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PART 1 - GENERAL

This Section provides for vibration isolation as well as seismic control for the “equipment” components as listed below. This specification is part of the general conditions for the HVAC, Plumbing, Fire Protection and Electrical contracts.

Approved Manufacturers

- 1) SGMEC Group
- 2) Approved Equal

1.01 DESCRIPTION

A. Intent

1. All equipment, piping, ductwork and conduit as noted on the drawings schedule or in the specification shall be seismically braced. Vibration control shall apply as described herein.
2. Seismic bracing and isolation materials shall be of the same manufacturer and shall be certified by the manufacturer.
3. It is the intent of the seismic portion of this specification to keep all mechanical, electrical, plumbing and fire protection building system components in place during a seismic event and operational where this specification so requires.
4. All such systems must be installed in strict accordance with seismic codes, component manufacturer's and building construction standards. Whenever a conflict occurs between the manufacturers or construction standards, the most stringent shall apply.
5. This specification is considered to be minimum requirements for seismic consideration.
6. Any variance or non-compliance with this specification requirement shall be corrected by the contractor in an approved manner.

B. The work in this section includes, but is not limited to the following:

1. Vibration isolation for piping, ductwork, conduit and equipment.
2. Equipment isolation bases.
3. Seismic restraints for isolated equipment.
4. Seismic restraints for non-isolated equipment.

5. Certification of seismic restraint designs and installation supervision.
6. Certification of seismic attachment of housekeeping pads.
7. All equipment (components) requiring IBC certification.
8. All inspection and test procedures for equipment (components) requiring IBC certification.
9. All mechanical, electrical, plumbing or fire protection equipment and systems within or on the building. Equipment buried underground is included. Entry of services to building, up to but not including the utility connection point is part of this Specification.
10. Equipment referred to below is typical. (Equipment not listed is still included in this specification)

For IBC projects, all systems listed in or part of this paragraph are referred to as components:

AC Units	Generators
Air Handling Units	Heat Exchangers
Air Separators	Humidifiers
Battery Chargers	Light Fixtures
Battery Racks	Motor Control Centers
Boilers	Ductwork
Bus Ducts	Pipe
Cabinet Unit Heaters	Pumps (all types)
Cable Trays	Risers
Chillers	Rooftop Units
Compressors	Supports
Computer Room Units	Switch Gear
Condensers	Tanks (all types)
Condensing Units	Transformers
Conduit	Unit Heaters
Curbs	Unit Substations
Electrical Panels	Unit Ventilators
Equipment Supports	Variable Frequency Drives
Fans (all types)	Vibration Isolators
Fan Coil Units	Water Heaters
Fire Alarm Panels	

### C. Definitions

1. Life Safety Systems:
  - a. All systems involved with fire protection including sprinkler piping, jockey pumps, fire pumps, control panels, service water supply piping, water tanks, fire dampers and smoke exhaust systems And fire alarm panels.

- b. All mechanical, electrical, plumbing or fire protection systems that support the operation of or are connected to emergency power equipment including all lighting, generators, transfer switches and transformers.
  - c. All medical and life support systems.
  - d. Hospital heating systems and air conditioning systems for maintaining normal ambient temperature.
  - e. Automated supply, exhaust, fresh air and relief air systems on emergency control sequence including air handlers, duct, dampers, etc. or manually operated systems used for smoke evacuation, purge or fresh air relief by the fire department.
2. Positive Attachment:
- a. Positive attachment is defined as a cast-in anchor, a drill-in wedge anchor, a double-sided beam clamp loaded perpendicular to a beam, or a welded or bolted connection to structure. Single sided "C" type beam clamps for support rods of overhead piping, ductwork, fire protection or any other equipment are not acceptable on this project as seismic bracing points.
3. Transverse Bracing:
- a. Restraint(s) applied to limit motion perpendicular to the centerline of the pipe or duct.
4. Longitudinal Bracing:
- a. Restraint(s) applied to limit motion parallel to the centerline of the pipe or duct.
5. Definitions, IBC (in addition to the above).

**Anchor:** A device, such as an expansion bolt, for connecting duct or pipe bracing members into the structure of a building.

**Approved Agency:** An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved.

**Attachment:** see Positive Attachment below

**Bracing:** Metal channels, cables or hanger angles that prevent ducts and pipes from breaking away from the structure during an earthquake. See also Longitudinal Bracing and Transverse Bracing. Together, they resist lateral loads from any direction.

**Certificate of Compliance:** A certificate stating that materials and products meet specified standards or that work was done in compliance with approved construction documents, provided by an approved agency.

**Component:** A part or element of an architectural, electrical, mechanical, or structural system.

Component, equipment: A mechanical or electrical component or element that is part of a mechanical and/or electrical system within or without a building system.

Component, flexible: Component, including its attachments, having a fundamental period greater than 0.06 seconds.

Component, rigid: Component, including its attachments, having a fundamental period less than or equal to 0.06 seconds.

Dynamic properties of piping: The tendency of pipe to change in weight and size because of the movement and temperature of fluids in them. This does not refer to movement due to seismic forces.

Equipment: Systems associated with ducts, pipes and conduit, also called components.

Gas pipes: For the purposes of this Specification Guide, gas pipe is any pipe that carries fuel gas, fuel oil, medical gas, or compressed air.

Hazardous Contents: A material that is highly toxic or potentially explosive and in sufficient quantity to pose a significant life-safety threat to the general public if an uncontrolled release were to occur.

Inspection Certificate: An identification applied on a product by an approved agency containing the name of the manufacturer, the function and performance characteristics, and the name and identification of an approved agency that indicates that the product or material has been inspected and evaluated by an approved agency (*see Section 1703.5 and "Label" and "Manufacturer's Designation and "Mark"*).

Label: An identification applied on a product by the manufacturer that contains the name of the manufacturer, the function and performance characteristics of the product or material, and the name and identification of an approved agency and that indicates that the representative sample of the product or material has been tested and evaluated by an approved agency (*see Section 1703.5 and "Inspection Certificate" and "Manufacturer's Designation and "Mark"*).

Lateral forces: A force acting on a duct or pipe in the horizontal plane. This force can be in any direction.

Load:

Gravity Load ( $W$ ): The total dead load and applicable portions of other loads as defined in *Section 1613 through 1622*.

Longitudinal bracing: Bracing that prevents a duct or pipe from moving in the direction of its run.

Longitudinal force: A lateral force that happens to be in the same direction as the duct or pipe.

Manufacturer's Designation: An identification applied on a product by the manufacturer indicating that a product or material complies with a specified standard or set of rules (see also "Inspection Certificate" and "Label").



Occupancy Importance Factor: A factor assigned to each structure according to its Seismic Use Group as prescribed on Page 244 of the IBC.

Positive Attachment: A mechanical device, designed to resist seismic forces, that connects a non-structural element, such as a duct, to a structural element, such as a beam. Bolts and screws are examples of positive attachments. Glue and friction due to gravity do not create positive attachments.

Seismic Design Category: A classification assigned to a structure based on its Seismic Use Group and the severity of the design earthquake ground motion at the site.

Seismic Forces: The assumed forces prescribed herein, related to the response of the structure to earthquake motions, to be used in the design of the structure and its components.

Seismic Use Group: A classification assigned to a building based on its use as defined in *Section 1616.2*.

Seismic: (adj.) Related to an earthquake. Seismic loads on a structure are caused by wave movements in the earth during an earthquake.

