

SELECTION & LOCATION OF RESTRAINTS FOR PIPE AND DUCT

S7.1 – Introduction:

The actual selection of the seismic restraints and the approximate locations for those restraints along the pipe or duct has typically been done by the supplier of the seismic restraint components. Kinetics Noise Control provides this service to the building industry because we are expected, and in many cases required, to certify that the restraint components that we supply will meet the site specific seismic requirements for the project. As part of the certification process, Kinetics Noise Control will provide tentative restraint selections, quantities, and approximate locations of the seismic restraints for the project in question and then provide a certification letter stating that the restraints will meet the seismic requirements of the project. Keep in mind that the selection, quantities, and indicated locations are tentative and approximate based on the project information submitted to Kinetics Noise Control. Project parameters tend to evolve as the project progresses. Therefore, the number of restraints required may change between the time of submittal and installation. This section will provide the project engineer responsible for the pipe or duct some insight on the selection and application of the seismic restraints for their project.

S7.2 – Information Required for the Selection of Seismic Restraints for Pipe and Duct:

The information required to perform the necessary calculations and make the appropriate selection of seismic restraints for pipe and duct, is described and detailed in Section S2.0 of this manual. For convenience, this required information will be summarized below.

1. Building Occupancy Category – needed to establish the building use.
2. Seismic Design Category – A, B, C, D, E, or F.
3. Design Acceleration Value – either a or b below may be given.
 - a. S_s & Soil Type
 - b. S_{DS}
4. Component Importance Factor – either 1.0 or 1.5.

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5. The height of the building roof as measured from grade.
6. Elevation of the attachment point for the run of pipe or duct as measured from grade.

S7.3 – Horizontal Force Class:

Since the seismic design force discussed in Section S5.0 acts in a horizontal direction, Kinetics Noise Control has developed a Horizontal Force Class system to rate their seismic restraints for Pipe and Duct and to classify the seismic requirements for projects. This system is defined in Table S7-1 below. The Horizontal Force Class system provides a quick and easy way to select the proper components while being sure that a satisfactory Factor of Safety is being maintained. It simply requires matching the Horizontal Force Class rating of the seismic restraint with the calculated Horizontal Force Class requirement of the pipe or duct.

Table S7-1; Horizontal Seismic Force Class System Designations

Horizontal Force Class	Horizontal Seismic Force Range per Force Class (lbs)
I	$0 \leq F_P \leq 250$
II	$250 < F_P \leq 500$
III	$500 < F_P \leq 1,000$
IV	$1,000 < F_P \leq 2,000$
V	$2,000 < F_P \leq 5,000$
VI	$5,000 < F_P \leq 10,000$

S7.4 – Seismic Restraint Kit and Attachment Kit Cross-Reference:

In the discussion that follows various code or “shorthand” symbols will be used to simplify seismic restraint location drawings and calculation documents. These code symbols may be cross-referenced to their respective restraint cable kits and attachment kits as shown in Tables S7-2, S7-3, and S7-4.

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Kinetics Noise Control primarily sells cable type seismic restraints. However, Kinetics Noise Control offers attachment brackets and hardware for the use of strut type restraints. Each restraint cable kit contains enough components to make two complete cable assemblies. This will provide one complete transverse restraint or one complete longitudinal restraint. The attachment kits contain enough hardware to attach two cable restraints to the pipe or duct, and then to the building structure.

Table S7-2; Seismic Restraint Cable Kit vs. Code Cross-Reference

KNC Restraint Kit Code	Restraint Kit Description
K2	KSCU-2 Cable Kit – 2 mm Cable & GRIPPLE HANGFAST No, 2 Connectors
K3	KSCU-3 Cable Kit – 3 mm Cable & GRIPPLE HANGFAST No, 3 Connectors
K4	KSCU-4 Cable Kit – 5 mm Cable & GRIPPLE HANGFAST No, 4 Connectors
K5	KSCU-5 Cable Kit – 6 mm Cable & GRIPPLE Lockable 6 mm Connectors
C1	KSCC-250 Cable Kit – 1/4" Cable & Saddle + U-bolt Connectors
C2	KSCC-375 Cable Kit – 3/8" Cable & Saddle + U-bolt Connectors
C3	KSCC-500 Cable Kit – 1/2" Cable & Saddle + U-bolt Connectors
F	Direct Mounted to Floor or Roof Using Anchor Bolts
W	Direct Mounted to Wall Using Anchor Bolts

Space and structural constraints sometimes make it necessary to use rigid strut restraints instead of cable restraints. Each of the strut restraint kits provided by Kinetics Noise Control will contain enough attachment brackets and hardware for one strut type restraint. The most common materials that are used for rigid strut restraints are structural angles, UNISTRUT® type channels, and pipe. Tables S7-5, S7-6, and S7-7 provide a cross-reference between the Kinetics Noise Control code symbols for the restraint cable kits and struts made from structural angles, UNISTRUT® channel, and pipe respectively. Note that only the KSCU restraint cable kits are supported for strut type restraints using pipe. This is due to the difficulty of attaching the KSCC brackets to the pipe.

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Table S7-3; Structural Concrete/Steel Attachment Kit vs. Code Cross-Reference

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

Table S7-4; Structural Wood/Steel Attachment Kit vs. Code Cross-Reference

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

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Table S7-5; Seismic Strut Restraint Size per KNC Restraint Code for Structural Steel Angle

KNC Restraint Code	Restraint Cable Kit	Structural Steel Angle Size (in)											
		1 x 1 x 1/8	1 x 1 x 1/4	1-1/2 x 1-1/2 x 1/4	2 x 2 x 1/4	2 x 2 x 3/8	2-1/2 x 2-1/2 x 1/4	2-1/2 x 2-1/2 x 1/2	3 x 3 x 1/4	3 x 3 x 1/2	3-1/2 x 3-1/2 x 1/4	3-1/2 x 3-1/2 x 1/2	4 x 4 x 1/4
		Maximum Strut Length (in)											
K2	KSCU-2	173	205	----	----	----	----	----	----	----	----	----	----
K3	KSCU-3	122	145	197	189	----	----	----	----	----	----	----	----
K4	KSCU-4	77	92	125	120	164	153	210	189	----	----	----	----
K5	KSCU-5	52	61	84	80	110	103	141	127	174	209	----	----
C1	KSCC-250	53	63	86	82	113	105	144	130	178	213	----	----
C2	KSCC-375	37	44	60	57	78	73	100	90	124	149	203	232
C3	KSCC-500	30	36	49	47	64	60	82	74	101	121	166	190

Table S7-6; Seismic Strut Restraint Size per KNC Restraint Code for UNISTRUT® Profiles

KNC Restraint Code	Restraint Cable Kit	UNISTRUT® Profile			
		P1000	P1001	P5000	P5001
		Maximum Strut Length (in)			
K2	KSCU-2	165	----	----	----
K3	KSCU-3	117	186	179	----
K4	KSCU-4	74	118	113	160
K5	KSCU-5	49	79	76	108
C1	KSCC-250	51	81	78	110
C2	KSCC-375	34	56	54	77
C3	KSCC-500	16	46	44	62

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Table S7-7; Seismic Strut Restraint Size per KNC Restraint Code for Pipe

KNC Restraint Code	Restraint Cable Kit	Nominal Pipe Size & Schedule						
		1" Sch. 40	1-1/4" Sch. 40	1-1/2" Sch. 40	2" Sch. 10	2" Sch. 40	2-1/2" Sch. 10	2-1/2" Sch. 40
		Maximum Strut Length (in)						
K2	KSCU-2	111	166	210	----	----	----	----
K3	KSCU-3	79	118	148	188	218	----	----
K4	KSCU-4	50	75	94	120	138	168	210
K5	KSCU-5	33	50	63	80	93	113	141

S7.5 – Kinetics Noise Control Pipe & Duct Seismic Restraint Analysis Output:

Using the product information supplied by the customer, Kinetics Noise Control will run a Site Specific seismic analysis for the restraint of pipe or duct. The output of the analysis is based on the weight per foot of the component being restrained. It is not specific to pipe or duct and may be used for both. It is also not specific to single clevis hung pipe or trapeze supported pipe and may be used for both. There are four basic output sheets from the analysis, and they are shown in an example in Tables S7-8 through S7-11.

