CHAPTER D12

RECOMMENDED SEISMIC SPECIFICATIONS

TABLE OF CONTENTS

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

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

KINETICS LONG FORM SEISMIC SPECIFICATION

1.0 General

1.01 Related Work Specified Elsewhere

(Vibration Isolation portion of specs, fill in as required)

1.02 Definitions

1) A_v: Effective peak velocity related acceleration coefficient BOCA, SBC Code.
2) S_1: Mapped Long Period Seismic acceleration coefficient IBC, TI-809-04 Code.
3) S_s: Mapped Short Period Seismic acceleration coefficient IBC, TI-809-04 Code.
4) v: Zonal Velocity coefficient NBC-Canada
5) SMACNA: (Sheet Metal and Air Conditioning Contractors National Association) has developed Guidelines for the installation of restraints for piping and duct systems.
6) VISCMA: (Vibration Isolation and Seismic Control Manufactures Association) has developed Testing and Rating Standards for Seismic Restraint Components that comply with Code and ASHRAE based requirements.
7) Z: Seismic Zone defines Seismic Coefficient C_a used by UBC Code.

1.03 Performance Requirements

1) Design Ground Acceleration Coefficient (A_v, S_s, v or Z depending on Code =X.XX)
2) *(If IBC or TI-809-04)* Design Long Period Ground Acceleration Coefficient (S_1 =X.XX)
3) Design Soil Type = (S_a, S_b, S_c, S_d) as appropriate. (If NBC Canada, the Foundation Factor)
4) Importance or Performance Factor appropriate to structure = X.XX
5) If UBC Zone 4, Proximity to Fault and, if less than 10km, Fault Type
6) Equipment Schedule (IBC, TI-808-04, 97UBC) The Mechanical Engineer of record will provide a comprehensive Equipment Schedule indication individual equipment importance factors, Ip, (including equipment whose importance factor, Ip, may be increased by proximity to essential life safety or hazardous components), equipment elevation both in the structure and(if floor mounted, relative to the floor), roof elevation and structural interface material, i.e., anchored to concrete, bolted or welded to steel.
7) Schedule or drawings indicating critical (Ip=1.5) Duct/Piping systems, including systems whose importance factor may be increased by proximity to critical components.

1.04 Submittals

1) Product Data: Include Seismic Rating Curve for each seismically rated isolator or

KINETICS Noise Control
DUBLIN, OHIO, USA • MISSISSAUGA, ONTARIO, CANADA
Toll Free (USA only): 800-959-1229
International: 614-889-0480
Fax: 614-889-0540
World Wide Web: www.kineticsnoise.com
Email: sales@kineticsnoise.com

restraint component

2) Samples: The contractor shall submit samples of specified seismic snubber devices upon request of the engineer for approval

3) Shop Drawings: Include the following:

A) Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases. Certification documents to be signed and sealed by a qualified Professional Engineer with at least 5 years experience in the design of seismic restraints.

B) Vibration Isolation Bases: Dimensional drawings including anchorage and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads.

C) Seismic-Restraint Details: Detail submittal drawings of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

D) Submittals for Interlocking Snubbers: Include ratings for horizontal, vertical and combined loads.

E) Equipment Manufacturer Seismic Qualification Certification: The Equipment Manufacturer must submit certification that each piece of provided equipment will withstand seismic forces identified in "Performance Requirements" Article above. Include the following:

1) Basis for Certification: Indicate whether the “withstand” certification is based on actual test of assembled components or on calculations.

2) Indicate the equipment is certified to be durable enough to:

A) structurally resist the design forces and/or

B) will also remain functional after the seismic event.

F) Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

G) Detailed description of the assumed equipment anchorage devices on which the certification is based.

1.05 Work Furnished But Not Installed

1) The materials and systems specified in this section shall be purchased by the mechanical contractor from a single seismic snubber restraint materials manufacturer to assure sole source responsibility for the performance of the seismic restraints used.