Site Class: A classification assigned to a site based on the types of soils present and their engineering properties as defined in *Section 1615.1.5*.

Special Inspection, Continuous: The full-time observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed.

Special Inspection, Periodic: The part-time or intermittent observation of work requiring special inspection by an approved special inspector who is present in the area where the work has been or is being performed and at the completion of the work.

Special Inspection: Inspection as herein required of the materials, installation, fabrication, erection or placement of components and connections requiring special documents and referenced standards (*see Section 1704*).

Story Drift Ratio: The story drift divided by the story height.

Transverse bracing: Bracing that prevents a duct or pipe from moving from side to side.

## 1.02 QUALITY ASSURANCE

- A. Substitution of internally or externally isolated and restrained equipment supplied by the equipment vendor, in lieu of the isolation and restraints specified in this section, is acceptable provided all conditions of this section are met. The Equipment manufacturer shall provide a letter of guarantee from their Engineering Department PE stamped and certified per the section on Seismic Restraint Design (See paragraph 1.3) stating that the seismic restraints are in full compliance with these specifications. Where IBC is required, manufacturer certification shall be in addition to all requirements which are stated in Paragraph 1.3 of Article 4.

Letters from field offices or representatives are unacceptable. All costs for converting to the specified vibration isolation and/or restraints shall be borne by the equipment vendor in the event of non-compliance with the preceding. Internal isolation is not acceptable for:

- a. Indoor or outdoor mounted equipment over or adjacent to:
  - 1) Patient or operating areas
  - 2) Theatre space
  - 3) Office locations
  - 4) Assembly areas

B. Letters from representatives are unacceptable.

### 1.03 SUBMITTAL DATA REQUIREMENTS

A. Refer to Part I General Requirements.

B. The manufacturer of vibration isolation and seismic restraints shall provide submittals for products as follows:

#### 1. Descriptive Data:

- a. Catalog cuts or data sheets on vibration isolators and specific restraints detailing compliance with the specification.
- b. Detailed schedules of flexible and rigidly mounted equipment, showing vibration isolators and seismic restraints by referencing numbered descriptive drawings.

#### 2. Shop Drawings:

- a. Submit fabrication details for equipment bases including dimensions, structural member sizes and support point locations.
- b. Provide all details of suspension and support for ceiling hung equipment.
- c. Where walls, floors, slabs or supplementary steel work are used for seismic restraint locations, details of acceptable attachment methods for ducts and pipe must be included and approved before the condition is accepted for installation. Restraint manufacturers' submittals must include spacing, static loads and seismic loads at all attachment and support points.
- d. Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.

#### 3. Seismic Certification and Analysis:

- a. Calculations by the Manufacturer's qualified licensed Engineer substantiating the mounting system, seismic restraints and recommended anchor bolts shall be submitted for approval along with the shop drawings. Calculations shall be based on the loads as established in *Section 4d – Design Loads* at the end of this section. All analysis

shall be stamped by a registered professional having a PE from the same state as the project.

- b. Unless otherwise specified, all equipment, piping and ductwork shall be restrained to resist seismic forces. Restraints shall maintain mechanical equipment, piping or ductwork in a captive position. Restraint devices shall be designed and selected to meet seismic requirements as defined in the latest issue of:
  - 1) Uniform Building Code
  - 2) BOCA
  - 3) Southern Building Code
  - 4) Applicable state and local codes
  - 5) NFPA, (fire protection only).
  - 6) IBC International Building Code (See paragraph 4).

4. International. Building Code Additions:

In addition to all of the above provisions, all trades shall comply with sections 16 & 17 of the International Building Code using only vendors that comply with the provisions stated herein and submitting the special inspections listed within these specifications. Where compliance is not possible, each contractor shall submit a vendor report clearly indicating that none of the specified, listed or other vendors known to the contractors meet the compliance, testing and certification portions of the IBC specifications Section 16 and 17. Special inspections shall still be conducted (Paragraph 4 b) even if no vendors meet the following requirements. All non-isolated and isolated equipment, (components) shall be secured to the structure in accordance with that code!

- a. All component manufacturers will submit for approval the following as required below:
  - 1) All life safety system components noted in this specification will have the manufacturer of that component submit the Approved Agencies Certificate of Compliance for the specific equipment on this project when the Seismic Design Category is “C-F”. Analytical or Shaker Test certification thru the component’s load path including structure at its center of gravity shall include anchorage, structural and online capability.
  - 2) For Seismic Hazard Exposure Group III projects, all components noted in this specification will have the manufacturer of that component submit the Approved Agencies Certificate of Compliance for their equipment when the Seismic Design Category is “C-F”. This requirement also pertains to projects that combine an emergency preparedness center within a structure of another Use Group where that component is needed for continued operation of the building or whose failure could impair the continued operation of the building. Note: the definition of the above refers to any component which does not allow or hampers the use or capability of the intended purpose of that structure Analytical or Shaker Test certification through the total component’s load path to structure at its center of gravity shall include anchorage, structural and online capability.

- 3) All components containing Hazardous or Flammable materials will have the manufacturer of that component submit the Approved Agencies Certificate of Compliance for their equipment when used on any project having a minimum Seismic Design Category of "C-F". Analytical or Shaker Test certification through the total component's load path to structure at its center of gravity shall include anchorage, structural on line capability to insure against loss of hazardous or flammable (explosive) material. Test shall prove that no internal component will fail which could support combustion and/or explosion.
  - 4) All COMPONENTS NOT LISTED IN THE ABOVE CATEGORIES shall have the manufacturer of each component submit a PE stamped calculation package that their project specific equipment will accept anchorage through the component's load path to structure at its center of gravity at the designated anchorage locations. This requirement is for all projects having a Seismic Design Category of C-F.
- b. The following systems shall require Special Inspection and Periodic Special Inspection for anchorage during the course of construction, as defined earlier in this section for all buildings in Seismic Design Categories C-F.
- 1) All smoke control systems. Periodic Special Inspection during erection of ductwork and prior to concealment, for leakage testing. Additionally, prior to occupancy for pressure differential testing (see IBC-2000, section 1704.14).
  - 2) All electrical components for standby or emergency power systems require Periodic Special inspection. \*
  - 3) All electrical equipment in Seismic Design Categories E and F. (Periodic)\*
  - 4) All flammable, combustible and highly toxic piping and their associated mechanical systems. (Periodic) \*
  - 5) All ductwork containing hazardous materials. (Periodic) \*
  - 6) All equipment using combustible or toxic energy sources. (Special<sup>-1</sup>)
  - 7) All electric motors, transformers, switchgear unit substations and motor control centers. (Special. -1)
  - 8) Reciprocating and rotating type machinery. (Special<sup>-1</sup>)
  - 9) Pipe, 3" & larger. (Special. -1)
  - 10) Tanks, heat exchangers & pressure vessels. (Special. -1)
  - 11) Isolator units for seismic isolation system (Periodic)\*
  - 12) Manufacturer's Quality Control Program for projects in Seismic Design Categories E or F.
- c. Contractor Responsibilities and Approvals:

Each contractor responsible for the installation of the components asterisked above, (\*) shall be responsible for submitting to the design team for their approval, a written contractor's statement of responsibility as outlined below. In addition all (-1) items above require special inspection in accordance with *IBC Section 1707.7.1*

