transverse (T) restraint, Figure I6-34 shows a longitudinal (L) restraint, and Figure I6-35 shows a combination transverse and longitudinal (TL) restraint.

Figure I6-33; KSCC Brackets Attached to a KFPC Clamp (May be Used for Fire Protection Piping) – Transverse (T) Restraints
Figure I6-34; KSCC Brackets Attached to a KFPC Clamp (May be Used for Fire Protection Piping) – Longitudinal (L) Restraints
Figure I6-35; KSCC Brackets Attached to a KFPC Clamp (May be Used for Fire Protection Piping) – Combined Transverse and Longitudinal (TL) Restraints
I6.4.4 – KSCC Brackets – Attachment to Trapeze Bars:

KSCC brackets may be attached to trapeze bars constructed of rolled structural shapes as shown in Figures I6-36 (transverse (T) restraints), I6-37 (longitudinal (L) restraints, and I6-38 (Combined transverse and longitudinal (TL) restraints). When one of the bolting surfaces on the structural shape has a taper such the inner leg surface of a C-channel, use a tapered structural washer against this surface to prevent bending in the hanger rods, or bolts.

Option #1 Transverse Restraint (T) Typical Both Ends of Trapeze Bar

Option #2 Transverse Restraint (T) Typical Both Ends of Trapeze Bar

Option #3 Transverse Restraint (T) Typical Both Ends of Trapeze Bar

Option #4 Transverse Restraint (T) Typical Both Ends of Trapeze Bar

Option #5 Transverse Restraint (T) Typical Both Ends of Trapeze Bar

Sheet F - Views L & M

Figure I6-36; KSCC Brackets Attached to a Rolled Structural Trapeze Bar – Transverse (T) Restraints
Option #1 Longitudinal Restraint (L)
Typical - Both Ends of Trapeze Bar

Option #2 Longitudinal Restraint (L)
Typical - Both Ends of Trapeze Bar

Option #3 Longitudinal Restraint (L)
At Center of Trapeze Bar

Figure I6-37; KSCC Brackets Attached to a Rolled Structural Trapeze Bar – Longitudinal (L) Restraints
Option #1 Combined Restraint (TL)
Typical - Both Ends of Trapeze Bar

Option #2 Combined Restraint (TL)
Typical - Both Ends of Trapeze Bar

Figure I6-38; KSCC Brackets Attached to a Rolled Structural Trapeze Bar –
Combined Transverse and Longitudinal (TL) Restraints
I6.5 – Finishing Touches:

1. Make sure all restraints have two restraint cables 180° apart. Remember: You can’t push a rope!

2. Be sure all restraint locations have the proper restraints, transverse (T) and/or Longitudinal (L) and/or (TL), installed per the drawings provided by Kinetics Noise Control or the responsible engineer of record.

3. Make sure all longitudinal (L) restraints on trapeze supported pipe and duct are balanced. Seismic forces acting through the longitudinal (L) restraints should not twist the pipe or duct through the trapeze bar.

4. All seismic restraints cable must be hand tight as shown in Figure I6-39, and the pipe(s) or duct must be centered.

![Diagram showing correct and incorrect cable tensioning](Figure I6-39; All Seismic Restraint Cables must be Hand Tight)
5. Excess seismic restraint cable may be coiled and tied off with tape, plastic or metal wire ties, or tie wire in a fashion that is compatible with the installed environment. For corrosive and damp environments use stainless steel wire ties and tie wire. Excess Cable may be coiled as shown in Figures I6-40 and I6-41 for KSCU and KSCC Seismic Restraint Cable Kits respectively.

6. Finally, if the excess cable is to be removed, do not cut off the excess until after the final inspection and approval of the system.

**Figure I6-40; Coiling Excess Seismic Restraint Cables for KSCU Cable Kits**
Coil Excess Cable & Tie Off

Orientation 1

Orientation 2

Figure I6-41; Coiling Excess Seismic Restraint Cables for KSCC Cable Kits
I7.1 – Introduction:

Many field installation situations will require the contractor to make a decision to use strut type restraints rather than the cable restraints recommended by Kinetics noise control. Some of these situations will be:

1. Other components directly in the intended path of one of the restraint cables.
2. The pipe or duct is too close to a wall that cannot be penetrated.
3. There is no competent structure for attachment of one of the cable restraints.
4. The specification will not permit cable restraints, also known as tension only braces.

This section is designed to assist the contractor in selecting and installing strut members to be used in conjunction with the brackets and attachment hardware included in the restraint cable kits provided by Kinetics Noise Control to generate strut type restraints with equal capacity to the restraint cable kits. Each KSCU and KSCC Restraint Cable Kit provided by Kinetics Noise Control for any given restraint location will have enough KSCA and KSCC brackets respectively to fabricate strut type restraints for that location. The KSCA bracket is shown in Figure I7-1, and the KSCC brackets are shown in Figure I7-2.

I7.2 – Conditions of Use for Strut Type Restraints:

1. If a run of pipe or duct requires the use of even one strut type restraint along its length, all of the restraints on that run of pipe or duct must be strut type restraints.
2. If concrete anchors are used to attach the hanger rods for the pipe or duct to the ceiling or roof structure, they must be anchors approved for use in seismic applications, see ASCE 7-05 Section 13.4.2. Consult with the engineer of record for the system being installed for the specification of the proper anchor.
3. Hanger rod sizes and anchor sizes may need to be increased to handle the additional tensile loads imposed on the hangers by the seismic loads see Section 8.0 of this manual. Consult
with the engineer of record for the system being installed for the proper hanger rod and/or anchor size for use with strut type restraints.

4. The installation angle for the strut restraints will be limited to 45° by virtue of the design of the KSCA and KSCC brackets.

5. One strut restraint will replace one pair of cable restraints.

6. A web based program available from Kinetics Noise Control at www.kineticsnoise.com may be used to verify the adequacy of hanger rods and hanger rod anchors based on the particulars of the restraint in question.

**I7.3 – Using the Restraint Designation Symbol to Select Struts:**

Figure I7-1 shows a typical designation symbol for seismic restraints on the drawings produced by Kinetics Noise Control indicating the recommended seismic cable restraint and attachment hardware kits.

**Restraint Type Designation:**
- **T** - Transverse Restraint
- **L** - Longitudinal Restraint
- **TL** - Both Transverse & Longitudinal
- **TT** - Two Transverse Restraints -180° Apart & Used Primarily For Riser Applications

**KNC Restraint Kit Code:**
Restraint Capacity Required
At This Location, See Table I7-1.

**KNC Anchorage Kit Code:**
Anchorage Capacity Required
At This Location, See Tables I7-2 & I7-3.

**Figure I7-1; Typical Kinetics Noise Control Restraint Kit and Attachment Kit Designation Symbol**

The KNC Restraint Codes are described in Table I7-1 and KNC Attachment Kit Codes are described in Tables I7-2 and I7-3. The restraint kit codes in Table I7-1 will be used to select the proper structural shape and size for the material used in the strut type restraint. The attachment kits described in Tables I7-2 and I7-3 will apply to both the cable type restraints and the strut type restraints.

Kinetics Noise Control provides conversion data for three types of structural members that may be used for strut type restraints, rolled structural angle, UNISTRUT® or equal strut channel, and pipe.
The first type of structural member discussed will be the rolled structural channels. The strut equivalents for Kinetics Noise Control restraint cable kits with rolled structural channel are shown in Table I7-4. This table covers the most readily available and easily handled sizes. Other sizes may be used, but will require analysis by the design professional responsible for the system.