Currently, the use of the Kinetics Noise Control web based tools for performing the calculations for pipe and duct are limited to employees and representatives of Kinetics Noise Control. The procedure for performing the calculations, selection, and location of seismic restraints for pipe and duct is still under development due to changes in the code and the introduction of new products by Kinetics Noise Control. These web based tools may be made available to design professionals at sometime in the future.

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The site specific selection of seismic restraints and attachment hardware for pipe and duct is based on the restraint cable kit capacities with various attachment kits. These kit capacities are presented in Appendix A1.1 of this manual. These tables will help design professionals of record to verify that the proper selection of restraints and attachment hardware have been made for their specific applications. Also, the data presented in these tables will be pertinent to the discussion which will follow concerning the interpretation of Tables S7-8 through S7-11.

In each of the Tables S7-8 through S7-11 there are columns on the left hand side that give approximate weights per foot for insulated standard steel schedule 40 pipe with water and steam, and for typical rectangular duct that is non-insulated and non-lagged. Appendices A2.1 through A2.5 give the weight per foot for many different types of pipe that are water filled or steam filled, and insulated and non-insulated. Appendices A3.1 through A3.3 give the weight per foot for many different types of duct that are both insulated and non-insulated, and where appropriate with acoustical lagging.

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Table S7-8; Site Specific Seismic Pipe & Duct Horizontal Force Class Example



KINETICS NOISE CONTROL
6300 IRELAN PLACE
DUBLIN, OHIO 43017
ph 614-889-0480

Cracked Concrete Anchor (KCCAB) or Through Bolt

Project:	S7.0 Example	KNC#	KN1611
Mapped S _{ps} :	0.25	I _p :	1.5
		R _p :	6
Maximum Installation Angle: 45	Installation Orientation: BOTH		

G's by Building Elevation listed below						
Grade	16%	Elevation in Structure (% of Total Building Height)		66%	84%	Roof
0.113	0.113	33%	50%	0.125	0.146	0.166
		0.113	0.125	0.146	0.166	0.188

Table 1A

Site Specific Horizontal Force Selection Tables 2006 IBC

Horizontal Force Class	
Max Force (lbs)	Force Class
250	I
500	II
1000	III
2000	IV
5000	V
10000	VI

Typ. Lb/Ft Includes Insulation		
Pipe Size	Filled Pipe	Steam Pipe
1	2.91	3.24
1.5	4.67	4.61
2	6.35	5.81
2.5	9.3	8.22
3	12.44	10.35
4	18.34	14.12
5	27.2	20.22
6	35.99	25.36
8	55.84	36.42
10	81.43	49.92
12	106.45	60.48
14	122.88	66.42
16	151.4	75.91
18	182.63	85.41
20	216.59	94.91
24	292.68	113.91

Maximum Rectangular Duct Weight	
Duct Size	Lb/Ft
30 x 30	26
42 x 42	36
54 x 54	47
60 x 60	54
84 x 84	103
96 x 96	129
54 x 28	35
60 x 30	39
84 x 42	74
96 x 48	97
108 x 54	110
120 x 60	121

- Instructions for Use**
- Determine the max restraint spacing, from the geometry of the installation but do not exceed values listed in Table 2.
 - Determine the weight of the pipe or duct component(s) from the tables above (adding trapezoid items together.)
 - Use the tables at right to determine the Horizontal Force, Force Class, Cable & Attachment Kit Or Kit Type Designator based on the Restraint Spacing
 - For other pipe and duct types see appendices A2.0 and A3.0 of Kinetics Pipe & Duct Application Manual.
- (Force Class Units are LRFD [Strength] Based)

Restraints Located 10 ft OC [lbs]

Wt/Ft (Lb)	Elevation in Structure (% of Total Building Height)						
	Grade	16%	33%		50%	66%	84%
10	11	11	11	13	15	17	19
25	28	28	28	31	36	42	47
50	56	56	56	63	73	83	94
100	113	113	113	125	146	166	188
150	169	169	169	188	218	249	281
200	225	225	225	250	291	333	375
250	281	281	281	313	364	416	469
300	338	338	338	375	437	499	563

Restraints Located 20 ft OC [lbs]

Wt/Ft (Lb)	Elevation in Structure (% of Total Building Height)						
	Grade	16%	33%		50%	66%	84%
10	23	23	23	25	29	33	38
25	56	56	56	63	73	83	94
50	113	113	113	125	146	166	188
100	225	225	225	250	291	333	375
150	338	338	338	375	437	499	563
200	450	450	450	500	583	665	750
250	563	563	563	625	728	831	938
300	675	675	675	750	874	998	1125

Restraints Located 30 ft OC [lbs]

Wt/Ft (Lb)	Elevation in Structure (% of Total Building Height)						
	Grade	16%	33%		50%	66%	84%
10	34	34	34	38	44	50	56
25	84	84	84	94	109	125	141
50	169	169	169	188	218	249	281
100	338	338	338	375	437	499	563
150	506	506	506	563	655	748	844
200	675	675	675	750	874	998	1125
250	844	844	844	938	1092	1247	1406
300	1013	1013	1013	1125	1311	1496	1688

Restraints Located 40 ft OC [lbs]

Wt/Ft (Lb)	Elevation in Structure (% of Total Building Height)						
	Grade	16%	33%		50%	66%	84%
10	45	45	45	50	58	67	75
25	113	113	113	125	146	166	188
50	225	225	225	250	291	333	375
100	450	450	450	500	583	665	750
150	675	675	675	750	874	998	1125
200	900	900	900	1000	1165	1330	1500
250	1125	1125	1125	1250	1456	1663	1875
300	1350	1350	1350	1500	1748	1995	2250

Restraints Located 60 ft OC [lbs]

Wt/Ft (Lb)	Elevation in Structure (% of Total Building Height)						
	Grade	16%	33%		50%	66%	84%
10	68	68	68	75	87	100	113
25	169	169	169	188	218	249	281
50	338	338	338	375	437	499	563
100	675	675	675	750	874	998	1125
150	1013	1013	1013	1125	1311	1496	1688
200	1350	1350	1350	1500	1747	1995	2250
250	1688	1688	1688	1875	2184	2494	2813
300	2025	2025	2025	2250	2621	2993	3375

Restraints Located 80 ft OC [lbs]

Wt/Ft (Lb)	Elevation in Structure (% of Total Building Height)						
	Grade	16%	33%		50%	66%	84%
10	90	90	90	100	117	133	150
25	225	225	225	250	291	333	375
50	450	450	450	500	583	665	750
100	900	900	900	1000	1165	1330	1500
150	1350	1350	1350	1500	1748	1995	2250
200	1800	1800	1800	2000	2330	2660	3000
250	2250	2250	2250	2500	2913	3325	3750
300	2700	2700	2700	3000	3495	3990	4500

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Table S7-9; Site Specific Seismic Pipe & Duct Horizontal Seismic Force



KINETICS NOISE CONTROL
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ph 614-889-0480

Cracked Concrete Anchor (KCCAB) or Through Bolt

Project:	S7.0 Example	KNC#	KN1611
Mapped S _{DS} :	0.25	I _p :	1.5
		R _p :	6
Maximum Installation Angle: 45	Installation Orientation: BOTH		