- 1) Identify the components that are part of the Quality Assurance Plan. (asterisked above)\*
- 2) Identify all Special Inspection and Testing for components installed as part of this contract.
- 3) List control procedures within the contractor's organization for all special inspection and testing including methods, frequency of reporting and their distribution of those reports.
- 4) List personnel and their qualifications exercising control over the seismic aspects of the project.

d. Design loads:

- 1) Projects located in the states of Connecticut, Delaware, New Jersey, New York and Pennsylvania, have a maximum design load of .4g for statically mounted components and .9g for resiliently mounted components. Actual loads shall be as above or as calculated but shall not be less than .4g for static and .5g for resiliently mounted components including internal components as part of a manufactured system.
- 2) Exclusions for seismic restraint of piping and duct shall be according to applicable codes. The minimum horizontal restraint capability shall be .4g horizontal and .27g vertical. Life safety equipment defined above shall be designed to survive a horizontal load of .9g and a vertical load of .6g.
- 3) Testing or calculations (including the combining of tensile and shear loadings) to support seismic restraint designs must be stamped by a registered PE with at least five years of seismic design experience and licensed in the state of the job location. Testing and calculations must include shear and tensile loads as well as one test or analysis at 45° to the weakest mode. IBC Component testing must be by an Approved Agency.
- 4) Analysis for anchorage must indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and/or welded length. All seismic restraint devices shall be designed to accept, without failure, the forces detailed in Section 4 acting through the equipment center of gravity. Overturning moments may exceed forces at ground level.
- 5) Vertical load shall be calculated at 2/3 the horizontal load.

- 6) Internally isolated equipment in lieu of specified isolation and restraint systems must meet all of the requirements of paragraph 4 (a-d) and Section 1.6.
- 7) A seismic design Errors and Omissions insurance certificate MUST accompany the equipment manufacturer's certification. Product liability insurance certificates are not acceptable.
- 8) In the event that the equipment is internally isolated and restrained, the entire unit assembly must be seismically attached to the structure. Curb or roof rail mounted equipment must not only have seismic attachment of the equipment to the roof but also to the curb or rails. The attachment and certification thereof shall be by this section. Sheet metal screw attachment is unacceptable.
- 9) Failure is defined as the discontinuance of any attachment point between equipment or structure, vertical permanent deformation greater than 1/8 inch and/or horizontal permanent deformation greater than 1/4 inch or failure of the equipment to operate.

#### 1.04 RELATED WORK

- A. Housekeeping pad design shall be by the project structural engineer or as shown on the contract drawings. Attachment shall be designed and certified according to this section by the seismic/isolation supplier. Material and labor required for attachment and construction shall be by the concrete section contractor, or by this contractor where specified. Housekeeping pads shall be sized to accommodate a minimum of 6 " of clearance all around the equipment or 12 times the anchor bolt diameter, whichever is greater. Where exterior isolators are used this distance shall be as measured from the outboard holes in the isolator base plate and its mounting package.
- B. Structural support and connections for all equipment, including roof-mounted equipment, specified in other sections shall comply with all IBC requirements indicating load path to the structure.
- C. Roof steel supporting roof-mounted equipment shall be designed for all seismic forces including, but not limited to, tension, compression and moment loads.
- D. Chimneys, stacks and boiler breeching passing through floors are to be bolted at each floor level or secured above and below each floor with riser clamps.
- E. Where ceiling are not braced (Exclusion "C"- Building Category I or II  $I_p = 1.0$  Section 1621.2.5) lighting fixtures shall have independent 4 corner diagonal wire ties to structure.
- F. Lay-in ceilings in compliance with seismic zone requirements may use earthquake clips or other approved means of positive attachment to brace fixtures such as panel light and diffusers less than 75 pounds to T-bar structures. Local codes dictate support requirements.

#### 1.05 CODE AND STANDARDS REQUIREMENTS

- A. Typical Applicable Codes and Standards

1. All City, State and Local Codes (Code)
2. SMACNA Guidelines for Seismic Restraint of Mechanical Systems (To be used as a Standard, not a code)
3. NFPA 13 and 14 for Fire Protection System (Standard)
4. American Society For Testing and Materials (ASTM) (Standard)
5. International Conference of Building Officials (ICBO) (Standard)
6. International Building Code (Code)
7. Uniform Building Code (Code)
8. Ashrae (Standard)

B. In cases where requirements vary, the guideline for the most stringent shall be utilized.

C. Use IBC-2000 as reference code standard unless otherwise designated.

#### 1.06 MANUFACTURER'S RESPONSIBILITY

A. Manufacturer of vibration isolation and seismic control equipment shall have the following responsibilities:

1. Determine vibration isolation and seismic restraint sizes and locations.
2. Provide vibration isolation and seismic restraints as scheduled or specified.
3. Provide calculations and materials if required for restraint of unisolated equipment.
4. Provide installation instructions, drawings and trained field supervision to insure proper installation and performance.
5. Certify correctness of installation upon completion.
6. All provisions of section 1.3, section "C", Seismic Certification & Analysis
  - a. All manufacturers including Original Equipment Manufacturer (OEM) providing equipment and/or vibration/seismic control systems must provide a Seismic Design Error and Omissions Insurance Certificate for their firm or their design consultant to certify their ability to provide engineering and design as required by this section.

B. All manufacturers of any type of equipment including Original Equipment Manufacturers (OEM) are responsible for Section 1.1.-1.6 including 1.3, Section "C", Seismic Certification and Analysis.

PART 2 - PRODUCTS

2.01 DESCRIPTION

- A. All vibration isolators and seismic restraints described in this section shall be the product of a single manufacturer. The basis of this specification is Vibration Mountings & Controls. Products from other nationally recognized manufacturers are acceptable provided their systems strictly comply with these specifications and have the approval of the specifying engineer. (See Form VL-1 listing other manufacturers to be considered for use on this project)

2.02 VIBRATION ISOLATION TYPES

A. Type A: Spring Isolator - Free Standing VMC: ASC

1. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or 1/4" neoprene acoustical friction pad between the base plate and the support.
2. All mountings shall have leveling bolts that must be rigidly bolted to the equipment.
3. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load.
4. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection.
5. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height.

B. Type B: Seismically Restrained Spring Isolator VMC: AWRS, ASCM

1. Restrained spring mountings shall have a Type A spring isolator within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of 1/4" shall be maintained around restraining bolts and internal neoprene deceleration bushings so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position there must be an internal isolation pad. Housing shall be designed to resist all seismic forces.

C. Type C: Combination Spring/Elastomer Hanger Isolator (30° Type) VMC: RSH30

1. Hangers shall consist of rigid steel frames containing minimum 1 1/4" thick neoprene elements at the top and a steel spring with general characteristics as in Type A. The neoprene element shall have neoprene bushings projecting through the steel box.
2. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc from side to side before contacting the rod bushing and short circuiting the spring.
3. Submittals shall include a hanger-drawing showing the 30° capabilities.