KINETICS Noise Control
DUBLIN, OHIO, USA • MISSISSAUGA, ONTARIO, CANADA
Toll Free (USA only): 800-959-1229
International: 614-889-0480
Fax: 614-889-0540
World Wide Web: www.kineticsnoise.com
Email: sales@kineticsnoise.com

2) The materials and systems specified in this section can, at the contractor's option, be installed by the subcontractor who installs the mechanical equipment, piping, or ductwork.

1.06 Coordination

1) Coordinate size, shape, reinforcement and locate cast in place anchor-bolt inserts for concrete Inertia bases. 3000 psi min Concrete and/or formwork as needed is provided by others.

2) Coordinate design of roof curbs and equipment supports to be compatible with equipment parameters.

1.07 Description of System

1) It shall be understood that the requirements of this seismic restraint section are in addition to other requirements as specified elsewhere for the support and attachment of equipment and mechanical services, and for the vibration isolation of same equipment. Nothing on the project drawings or specifications shall be interpreted as justification to waive the requirements of this seismic restraint section.

2) The work under this section shall include furnishing all labor, materials, tools, appliances, and equipment, and performing all operations necessary for the complete execution of the installation of seismic snubber restraint assemblies as shown, detailed, and/or scheduled on the drawing and/or specified in this section of the specifications

3) All seismic snubber restraint assemblies shall meet the following minimum requirements:

   A) The snubber shall include a high quality elastomeric element that will ensure that no un-cushioned shock can occur.

   B) It shall be possible to visually inspect the resilient material for damage and replace it if necessary.

   C) Resilient material used in snubber assemblies to be a minimum of 0.25" (6 mm) thick.

   D) Resilient material used in snubber grommets to be a minimum of 0.12" (3 mm) thick.

   E) All Interlocking Snubbers to include a maximum air gap of .25 in (6mm).

   F) Assembly must be designed to offer seismic restraint in all directions, unless otherwise noted below.

   G) Seismic restraint capacities to be verified by an independent test laboratory or certified by an experienced registered Professional Engineer to ensure that the design intent of this specification is realized.

4) Vibration Isolation Bases: Dimensional drawings including anchorage and attachments to structure and to supported equipment. Include auxiliary motor slides

1.08 System Design

KINETICS Noise Control
DUBLIN, OHIO, USA • MISSISSAUGA, ONTARIO, CANADA
Toll Free (USA only): 800-959-1229
International: 614-889-0480
Fax: 614-889-0540
World Wide Web: www.kineticsnoise.com
Email: sales@kineticsnoise.com

1) Seismic snubber manufacturer shall be responsible for the structural design of attachment hardware as required to attach snubbers to both the equipment and supporting structure on vibration isolated equipment, or to directly attach equipment to the building structure for non-isolated equipment.

2) The contractor shall furnish a complete set of approved shop drawings of all mechanical and electrical equipment which is to be restrained to the seismic restraint manufacturer, from which the selection and design of seismic restraint devices and/or attachment hardware will be completed. The shop drawings furnished shall include, at a minimum, basic equipment layout, length and width dimensions, installed operating weights of the equipment to be restrained and the distribution of weight at the restraint points.

3) All piping and ductwork is to be restrained to meet code requirements. Spacing between restraints is not to exceed the allowable spacing listed in the latest revision of the SMACNA manual (Sheet Metal and Air Conditioning Contractors National Association, Inc.) "Seismic Restraint Manual Guidelines for Mechanical Systems", Second Edition, 1998. At a minimum, the seismic restraint manufacturer will provide documentation on maximum restraint spacing for various cable sizes and anchors, as well as 'worst case' reaction loads at restraint locations. In addition, seismic restraint manufacturer will provide support documentation containing adequate information to allow the installation contractor to make reasonable field modifications to suit special case conditions.

4) The contractor shall ensure that all housekeeping pads used are adequately reinforced and are properly attached to the building structural flooring, so to withstand anticipated seismic forces. In addition, the size of the housekeeping pad is to be coordinated with the seismic restraint manufacturer so to ensure that adequate edge distances exist in order to obtain desired design anchor capabilities.

1.09 Alternate Systems

1) Provisions of the General Conditions and Supplemental Conditions of the specifications shall govern the use of alternate systems to those specified.