Table I

Site Specific Horizontal Force Class Selection Tables 2006 IBC

Horizontal Force Class	
Max Force (lbs)	Force Class
250	I
500	II
1000	III
2000	IV
5000	V
10000	VI

Pipe Size	Typ. Lb/Ft Includes Insulation	
	Filled Pipe	Steam Pipe
1	2.91	3.24
1.5	4.67	4.61
2	6.35	5.81
2.5	9.3	8.22
3	12.44	10.35
4	18.34	14.12
5	27.2	20.22
6	35.99	25.36
8	55.84	36.42
10	81.43	49.92
12	106.45	60.48
14	122.88	66.42
16	151.4	75.91
18	182.63	85.41
20	216.59	94.91
24	292.68	113.91

Maximum Rectangular Duct Weight	
Duct Size	Lb/Ft
30 x 30	26
42 x 42	36
54 x 54	47
60 x 60	54
84 x 84	103
96 x 96	129
54 x 28	35
60 x 30	39
84 x 42	74
96 x 48	97
108 x 54	110
120 x 60	121

- Instructions for Use**
- Determine the max restraint spacing, from the geometry of the installation but do not exceed values listed in Table 2.
 - Determine the weight of the pipe or duct component(s) from the tables above (adding trapezoid items together.)
 - Use the tables at right to determine the Horizontal Force, Force Class, Cable & Attachment Kit Or Kit Type Designator based on the Restraint Spacing
 - For other pipe and duct types see appendices A2.0 and A3.0 of Kinetics Pipe & Duct Application Manual.
- (Force Class Units are LRFD [Strength] Based)

Grade	16%	Elevation in Structure (% of Total Building Height)		66%	84%	Roof
		33%	50%			
0.113	0.113	0.113	0.125	0.146	0.166	0.188

Restraints Located 10 ft OC [lbs]

Wt/Ft (Lb)	Grade	Elevation in Structure (% of Total Building Height)					Roof
		16%	33%	50%	66%	84%	
10	I	I	I	I	I	I	I
25	I	I	I	I	I	I	I
50	I	I	I	I	I	I	I
100	I	I	I	I	I	I	I
150	I	I	I	I	I	I	II
200	I	I	I	I	II	II	II
250	II	II	II	II	II	II	II
300	II	II	II	II	II	II	III

Restraints Located 20 ft OC [lbs]

Wt/Ft (Lb)	Grade	Elevation in Structure (% of Total Building Height)					Roof
		16%	33%	50%	66%	84%	
10	I	I	I	I	I	I	I
25	I	I	I	I	I	I	I
50	I	I	I	I	I	I	I
100	I	I	I	I	I	I	I
150	II	II	II	II	II	II	III
200	II	II	II	II	III	III	III
250	III	III	III	III	III	III	III
300	III	III	III	III	III	III	IV

Restraints Located 30 ft OC [lbs]

Wt/Ft (Lb)	Grade	Elevation in Structure (% of Total Building Height)					Roof
		16%	33%	50%	66%	84%	
10	I	I	I	I	I	I	I
25	I	I	I	I	I	I	I
50	I	I	I	I	I	I	I
100	II	II	II	II	II	II	III
150	III	III	III	III	III	III	III
200	III	III	III	III	III	III	IV
250	III	III	III	III	IV	IV	IV
300	IV	IV	IV	IV	IV	IV	IV

Restraints Located 40 ft OC [lbs]

Wt/Ft (Lb)	Grade	Elevation in Structure (% of Total Building Height)					Roof
		16%	33%	50%	66%	84%	
10	I	I	I	I	I	I	I
25	I	I	I	I	I	I	I
50	I	I	I	I	II	II	II
100	II	II	II	II	III	III	III
150	III	III	III	III	III	III	IV
200	III	III	III	III	IV	IV	IV
250	IV	IV	IV	IV	IV	IV	IV
300	IV	IV	IV	IV	IV	IV	V

Restraints Located 60 ft OC [lbs]

Wt/Ft (Lb)	Grade	Elevation in Structure (% of Total Building Height)					Roof
		16%	33%	50%	66%	84%	
10	I	I	I	I	I	I	I
25	I	I	I	I	I	I	II
50	II	II	II	II	II	II	III
100	III	III	III	III	III	III	IV
150	IV	IV	IV	IV	IV	IV	IV
200	IV	IV	IV	IV	IV	IV	V
250	IV	IV	IV	IV	V	V	V
300	V	V	V	V	V	V	V

Restraints Located 80 ft OC [lbs]

Wt/Ft (Lb)	Grade	Elevation in Structure (% of Total Building Height)					Roof
		16%	33%	50%	66%	84%	
10	I	I	I	I	I	I	I
25	I	I	I	I	II	II	II
50	II	II	II	II	III	III	III
100	III	III	III	III	IV	IV	IV
150	IV	IV	IV	IV	IV	IV	V
200	IV	IV	IV	IV	V	V	V
250	V	V	V	V	V	V	V
300	V	V	V	V	V	V	V

SELECTION & LOCATION OF SEISMIC RESTRAINTS FOR PIPE AND DUCT SECTION – S7.0



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Table 10; Site Specific Seismic Pipe & Duct Cable & Attachment Kit Selection



KINETICS NOISE CONTROL
6300 IRELAN PLACE
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Table 1B

Site Specific Cable & Attachment Kit Selection Tables 2006 IBC

Horizontal Force Class	
Max Force (lbs)	Force Class
250	I
500	II
1000	III
2000	IV
5000	V
10000	VI

Pipe Size	Typ. Lb/Ft Includes Insulation	
	Filled Pipe	Steam Pipe
1	2.91	3.24
1.5	4.67	4.61
2	6.35	5.81
2.5	9.3	8.22
3	12.44	10.35
4	18.34	14.12
5	27.2	20.22
6	35.99	25.36
8	55.84	36.42
10	81.43	49.92
12	106.45	60.48
14	122.88	66.42
16	151.4	75.91
18	182.63	85.41
20	216.59	94.91
24	292.68	113.91

Maximum Rectangular Duct Weight	
Duct Size	Lb/Ft
30 x 30	26
42 x 42	36
54 x 54	47
60 x 60	54
84 x 84	103
96 x 96	129
54 x 28	35
60 x 30	39
84 x 42	74
96 x 48	97
108 x 54	110
120 x 60	121

- Instructions for Use
- Determine the max restraint spacing, from the geometry of the installation but do not exceed values listed in Table 2.
 - Determine the weight of the pipe or duct component(s) from the tables above (adding trapezoid items together.)
 - Use the tables at right to determine the Horizontal Force, Force Class, Cable & Attachment Kit Or Kit Type Designator based on the Restraint Spacing
 - For other pipe and duct types see appendices A2.0 and A3.0 of Kinetics Pipe & Duct Application Manual.
- (Force Class Units are LRFD [Strength] Based)

Cracked Concrete Anchor (KCCAB) or Through Bolt

Project: S7.0 Example	KNC#	KN1611
Mapped S _{ps} : 0.25	I _p :	1.5
	R _p :	6
Maximum Installation Angle: 45	Installation Orientation: BOTH	

Grade	16%	G's by Building Elevation listed below		66%	84%	Roof
		33%	50%			
	0.113	0.113	0.113	0.125	0.146	0.166
				0.125	0.146	0.166

Restraints Located 10 ft OC [lbs]

Wt/Ft (Lb)	Elevation in Structure (% of Total Building Height)						
	Grade	16%	33%	50%	66%	84%	Roof
10	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375
25	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375
50	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375
100	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375
150	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-3-375	KSCU-3-375
200	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-3-375	KSCU-3-375	KSCU-3-375	KSCU-3-375
250	KSCU-3-375	KSCU-3-375	KSCU-3-375	KSCU-3-375	KSCU-3-375	KSCU-3-375	KSCU-3-375
300	KSCU-3-375	KSCU-3-375	KSCU-3-375	KSCU-3-375	KSCU-3-375	KSCU-4-500	KSCU-4-500