4. Hanger locations requiring pre-compression for holding piping at fixed elevation shall be type pre-compressed for all manufacturers.
- D. Type D: Elastomer Double Deflection Hanger Isolator VMC: RHD
1. Molded (minimum 1 1/4" thick) neoprene element with projecting bushing lining the rod clearance hole. Static deflection at rated load shall be a minimum of 0.35".
  2. Steel retainer box encasing neoprene mounting capable of supporting equipment up to four times the rated capacity of the element.
- E. Type E: Combination Spring/Elastomer Hanger Isolator VMC: RSH
1. Spring and neoprene elements in a steel retainer box with the features as described for Type C and D isolators.
  2. Hanger locations requiring pre-compression for holding piping at fixed elevation shall be type pre-compressed for all manufacturers.
  3. 30° angularity feature is not required.
- F. Type F: Seismically Restrained Elastomer Floor Isolator VMC: RSM
1. Bridge-bearing neoprene mountings shall have a minimum static deflection of 0.2" and all directional seismic capability. The mount shall consist of a ductile iron or aluminum casting containing two separated and opposing molded neoprene elements. The elements shall prevent the central threaded sleeve and attachment bolt from contacting the casting during normal operation. The shock absorbing neoprene materials shall be compounded to bridge-bearing specifications.
- G. Type G: Pad Type Elastomer Isolator (Standard) VMC: Maxiflex
1. One layer of 3/4" thick neoprene pad consisting of 2" square modules for size required.
  2. Load distribution plates shall be used as required.
  3. Bolting required for seismic compliance. Neoprene and duck washers and bushings shall be provided to prevent short-circuiting.
- H. Type H: Pad Type Elastomer Isolator (High Density) VMC: Fabriflex
1. Laminated canvas duck & neoprene, maximum loading 1000 psi, minimum 1/2" thick.
  2. Load distribution plate shall be used as required.
  3. Bolting required for seismic compliance. Neoprene and duck washers and bushings shall be provided to prevent short-circuiting.
- I. I. Type I: Thrust Restraints VMC: RSHTR

1. A spring element similar to Type A isolator shall be combined with steel angles, backup plates, threaded rod, washers and nuts to produce a pair of devices capable of limiting movement of air handling equipment to 1/4".
  2. Restraint shall be easily converted in the field from compression type to tension type.
  3. Unit shall be factory precompressed.
  4. Thrust restraints shall be installed on all cabinet fan heads, axial or centrifugal fans whose thrust exceeds 10% of unit weight.
- J. Type J: Pipe Anchors VMC: MDPA
1. All-directional acoustical pipe anchor, consisting of two sizes of steel tubing separated by a minimum 1/2" thick 60 durometer neoprene.
  2. Vertical restraint shall be provided by similar material arranged to prevent vertical travel in either direction.
  3. Allowable loads on the isolation material should not exceed 500 psi and the design shall be balanced for equal resistance in any direction.
- K. Type K: Pipe Guides VMC: PG
1. Pipe guides shall consist of a telescopic arrangement of two sizes of steel tubing separated by a minimum 1/2" thickness of 60-durometer neoprene.
  2. The height of the guides shall be preset with a shear pin to allow vertical motion due to pipe expansion or contraction. Shear pin shall be removable and reinsertable to allow for selection of pipe movement.
  3. Guides shall be capable of  $\pm 1 \frac{5}{8}$ " motion, or to meet location requirements.
- L. Type L: Isolated Pipe Hanger System VMC: CIH, CIR, TIH, PIH
1. Precompressed spring and elastomer isolation hanger combined with pipe support into one assembly. Replaces standard clevis, single or double rod roller, or double rod fixed support.
  2. Spring element (same as Type A) with steel lower spring retainer and an upper elastomer retainer cup with an integral bushing to insulate support rod from the isolation hanger.
  3. The neoprene element under the lower steel spring retainer shall have an integral bushing to insulate the support rod from the steel spring retainer.
  4. Hangers shall be designed and constructed to support loads over three times the rated load without failure.
  5. System shall be precompressed to allow for rod insertion and standard leveling.

2.03 SEISMIC RESTRAINT TYPES

- A. Type I: Spring Isolator, Restrained VMC: ASCM, AWR
  - 1. Refer to vibration isolation Type B.
- B. Type II: Seismically Restrained Elastomer Floor Isolator VMC: RSM
  - 1. Refer to vibration isolation Type F.
- C. Type III: All-Directional Seismic Snubber VMC: Type SR:
  - 1. All-directional seismic snubbers shall consist of interlocking steel members restrained by a one-piece molded neoprene bushing of bridge bearing neoprene. Bushing shall be replaceable and a minimum of 1/4 inch thick. Rated loadings shall not exceed 1000 psi. A minimum air gap of 1/8 inch shall be incorporated in the snubber design in all directions before contact is made between the rigid and resilient surfaces. Snubber end caps shall be removable to allow inspection of internal clearances. Neoprene bushings shall be rotated to insure no short circuits exist before systems are activated.
- D. Type IV: Floor or Roof Anchorage VMC: FA
  - 1. Rigid attachment to structure utilizing wedge type anchor bolts, anchored plates machine screw, bolting or welding. Powder shots are unacceptable.
- E. Type V: Seismic Cable Restraints VMC: SCR:
  - 1. Seismic Cable Restraints shall consist of galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of 2 and arranged to provide all-directional restraint. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize 2 clamping bolts to provide proper cable engagement. Cables must not be allowed to bend across sharp edges. Single arm braces with resilient bushings can be substituted for seismic cable restraints. Deck fitting shall have two through bolts spaced to ICBO standards for attachment to concrete!
- F. Type VI: Rigid Arm Brace VMC: SAB
  - 1. Seismic solid braces shall consist of steel angles or channels to resist seismic loads with a minimum safety factor of 2 and arranged to provide all directional restraint. Seismic solid brace end connectors shall be steel assemblies that swivel to the final installation angle and utilize 2 through bolts to provide proper attachment spaced to ICBO standards for attachment to concrete.
- G. Type VII: Internal Clevis Cross Brace VMC: ICB
  - 1. Internal clevis cross braces at seismic locations shall be pre-cut pipe sized for internal clevis dimensions.

## 2.04 EQUIPMENT BASES

### A. General

1. All curbs and roof rails are to be bolted or welded to the building steel or anchored to the concrete deck (minimum thickness shall be 4") for resisting wind and seismic load forces in accordance with the project location. (Fastening to metal deck is unacceptable.)

### B. Base Types

1. Type B-1: Integral Structural Steel Base VMC: WFB
  - a. Rectangular bases are preferred for all equipment.
  - b. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split case pump shall include supports for suction and discharge elbows.
  - c. All perimeter members shall be steel beams with a minimum depth equal to 1/12 of the longest dimension of the base.
  - d. Base depth need not exceed 12" provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer.
  - e. Height saving brackets shall be employed in all mounting locations to provide a minimum base clearance of 2".
2. Type B-2: Concrete Inertia Base VMC: MPF
  - a. Vibration isolation manufacturer shall furnish rectangular steel concrete pouring forms for floating and inertia foundations.
  - b. Bases for split case pumps shall be large enough to provide for suction and discharge elbows.
  - c. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6".
  - d. The base depth need not exceed 12" unless specifically recommended by the base manufacturer for mass or rigidity.
  - e. Forms shall include minimum concrete reinforcing consisting of 1/2" bars welded in place on 6" centers running both ways in a layer 1-1/2" above the bottom.
  - f. Forms shall be furnished with steel templates to hold the anchor bolts sleeves and anchors while concrete is being poured.
  - g. Height saving brackets shall be employed in all mounting locations to maintain a 2" minimum clearance below the base.