2) Manufacturers not listed as approved in "Part 2 Materials" of this section must secure approval to bid a minimum of ten (10) days prior to the project bid date.

3) Uncertified internal equipment seismic restraint systems are disallowed for use on this project.

1.10 Installation

1) Installation of all seismic restraint materials specified herein shall be accomplished following the manufacturer's written instructions. Installation instructions shall be submitted to the engineer for approval prior to the beginning of the work.

2.0 Materials

2.01 Source of Materials

KINETICS Noise Control
DUBLIN, OHIO, USA • MISSISSAUGA, ONTARIO, CANADA
Toll Free (USA only): 800-959-1229
International: 614-889-0480
Fax: 614-889-0540
World Wide Web: www.kineticsnoise.com
Email: sales@kineticsnoise.com

1) All seismic snubbers and combination snubber / vibration isolation materials specified herein shall be provided by a single manufacturer to assure sole source responsibility for the proper performance of the materials used. Manufacturer is to be a member of VISCMA (Vibration Isolation and Seismic Control Manufacturers Association).

2) Mechanical anchor types and sizes are to be per the design data as provided by the seismic restraint manufacturer.

3) Materials and systems specified herein and detailed or scheduled on the drawings are based upon materials manufactured by Kinetics Noise Control, Inc. Materials and systems provided by other manufacturers are acceptable, provided that they meet all requirements as listed in this specification.

4) Where not protected by a shield, resilient materials shall be easy to visually inspect for damage.

2.02 Factory Finishes

1) Manufacturer's standard prime-coat finish ready for field painting.

2) Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

A) Powder coating on springs and housings.

B) All hardware shall be electrogalvanized. Hot-dip galvanize or powder coat metal housings for exterior use.

C) Enamel or powder coat metal components on isolators for interior use.

D) Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

2.03 Seismic Snubber Types

Isolator / Snubber Types contained herein are per ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.) Handbook, 2003 HVAC Applications, Chapter 54 "Seismic and Wind Restraint Design", Pages 12 and 13.

1) Type A): Coil Spring Isolator Incorporated Within A Ductile Iron Or Cast Aluminum Housing

A) Cast iron or aluminum housings are brittle when subjected to shock loading and are therefore not approved for seismic restraint applications.

2) Type B): Coil Spring Isolator Incorporated Within A Steel Housing

A) Spring isolators shall be seismic control restrained spring isolators, incorporating a single or multiple coil spring element, having all of the characteristics of free standing coil spring isolators as specified in the vibration isolation portion of this specification. Springs shall be restrained using a housing engineered to limit both lateral and vertical

KINETICS Noise Control
DUBLIN, OHIO, USA • MISSISSAUGA, ONTARIO, CANADA
Toll Free (USA only): 800-959-1229
International: 614-889-0480
Fax: 614-889-0540
World Wide Web: www.kineticsnoise.com
Email: sales@kineticsnoise.com

movement of the supported equipment during an earthquake without degrading the vibration isolation capabilities of the spring during normal equipment operating conditions.

B) Vibration isolators shall incorporate a steel housing and neoprene snubbing grommet system designed to limit motion to no more than ¼" (6 mm) in any direction and to prevent any direct metal-to-metal contact between the supported member and the fixed restraint housing. The restraining system shall be designed to withstand the seismic design forces in any lateral or vertical direction without yield or failure. Where the capacity of the anchorage hardware in concrete is inadequate for the required seismic loadings, a steel adapter base plate to allow the addition of more or larger anchors will be fitted to fulfill these requirements. In addition to the primary isolation coil spring, the load path will include a minimum ¼" (6 mm) thick neoprene pad.

C) Spring elements shall be color coded or otherwise easily identified. Springs shall have a lateral stiffness greater than 1.2 times the rated vertical stiffness and shall be designed to provide a minimum of 50% overload capacity. Non-welded spring elements shall be epoxy powder coated and shall have a minimum of a 1000 hour rating when tested in accordance with ASTM B-117.

D) To facilitate servicing, the isolator will be designed in such a way that the coil spring element can be removed without the requirement to lift or otherwise disturb the supported equipment.