Restraints Located 20 ft OC [lbs]

Wt/Ft (Lb)	Elevation in Structure (% of Total Building Height)						
	Grade	16%	33%	50%	66%	84%	Roof
10	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375
25	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375
50	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375
100	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-3-375	KSCU-3-375	KSCU-3-375	KSCU-3-375
150	KSCU-3-375	KSCU-3-375	KSCU-3-375	KSCU-3-375	KSCU-3-375	KSCU-4-500	KSCU-4-500
200	KSCU-3-375	KSCU-3-375	KSCU-3-375	KSCU-3-375	KSCU-4-500	KSCU-4-500	KSCU-4-500
250	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500
300	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500

Restraints Located 30 ft OC [lbs]

Wt/Ft (Lb)	Elevation in Structure (% of Total Building Height)						
	Grade	16%	33%	50%	66%	84%	Roof
10	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375
25	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375
50	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375
100	KSCU-2-375	KSCU-3-375	KSCU-3-375	KSCU-3-375	KSCU-3-375	KSCU-3-375	KSCU-3-375
150	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500
200	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500
250	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCC-250-750	KSCC-250-750
300	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCC-250-750	KSCC-375-750	KSCC-375-750

Restraints Located 40 ft OC [lbs]

Wt/Ft (Lb)	Elevation in Structure (% of Total Building Height)						
	Grade	16%	33%	50%	66%	84%	Roof
10	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375
25	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375
50	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375
100	KSCU-3-375	KSCU-3-375	KSCU-3-375	KSCU-3-375	KSCU-3-375	KSCU-3-375	KSCU-3-375
150	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500
200	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCC-250-750	KSCC-250-750	KSCC-375-750
250	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCC-250-750	KSCC-250-750	KSCC-375-750	KSCC-375-750
300	KSCC-250-750	KSCC-250-750	KSCC-250-750	KSCC-375-750	KSCC-375-750	KSCC-375-750	KSCC-375-750

Restraints Located 60 ft OC [lbs]

Wt/Ft (Lb)	Elevation in Structure (% of Total Building Height)						
	Grade	16%	33%	50%	66%	84%	Roof
10	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375
25	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375
50	KSCU-3-375	KSCU-3-375	KSCU-3-375	KSCU-3-375	KSCU-3-375	KSCU-4-500	KSCU-4-500
100	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500
150	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCC-250-750	KSCC-375-750	KSCC-375-750
200	KSCC-250-750	KSCC-250-750	KSCC-250-750	KSCC-375-750	KSCC-375-750	KSCC-375-750	-
250	KSCC-375-750	KSCC-375-750	KSCC-375-750	KSCC-375-750	KSCC-375-750	-	-
300	KSCC-375-750	KSCC-375-750	KSCC-375-750	-	-	-	-

Restraints Located 80 ft OC [lbs]

Wt/Ft (Lb)	Elevation in Structure (% of Total Building Height)						
	Grade	16%	33%	50%	66%	84%	Roof
10	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375
25	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-2-375	KSCU-3-375	KSCU-3-375
50	KSCU-3-375	KSCU-3-375	KSCU-3-375	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500
100	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCU-4-500	KSCC-250-750	KSCC-250-750	KSCC-375-750
150	KSCC-250-750	KSCC-250-750	KSCC-250-750	KSCC-375-750	KSCC-375-750	KSCC-375-750	-
200	KSCC-375-750	KSCC-375-750	KSCC-375-750	KSCC-375-750	-	-	-
250	-	-	-	-	-	-	-
300	-	-	-	-	-	-	-

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KINETICS™ Pipe & Duct Seismic Application Manual

Table S7-11; Site Specific Seismic Pipe & Duct Cable & Attachment Kit Type Designator



KINETICS NOISE CONTROL
6300 IRELAN PLACE
DUBLIN, OHIO 43017
ph 614-889-0480

Table 1C

**Site Specific
Kit Type Designator
Selection Tables
2006 IBC**

Horizontal Force Class	
Max Force (lbs)	Force Class
250	I
500	II
1000	III
2000	IV
5000	V
10000	VI

Pipe Size	Typ. Lb/Ft Includes Insulation	
	Filled Pipe	Steam Pipe
1	2.91	3.24
1.5	4.67	4.61
2	6.35	5.81
2.5	9.3	8.22
3	12.44	10.35
4	18.34	14.12
5	27.2	20.22
6	35.99	25.36
8	55.84	36.42
10	81.43	49.92
12	106.45	60.48
14	122.88	66.42
16	151.4	75.91
18	182.63	85.41
20	216.59	94.91
24	292.68	113.91

Maximum Rectangular Duct Weight	
Duct Size	Lb/Ft
30 x 30	26
42 x 42	36
54 x 54	47
60 x 60	54
84 x 84	103
96 x 96	129
54 x 28	35
60 x 30	39
84 x 42	74
96 x 48	97
108 x 54	110
120 x 60	121

- Instructions for Use
- Determine the max restraint spacing, from the geometry of the installation but do not exceed values listed in Table 2.
 - Determine the weight of the pipe or duct component(s) from the tables above (adding trapezoid items together.)
 - Use the tables at right to determine the Horizontal Force, Force Class, Cable & Attachment Kit Or Kit Type Designator based on the Restraint Spacing
 - For other pipe and duct types see appendices A2.0 and A3.0 of Kinetics Pipe & Duct Application Manual.
- (Force Class Units are LRFD [Strength] Based)

Cracked Concrete Anchor (KCCAB) or Through Bolt

Project: S7.0 Example	KNC# KNI611
Mapped Spgs : 0.25	Ip : 1.5
	Rp : 6
Maximum Installation Angle: 45	Installation Orientation: BOTH

Grade	16%	G's by Building Elevation listed below 33%	50%	66%	84%	Roof
0.113	0.113	0.113	0.125	0.146	0.166	0.188

Restraints Located 10 ft OC [lbs]

Wt/Ft (Lb)	Elevation in Structure (% of Total Building Height)						
	Grade	16%	33%	50%	66%	84%	Roof
10	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2
25	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2
50	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2
100	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2
150	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K3-X2	K3-X2
200	K2-X2	K2-X2	K2-X2	K3-X2	K3-X2	K3-X2	K3-X2
250	K3-X2	K3-X2	K3-X2	K3-X2	K3-X2	K3-X2	K3-X2
300	K3-X2	K3-X2	K3-X2	K3-X2	K3-X2	K4-X3	K4-X3

Restraints Located 20 ft OC [lbs]

Wt/Ft (Lb)	Elevation in Structure (% of Total Building Height)						
	Grade	16%	33%	50%	66%	84%	Roof
10	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2
25	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2
50	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2
100	K2-X2	K2-X2	K2-X2	K3-X2	K3-X2	K3-X2	K3-X2
150	K3-X2	K3-X2	K3-X2	K3-X2	K3-X2	K4-X3	K4-X3
200	K3-X2	K3-X2	K3-X2	K4-X3	K4-X3	K4-X3	K4-X3
250	K4-X3	K4-X3	K4-X3	K4-X3	K4-X3	K4-X3	K4-X3
300	K4-X3	K4-X3	K4-X3	K4-X3	K4-X3	K4-X3	K4-X3

Restraints Located 30 ft OC [lbs]