- h. Flush profile wooden formed bases having correct depth and reinforcing requirements are acceptable.
3. Type B-3: Seismic Isolation Curb VMC: P62/P6300 Sound package type VMC type RPFMA/SRPFMA
- a. Curb mounted rooftop equipment shown on isolation schedule shall be mounted on structural seismic spring isolation curbs. The upper frame must provide continuous support for the equipment and must be captive so as to resiliently resist wind and seismic forces. The lower frame must accept point support for both seismic attachment and leveling. The upper frame must be designed with positive fastening provisions (welding or bolting), to anchor the roof top unit to the curb, which will not violate the National Roofing Contractor's Association (NRCA) ratings of the membrane waterproofing. Sheetmetal screws are unacceptable. Contact points between the roof top unit, the curb and the building's structure shall show load path through those locations only.
  - b. All directional neoprene snubber bushings shall be a minimum of 1/4" thick. Steel springs shall be laterally stable and rest on 1/4" thick neoprene acoustical pads.
  - c. Hardware must be plated and the springs provided with a rust resistant finish.
  - d. The curbs waterproofing shall be designed to meet all NRCA requirements.
  - e. All spring locations shall have access ports with removable waterproof covers and all isolators shall be adjustable, removable and interchangeable.
  - f. The curb shall be the sound attenuating type utilizing standard 2" roof insulation supplied and installed by the roofing contractor to act thermally outside and acoustically inside. Curbs supplied without this feature shall be factory acoustically lined with 2" duct liner.

Option #1: Where sound barrier package is required, curb shall have full size lay in attenuation panels having a minimum STC rating of 60 when combined with the roof deck's rating. Attenuation system shall add a full sound attenuation structural floor to the curb capable of spanning the curb's width and designed for live loads of 20 psf. Panels shall not weigh more than 6 psf. The 4" nominal galvanized panel shall be joined to allow for airtight construction and additionally shall have a support system where the panels are used below an outside condenser section. Panels shall be waterproof for both outdoor and indoor application. The space below the curb panels and the roof deck shall have 4" of insulation contractor furnished and installed.

Curb wall construction shall utilize the roofer's standard insulation where curbs use the TAS open thermal acoustical screening system. Solid wall curbs shall use 2" of factory ductliner installed by the curb manufacturer. The entire curb shall have a continuous neoprene air seal. Type RPFMA shall use an open return system with the roof return opening set as far as possible from the unit's return opening.

Option # 2: When curb type SRPFMA (Supply Return Plenum Construction) is required, in addition to Option # 1 the walls of the supply section will use 2” sound attenuating panels as well as a continuous inner neoprene air seal and isolated plenum divider. Both supply and return ducts shall seal directly to curb base floor attenuation panels.

4. Type B-4: Seismic Non-Isolated Curbs VMC: P6000 Sound Package Type – VMC – RPFMA/SRPFMA System
  - a. These curbs shall have all provisions as Type B-3 curbs with the exception of spring isolation.
5. Type B-5: Isolated Equipment Supports VMC: R7200/R7300
  - a. Continuous structural equipment support rails that combine equipment support and isolation mounting into one utilized roof flashed assembly with all features as described for Type B-3.
  - b. System shall be designed for positive anchorage or welding of equipment to supports and welding of supports to the building steel.
6. Type B-6: Non-Isolated Equipment Supports VMC: R7000
  - a. This shall have the same provisions as Type B-5 without the spring isolation.
7. Type B-7: Computer Room Unit Base VMC: CRC
  - a. Computer Room air conditioning units shall be welded or bolted to welded structural steel stands having a minimum 0.5 “G” certified lateral acceleration capabilities.
  - b. Non-isolated stand shall have 1” of adjustment to accommodate floor irregularities.
  - c. Bolting or welding required to meet seismic criteria.

2.05 FLEXIBLE CONNECTORS

- A. Type FC-2: Flexible Stainless Steel Hose VMC: BS
  1. Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3” and larger shall be flanged. Smaller sizes shall have male nipples.
- B. Type FC-2 connector shall be braided bronze for freon connections.
  1. Minimum lengths shall be as tabulated:

<u>Flanged</u>		<u>Male Nipples</u>	
3 x 14	10 x 26	1/2 x 9	1½ x 13
4 x 15	12 x 28	3/4 x 10	2 x 14
5 x 19	14 x 30	1 x 11	2½ x 18
6 x 20	16 x 32	1¼ x 12	

2. Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible.

### PART 3 - EXECUTION

#### 3.01 GENERAL

- A. All vibration isolators and seismic restraint systems must be installed in strict accordance with the manufacturer's written instructions and all certified submittal data.
- B. Installation of vibration isolators and seismic restraints must not cause any change of position of equipment, piping or ductwork resulting in stresses or misalignment.
- C. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system herein specified.
- D. The contractor shall not install any isolated equipment, piping or duct, which makes rigid connections with the building unless isolation is not specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls.
- E. Coordinate work with other trades to avoid rigid contact with the building.
- F. Overstressing of the building structure must not occur because of overhead support of equipment. Contractor must submit loads to the structural engineer of record for approval. General bracing may occur from flanges of structural beams, upper truss cords in bar joist construction and cast in place inserts or wedge type drill-in concrete anchors.
- G. Seismic cable restraints shall be installed slightly slack to avoid short circuiting the isolated suspended equipment or piping.
- H. Seismic cable assemblies are installed taut on non-isolated systems. Seismic solid braces may be used in place of cables on rigidly attached systems except where single arm braces incorporate resilient bushings.
- I. At locations where seismic cable restraints or seismic solid braces are located the support rods must be braced when necessary to accept compressive loads.
- J. At all locations where seismic cable braces and seismic cable restraints are attached to the pipe clevis, the clevis bolt must be reinforced with pipe clevis cross bolt braces or double inside nuts if required by seismic acceleration levels.
- K. Vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not permitted.
- L. Where piping passes through walls, floors or ceilings, the contractor shall provide wall seals or resilient packed pipe sleeves.

- M. Air handling equipment and centrifugal fans shall be protected against excessive displacement which results from high air thrust in relation to the equipment weight. Horizontal thrust restraints shall be those described in the specification when horizontal motion exceeds 3/8".
- N. Special and Periodic Inspections for items listed in Section 1.3, Article 4 shall be conducted and submitted on a timely basis.

### 3.02 EQUIPMENT INSTALLATION

- A. Equipment shall be isolated and restrained as per Tables A, B and C at the end of this section.
- B. Place floor mounted equipment on 4" high concrete housekeeping pads properly doweled or expansion shielded to the deck to meet acceleration criteria (see Section 1.4). Anchor isolators and/or bases to housekeeping pads. Concrete work is specified under Concrete in the specifications of the contract.
- C. Additional Requirements
  - 1. The minimum operating clearance under all isolated components bases shall be 2".
  - 2. All bases shall be placed in position and supported temporarily by blocks or shims, as appropriate, prior to the installation of the equipment, isolators and restraints.
  - 3. The equipment shall be installed on blocks to the operative height of the isolators. After the entire installation is complete, and under full operational load, the isolators shall be adjusted so that the load is transferred from the blocks to the isolators. Remove all debris from beneath the equipment and verify that there are no short circuits of the isolation. The equipment shall be free in all directions.
  - 4. Ceilings containing diffusers must meet seismic zone requirements by using earthquake clips or other approved means of positive attachment to secure diffuser to T-bar structure.
  - 5. All floor or wall mounted equipment and tanks shall be restrained with Type IV restraints.