Table I7-1; Seismic Restraint Cable Kit vs. Code Cross-Reference

<table>
<thead>
<tr>
<th>KNC Restraint Kit Code</th>
<th>Restraint Kit Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>K2 KSCU-2 Cable Kit – 2 mm Cable &amp; GRIPPLE HANGFAST No, 2 Connectors</td>
<td></td>
</tr>
<tr>
<td>K3 KSCU-3 Cable Kit – 3 mm Cable &amp; GRIPPLE HANGFAST No, 3 Connectors</td>
<td></td>
</tr>
<tr>
<td>K4 KSCU-4 Cable Kit – 5 mm Cable &amp; GRIPPLE HANGFAST No, 4 Connectors</td>
<td></td>
</tr>
<tr>
<td>K5 KSCU-5 Cable Kit – 6 mm Cable &amp; GRIPPLE Lockable 6 mm Connectors</td>
<td></td>
</tr>
<tr>
<td>C1 KSCC-250 Cable Kit – 1/4” Cable &amp; Saddle + U-bolt Connectors</td>
<td></td>
</tr>
<tr>
<td>C2 KSCC-375 Cable Kit – 3/8” Cable &amp; Saddle + U-bolt Connectors</td>
<td></td>
</tr>
<tr>
<td>C3 KSCC-500 Cable Kit – 1/2” Cable &amp; Saddle + U-bolt Connectors</td>
<td></td>
</tr>
</tbody>
</table>

Table I7-2; Structural Concrete/Steel Attachment Kit vs. Code Cross-Reference

<table>
<thead>
<tr>
<th>KNC Attachment Kit Code</th>
<th>Attachment Kit Description per Restraint Cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note: Through bolts &amp; nuts of the same size may be used for each kit and code shown below.</td>
<td></td>
</tr>
<tr>
<td>X1 (1) 1/4” Concrete Anchor (with Grommet)</td>
<td></td>
</tr>
<tr>
<td>X2 (1) 3/8” Concrete Anchor (with Grommet)</td>
<td></td>
</tr>
<tr>
<td>X3 (1) 1/2” Concrete Anchor</td>
<td></td>
</tr>
<tr>
<td>Y1 (1) 5/8” Concrete Anchor</td>
<td></td>
</tr>
<tr>
<td>Y2 (1) 3/4” Concrete Anchor</td>
<td></td>
</tr>
<tr>
<td>Y3 (1) 7/8” Concrete Anchor</td>
<td></td>
</tr>
<tr>
<td>Z1 (2) 3/8” Concrete Anchors with Oversized Base Plate</td>
<td></td>
</tr>
<tr>
<td>Z2 (4) 3/8” Concrete Anchors with Oversized Base Plate</td>
<td></td>
</tr>
<tr>
<td>Z3 (2) 1/2” Concrete Anchors with Oversized Base Plate</td>
<td></td>
</tr>
<tr>
<td>Z4 (4) 1/2” Concrete Anchors with Oversized Base Plate</td>
<td></td>
</tr>
</tbody>
</table>
### Table I7-3; Structural Wood/Steel Attachment Kit vs. Code Cross-Reference

<table>
<thead>
<tr>
<th>KNC Attachment Kit Code</th>
<th>Attachment Kit Description per Restraint Cable Note: Through bolts &amp; nuts of the same size may be used for each kit and code shown below.</th>
</tr>
</thead>
<tbody>
<tr>
<td>W1</td>
<td>(1) 1/4” Lag Screw (with Grommet)</td>
</tr>
<tr>
<td>W2</td>
<td>(1) 3/8” Lag Screw (with Grommet)</td>
</tr>
<tr>
<td>W3</td>
<td>(1) 1/2” Lag Screw</td>
</tr>
<tr>
<td>W4</td>
<td>(1) 5/8” Lag Screw</td>
</tr>
<tr>
<td>W5</td>
<td>(1) 3/4” Lag Screw</td>
</tr>
<tr>
<td>W6</td>
<td>(1) 7/8” Lag Screw</td>
</tr>
<tr>
<td>W7</td>
<td>(2) 3/8” Lag Screws with Oversized Base Plate</td>
</tr>
<tr>
<td>W8</td>
<td>(4) 3/8” Lag Screws with Oversized Base Plate</td>
</tr>
<tr>
<td>W9</td>
<td>(2) 1/2” Lag Screws with Oversized Base Plate</td>
</tr>
<tr>
<td>W10</td>
<td>(4) 1/2” Lag Screws with Oversized Base Plate</td>
</tr>
</tbody>
</table>

### Table I7-4; Seismic Strut Restraint Size per KNC Restraint Code for Structural Steel Angle

<table>
<thead>
<tr>
<th>Structural Steel Angle Size (in)</th>
<th>KNC Restraint Code</th>
<th>Restraint Cable Kit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1 x 1 x 1/8</td>
</tr>
<tr>
<td>K2</td>
<td>KSCU-2</td>
<td>173</td>
</tr>
<tr>
<td>K3</td>
<td>KSCU-3</td>
<td>122</td>
</tr>
<tr>
<td>K4</td>
<td>KSCU-4</td>
<td>77</td>
</tr>
<tr>
<td>K5</td>
<td>KSCU-5</td>
<td>52</td>
</tr>
<tr>
<td>C1</td>
<td>KSCC-250</td>
<td>53</td>
</tr>
<tr>
<td>C2</td>
<td>KSCC-375</td>
<td>37</td>
</tr>
<tr>
<td>C3</td>
<td>KSCC-500</td>
<td>30</td>
</tr>
</tbody>
</table>

The strut equivalents for Kinetics Noise Control restraint cable kits with UNISTRUT® or equal strut channel are shown in Table I7-5. The UNISTRUT® channels listed in Table I7-5 are 1-5/8” channels. Other sizes may be used, but will require analysis by the design professional responsible for the system.
The strut equivalents for Kinetics Noise Control restraint cable kits with pipe are shown in Table I7-6. The KSCA and KSCC brackets do not lend themselves well to use with struts fabricated from pipe. Either the pipe would need to be welded to the brackets, or the ends of the pipe would need to be flattened and drilled for bolts. The pipe listed in Table I7-6 covers the most readily available and easily handled sizes. Other sizes may be used, but will require analysis by the design professional responsible for the system.