Wt/Ft (Lb)	Elevation in Structure (% of Total Building Height)						
	Grade	16%	33%	50%	66%	84%	Roof
10	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2
25	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2
50	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K3-X2	K3-X2
100	K3-X2	K3-X2	K3-X2	K3-X2	K3-X2	K3-X2	K4-X3
150	K4-X3	K4-X3	K4-X3	K4-X3	K4-X3	K4-X3	K4-X3
200	K4-X3	K4-X3	K4-X3	K4-X3	K4-X3	K4-X3	K4-X3
250	K4-X3	K4-X3	K4-X3	K4-X3	K4-X3	K4-X3	K4-X3
300	K4-X3	K4-X3	K4-X3	K4-X3	K4-X3	C1-Y2	C2-Y2

Restraints Located 40 ft OC [lbs]

Wt/Ft (Lb)	Elevation in Structure (% of Total Building Height)						
	Grade	16%	33%	50%	66%	84%	Roof
10	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2
25	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2
50	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K3-X2	K3-X2
100	K3-X2	K3-X2	K3-X2	K3-X2	K3-X2	K3-X2	K4-X3
150	K4-X3	K4-X3	K4-X3	K4-X3	K4-X3	K4-X3	K4-X3
200	K4-X3	K4-X3	K4-X3	K4-X3	K4-X3	C1-Y2	C2-Y2
250	K4-X3	K4-X3	K4-X3	C1-Y2	C1-Y2	C2-Y2	C2-Y2
300	C1-Y2	C1-Y2	C2-Y2	C2-Y2	C2-Y2	C2-Y2	-

Restraints Located 60 ft OC [lbs]

Wt/Ft (Lb)	Elevation in Structure (% of Total Building Height)						
	Grade	16%	33%	50%	66%	84%	Roof
10	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2
25	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K3-X2	K3-X2
50	K3-X2	K3-X2	K3-X2	K3-X2	K3-X2	K4-X3	K4-X3
100	K4-X3	K4-X3	K4-X3	K4-X3	K4-X3	K4-X3	K4-X3
150	K4-X3	K4-X3	K4-X3	K4-X3	K4-X3	C1-Y2	C2-Y2
200	C1-Y2	C1-Y2	C1-Y2	C2-Y2	C2-Y2	C2-Y2	-
250	C2-Y2	C2-Y2	C2-Y2	C2-Y2	-	-	-
300	C2-Y2	C2-Y2	C2-Y2	-	-	-	-

Restraints Located 80 ft OC [lbs]

Wt/Ft (Lb)	Elevation in Structure (% of Total Building Height)						
	Grade	16%	33%	50%	66%	84%	Roof
10	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2
25	K2-X2	K2-X2	K2-X2	K2-X2	K2-X2	K3-X2	K3-X2
50	K3-X2	K3-X2	K3-X2	K3-X2	K4-X3	K4-X3	K4-X3
100	K4-X3	K4-X3	K4-X3	K4-X3	C1-Y2	C1-Y2	C2-Y2
150	C1-Y2	C1-Y2	C1-Y2	C2-Y2	C2-Y2	C2-Y2	-
200	C2-Y2	C2-Y2	C2-Y2	C2-Y2	-	-	-
250	-	-	-	-	-	-	-
300	-	-	-	-	-	-	-

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There are several areas of all of Tables S7-8 through S7-11 which are identical.

1. At the top of each table is a header that specifies the type of attachment hardware that has been requested.
2. Directly below this header is an area where the project and site specific information is listed.
3. Immediately below the project and site specific information is a table that lists the code based horizontal seismic acceleration that is to be applied to the pipe or duct in G's as it varies from grade line to roof line of the building. This is the elevation of the attachment point for the pipe or duct in the building. Keep in mind that it is the attachment point for the pipe or duct to which the earthquake displacement or acceleration is applied.
4. Below the acceleration by building elevation table are six tables that are segregated according to the seismic restraint spacing. The listed seismic restraint spacings are 10 ft, 20 ft, 30 ft, 40 ft, 60 ft, and 80 ft. The left hand column is the insulated weight per foot of the pipe, and non-insulated and non-lagged weight per foot of the duct that is being restrained. The column headings across the top of each table are the elevation of the attachment point for the pipe or duct in the building from grade line to roof line as a per cent of the roof line elevation. The contents of these six tables will vary as follows.
 - a. Table S7-8: These values are the horizontal seismic force expressed as Horizontal Force Class for each weight per foot and each attachment point elevation within the building. This information may be used to make a conservative selection of seismic restraints and attachment hardware by matching the Horizontal Force Class value from Table S7-8 with the Horizontal Force Class Rating of the seismic restraints listed in Appendix A1.0.
 - b. Table S7-9: The values listed in these six tables are the actual horizontal force values computed for each weight per foot and each attachment point elevation within the building. These values are used when trying to optimize the selection of seismic restraints and attachment hardware.
 - c. Table S7-10: The information contained in these six tables is the Kinetics Noise Control cable restraint kit and the attachment hardware size, of the type specified in

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the table header, for each weight per foot and each attachment point elevation within the building. These selections are based on the actual horizontal seismic force values from Table S7-9 and the seismic restraint capacity data in Appendix A1.1.

- d. Table S7-11: These six tables specify the KNC Restraint Kit Code and the KNC Attachment Kit Code in the order. These are the codes that are used to indicate the capacity of the restraints and attachments to the building structure on the pipe and duct drawings that are reviewed and marked by Kinetics Noise Control.

S7.6 – Maximum Allowable Seismic Restraint Spacing:

Typically, the maximum seismic restraint spacing will be for the longitudinal restraints. The seismic restraint spacing values that have been recommended by SMACNA for both transverse and longitudinal restraints are discussed in Section S11.0 of this manual. The SMACNA Seismic Restraint Manual does not make clear the basis for their recommendations. However, it would appear to be based on a combination of the capacity of the hardware components specified, the stiffness of the system being restrained, and the type of system being restrained. The tables developed by Kinetics Noise Control extract the hardware size from consideration at this point leaving the gross buckling of the pipe or duct along with system data to control the length of pipe that may be restrained. Appendices A6.1 through A6.7 were created to investigate the buckling potential of pipe and duct versus the restrained length of the pipe and duct and the design level seismic acceleration.

A brief review of Appendices A6.1 through A6.5 confirms that the restraint spacing recommendation in the SMACNA Seismic Restraint Manual were, in deed, based on the maximum capacity of the restraints specified, and not on the buckling resistance of the pipe itself. Since system performance is factored independently by Kinetics Noise Control, the maximum un-factored seismic restraint spacing for pipe can be selected based on the tables in Appendices A6.1 through A6.5 for the Maximum Allowable Seismic Restraint Spacing. This is based purely on

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the buckling resistance of the pipe, and includes a Factor of Safety of 2:1 with respect to the applied load.

Special Note: For trapeze supported piping, the maximum allowable seismic restraint spacing is to be based on the maximum permitted spacing for the most critical or most sensitive pipe being supported by the trapeze bar. This is based on keeping the unbraced length of the smallest pipe short enough to prevent buckling. This is a particular problem with copper, PVC, and CPVC pipe since their Modulus of Elasticity is much lower than that for steel pipe. See Sections S11.4 and S11.5 and Appendix 6.0.

For duct, the seismic restraint spacing recommended by SMACNA for transverse and longitudinal seismic restraints appears to be conservative when compared to the values in Appendices A6.6 and A6.7. Because sheet metal ductwork and connections can vary widely in performance and are less predictable than piping systems, it is prudent to use the SMACNA recommended values listed in Section 11.0 of this manual based on their greater experience with design, construction, and field performance of HVAC duct.

S7.7 – Kinetics Noise Control Pipe & Duct Seismic Restraint Drawing Symbols:

Kinetics Noise Control will accept pipe and duct drawings from their customers to produce drawings showing the proper seismic restraint selections and their locations per project site specific information. These drawings are reviewed by highly trained engineers at Kinetics Noise Control who will then mark the locations for the restraints and indicate the proper restraint to use for each location. These seismic restraint specification and location drawings are then reviewed and signed and sealed by one of Kinetics Noise Control licensed professional engineers. Along with the drawings a signed and seal letter certifying the suitability of the restraints and attachments for the application is also issued by the Kinetics Noise Control licensed professional engineer.