### 3.03 PIPING AND DUCTWORK ISOLATION

- A. Vibration Isolation of Piping
  - 1. Water Piping: All spring type isolation hangers shall be precompressed if isolators are installed prior to fluid charge. If installed afterwards, standard, non-precompressed isolators can be used. All piping in the machine room shall be isolated as well as pressurized runs in other locations of the building 6" and larger. Horizontal pressurized runs in all other locations of the building shall be isolated by Type E hangers. Floor supported piping shall rest on Type B isolators. Heat exchangers and expansion tanks are considered part of the piping run. The first 3 isolators from the isolated equipment will have the same static deflection as specified for the mountings under the connected equipment. If piping is connected to equipment located in basements and hangs from ceilings under occupied spaces, the first 3 hangers shall have 0.75" deflection for pipe sizes up to and including 3", 1 3/8" deflection for pipe sizes thereafter. Where column spacing exceeds 35', isolation



hanger deflection shall be 2-1/2" for pipes exceeding 3" diameter. Type L hangers may be substituted for the above where isolation hangers are required.

2. Steam and Condensate Piping: All ceiling suspended piping in the mechanical equipment room shall be isolated with Type D hangers. All floor supported piping shall be supported with Type F isolators.
3. Riser Location: All risers shall be supported on Type J or K anchors or guide restraints positive attached to both the riser and structure. Spiders welded to the pipe can substitute for Type K guides using J Type anchors.
4. Control Air Piping: Where control air piping is connected to mechanical piping equipment shall be flexibly connected in horizontal and vertical plane with Type FC-2 flexible connectors.

B. Seismic Restraint of Piping, Conduit, Bus Duct and Cable Tray

1. All high hazard and life safety pipe regardless of size such as fuel oil piping, fire protection mains, gas piping, medical gas piping and compressed air piping shall be seismically restrained. Type V seismic cables restraints or resilient single arm braces shall be used if piping is isolated. Type V seismic cable restraints or Type VI seismic solid braces may be used on unisolated piping. There are no exclusions for size or distance in this category.
2. Seismically restrain piping located in boiler rooms, mechanical equipment rooms and refrigeration equipment rooms that is 1 1/4" I.D. and larger. Type V seismic cables restraints or resilient single arm braces shall be used if piping is isolated. Type V seismic cable restraints or Type VI seismic solid braces may be used on unisolated piping.
3. Seismically restrain all other piping 2 1/2" diameter and larger. Type V seismic cables restraints or resilient single arm braces shall be used if piping is isolated. Type VI seismic cable restraints or seismic solid braces may be used on unisolated piping.
4. See Table D for maximum seismic bracing distances.
5. Multiple runs of pipe on the same support shall have distance determined by calculation.
6. Rod braces shall be used for all rod lengths greater than 3'.
7. Clevis hangers shall have spacers placed inside of hanger at seismic brace locations.
8. Where thermal expansion is a consideration, guides and anchors may be used as transverse and longitudinal restraints provided they have a capacity equal to or greater than the restraint loads in addition to the loads induced by expansion or contraction.
9. For fuel oil and all gas piping, transverse restraints must be at 20' maximum and longitudinal restraints at 40' maximum spacing.
10. Transverse restraint for one pipe section may also act as a longitudinal restraint for a pipe section of the same size connected perpendicular to it if the restraint is installed within 24" of the elbow or TEE or combined stresses are within allowable limits at longer distances.

11. Hold down clamps must be used to attach pipe to all trapeze members before applying restraints. Use Type V or VII restraint, if trapeze is smaller than 48" long.
12. Branch lines may not be used to restrain main lines.
13. All PVC and glass pipe less than 6" are braced only if the pipe use involves hazardous or toxic materials. All other PVC and glass pipe greater than 6" shall be braced at 20' transversely and 40' longitudinally with bottom shields.
14. Fire protection branch lines shall be end tied.

C. Vibration Isolation of Ductwork

1. All discharge runs for a distance of 50' from the connected equipment shall be isolated from the building structure by means of Type E combination spring/elastomer hanger or Type A floor spring isolators. Spring deflection shall be a minimum of 0.75".
2. All duct runs having air velocity of 1500 feet per minute (fpm) or more shall be isolated from the building structure by Type E combination spring/ elastomer hangers or Type A floor spring supports. Spring deflection shall be a minimum of 0.75".

D. Seismic Restraint of Ductwork

1. Restrain rectangular ductwork with cross sectional area of 6 square feet or larger. Type V seismic cable restraints or Type VI seismic solid braces shall be used on this ductwork. Ductwork which serves a life safety function or carries toxic materials must be braced.
2. Restrain round ducts with diameters of 28" or larger. Type V seismic cable restraints or Type VI seismic solid braces shall be used on this ductwork.
3. Restrain flat oval ducts the same as rectangular ducts of the same nominal size.
4. See Table D for maximum seismic bracing distances.
5. The ductwork must be reinforced at the restraint locations. Reinforcement shall consist of an additional angle on top of the ductwork that is attached to the support hanger rods. Ductwork is to be attached to both upper angle and lower trapeze.
6. A group of ducts may be combined in a larger frame so that the combined weights and dimensions of the ducts are less than or equal to the maximum weight and dimensions of the duct for which bracing details are selected.
7. Walls, including gypsum board non-bearing partitions, which have ducts running through them, may replace a typical transverse brace. Provide channel framing around ducts and solid blocking between the duct and frame.

3.04 EXCLUSIONS

Curb mounted mushroom, exhaust and vent fans with curb area less than nine square feet are excluded unless specifically detailed in the schedules or drawings.

#### DUCT

Rectangular, square, and oval air handling ducts less than six square feet in cross sectional area.  
Round air-handling duct less than 28 inches in diameter. Duct supported at locations by two rods less than 12 inches in length from the structural support to the structural connection to the ductwork.

#### PIPE, CONDUIT, CABLE TRAYS & BUS DUCTS (Components)

All pipe or conduit less than 2 1/2" diameter suspended by individual hanger rods. All clevis supported pipe or conduit less than 12" (6" or less for fire protection piping) from the top of the pipe to the underside of the support point. Trapeze supported pipe, cable trays and bus ducts suspended by hanger rods having a distance less than 12" in length from the underside of the pipe support to the support point of the structure.

#### EXCLUSIONS

DO NOT apply for LIFE SAFETY or HIGH HAZARD equipment as listed in Section 1.1, C regardless of governing code for HVAC, Plumbing, Electrical or Fire Protection. *(A partial list is illustrated)* High Hazard is additionally classified as any system handling flammable, combustible or toxic material. Typical systems not excluded are additionally listed below.

#### ELECTRICAL

Critical, standby or emergency power conduit (1" nominal diameter and larger), cable tray or bus duct, lighting, panels, communication lines involving 911, etc.

#### PIPING

Fuel oil, gasoline, natural gas, medical gas, steam, compressed air or any piping containing hazardous, flammable, combustible, toxic or corrosive materials. Fire protection standpipe, risers and mains. Branches must be end tied.

#### DUCT

Smoke evacuation duct or fresh air make up connected to emergency system, emergency generator exhaust, boiler breeching or as used by the fire department on manual override!

#### EQUIPMENT

Previously excluded non life safety duct mounted systems such as fans, variable air volume boxes, heat exchangers and humidifiers having a weight greater than 75 lbs require independent seismic bracing.