E) Spring isolators shall be Model FHS as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02 and 2.03 (2).

3) Type C): Coil Spring Isolator Incorporated Within A Steel Housing

A) Spring isolators shall be seismic control restrained spring isolators, incorporating one or more coil spring elements, having all of the characteristics of free standing coil spring isolators per the vibration isolation section of this specification, for equipment which is subject to load variations and/or large external forces. Isolators shall consist of one or more laterally stable steel coil springs assembled into fabricated welded steel housings designed to limit movement of the supported equipment in all directions.

B) Housing assembly shall be made of fabricated steel members and shall consist of a top load plate complete with adjusting and leveling bolts, adjustable vertical restraints, isolation washers, and a bottom load plate with internal non-skid isolation pads and holes for anchoring the housing to the supporting structure. Housing shall be hot dipped galvanized for outdoor corrosion resistance. Housing shall be designed to provide a constant free and operating height within 1/8" (3 mm).

C) The isolator housing shall be designed to withstand the project design

KINETICS Noise Control
DUBLIN, OHIO, USA • MISSISSAUGA, ONTARIO, CANADA
Toll Free (USA only): 800-959-1229
International: 614-889-0480
Fax: 614-889-0540
World Wide Web: www.kineticsnoise.com
Email: sales@kineticsnoise.com

seismic forces in all directions.

D) Coil spring elements shall be selected to provide static deflections as shown on the vibration isolation schedule or as indicated or required in the project documents. Spring elements shall be color coded or otherwise easily identified. Springs shall have a lateral stiffness greater than 1.2 times the rated vertical stiffness and shall be designed to provide a minimum of 50% overload capacity. Non-welded spring elements shall be epoxy powder coated and shall have a minimum of a 1000 hour rating when tested in accordance with ASTM B-117.

E) Spring isolators shall be Model FLSS as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02 and 2.03 (3)

4) Type D): Coil Spring Isolator Incorporated With Integral Seismic Restraint

A) Spring isolators shall be single or multiple coil spring elements which have all of the characteristics of free standing coil spring isolators as specified in the vibration isolation portion of this specification, incorporating lateral and vertically restrained seismic housing assemblies. Spring elements shall be readily replaceable without the need to lift or remove the supported equipment.

B) Restraint housing shall be sized to meet or exceed the force requirements of the application and shall have the capability of accepting coil springs of various sizes, capacities, and deflections as required to meet the required isolation criteria. All spring forces shall be contained within the coil / housing assembly, and the restraint anchoring hardware shall not be exposed to spring generated forces under conditions of no seismic force. Spring element leveling adjustment shall be accessible from above and suitable for use with a conventional pneumatic or electric impact wrench.

C) Restraint element shall incorporate a steel housing with elastomeric elements at all dynamic contact points. Elastomeric elements shall be replaceable. Restraint shall allow ¼" (6 mm) free motion in any direction from the neutral position. Restraint shall have an overturning factor (ratio of effective lateral snubber height to short axis anchor spacing) of 0.33 or less to ensure optimum anchorage capacity.

D) Spring isolators shall be Model FMS as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02 and 2.03 (4).

5) Type E): All Direction Neoprene Isolator

A) Vibration Isolators shall be neoprene, molded from oil resistant compounds, designed to operate within the strain limits of the isolator so to provide the maximum isolation and longest life expectancy possible

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

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

using neoprene compounds. Isolators shall include encapsulated cast-in-place top steel load transfer plate for bolting to equipment and a steel base plate with anchor holes for bolting to the supporting structure. Ductile iron or cast aluminum components are not acceptable alternatives and shall not be used due to brittleness when subjected to shock loading.

B) Isolator shall be capable of withstanding the design seismic loads in all directions with no metal-to-metal contact.

C) Isolator shall have minimum operating static deflections as shown on the project Vibration Isolation Schedule or as otherwise indicated in the project documents and shall not exceed published load capacities.