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The symbol shown in Figure S7-1 indicates the type of restraint and the capacity of the restraint and the anchorage.

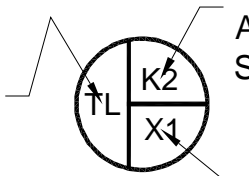
Restraint Type Designation:

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
S7-2.

KNC Anchorage Kit Code:

Anchorage Capacity Required
At This Location, See Tables
S7-3 & S7-4.

Figure S7-1; Kinetics Noise Control Restraint Type and Capacity Symbol

The KNC Restraint Kit Codes and the KNC Anchorage Kit Codes are defined in Tables S7-2 and S7-3 respectively. In general, Kinetics Noise Control will attempt to select seismic restraint kits and anchorage kits so that a limited number kits are used for as many locations and restraint types, transverse and longitudinal as possible. There will be cases where it becomes impractical to use the same restraints in all locations on a pipe or duct drawing. In these cases, Kinetics Noise Control will attempt to limit the use of the larger and more expensive components as much as possible. This practice is intended to assist the contractor during installation and may result in a less than optimum restraint selection if cost control is the primary factor. The contractor will make far fewer mistakes during installation if they have a few types restraint and anchorage kits to worry about.

Each transverse restraint (**T**) and longitudinal (**L**) restraint callout represent one pair of restraint cables. For some special cases, an extra pair of restraint cables may be required for a longitudinal restraint location for a duct or trapeze supported pipe run.

The symbols used to indicate the actual locations of the seismic restraints on a run of pipe or duct are shown in Figure S7-2.

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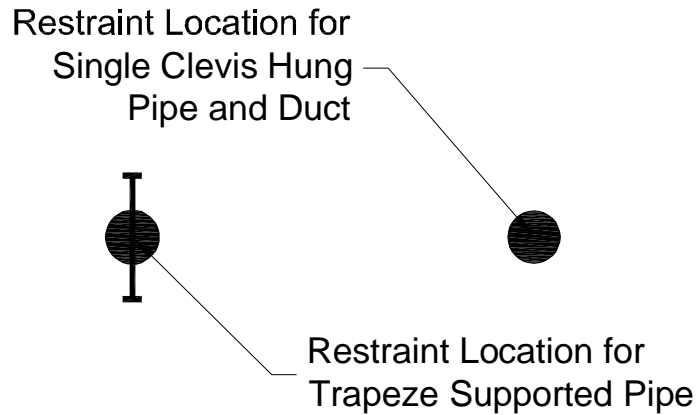


Figure S7-2; Kinetics Noise Control Restraint Location Symbols

For duct or single clevis hung pipe the seismic restraint location is indicated with a single large dot. For trapeze supported pipe, the symbol is an “I” shaped bar with a large central dot. The “I” shaped bar will extend on either side of the central dot to encompass all of the pipes that are assumed to be supported on the same set of trapeze bars. When two or more pipes run parallel and relatively close together, it is the standard practice of Kinetics Noise Control to assume that all of these pipes are to be supported on the same trapeze bars. This practice allows us to minimize the number of seismic restraint kits and anchorage kits that will be required.

For single clevis hung pipe a typical run of pipe will be marked for seismic restraint and anchorage kits as shown in Figure S7-3. Typically, half of the time, a longitudinal seismic restraint will fall at the same location as a transverse seismic restraint. This is because the spacing for the longitudinal seismic restraints ($S_L \leq 2S_T$) may be up to twice that of the transverse seismic restraints (S_T), which will help reduce the total number of restraints required for a run of pipe or duct. For HVAC piping, the transverse seismic restraints may be attached directly to the pipe. They may also be attached to the pipe clevis hanger, or the pipe hanger rod directly above the clevis hanger. For HVAC applications the longitudinal restraints may be attached directly to the pipe. It is also possible for longitudinal restraints to be attached to the clevis hanger or the pipe hanger rod directly above the clevis hanger only if the clevis hanger has been rigidly attached to

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the pipe in such a fashion so as to prevent axial motion. For Fire Protection piping, all seismic restraints must always be attached directly to the pipe.

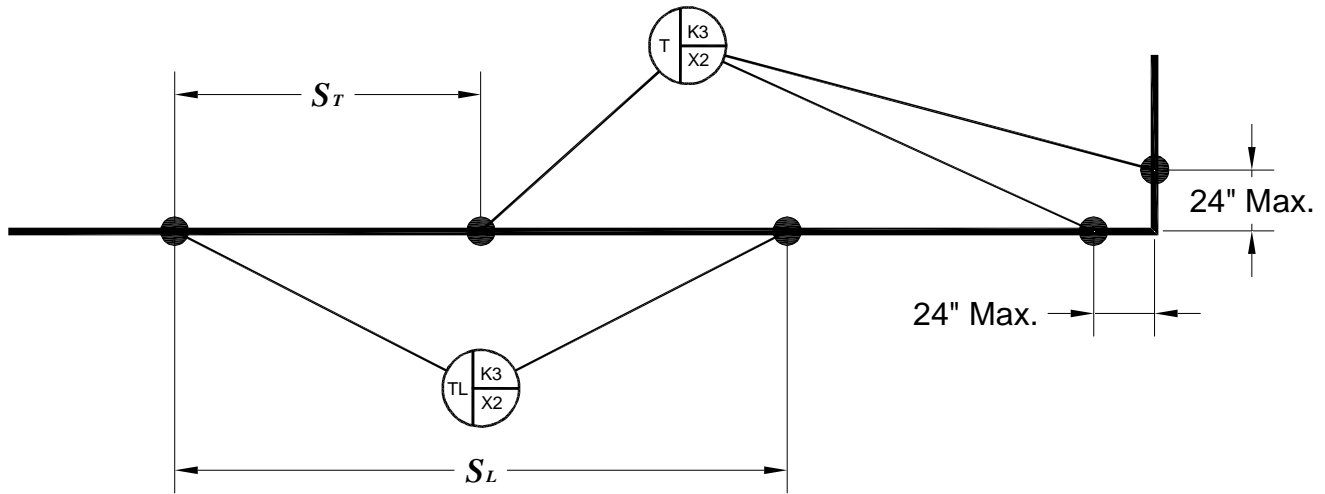


Figure S7-3; Typical KNC Seismic Restraint and Location Callouts for Single Clevis Hung Pipe

Figure S7-4 shows the seismic restraints and locations for a typical run of duct. The locations of the restraints are shown along the centerline of the duct. Rectangular duct is normally supported on trapeze bars which may require special consideration for the actual placement of the restraints. This will be discussed further in a later portion of this section of the manual. The duct must be strong enough to be able to transfer seismic forces along its length between seismic restraint locations. The design of the duct is the responsibility of the HVAC engineer of record. In particular the longitudinal seismic forces which may tend to buckle the sheet metal ducts unless they are rigid enough to resist the buckling loads. If the ducts are supported on trapeze bars, they must be rigidly attached to those trapeze bars to properly transfer the seismic loads to the restraints.