**Table I7-5; Seismic Strut Restraint Size per KNC Restraint Code for UNISTRUT® Profiles**

<table>
<thead>
<tr>
<th>KNC Restraint Code</th>
<th>Restraint Cable Kit</th>
<th>UNISTRUT® Profile</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>P1000</td>
</tr>
<tr>
<td>K2</td>
<td>KSCU-2</td>
<td>165</td>
</tr>
<tr>
<td>K3</td>
<td>KSCU-3</td>
<td>117</td>
</tr>
<tr>
<td>K4</td>
<td>KSCU-4</td>
<td>74</td>
</tr>
<tr>
<td>K5</td>
<td>KSCU-5</td>
<td>49</td>
</tr>
<tr>
<td>C1</td>
<td>KSCC-250</td>
<td>51</td>
</tr>
<tr>
<td>C2</td>
<td>KSCC-375</td>
<td>34</td>
</tr>
<tr>
<td>C3</td>
<td>KSCC-500</td>
<td>16</td>
</tr>
</tbody>
</table>

**Table I7-6; Seismic Strut Restraint Size per KNC Restraint Code for Pipe**

<table>
<thead>
<tr>
<th>KNC Restraint Code</th>
<th>Restraint Cable Kit</th>
<th>Nominal Pipe Size &amp; Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1’’ Sch. 40</td>
</tr>
<tr>
<td>K2</td>
<td>KSCU-2</td>
<td>111</td>
</tr>
<tr>
<td>K3</td>
<td>KSCU-3</td>
<td>79</td>
</tr>
<tr>
<td>K4</td>
<td>KSCU-4</td>
<td>50</td>
</tr>
<tr>
<td>K5</td>
<td>KSCU-5</td>
<td>33</td>
</tr>
</tbody>
</table>
All three of these tables are used in the same manner. The steps required to convert the recommended cable restraint kits to strut type restraints are as follows.

1. Determine the KNC Restraint Codes from the restraint symbol on the drawing for the run of pipe of duct that requires the use of strut type restraints.

2. Determine the approximate length of the structural member required for the strut. Measure from the intended attachment point on the clevis, pipe, duct, or trapeze bar at a 45° angle, 1” of rise for 1” of horizontal distance, to the intended anchor point on the structure.

3. Determine the type or structural member that will be used for the strut restraint, rolled structural angle – Table I7-4, UNISTRUT® channel – Table I7-5, or pipe – Table I7-6.

4. Find the row in the table for the selected structural member for the strut that corresponds to the KNC Restraint Code from the drawing symbol, K2 through K5 or C1 through C3.

5. Move across this row until a Maximum Strut Length that exceeds the approximate length required for the strut as measured in step 2 above is found.

6. Move up this column to determine the required size for the structural member to be used for the strut restraint.

I7.4 – Attaching Strut Members to KSCA & KSCC Brackets:

The KSCA bracket is shown in Figure I7-2, and the KSCC bracket is shown in Figure I7-3 below. For each bracket type and size, the appropriate holes are shown in Figures I7-2 and I7-3 for attaching to the strut and the building structure. Always use the strut attachment hardware size indicated in Figures I7-2 and I7-3 to ensure the maximum possible capacity for the strut restraint assembly.
Attachment Hole for Structure, Pipe, Duct, or Trapeze Bar Use:

- 3/8" Bolt with Kinetics Supplied Grommet or 1/2" Bolt.

Strut Attachment Holes for 1/2" Bolts

Figure I7-2; KSCA Bracket with Strut and Structure Attachment Holes Identified

- Ø25/32" Hole for 3/4" Strut Attachment Hardware
- Ø15/16" Hole for 1/2" & 5/8" Structural Attachment Hardware

KSCC-1

45°

- 4 19/32" Height

45°

KSCC-2

3/8" Width

5 1/8" Width

Figure I7-3; KSCC-1 & -2 Brackets with Strut and Structure Attachment Holes Identified
I7.5 – Attaching Strut Channel to KSCA & KSCC Brackets:

The attachment of strut channel to the KSCA and KSCC brackets is most easily accomplished using bolts and channel nuts. **Please note the following!**

1. **Not all strut channels are created equal!** Different manufacturer’s strut channels may have different strengths and capacities. If using other than UNISTRUT® brand strut channel, contact the design professional of record for the system for assistance in selecting the appropriate strut channel for use as seismic strut type restraint. Table I7-5 is based on 1-5/8 UNISTRUT® or equivalent channel.

2. **Not all channel nuts are created equal!** Different manufacturer’s channel nuts will have different Allowable Pullout Strength and Resistance to Slip values. The channel nuts used in conjunction with Kinetics Noise Control KSCA and KSCC brackets must have serrated teeth to grip the strut channel and maximize the Resistance to Slip rating. Table I7-7 gives the Allowable Pull-Out Strength and Resistance to Slip for strut nut supplied by UNISTRUT®. If another manufacturer’s channel nuts are to be used, the design professional of record for the system must ensure that their Allowable Pullout Strength and Resistance to Slip values are consistent with the seismic requirements indicated by Kinetics Noise Control for the application.

<table>
<thead>
<tr>
<th>Channel Nut Size</th>
<th>Torque (ft-lbs)</th>
<th>Allowable @ 3:1</th>
<th>Seismic Allowable @ 2:1</th>
<th>Force Class</th>
<th>Compatible Attachment Kits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2-13 UNC</td>
<td>50</td>
<td>2,000</td>
<td>1,500</td>
<td>3,000</td>
<td>2,250</td>
</tr>
<tr>
<td>5/8-11 UNC</td>
<td>100</td>
<td>2,500</td>
<td>1,500</td>
<td>3,750</td>
<td>2,250</td>
</tr>
<tr>
<td>3/4-10 UNC</td>
<td>125</td>
<td>2,500</td>
<td>1,700</td>
<td>3,750</td>
<td>2,550</td>
</tr>
</tbody>
</table>
I7.5.1 – KSCA Brackets to Strut Channel:

There are two options available for attaching KSCA brackets to strut channel. These options are shown in Figures I7-4 and I7-5. Both options are based on 1-5/8 strut channel and channel nuts with serrated teeth. Combinations of these two attachment options may be used to create at least six general strut restraint arrangements which are illustrated in Figures I7-6 through I7-11.

Figure I7-4; Attachment of KSCA Bracket to Strut Channel – Option #1
(2) Channel Nuts With Serrated Teeth By Others

1 5/8" Strut Channel By Others

KSCA Bracket By Kinetics

(4) 1/2" Standard Steel Flat Washers By Others

(2) 1/2-13 UNC x 1 3/4" SAE Grade 2 Bolts By Others

Figure I7-5; Attachment of KSCA Bracket to Strut Channel – Option #2

45°

For Structural Attachment With Orientation 1 Use KSCA - Strut Channel Attachment Option #2

For Equipment, Pipe, Or Duct Attachment With Orientation 2 Use KSCA - Strut Channel Attachment Option #2

Figure I7-6; Attachment of KSCA Brackets to Strut Channel for Seismic Strut Restraints – General Arrangement #1
**Figure I7-7; Attachment of KSCA Brackets to Strut Channel for Seismic Strut Restraints – General Arrangement #2**

- For Equipment, Pipe, Or Duct Attachment With Orientation 2 Use KSCA - Strut Channel Attachment Option #1

- Structural Attachment With Orientation 2 Use KSCA - Strut Channel Attachment Option #2

**Figure I7-8; Attachment of KSCA Brackets to Strut Channel for Seismic Strut Restraints – General Arrangement #3**

- For Equipment, Pipe, Or Duct Attachment With Orientation 1 Use KSCA - Strut Channel Attachment Option #2

- For Structural Attachment With Orientation 2 Use KSCA - Strut Channel Attachment Option #2
Figure I7-9; Attachment of KSCA Brackets to Strut Channel for Seismic Strut Restraints – General Arrangement #4

Figure I7-10; Attachment of KSCA Brackets to Strut Channel for Seismic Strut Restraints – General Arrangement #5
I7.5.2 – KSCC Brackets to Strut Channel:

There are two options available for attaching KSCC brackets to strut channel. These options are shown in Figures I7-12 and I7-13. Both options are based on 1-5/8 strut channel and channel nuts with serrated teeth. Combinations of these two attachment options may be used to create at least six general strut restraint arrangements which are illustrated in Figures I7-14 through I7-19.
Figure I7-12; Attachment of KSCC Bracket to Strut Channel – Option #1

Figure I7-13; Attachment of KSCC Bracket to Strut Channel – Option #2
For Equipment, Pipe, Or Duct Attachment With Orientation 2 Use KSCC - Strut Channel Attachment Option #2

For Equipment, Pipe, Or Duct Attachment With Orientation 2 Use KSCC - Strut Channel Attachment Option #1

Figure I7-14; Attachment of KSCC Brackets to Strut Channel for Seismic Strut Restraints – General Arrangement #1

For Structural Attachment With Orientation 1 Use KSCC - Strut Channel Attachment Option #2

For Structural Attachment With Orientation 2 Use KSCC - Strut Channel Attachment Option #2

Figure I7-15; Attachment of KSCC Brackets to Strut Channel for Seismic Strut Restraints – General Arrangement #2
For Equipment, Pipe, Or Duct Attachment With Orientation 1 Use KSCC - Strut Channel Attachment Option #2

For Structural Attachment With Orientation 2 Use KSCC - Strut Channel Attachment Option #2

45°

Figure I7-16; Attachment of KSCC Brackets to Strut Channel for Seismic Strut Restraints – General Arrangement #3

For Equipment, Pipe, Or Duct Attachment With Orientation 2 Use KSCC - Strut Channel Attachment Option #1

For Structural Attachment With Orientation 1 Use KSCC - Strut Channel Attachment Option #2

45°

Figure I7-17; Attachment of KSCC Brackets to Strut Channel for Seismic Strut Restraints – General Arrangement #4
For Equipment, Pipe, Or Duct Attachment
With Orientation 1 Use KSCC - Strut Channel Attachment Option #1

For Structural Attachment With Orientation 2 Use KSCC - Strut Channel Attachment Option #1

Figure I7-18; Attachment of KSCC Brackets to Strut Channel for Seismic Strut Restraints – General Arrangement #5

For Equipment, Pipe, Or Duct Attachment
With Orientation 2 Use KSCC - Strut Channel Attachment Option #2

For Structural Attachment With Orientation 2 Use KSCC - Strut Channel Attachment Option #1

Figure I7-19; Attachment of KSCC Brackets to Strut Channel for Seismic Strut Restraints – General Arrangement #6
I7.6 – Attaching KSCA & KSCC Brackets to Rolled Structural Angle:

The attachment of rolled structural angle to the KSCA and KSCC brackets is most easily accomplished using bolts, nuts, and washers. The capacities restraints using these attachments will match those of the kits recommended by Kinetics noise control if the following conditions are met.

1. The rolled structural angle to be used for the restraint is properly selected according to the instructions provided in Section I7.2 – Using the Restraint Designation Symbol to Select Struts.
2. The attachment hardware sizes and grades are as specified in Figures I7-20, I7-21, I7-22, I7-23, I7-24, I7-35 and I7-36.

I7.6.1 – KSCA Brackets to Rolled Structural Angle:

There are five workable options available for attaching KSCA brackets to rolled structural angles. These options are shown in Figures I7-20, I7-21, I7-22, I7-23, and I7-24. Options #3, #4, and #5 shown in Figures I7-22, I7-23, and I7-24 may require that the corner of the angle leg be trimmed to eliminate interference with the structure, equipment, pipe, duct, or KSCA bracket. Combinations of the first three attachment options may be used to create at least ten practical general strut restraint arrangements which are illustrated in Figures I7-25 through I7-34.
**KINETICS™ Pipe & Duct Seismic Application Manual**

**Figure I7-20; Attachment of KSCA Bracket to Rolled Angle – Option #1**

- Drill $\frac{9}{16}$" Holes In Angle 2 Places Each End
- Rolled Structural Angle By Others
- KSCA Bracket By Kinetics
- (2) $\frac{1}{2}$-13 UNC x $1\frac{3}{4}$" SAE Grade 2 Bolts
- (2) $\frac{1}{2}$" Standard Steel Flat Washers
- (2) $\frac{1}{2}$-13 UNC SAE Grade 2 Hex Nuts
- Each End By Others

---

**Figure I7-21; Attachment of KSCA Bracket to Rolled Angle – Option #2**

- Drill $\frac{9}{16}$" Holes In Angle 2 Places Each End
- Rolled Structural Angle By Others
- KSCA Bracket By Kinetics
- (2) $\frac{1}{2}$-13 UNC x $1\frac{3}{4}$" SAE Grade 2 Bolts
- (4) $\frac{1}{2}$" Standard Steel Flat Washers
- (2) $\frac{1}{2}$-13 UNC SAE Grade 2 Hex Nuts
- Each End By Others
Drill Ø 9/16" Holes In Angle 2 Places Each End

Rolled Structural Angle By Others

Trim Angle As Needed

KSCA Bracket By Kinetics

(2) 1 1/2"-13 UNC x 1 3/4" SAE Grade 2 Bolts
(4) 1" Standard Steel Flat Washers
(2) 1 1/2"-13 UNC SAE Grade 2 Hex Nuts
Each End By Others

Figure I7-22; Attachment of KSCA Bracket to Rolled Angle – Option #3 Trim as Angle Needed

(1) 1 3/4"-13 UNC x 1 3/4" SAE Grade 2 Bolt
(1) 1 3/4" Standard Steel Flat Washer
(1) 1 3/4"-13 UNC SAE Grade 2 Hex Nut
(1) 1 3/4"-13 UNC SAE Grade 2 Hex Nut
(2) KSCA Brackets
All Part Of The KSCA Kit By Kinetics
(1) 3/4"-13 UNC x 1 1/2" SAE Grade 2 Bolt
(1) 1 1/2" Standard Steel Flat Washer
(1) 1 1/2"-13 UNC SAE Grade 2 Hex Nut

Figure I7-23; Attachment of KSCA Bracket to Rolled Angle for a Clevis Hanger Rod – Option #4 Trim as Angle Needed
Figure I7-24; Attachment of KSCA Bracket to Rolled Angle for a Trapeze Bar Hanger Rod – Option #5 *Trim as Angle Needed*

For Equipment, Pipe, Or Duct Attachment With Orientation 2 Use KSCA - Rolled Angle Attachment Option #2

For Structural Attachment With Orientation 1 Use KSCA - Rolled Angle Attachment Option #2

Figure I7-25; KSCA Brackets – Rolled Angle for Seismic Strut Restraints–General Arrangement #1
For Equipment, Pipe, Or Duct Attachment With Orientation 1 Use KSCA - Rolled Angle Attachment Option #1

For Structural Attachment With Orientation 1 Use KSCA - Rolled Angle Attachment Option #2

Figure I7-26; KSCA Brackets – Rolled Angle for Seismic Strut Restraints–General Arrangement #2

For Equipment, Pipe, Or Duct Attachment With Orientation 2 Use KSCA - Rolled Angle Attachment Option #2

Trim Angle As Needed

For Structural Attachment With Orientation 2 Use KSCA - Rolled Angle Attachment Option #3

Figure I7-27; KSCA Brackets – Rolled Angle for Seismic Strut Restraints–General Arrangement #3
For Equipment, Pipe, or Duct Attachment With Orientation 1 Use KSCA - Rolled Angle Attachment Option #1