D) Neoprene isolators shall be Model RQ as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02 and 2.03 (5)

6) Type F): Light Capacity All Direction 3-Axis External Seismic Snubber Assembly

A) Equipment shall be restrained against excessive movement during a seismic event by the use of 3-axis resilient snubbers, designed to withstand the project required seismic forces. A minimum of two (2) snubbers are to be used at each equipment installation, oriented to effectively restrain the isolated equipment in all three directions, and additional snubbers shall be used as required by seismic design conditions.

B) Snubbers shall be of interlocking steel construction and shall be attached to the equipment structure and equipment in a manner consistent with anticipated design loads. Snubbers shall limit lateral and vertical equipment movement at each snubber location to a maximum of ¼" (6 mm) in any direction.

C) Snubbers shall include a minimum ¼" (6 mm) thick resilient neoprene pads to cushion any impact and to avoid any potential for metal-to-metal contact. Maximum neoprene bearing pressure shall not exceed 1500 pounds / sq. inch (10.4 N / sq. mm). Snubber shall be capable of withstanding an externally applied seismic force of up to 3,000 pounds (1360 kg.) in any direction. Snubber shall be installed only after the isolated equipment is mounted, piped, and operating so as to ensure that no contact occurs during normal equipment operation.

D) Three-axis seismic snubbers shall be Model HS-5 as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and 2.01, 2.02 and 2.03 (6)

7) Type G): Lateral 2-Axis External Seismic Snubber Assembly

A) Equipment shall be restrained against excessive lateral movement

KINETICS Noise Control
DUBLIN, OHIO, USA • MISSISSAUGA, ONTARIO, CANADA
Toll Free (USA only): 800-959-1229
International: 614-889-0480
Fax: 614-889-0540
World Wide Web: www.kineticsnoise.com
Email: sales@kineticsnoise.com

during a seismic event by the use of 2-axis horizontal resilient snubbers, designed to withstand the project required seismic forces. A minimum of two (2) snubbers are to be used at each equipment installation, oriented to effectively restrain the isolated equipment in all horizontal directions, and additional snubbers shall be used as required by seismic design conditions.

B) Snubbers shall be of interlocking steel construction and shall be attached to the equipment structure and equipment in a manner consistent with anticipated design loads. Snubbers shall limit lateral equipment movement at each snubber location to a maximum of ¼" (6 mm).

C) Snubbers shall include a minimum of ¼" (6 mm) thick resilient neoprene pads to cushion any impact and to avoid any potential for metal-to-metal contact. Snubber shall be installed only after the isolated equipment is mounted, piped, and operating so as to ensure that no contact occurs during normal equipment operation.

D) Two-axis lateral seismic snubbers shall be Model HS-2 as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02 and 2.03 (7)

8) Type H): Heavy Capacity All Direction 3-Axis External Seismic Snubber Assembly

A) Equipment shall be restrained against excessive vertical and horizontal movement during a seismic event by the use of 3-axis resilient snubbers, designed to withstand the project required seismic forces. A minimum of two (2) snubbers are to be used at each equipment installation, oriented to effectively restrain the isolated equipment in all three directions, and additional snubbers shall be used as required by seismic design conditions.

B) Snubbers shall be of welded interlocking steel construction and shall be attached to the equipment structure and equipment in a manner consistent with anticipated design loads. Snubbers shall limit lateral and vertical equipment movement at each snubber location to a maximum of ¼" (6 mm) in any direction.

C) Snubbers shall include resilient neoprene pads with a minimum thickness of ¼" (6 mm) to cushion any impact and to avoid any potential for metal-to-metal contact. Snubber shall be capable of withstanding an externally applied seismic force of up to 10,000 pounds (4,540 kg.) in any direction. Snubber shall be installed only after the isolated equipment is mounted, piped, and operating so as to ensure that no contact occurs during normal equipment operation.

D) Three-axis seismic snubbers shall be Model HS-7 as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and

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

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

sections 2.01, 2.02 and 2.03 (8)

9) Type I): Horizontal 1-Axis External Seismic Snubber Assembly

A) Equipment shall be restrained against excessive horizontal one-axis movement during a seismic event by the use of single-axis resilient snubbers, designed to withstand the project required seismic forces. A minimum of four (4) snubbers are to be used at each equipment installation, oriented to effectively restrain the isolated equipment in all lateral directions.