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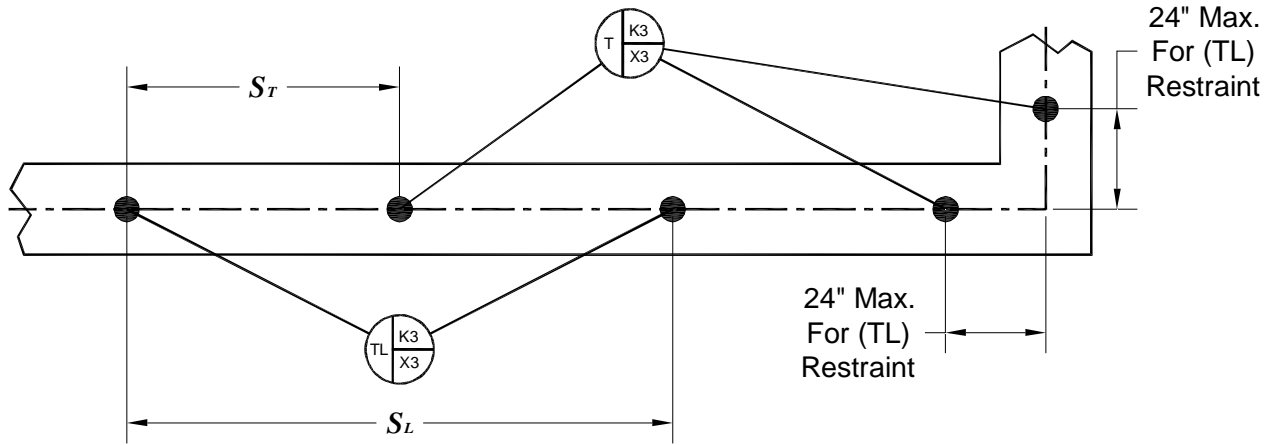


Figure S7-4; Typical KNC Seismic Restraint and Location Callouts for Duct

Typical callouts for seismic restraints and location for trapeze supported pipe are shown in Figure S7-5. Note that the “I” shaped bars indicate that the three pipe shown are assumed to be supported on the same set of trapeze bars. The pipes must be rigidly clamped to the trapeze bars to prevent any relative motion between them and the trapeze bar. The dot indicating the location of the seismic restraints is placed on the centerline of the trapeze supported run of pipes. In some cases, special arrangements may be necessary to create a proper longitudinal restraint arrangement. Some of these will be discussed in a later portion of this document.

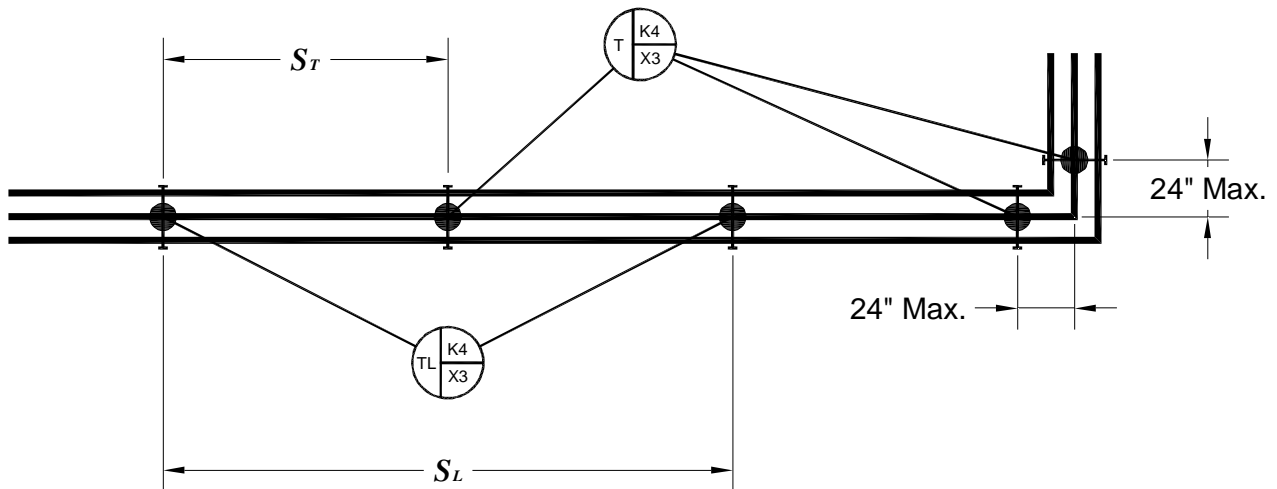


Figure S7-5; Typical KNC Seismic Restraint and Location Callouts for Trapeze Supported Pipe

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In all of the previous examples, the longitudinal seismic restraint spacing has been shown to be twice the transverse seismic restraints spacing. There are often times where it is not possible, or desirable, to have the longitudinal restraint spacing twice that of the transverse restraints for the following reasons.

1. The site and project specific seismic requirements are high enough that restraints of the proper capacity do not exist.
2. The weight of the components being restrained is high enough that restraints of the proper capacity do not exist.
3. There is a desire, or need, to standardize on a particular size or type of restraint device.
4. Connections between pipe segments are not robust enough to transfer longitudinal seismic loads.

A situation of this type is demonstrated in Figure S7-6.

S7.8 – Seismic Restraint and Hanger Locations:

When using cable restraints and rigid strut restraints, the seismic restraint locations must coincide with the hanger locations in order to ensure that there is a clear load path to the structure for any upward reaction loads generated by the horizontal seismic loads. The current standard industry practice is that the seismic restraints for pipe and duct must be located within ± 4 inches of the hanger location. Also, the hangers must be rigid members capable of carrying compressive loads.

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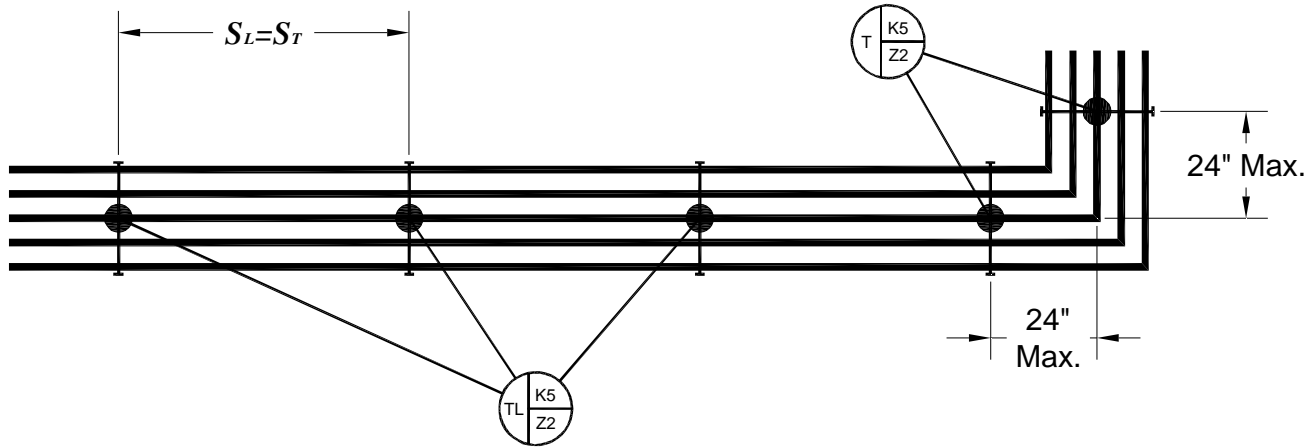


Figure S7-6; Equal Longitudinal and Transverse Seismic Restraint Spacing

Generally speaking, the drawings given to Kinetics Noise Control for marking seismic restraints and locations do not have the hanger locations specified on them. As a result, the locations for seismic restraints indicated on the drawings by Kinetics Noise Control are approximate, and the entire pattern of restraints for a run of pipe or duct must be shifted one way or the other to match the actual hanger spacing. Also, Kinetics Noise Control is rarely provided with the actual hanger spacing that will be used for the runs of pipe or duct for which restraints are to be specified. Actual hanger spacings of 5 ft. or 10 ft. are compatible with the restraint spacings normally used by Kinetics Noise Control. If the actual hanger spacings are not 5 ft. or 10 ft. then the restraint spacing, as installed, must be reduced below the restraint spacing as indicated by Kinetics Noise Control to ensure a acceptable installation. For example, if the actual hanger spacing is 15 ft. and the recommended transverse seismic restraint spacing by Kinetics Noise Control is 20 ft with a recommended longitudinal seismic restraint spacing of 40 ft. The actual transverse restraint spacing must be reduced to 15 ft. and the actual longitudinal restraint spacing must be reduced to 30 ft.