For Structural Attachment With Orientation 2 Use KSCA - Rolled Angle Attachment Option #3

Trim Angle As Needed

For Equipment, Pipe, or Duct Attachment With Orientation 1 Use KSCA - Rolled Angle Attachment Option #3

Trim Angle As Needed

Figure I7-28; KSCA Brackets – Rolled Angle for Seismic Strut Restraints–General Arrangement #4

Figure I7-29; KSCA Brackets – Rolled Angle for Seismic Strut Restraints–General Arrangement #5
Figure I7-30; KSCA Brackets – Rolled Angle for Seismic Strut Restraints–General Arrangement #6

Figure I7-31; KSCA Brackets – Rolled Angle for Seismic Strut Restraints–General Arrangement #7
For Equipment, Pipe, or Duct Attachment With Orientation 2 Use KSCA - Rolled Angle Attachment Option #3 Trim Angle As Needed

For Structural Attachment With Orientation 1 Use KSCA - Rolled Angle Attachment Option #3 Trim Angle As Needed

Figure I7-32; KSCA Brackets – Rolled Angle for Seismic Strut Restraints–General Arrangement #8

For Equipment, Pipe, or Duct Attachment With Orientation 2 Use KSCA - Rolled Angle Attachment Option #1

For Structural Attachment With Orientation 1 Use KSCA - Rolled Angle Attachment Option #3 Trim Angle As Needed

Figure I7-33; KSCA Brackets – Rolled Angle for Seismic Strut Restraints–General Arrangement #9
I7.6.2 – KSCC Brackets to Rolled Structural Angle:

There are two useful options available for attaching KSCC brackets to rolled structural angles. These options are shown in Figures I7-35 and I7-36. Option #2, shown in Figure I7-36 may require that the corner of the angle leg be trimmed to eliminate interference with the structure, equipment, pipe, or duct. Combinations of these attachment options may be used to create at least eight practical general strut restraint arrangements which are illustrated in Figures I7-37 through I7-44.
Figure I7-35; Attachment of KSCC Bracket to Rolled Angle – Option #1

Drill Ø\(\frac{13}{16}\)" Hole 1 Place Each End

\[\frac{3}{4}\]" Min.

KSCC Bracket By Kinetics

Rolled Structural Angle By Others

(1) \(\frac{3}{4}\)-10 UNC x 1\(\frac{1}{2}\)" SAE Grade 2 Bolt

(1) \(\frac{3}{4}\)" Standard Steel Flat Washer

(1) \(\frac{3}{4}\)-10 UNC SAE Grade 2 Hex Nut

By Others

Figure I7-36; Attachment of KSCC Bracket to Rolled Angle – Option #2

Drill Ø\(\frac{13}{16}\)" Hole 1 Place Each End

\[\frac{3}{4}\]" Min.

Rolled Structural Angle By Others

Trim Angle As Needed

KSCC Bracket By Kinetics

1"

(1) \(\frac{3}{4}\)-10 UNC x 1\(\frac{1}{2}\)" SAE Grade 2 Bolt

(1) \(\frac{3}{4}\)" Standard Steel Flat Washer

(1) \(\frac{3}{4}\)-10 UNC SAE Grade 2 Hex Nut

By Others
For Equipment, Pipe, Or Duct Attachment With Orientation 2 Use KSCC - Rolled Angle Attachment Option #1

For Equipment, Pipe, Or Duct Attachment With Orientation 1 Use KSCC - Rolled Angle Attachment Option #2 Trim Angle As Needed

For Structural Attachment With Orientation 1 Use KSCC - Rolled Angle Attachment Option #1

Figure I7-37; KSCC Brackets – Rolled Angle for Seismic Strut Restraints–General Arrangement #1

Figure I7-38; KSCC Brackets – Rolled Angle for Seismic Strut Restraints–General Arrangement #2
For Equipment, Pipe, Or Duct Attachment With Orientation 1 Use KSCC - Rolled Angle Attachment Option #1

For Structural Attachment With Orientation 2 Use KSCC - Rolled Angle Attachment Option #1

Figure I7-39; KSCC Brackets – Rolled Angle for Seismic Strut Restraints–General Arrangement #3

For Equipment, Pipe, Or Duct Attachment With Orientation 2 Use KSCC - Rolled Angle Attachment Option #2 Trim Angle As Needed

For Structural Attachment With Orientation 2 Use KSCC - Rolled Angle Attachment Option #1

Figure I7-40; KSCC Brackets – Rolled Angle for Seismic Strut Restraints–General Arrangement #4
For Equipment, Pipe, Or Duct Attachment With Orientation 2 Use KSCC - Rolled Angle Attachment Option #2 Trim Angle As Needed

For Equipment, Pipe, Or Duct Attachment With Orientation 1 Use KSCC - Rolled Angle Attachment Option #2 Trim Angle As Needed

Figure I7-41; KSCC Brackets – Rolled Angle for Seismic Strut Restraints–General Arrangement #5

Figure I7-42; KSCC Brackets – Rolled Angle for Seismic Strut Restraints–General Arrangement #6
For Equipment, Pipe, Or Duct Attachment With Orientation 1 Use KSCC - Rolled Angle Attachment Option #2
Trim Angle As Needed

For Equipment, Pipe, Or Duct Attachment With Orientation 2 Use KSCC - Rolled Angle Attachment Option #2
Trim Angle As Needed

Figure I7-43; KSCC Brackets – Rolled Angle for Seismic Strut Restraints–General Arrangement #7

Figure I7-44; KSCC Brackets – Rolled Angle for Seismic Strut Restraints–General Arrangement #8
I7.7 – Attaching KSCA & KSCC Brackets to Schedule 40 IPS Pipe:

Due to the nature of pipe, it will be difficult to drill the pipe to accurately locate the KSCA and KSCC brackets, and make the attachment using bolts, nuts and washers. Kinetics Noise Control recommends that the attachment of the KSCA brackets to schedule 40 IPS pipe be made by welding. The weld attachment details for the KSCA bracket are shown in Figure I7-45. The weld size and length specified will generate the full capacity of the restraints recommended by Kinetics Noise Control when the appropriate schedule 40 IPS pipe has been selected from Table I7-6 according to the instructions outlined in Section I7.2 – Using the Restraint Designation Symbol to Select Struts. It is not possible to weld the KSCC brackets to the schedule 40 IPS pipes shown in Table I7-6 securely enough to generate the full rated capacity of the restraints recommended by Kinetics Noise Control. This is due to the wall thickness of the pipe, and the possible length of contact between the pipe and the KSCC brackets. Therefore, Kinetics Noise Control does not recommend using the KSCC brackets for strut type restraints fabricated from schedule 40 IPS pipe.