B) Snubbers shall be of steel construction and shall be attached to the equipment structure and equipment in a manner consistent with anticipated design loads. Snubbers shall limit lateral equipment movement at each snubber location in the direction of impact to a maximum of ¼" (6 mm).

C) Snubbers shall include resilient neoprene pads with a minimum thickness of ¼" (6 mm) to cushion any impact and to avoid any potential for metal-to-metal contact. Snubber shall be installed only after the isolated equipment is mounted, piped, and operating so as to eliminate any contact during normal equipment operation.

D) Single-axis seismic snubbers shall be Model HS-1 as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02 and 2.03 (9)

10) Type J): Cable Restraints For Suspended Piping and Ductwork

A) Seismic wire rope cable restraints shall consist of steel wire strand cables, sized to resist project seismic loads, arranged to offer seismic restraint capabilities for piping, ductwork, and suspended equipment in all lateral directions.

B) Building and equipment attachment brackets at each end of the cable shall be designed to permit free cable movement in all directions up to a 45 degree misalignment. Protective thimbles shall be used at sharp connection points as required to eliminate potential for dynamic cable wear and strand breakage.

C) Restraints shall be sized to the capacity of the cable or to the capacity of the anchorage, whichever is the lesser.

D) Seismic wire rope connections shall be made using overlap wire rope "U" clips or seismically rated tool-less wedge insert lock connectors.

E) Vertical suspension rods shall be braced as required to avoid potential for buckling due to vertical 'up' forces. Braces shall be structural steel angle uniquely selected to be of sufficient strength to prevent support rod bending. Brace shall be attached to the vertical suspension rod by a series of adjustable clips. Clips shall be capable of securely locking brace to suspension rod without the need for hand tools.

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

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

F) Where clevis hanger brackets are used for seismic restraint attachment, they will be fitted with clevis internal braces to prevent buckling of the hanger brackets.

G) Seismic cable shall be as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.03 through 1.07 inclusive, and sections 2.01, 2.02 and 2.03 (10)

H) Seismic cable building and equipment attachment brackets shall be Model KSCA, KSCU or KSCC as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02 and 2.03 (10).

I) Seismic cable concrete anchor bolts shall be (Model KCAB Wedge) / (Model KUAB Undercut) as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02 and 2.03 (10).

J) Seismic wire rope connectors shall be (Model KWRC - 'U' clamp) / (Model KWGC - Tool-less wedge lock) as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02 and 2.03 (10).

K) Seismic vertical suspension stiffener rod clips shall be Model KHRC as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02 and 2.03 (10).

L) Clevis Internal Braces shall be Model KHHB as manufactured by Kinetics Noise Control, or by other manufacturers who can meet the requirements as listed in sections 1.04 through 1.09 inclusive, and sections 2.01, 2.02 and 2.03 (10).

3.0 Execution

3.01 Installation

1) Installation of all seismic restraint materials specified in this section shall be accomplished as per the manufacturer's written instructions.

2) Upon completion of installation of all seismic restraint materials and before start up of restrained equipment, all debris shall be cleaned from beneath all protected equipment, leaving equipment free to contact snubbers.

3) No rigid connections between the equipment and the building structure shall be made which degrades the seismic restraint system herein specified. All electrical conduit to restrained equipment shall be looped to allow free motion of equipment without damage to the electrical wiring.

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

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

4) Adjust isolators after piping systems have been filled and equipment is at operating weight.

5) Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

6) Adjust snubbers according to manufacturer's written recommendations.

7) Adjust seismic restraints to permit free movement of equipment within normal mode of operation.

8) Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces

3.02 Execution

1) Shackle piping to the trapeze when restraining trapeze mounted piping, conduit and ductwork. Install cables so they do not bend across sharp edges of adjacent equipment or building structure.

2) Install steel angles to stiffen hanger rods and prevent buckling where appropriate. Clamp with adjustable steel clamps to hanger rods. Requirements apply equally to hanging equipment. Do not weld angles to rods

3) If there is greater than a 1/8" diameter mismatch between anchorage hardware and hole diameter, reduce clearance in hole with epoxy grout or flanged neoprene bushings.