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S7.9 – Longitudinal Seismic Restraints for Trapeze Supported Pipe and Duct:

Trapeze supported pipe and duct require that the longitudinal seismic restraint forces be balanced across the trapeze bar to prevent twisting of the support and bending in the pipe and duct. Figure S7-8 shows three plan views of trapeze supported pipe where the longitudinal seismic restraints are balanced side-to-side. Figure S7-8 shows three plan views of trapeze supported duct with balanced longitudinal restraints.

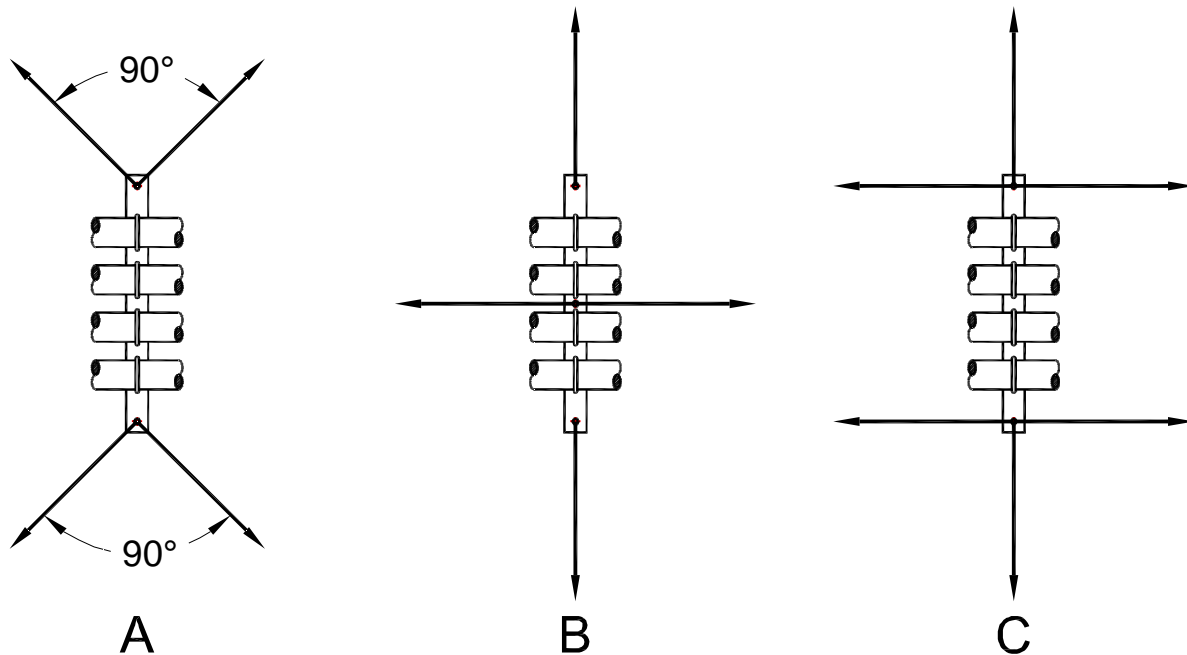


Figure S7-7; Balanced Longitudinal Restraints for Trapeze Supported Pipe

In both Figures S7-7 and S7-8, examples A and B may be achieved with the number of restraint kits, or pairs of restraint cables, which are normally specified by Kinetics Noise Control where transverse and longitudinal restraints are indicated at the same location on the drawing. In order to utilize the fewest possible restraint kits, Kinetics Noise Control assumes that either example A or example B will be followed for trapeze supported pipe and duct where ever transverse and longitudinal seismic restraints are indicated at the same location on the drawings. For example C

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in both Figure S7-7 and S7-8 and extra restraint cable kit will be required for the location indicated on the drawing.

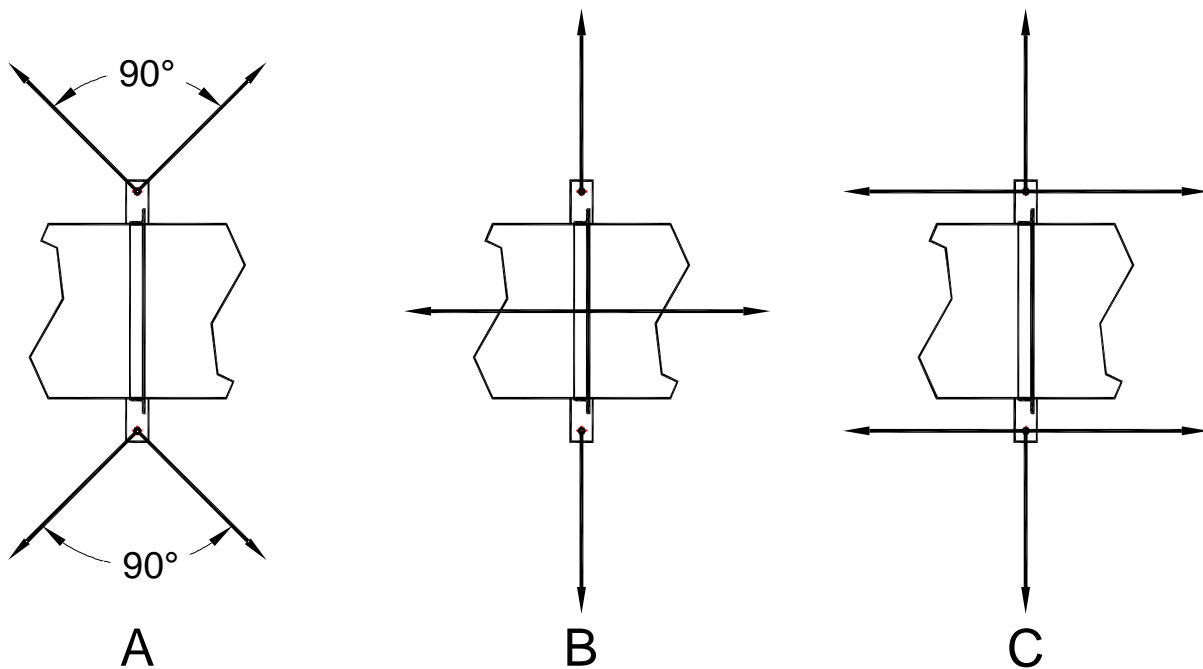


Figure S7-8; Balanced Longitudinal Restraints for Trapeze Supported Duct

S7.10 – Summary:

1. Typical seismic restraint spacings specified by Kinetics Noise Control are 10 ft, 20 ft, 30 ft, 40 ft, 60 ft, or 80 ft. The maximum allowable seismic restraint spacing for piping is specified in Appendices A6.1 through A6.5. The maximum allowable seismic restraint spacing for ductwork is specified the SMACNA Seismic Restraint Manual, and repeated for convenience in Section 11.0 of this manual.
2. For trapeze supported pipe, the maximum allowable seismic restraint spacing is selected based on the smallest pipe size supported by the trapeze bar.
3. Seismic restraint locations are approximate and must coincide with hanger locations ± 4 inches.
4. Hangers at seismic restraint locations must be stiff and capable of carrying compressive loads.

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5. If hanger locations do not match the recommended restraint locations and spacings, then the actual installed restraint spacings must be reduced to a value that is a multiple of the hanger spacing, but that is less than the maximum spacing specified by Kinetics Noise Control.
6. For trapeze supported pipe and duct, the longitudinal restraints must be balanced across the trapeze bar.

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