### 3.05 INSPECTION

- A. All Independent Special and Periodic Inspections must be performed and submitted on components as outlined in Article 1.3, Section 4b.
- B. Upon completion of installation of all vibration isolation devices, the local representative shall inspect the completed project and certify in writing to the Contractor that all systems are installed properly, or require correction. The contractor shall submit a report to the Architect, including the representative's report, certifying correctness of the installation or detailing corrective work to be done.

HVAC EQUIPMENT TABLE "A"										
ON GRADE, BASEMENT OR SLAB ON GRADE						ABOVE GRADE				
EQUIPMENT (See Note!)		MTNG	ISOL	DEFL (in.)	BASE	RESTR	ISOL	DEFL (in.)	BASE	RESTR
Absorption Machine		Flr.	---	---	---	IV	B	0.75	B-2	IV
Air Handling Units Indoor		Flr	B	0.75	---	IV	B	1.5	---	IV
		Clg	E	0.75	---	V	E	0.75	---	V
Axial Fans (Inline Type)		Flr	B	0.75	---	IV	B	See Guide	---	IV
		Clg	E	0.75	---	V	E	See Guide	---	V
Base Mounted Pumps	To 15 HP	Flr	B	0.75	B-2	IV	B	0.75	B-2	IV
	>15 HP	Flr	B	0.75	B-2	IV	B	1.50	B-2	IV
Boilers		Flr	G	0.10	---	IV	B	0.75	---	IV
Cabinet Fans & Packaged AHU Indoor	To 1 HP	Flr	F	0.20	---	IV	B	0.75	---	IV
		Clg	D	0.35	---	V	E	0.75	---	V
	>1 HP	Flr	B	0.75	---	IV	B	See Guide	---	IV
		Clg	E	0.75	---	V	E	See Guide	---	V
Centrif. Chillers		Flr	B	0.75	---	IV	B	1.50	---	IV
Centrif. Fans Arr. 1 & 3	Class 1	Flr	B	0.75	B-1	IV	B	See Guide	B-1	IV
	Class 2 & 3	Flr	B	0.75	B-2	IV	B	See Guide	B-2	IV
Centrif. Fans (Vent Sets) Arr. 9 & 10	Class 1	Flr	B	0.75	---	IV	B	See Guide	See Note 2	IV
	Class 2 & 3	Clg	E	0.75	B-2	V	E	See Guide	B-2	V
Computer Room Units		Flr	F	0.20	B-7	IV	B	1.5	B-7	IV
Condensate Pumps		Flr	F	0.20	If req.	IV	F	0.20	If req.	IV
Cooling Towers		Flr	B	0.75	---	IV	B	2.50	B-5 opt.	IV
Curb Mtd. Equip. (Non-Isol.)		Roof	---	---	---	IV	---	---	B-6	IV
Fan Coil Units		Flr	F	0.20	---	IV	B	0.75	---	IV
		Clg	D	0.35	---	V	E	0.75	---	V
Outdoor Reciprocating, Rotary or Screw Chillers		Flr	F	0.20	---	IV	B	1.50	---	IV
		Roof	---	---	---	IV	B	2.50	B-5	IV
Rooftop AHU/AC	< 10 Ton	Roof	---	---	---	IV	B	1.50	B-3 *(3,4)	IV
	> 10 Ton	Roof	---	---	---	IV	B	2.50	B-3 *(3,4)	IV
Unit/Cab Heaters		Clg	D	0.30	---	V	D	0.30	---	V

Minimum Deflection Guide for Table “A”

<b>R.P.M.</b>	<b>DEFLECTION</b>
<b>Less than 400</b>	<b>3.50”</b>
<b>401 to 600</b>	<b>2.50”</b>
<b>601 to 900</b>	<b>1.50”</b>
<b>OVER 900</b>	<b>0.75”</b>

Note for TABLES A, B, & C:

GENERAL: ISOL= ISOLATOR, DEFL= DEFLECTION, RESTR = SEISMIC RESTRAINT. MTNG= MOUNTING. ALL DEFLECTIONS INDICATED ARE IN INCHES.

Note 1: For equipment with variable speed driven components having driven operating speed below 600 rpm, select isolation deflection from minimum deflection guide

Note 2: For roof applications, use base Type B-5.

Note 3: Curb Type B-3 shall use sound barrier RPFMA when there is no concrete under roof top units. Curbs can be used for return plenums. (See Option #1)

Note 4: Where curbs require supply and return sound attenuation package type SRRFMA shall be used. (See Option #2)

*Engineers Note: Where Type 3 or 4 sound attenuation systems are used this note shall appear on equipment schedule.)*

Note 5: Units may not be capable of point support. Refer to separate air handling unit specification section. If base is not provided by that section and external isolation is required, provide Type B-1 base by this section for entire unit.

Note 6: Static deflection shall be determined based on the deflection guide for Table “A”.

Note 7: Deflection indicated are minimums at actual load and shall be selected for manufacturer's nominal 5", 4", 3" 2" and 1" deflection spring series, RPM is defined as the lowest operating speed of the equipment.

Note 8: Single stroke compressors may require inertia bases with thickness greater than 14" maximum as described for base B-2. Inertia base mass shall be sufficient to maintain double amplitude for 1/8".

Note 9: Floor mounted fans, substitute base Type B-2 for class 2 or 3 or any fan having static pressure over 5".

Note 10: Indoor utility sets with wheel diameters less than 24" need not have deflections greater than .75".

Note 11: Curb mounted fans with curb area less then 9 square feet are excluded.

Note 12: For equipment with multiple motors, Horse Power classification applies to largest single motor.

<b>PLUMBING EQUIPMENT TABLE B</b>										
			ON GRADE, BASEMENT OR SLAB ON GRADE				ABOVE GRADE			
EQUIPMENT	HP	MTNG	ISOL	DEFL (in.)	BASE	RESTR	ISOL	DEFL (in.)	BASE	RESTR
Air Compressors	To 10	Flr	F	0.20	---	IV	B	0.75	---	IV
And Vacuum Pumps		Flr	E	0.75	B-2	V	E	1.50	B-2	V
Base Mounted	To 15	Flr	F	0.20	B-2	IV	B	0.75	B-2	IV
Pumps	>15	Flr	B	0.75	B-2	IV	B	1.50	B-2	IV

**TABLE C  
VIBRATION ISOLATION & SEISMIC RESTRAINT  
REQUIREMENTS FOR ELECTRICAL EQUIPMENT  
INSTALLATION ATTACHMENT POINT**

			ON GRADE				ABOVE GRADE			
EQUIPMENT	SIZE	MTNG	ISOL	DEFL	BASE	RESTR	ISOL	DEFL	BASE	RESTR
TRANSFORMER Dry type	ALL	Flr	--	--	--	IV	D	0.30	*	IV
		CEILING	--	--	--	V	E	0.20	*	V
GENERATORS	ALL	Flr	B	1.0	--	IV	B	1.50	*	IV
GENERATORS	ALL	Over Occupied Space					B	2.50	*	IV
UPS SYSTEMS	M		II	.40		IV	B	1.50	*	IV