4) Housekeeping Pads must be adequately reinforced and adequately thick for proper embedment of equipment anchors. Refer also to written restraint manufacturers instructions.

   A) Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.

   B) Install adequate reinforcement in the concrete base to ensure its integrity in a seismic event.

   C) Install wedge type anchors into concrete base. If base thickness is inadequate for full anchor embedment, install epoxy-coated anchor bolts that extend through concrete base and adequately anchor into structural concrete floor.

   D) Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

   E) Install anchor bolts to elevations required for proper attachment to supported equipment.

   F) Install anchor bolts according to anchor bolt manufacturer's written instructions.

KINETICS Noise Control
DUBLIN, OHIO, USA • MISSISSAUGA, ONTARIO, CANADA
Toll Free (USA only): 800-959-1229
International: 614-889-0480
Fax: 614-889-0540
World Wide Web: www.kineticsnoise.com
Email: sales@kineticsnoise.com

3.03 Inspection

1) The contractor shall notify the local representative of the seismic restraint materials manufacturer prior to installing any seismic restraint devices. The contractor shall seek the representative's guidance in any installation procedures with which he is unfamiliar.

2) Upon completion of the installation of all seismic restraint devices herein specified, the local representative of the seismic snubbers manufacturer shall, at the contractors request, inspect the completed system and report in writing any installation errors, improperly selected snubber devices, or other fault in the system which could affect the performance of the system.

3) The installing contractor shall submit a report upon request to the building architect and/or engineer, including the manufacturer's representative's final report, indicating that all seismic restraint material has been properly installed, or steps to be taken by the contractor to properly complete the seismic restraint work as per the specifications.

4.0 Seismic Restraint for Piping and Ductwork

4.01 Piping

1) Seismically restrain all piping listed below. Use Type J Cable Restraints for all piping supported by vibration isolation hanger assemblies, including:

   A) Natural gas piping, medical gas piping, vacuum piping, petroleum based liquid piping, and compressed air piping equal to or greater than 1" (25 mm) in inside diameter.

   B) Brace remainder of piping to code requirements (IBC or TI-809-04)) or in conformance with SMACNA (Sheet Metal and Air Conditioning Contractors National Association, Inc.) "Seismic Restraint Manual Guidelines for Mechanical Systems", Second Edition (Remaining Codes)

4.02 Ductwork

1) Seismically restrain all ductwork listed below. Use Type J Cable Restraints for all ductwork supported by vibration isolation hanger assemblies, including:

   A) All rectangular and oval ducts with cross sectional area equal to or greater than 6 sq. ft. (0.55 sq. meters).

   B) All round ducts with diameters equal to or greater than 32" (812 mm).

   C) Brace remaining ductwork to code requirements (IBC or TI-809-04)) or in conformance with SMACNA (Sheet Metal and Air Conditioning Contractors National Association, Inc.) "Seismic Restraint Manual Guidelines for Mechanical Systems", Second Edition (Remaining Codes)

4.03 Conduit

KINETICS Noise Control
DUBLIN, OHIO, USA • MISSISSAUGA, ONTARIO, CANADA
Toll Free (USA only): 800-959-1229
International: 614-889-0480
Fax: 614-889-0540
World Wide Web: www.kineticsnoise.com
Email: sales@kineticsnoise.com

1) Seismically restrain all electrical conduit listed below. Use Type J Cable Restraints for all conduit supported by vibration isolation hanger assemblies, including:

   A) All round ducts with diameters equal to or greater than 32” (812 mm).

   B) Brace all conduit to code requirements (IBC or TI-809-04) or in conformance with SMACNA (Sheet Metal and Air Conditioning Contractors National Association, Inc.) “Seismic Restraint Manual Guidelines for Mechanical Systems”, Second Edition (Remaining Codes).

4.04 Fire Protection Piping

1) Fire protection, sprinkler piping, and related equipment is considered as “Life Safety Equipment” and is to be seismically restrained per guidelines as published by NFPA (National Fire Protection Association).

End of Section

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

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