There are four basic general arrangements possible for attaching KSCA brackets to schedule 40 IPS pipe. These options are shown in Figures I7-46, I7-47, I7-48, and I7-49. All of these options may require that the pipe be trimmed to clear the structure, pipe, duct, or trapeze bar.
KSCA Bracket By Kinetics

Locate KSCA 2 3/4"
From End Of Pipe

Both Sides 2 Places

Pipe By Others
Selected From Table I7-6
Trim Pipe As Needed

Figure I7-45; Weld Attachment of KSCA Bracket to Schedule 40 IPS Pipe

Figure I7-46; KSCA Brackets – Pipe for Seismic Strut Restraints—General Arrangement #1
Figure I7-47; KSCA Brackets – Pipe for Seismic Strut Restraints–General Arrangement #2

Figure I7-48; KSCA Brackets – Pipe for Seismic Strut Restraints–General Arrangement #3
Figure I7-49; KSCA Brackets – Pipe for Seismic Strut Restraints–General Arrangement #4
I7.8 – Strut Restraint Schematics for Piping:

Sheet H – View C shown in Figure I7-50 will be typical of the other figures in this section. They refer to the drawing sheet and view on the installation drawings provided by Kinetics Noise Control for each project requiring seismic restraint for pipe and duct systems.

![Diagram of Strut Restraint Schematics for Piping](image)

**Figure I7-50; Transverse (T) Strut Type Restraint Schematic for Single Clevis Supported Pipe – Strut Type Restraint Attached to Clevis Hanger**
Figure I7-51; Longitudinal (L) Strut Type Restraint Schematic for Single Clevis Supported Pipe – Strut Type Restraint Attached to a Pipe Riser Clamp Immediately Adjacent to the Clevis Hanger
Figure I7-52; Longitudinal (L) Strut Type Restraint Schematic for Single Clevis Supported Pipe – Strut Type Restraint Attached to a Clamp Type Clevis Hanger
Figure I7-53: Combined Transverse & Longitudinal (TL) Strut Type Restraint Schematic for Single Clevis Supported Pipe – Strut Type Restraints Attached to a Pipe Riser Clamp Immediately Adjacent to the Clevis Hanger
Figure I7-54; Transverse (T) Strut Type Restraint Schematic for Trapeze Supported Pipe – Strut Type Restraint Attached to One End, or One Hanger Rod, of the Trapeze Bar and Directed Outside the Trapeze.
Figure I7-55; Transverse (T) Strut Type Restraint Schematic for Trapeze Supported Pipe – Strut Type Restraint Attached to One End, or One Hanger Rod, of the Trapeze Bar and Directed Inside the Trapeze.
Figure I7-56: Transverse (T) Strut Type Restraint Schematic for Trapeze Supported Pipe – Strut Type Restraint Attached to One End, or One Hanger Rod, of the Trapeze Bar and Directed Inside the Trapeze with a Second Tier Trapeze Support for Additional Pipes.
Figure I7-57; Transverse (T) Strut Type Restraint Schematic Arrangement for Trapeze Supported Pipe – Strut Type Restraints Attached to One End, or One Hanger Rod, of the Trapeze Bar and Directed Outside the Trapeze Bar for Use in Tight Space Situations
Figure I7-58; Transverse (T) Strut Type Restraint Schematic for Trapeze Supported Pipe – Trapeze Bar is Too Close to a Wall to Allow a Normal Restraint Arrangement – Obtain Permission from the Structural Engineer and Architect Before Penetrating the Wall.
Figure I7-59: Longitudinal (L) Cable Restraint Schematic for Trapeze Supported Pipe – Option #1 – Restraint Forces are Balanced Side-to-Side
Figure I7-60; Longitudinal (L) Cable Restraint Schematic for Trapeze Supported Pipe – Option #2 – Restraint Forces are Balanced Side-to-Side
Figure I7-61; Combined Transverse & Longitudinal (TL) Strut Type Restraints for Trapeze Supported Pipe – All of the Options Shown Provide Balanced Longitudinal Restraint Forces Side-to-Side
I7.9 – Strut Restraint Schematics for Duct:

Sheet H1 – View A shown in Figure I7-62 will be typical of the other figures in this section. They refer to the drawing sheet and view on the installation drawings provided by Kinetics Noise Control for each project requiring seismic restraint for pipe and duct systems.

Figure I7-62; Transverse (T) Strut Type Restraint Schematic for Trapped Rectangular Duct – Restraint on Top Trapeze Bar at One Hanger Location Directed Outward from the Trapeze Bar
Figure I7-63; Transverse (T) Strut Type Restraint Schematic for Trapped Rectangular Duct – Restraint on Top Trapeze Bar at One Hanger Location Directed Inward Over the Top of the Duct
Figure I7-64; Transverse (T) Strut Type Restraint Schematic for Trapped Rectangular Duct – Restraint at the Center of the Top Trapeze Bar and Directed Outward Across the Top of the Duct
Figure I7-65; Transverse (T) Strut Type Restraint Schematic for Supported Rectangular Duct – Strut Type Restraint Attached to One End, or One Hanger Rod, of the Trapeze Bar and Directed Outward From the Trapeze Bar.
Figure I7-66; Transverse (T) Strut Type Restraint Schematic for Suspended Rectangular Duct – Restraint Attached to One End, or One Hanger Rod, of the Trapeze Bar and Directed Outward from the Trapeze Bar.
Figure I7-67; Transverse (T) Strut Type Restraint Schematic for Suspended Rectangular Duct – Strut Type Restraint at One Hanger Location and Directed Inward over the Top of the Duct
Figure I7-68; Transverse (T) Strut Type Restraint Schematic for Suspended Rectangular Duct – Two Strut Type Restraints Connected Through an Intermediate Trapeze Bar and Directed Inward from the Intermediate Trapeze Bar
Figure I7-69; Transverse (T) Strut Type Restraint Schematic for Suspended Rectangular Duct – Two Strut Type Restraints Connected Through an Intermediate Trapeze Bar and Directed Outward from the Intermediate Trapeze Bar
Figure I7-70; Transverse (T) Strut Type Restraint Schematic for Supported Rectangular Duct – Trapeze Bar is Too Close to a Wall to Allow a Normal Restraint Arrangement – Obtain Permission from the Structural Engineer and Architect Before Penetrating the Wall
Figure I7-71; Longitudinal (L) Strut Type Restraint Schematic for Rectangular Duct – Restraints Located on Each Side of the Bottom Trapeze Bar.
Figure I7-72; Longitudinal (L) Strut Type Restraint Schematic for Trapped Rectangular Duct – One Strut Type Restraints Located in the Center of the Top Trapeze Bar or Two Strut Type Restraints One Located on Each Side of the Top Trapeze Bar
Figure I7-73; Transverse (T) Strut Type Restraint Schematic for Round Duct Supported by Two Hanger Rods
Figure I7-74; Transverse (T) Strut Type Restraint Schematic for Round Duct Supported by One Hanger Rod – Restraint adjacent to Hanger Rod Attached to a Band Clamp
Figure I7-75; Longitudinal (L) Strut Type Restraint Schematic for Round Duct Supported by Two Hanger Rods – One Restraint on Each Side of the Duct
Figure I7-76: Longitudinal (L) Strut Type Restraint Schematic for Round Duct Supported by One Hanger Rod – One Restraint on each Side of the Duct, Adjacent to the Hanger Rod, and Attached to Band Clamps
Figure I7-77; Transverse (T) and Longitudinal (L) Basic Plan View Restraint Arrangements for Duct Being Restrained with Strut Type Restraints – Note: The Longitudinal (L) Restraint Cables in Longitudinal Restraint Options #1 & #2 are Arranged to Prevent Twisting of the Duct
Figure I7-78: Combined Transverse & Longitudinal (TL) Basic Plan View Restraint Arrangements for Duct Being Restrained with Strut Type Restraints – Note: The Restraint Cables in Options #1, #2, & #3 are Arranged to Prevent Twisting of the Duct.
I7.10 – Strut Restraint Schematics for Floor/Roof Mounted Pipe:

Figure I7-79; Transverse (T) Strut Type Restraint Schematic for Floor/Roof Mounted Pipe – Side Strut at a 45° Angle
Figure I7-80; Transverse (T) Strut Type Restraint Schematic for Floor/Roof Mounted Pipe – Cross Brace Strut at a 45° Angle
Strut Type Restraint Using Kinetics Hardware

Clamping Pipe to Cross Bar Section I3.13

Structural Attachment Section I5.0

Cross Bar Attachment Section I6.0

Building Structure

Figure I7-81; Transverse (T) Strut Type Restraint Schematic for Floor/Roof Mounted Pipe – Horizontal Strut
Figure I7-82; Longitudinal (L) Strut Type Restraint Schematic for Floor/Roof Mounted Pipe – Strut Attached to the Floor Stand or Support at a 45° Angle
Figure I7-83; Longitudinal (L) Strut Type Restraint Schematic for Floor/Roof Mounted Pipe – Strut Attached to the Duct at a 45° Angle
I7.11 – Strut Restraint Schematics for Floor/Roof Mounted Duct:

Figure I7-84; Transverse (T) Strut Type Restraint Schematic for Floor/Roof Mounted Duct – Side Strut at a 45° Angle
Attachment of Duct to Cross Bar. Sections A3.4, A3.5, & A3.6

Structural Attachment Seismic Rated Anchors Section I5.0

3 Max

45°

3 Max

Strut Type Restraint Using Kinetics Hardware

48 Max

Building Structure

Figure I7- 85; Transverse (T) Strut Type Restraint Schematic for Floor/Roof Mounted Duct – Cross Brace Strut at a 45° Angle
Figure I7-86; Transverse (T) Strut Type Restraint Schematic for Floor/Roof Mounted Duct – Horizontal Strut
Attachment of Duct to Cross Bar. Sections A3.4, A3.5, & A3.6

Cable Restraint Attachment Section I6.0

Structural Attachment (Orientation #1) Section I5.0

Strut Type Restraint Using Kinetics KSCA or KSCC Brackets

Building Structure

Figure I7-87; Longitudinal (L) Strut Type Restraint Schematic for Floor/Roof Mounted Duct – Strut Attached to the Floor Stand or Support at a 45° Angle
Figure I7-88; Longitudinal (L) Strut Type Restraint Schematic for Floor/Roof Mounted Duct – Strut Attached to the Duct at a 45° Angle
I7.12 – Summary:

When using strut type restraints instead of cable restraints, it is very important to remember the following items.

1.) One strut type restraint will replace a pair of cable restraints.
2.) Strut type restraints increase the tensile loads on the hanger rods beyond the dead weight of the pipe or duct. *Hanger rods and hanger attachments to structure may need to be changed!*
3.) When using Kinetics KSCA or KSCC brackets, the strut type restraints must be installed at a 45° angle measured from the horizontal.
4.) If *one restraint location* on a run of pipe or duct needs to be a strut type restraint, *all of the restraints will need to be strut type restraints!*
5.) Help in selecting and evaluating strut sizes, hanger rod s, anchorage, and etc. may be found at [www.kineticsnoise.com](http://www.kineticsnoise.com).
I8.1 – Why are Rod Stiffeners Needed?

Hanger rod stiffeners are used to prevent the buckling of the hanger rods under the compressive reaction loads during an earthquake. Buckling is very difficult to predict, and depends on many factors such as, hanger rod length, hanger rod size, the dead load carried by the hanger rod, the horizontal seismic forces applied to the pipe or duct, and the seismic restraint installation angle. Buckling is also a very dangerous type of failure. It occurs in long slender structural members under compressive load, and it occurs at loads far less than those required to yield the material in the structural member.

It is impractical for the installing contractor to be able to perform the calculations needed to determine if rod stiffeners are required, and to select the proper stiffener element. This section will provide the contractor with some basic tools that can be used to visually determine the need for rod stiffeners. Then the matter can be referred to the engineer of record for the system to have the proper calculations done using the on-line web tools provided by Kinetics Noise Control.

I8.2 – When are Rod Stiffeners Needed?

1. For Seismic Design Categories A & B no seismic restraints, and thus, no rod stiffeners are required for pipe and duct.
2. For Seismic Design Categories C & D, and cable/strut installation angles no greater than 45° as measured from the horizontal, use Tables I8.1 through I8.12. In these tables, N.S.R. means that no rod stiffener is required for the specified hanger rod size and restraint spacing. For all other cases the maximum Unstiffened, or critical, hanger rod length is given for single hanger rod supported pipe & duct, and for trapeze bar supported pipe and duct.
3. For Seismic Design Categories C & D, seismic restraint installation angles greater than 45° as measured from the horizontal, and or Hanger spacings less than 10’, assume that rod stiffeners will be required.
4. For Seismic Design Categories E & F rod stiffeners will be required for almost all cases, consult with the engineer of record.

Table I8-1: Maximum Unstiffened Hanger Rod Length for Pipe & Duct, Seismic Design Category C, Hanger Spacing is 10’, Restraint Spacing is 10’, and Restraint Installation Angle is 45°

N.S.R. = No Stiffener Required

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Table I8-2; Maximum Unstiffened Hanger Rod Length for Pipe & Duct – Seismic Design Category C, Hanger Spacing is 10’, Restraint Spacing is 20’, and Restraint Installation Angle is 45°

N.S.R. = No Stiffener Required

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Table I8-3; Maximum Unstiffened Hanger Rod Length for Pipe & Duct – Seismic Design Category C, Hanger Spacing is 10’, Restraint Spacing is 30’, and Restraint Installation Angle is 45°

N.S.R. = No Stiffener Required

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Table I8-4; Maximum Unstiffened Hanger Rod Length for Pipe & Duct – Seismic Design Category C, Hanger Spacing is 10’, Restraint Spacing is 40’, and Restraint Installation Angle is 45°

N.S.R. = No Stiffener Required

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Table I8-5; Maximum Unstiffened Hanger Rod Length for Pipe & Duct – Seismic Design Category C, Hanger Spacing is 10’, Restraint Spacing is 60’, and Restraint Installation Angle is 45°

N.S.R. = No Stiffener Required

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### Table I8-6; Maximum Unstiffened Hanger Rod Length for Pipe & Duct – Seismic Design Category C, Hanger Spacing is 10', Restraint Spacing is 80', and Restraint Installation Angle is 45°

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N.S.R. = No Stiffener Required

### Table I8-7; Maximum Unstiffened Hanger Rod Length for Pipe & Duct – Seismic Design Category D, Hanger Spacing is 10', Restraint Spacing is 10', and Restraint Installation Angle is 45°

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N.S.R. = No Stiffener Required
Table I8-8; Maximum Unstiffened Hanger Rod Length for Pipe & Duct – Seismic Design Category D, Hanger Spacing is 10', Restraint Spacing is 20', and Restraint Installation Angle is 45°

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Table I8-9; Maximum Unstiffened Hanger Rod Length for Pipe & Duct – Seismic Design Category D, Hanger Spacing is 10', Restraint Spacing is 30', and Restraint Installation Angle is 45°

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### Table I8-10; Max. Unstiffened Hanger Rod Length for Pipe & Duct – Seismic Design Category D, Hanger Spacing is 10’, Restraint Spacing is 40’, and Restraint Installation Angle is 45°

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N.S.R. = No Stiffener Required

### Table I8-11; Max. Unstiffened Hanger Rod Length for Pipe & Duct – Seismic Design Category D, Hanger Spacing is 10’, Restraint Spacing is 60’, and Restraint Installation Angle is 45°

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N.S.R. = No Stiffener Required
Table I8-12: Max. Unstiffened Hanger Rod Length for Pipe & Duct – Seismic Design Category D, Hanger Spacing is 10', Restraint Spacing is 80', and Restraint Installation Angle is 45°

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N.S.R. = No Stiffener Required

I8.3 – How are Rod Stiffeners Selected and Installed?