*\* where component cannot be point supported base type B-1 shall be used.*

<b>TABLE D</b>			
<b>SEISMIC BRACING TABLE</b>			
<b>(Maximum Spacing Shown- Actual Spacing to Be Determined by Calculation)</b>			
EQUIPMENT	ON CENTER TRANSVERSE	ON CENTER LONGITUDINAL	CHANGE DIRECTION      OF
DUCT	30 FEET	60 FEET	4 FEET
<b>PIPE THREADED, WELDED, SOLDERED OR GROOVED</b>			
TO 16"	40 FEET	80 FEET	4 FEET
18" – 28"	30 FEET	60 FEET	4 FEET
30" – 40"	20 FEET	60 FEET	4 FEET
42" & LARGER	10 FEET	30 FEET	4 FEET
<b>PIPE - NO HUB OR BELL AND SPIGOT</b>			
2.5" & LARGER	10 FEET	20 FEET	4 FEET
BOILER BREECHING	30 FEET	60 FEET	4 FEET
CHIMNEYS & STACKS	30 FEET	60 FEET	4 FEET
CONDUIT	40 FEET	80 FEET	4 FEET
BUS DUCT	20 FEET	40 FEET	4 FEET
CABLE TRAY	40 FEET	80 FEET	4 FEET



**FORM CQAP**

Section 15000  
Vibration Isolation and Seismic Restraints

Contractor Name: \_\_\_\_\_  
Date: \_\_\_\_\_  
Project: \_\_\_\_\_  
Specification Section: \_\_\_\_\_

Contractor IBC Quality Assurance Seismic Program (Part of SGMEC) Specification

This form is to be filled out before the first submission in any vendor group by the installing contractor. All items listed herein shall be part of the contractor's quality assurance program.

1. Acknowledge special requirements contained in the quality assurance plan
2. Acknowledge that control will be exercised to obtain conformance with the construction documents
3. Procedures for exercising control within the contractors organization including frequency and distributions of inspections and testing reports
4. Identification and qualification of the persons exercising control of this program within their organization

Contractor to submit this program acknowledging receipt and program implementation. Each of the 4 listed programs are to be submitted including all applicable details as listed above.

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Print Name

**FORM CVC-1**

Section 15000  
Vibration Isolation and Seismic Restraints

Contractor Name: \_\_\_\_\_  
Date: \_\_\_\_\_  
Project: \_\_\_\_\_  
Specification Section: \_\_\_\_\_

Notes to the installing contractor

The purpose of this form is for you the contractor to fill in all vendors that are IBC approved as part of your initial submission for any group of equipment, ie., fans, ac units, pumps, etc. By identifying which of the vendors have IBC approval, both you and the project's specifying engineer are protected. Only IBC approved vendors can participate on this project. In the event that no vendor in any group has IBC certification than any vendor who meets the project's performance specifications is acceptable.

Note: The cutoff date for this requirement, for any vendor group, is the project's plan filing date for Code Review on this project.

<b>Manufacturer</b>	<b>Yes</b>	<b>No</b>

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Print Name

**FORM SQA-1**

Section 15000

Vibration Isolation and Seismic Restraints

Seismic Quality Assurance Plan for The Installation of Life Safety  
And High Hazard Systems (Inspections)

Contractor Name: \_\_\_\_\_  
Date: \_\_\_\_\_  
Project: \_\_\_\_\_  
Specification Section: \_\_\_\_\_

The following are required for the Seismic Quality Assurance Installation Plan for Life Safety and High Hazard systems to be prepared and submitted by each installing contractor. This plan must reflect all of the provisions and reports outlined in the paragraphs below. As part of this contractor's final requisition, this form must accompany, along with all satisfactorily completed tests and reports, the final payments request including all applicable certification reports.

- Special field inspection and testing is required by IBC Sections 1704, 1707 & 1708 during the installation of Life Safety and High Hazard System components including equipment, piping and all electrical connections. Components must be inspected by a Building Official or approved independent special inspector periodically during the course of installation. Contractor shall submit such inspection reports as part of his project wrap up for each group of equipment, components so requiring this program. All components, which are Life Safety designate or Handle Hazardous substances fall into this category. Typical Life Safety and High Hazard components as well as non-life safety components listed in that section, are outlined in Section 4 of the SGMEC<sup>®</sup> Specifications.

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Print Name

END OF SECTION 15072

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes receptacles, connectors, switches, and finish plates.

1.03 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.

1.04 SUBMITTALS

- A. Product Data: For each product specified.
- B. Shop Drawings: Legends for receptacles and switch plates.
- C. Samples: For devices and device plates for color selection and evaluation of technical features.
- D. Maintenance Data: For materials and products to include in maintenance manuals specified in Division 1.

1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- B. Comply with NEMA WD 1.
- C. Comply with NFPA 70.

1.06 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
  - 1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Wiring Devices:

- a. Hubbell.
  - b. Leviton.
  - c. Pass & Seymour.
  - d. Arrow Hart.
2. Multioutlet Assemblies:
- a. Wiremold.
3. Poke-through, Floor Service Outlets and Telephone/Power Poles:
- a. American Electric.
  - b. Hubbell, Inc.
  - c. Pass & Seymour.
  - d. Wiremold.

## 2.02 RECEPTACLES

- A. Straight-Blade and Locking Receptacles: Heavy-Duty, specification grade.
- B. GFCI Receptacles: Feed-through type, with integral NEMA WD 6, Configuration 5-20R duplex receptacle arranged to protect connected downstream receptacles on same circuit. Design units for installation in a ~~2-3/4-inch~~ deep outlet box without an adapter.

## 2.03 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
  1. Cord: Rubber-insulated, stranded-copper conductors, with type SOW-A jacket. Green-insulated grounding conductor, and equipment-rating ampacity plus a minimum of 30 percent.
  2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

## 2.04 SWITCHES

- A. Snap Switches: Heavy-duty, quiet type, specification grade.

## 2.05 WALL PLATES

- A. Single and combination types match corresponding wiring devices.
  1. Plate-Securing Screws: Metal with head color to match plate finish.
  2. Material for Finished Spaces: ~~0.04-inch~~ thick, Type 302, satin-finished stainless steel.
  3. Material for Unfinished Spaces: Galvanized steel.

## 2.06 POKE-THROUGH ASSEMBLIES

- A. Description: Factory-fabricated and -wired assembly of below-floor junction box unit with multi-channeled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.

1. Size: Selected to fit nominal 3-inch cored holes in floor and matched to floor thickness.
2. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
3. Closure Plug: Arranged to close unused 3-inch cored openings and reestablish fire rating of floor.
4. Wiring: Three No. 12 AWG power and ground conductors; one 75-ohm coaxial telephone/data cable; and one four-pair, 75-ohm telephone/data cable.

#### 2.07 MULTIOUTLET ASSEMBLIES

- A. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- B. Raceway Material: Metal, with manufacturer's standard finish.
- C. Raceway Material: Nonmetal.
- D. Wire: No. 12 AWG.

#### 2.08 FINISHES

- A. Color: as selected by Architect.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Install devices and assemblies plumb and secure.
- B. Install wall plates when painting is complete.
- C. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.
- D. Protect devices and assemblies during painting.
- E. Adjust locations at which floor service outlets and telephone/power service poles are installed to suit arrangement of partitions and furnishings.

#### 3.02 IDENTIFICATION

- A. Comply with Division 16 Section "Electrical Identification."
  1. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate.
  2. Receptacles: Identify panelboard and circuit number from which served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of plate and durable wire markers or tags within outlet boxes.

3.03 CONNECTIONS

- A. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.
- B. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 FIELD QUALITY CONTROL

- A. Test wiring devices for proper polarity and ground continuity. Operate each device at least six times.
- B. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- C. Replace damaged or defective components.

3.05 CLEANING

- A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION 16140