The sizing of the rod stiffeners may be accomplished using the techniques outlined in Section S8.0 and Appendices A5.1 through A5.8 of this manual. Section S8.7 outlines the requirements and procedure for using the on-line web Rod Stiffener program provided by Kinetics Noise Control. Sizing rod stiffeners is not a task that should be attempted by the installing contractor in the field, and should be performed by a qualified design professional. The following basic rules will help to determine the need for rod stiffeners.

1. Rod stiffeners only need to be used on hanger rods that carry the reaction loads from seismic restraints.

2. When determining the requirements for rod stiffeners, consider both the transverse (T) and Longitudinal (L) restraints on the run of pipe or duct. Remember, the longitudinal (L) restraints are typically spaced further apart than the transverse (T) restraints and could
require rod stiffeners when the transverse (T) restraints did not, or require larger rod stiffeners when the transverse (T) restraints also required rod stiffeners.

3. Where hanger rods carry the loads from both Transverse (T) and Longitudinal (L) seismic restraints, the rod stiffeners need to be sized to carry only the reaction loads from the more severe case.

Kinetics Noise Control has designed a series of clamps that are used with standard rolled structural angle to create a rod stiffener system, which are shown in Figure I8-1. The model KHRC-B clamp has been designed to work with hanger rods from 3/8" to 1-1/8" in diameter. The model KHRC-C clamp is for use with hanger rods from 3/8" to 1-1/8" in diameter. Table I8-13 shows the rolled structural angles recommended for use as rod stiffeners by Kinetics Noise Control, and the model KHRC stiffener clamps to be used with each angle size. The analysis outlined in Section S8.0, and Appendix A5.1, or the on-line web based Rod Stiffener program will indicate which angle and clamp are to be used and how many clamps will be required to properly stiffen the hanger rod.
Figure I8-1; Kinetics Noise Control Model KHRC Rod Stiffener Clamps for Use with Rolled Structural Angle
Table I8-13; Rod Stiffener Angle Code Designation and Model KHRC Rod Stiffener Clamps

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<th>AISI Angle Designation</th>
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<tr>
<td>B</td>
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<tr>
<td>I</td>
<td>L 2-1/2 x 2-1/2 x 1/2</td>
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</table>

1 The Rod Stiffener Code is used by the Kinetics Noise Control Rod Stiffener Program streamline the specification of the rod stiffener.

2 These rod stiffener angles may be used with the Kinetics Noise Control Model KHRC-C rod stiffener clamp. Not all hanger rod sizes may work with these arrangements. Check with Kinetics Noise Control Engineering for your particular application.

The basic installation of the rod stiffener clamps is detailed in Figure I8-2, and typical rod stiffener installations are shown in Figures I8-3 through I8-6.
1.) Hold rod stiffener angle against hanger rod.
2.) Slide all required clamps over angle and hanger rod.
3.) Position top & bottom clamps 1/4” away from ends of angle & tighten clamp bolts.
4.) Equal space and tighten remaining clamps.

1.) Center clamp bolt on hanger rod.
2.) Tighten clamp bolt securely.
3.) Tighten jam nut against clamp body.

Figure I8-2; Basic Installation of Kinetics Noise Control Model KHRC Rod Stiffener Clamps
Figure I8-3; Typical Rod Stiffener Installation for Non-Isolated Single Clevis Hung Pipe
Figure I8-4; Typical Rod Stiffener Installation for Isolated Single Clevis Hung Pipe
Figure I8-5; Typical Rod Stiffener Installation for Trapeze Supported Pipe & Duct – Two Rods
Figure I8-6; Typical Rod Stiffener Installation for Trapeze Supported Pipe & Duct – One Rod

KINETICS™ Pipe & Duct Seismic Application Manual

HANGER ROD STIFFENERS – WHY, WHEN, & HOW

SECTION – I8.0

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Toll Free (USA Only): 800-959-1229
International: 614-889-0480
FAX: 614-889-0540
World Wide Web: www.kineticsnoise.com
E-mail: sales@kineticsnoise.com

Dublin, Ohio, USA • Mississauga, Ontario, Canada

Member
ELECTRICAL DISTRIBUTION SYSTEMS – CONTRACTOR SUMMARY

The seismic restraints for electrical distribution systems are applied and installed in the same basic way as are those for pipe and duct. The preceding sections in the Installation portion of this manual, Sections I1.0 through I8.0 will apply to the basic restraint installation for electrical distribution systems. There are, however, some points that will need to be considered.

1. Kinetics Noise Control restraint products are designed specifically for suspended distribution systems. The application of these products to wall mounted distribution systems is difficult. Each supported for wall mounted distribution systems should be designed, selected, and analyzed to support both the dead weight load of the distribution system, and the code based design horizontal seismic loads. This should be done by the engineer of record for the distribution system in conjunction with the structural engineer and/or the architect.

2. Sections I1.0 and I2.0 are valuable guides on the basics of seismic restraint planning and installation.

3. Single supported and trapeze supported conduit are treated exactly like single clevis supported and trapeze supported pipe. See Sections I3.0 and I6.0 of this manual for examples of restraint schematics and attachments to hangers and trapeze bars.

4. Trapeze supported bus ducts and cable trays are restrained in a manner similar to duct. See Sections I4.0 and I6.0 of this manual for examples of restraint schematics and attachments to trapeze bars.

5. The structural attachment end of the restraints for conduit, bus ducts, and cable trays is treated exactly like that for pipe and duct. See Section I5.0 of this manual for examples of structural attachments for Kinetics’ products.

6. There will be occasions when cable type restraints can not be used due to the close proximity of a wall, or another object. In situations like these, strut type restraints can also be used with conduit, bus ducts, and cable trays. See Section I7.0 of this manual for selecting and applying strut type restraints.
7. For “long” – small diameter hanger rods, hanger rod stiffeners may be required as they are for pipe and duct. See Section I8.0 of this manual for the use and installation of hanger rod stiffeners.

8. For cable trays – the cables in the trays should be strapped or clamped to the cable trays at a spacing not to exceed one half of the hanger spacing. This will make sure that the seismic loads are evenly distributed to the restraint locations.

9. Cable trays must be properly attached to the trapeze bars with seismic restraints. See Appendices A3.4 and A3.6 for hardware sizes and quantities required to resist seismic loads, and see Appendix A3.5 for weld sizes and lengths required to resist seismic loads.

10. Not all suspended cable trays are supported by trapeze bars. For those which are not supported by trapeze bars contact the manufacturer of the cable tray for the details required to attach seismic restraints to the cable trays.