SGMEC ® SECTION 15000
REVISED June 2020
VIBRATION ISOLATION, SEISMIC, WIND & FLOOD LOAD RESTRAINTS FOR HVAC, PLUMBING, ELECTRICAL & FIRE PROTECTION COMPONENTS

SECTION 1 – GENERAL

This section specifies required vibration control and seismic restraints for all equipment, where applicable, with the wind load requirements for all equipment in outdoor locations. Additionally, included are provisions for flood control as stated herein. When projects are located in a geographically active seismic, wind or flood location, Section 1.4, General Design and Performance Requirements, will elaborate on those requirements and include specifics pertaining to a facility's continued operation. Para. 1.1, Section D is a partial list of components covered herein. This specification is part of the general conditions for the HVAC, Plumbing, Electrical and Fire Protection contracts.

1.1 SUMMARY DESCRIPTION AND REQUIREMENTS

A. This section includes the following:

1. All equipment, piping, ductwork and conduit as noted on the drawing's schedule or in the specification shall be seismically braced if the building is so classified as listed herein. All equipment, piping, ductwork, and conduit shall comply with section 1613, Earthquake Loads, IBC-2018. Vibration control shall apply as described in all cases herein.

2. All outdoor equipment, including roof-mounted components, shall comply with Section 1609, Wind Load, IBC-2018. There shall be no decrease of the effects of wind load on a component due to other structures or components acting as blocks or screens.

3. Flood control shall apply to all equipment, piping, ductwork and conduit below, at grade or above grade located in a flood hazard area as defined and located herein. All equipment, piping, ductwork and conduit shall comply with section 1612, Flood Loads, IBC-2018.

4. Seismic bracing, wind, flood load and isolation materials shall be the certified products of the same manufacturing group and shall be certified by that group.

5. It is the intent of the seismic and wind load portion of this specification to keep all mechanical, electrical, plumbing and fire protection building system components in place during a seismic or high-wind event and additionally operational where the occupancy category of the building so requires as listed herein.

6. All such systems must be installed in strict accordance with seismic/wind/flood codes, component manufacturer's and building construction standards.

7. This specification is considered to be minimum requirements for seismic, wind, flood and vibration control considerations.

8. Any variation, which results in non-compliance with the specification requirements, 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, bus duct, cable tray conduit and equipment, all referred to as components.

2. Component isolation bases.

3. Seismic restraints for isolated components.

4. Seismic restraints for non-isolated components.

5. Wind restraints for isolated components.

6. Wind restraints for non-isolated components.

7. Flood restraints for isolated components.

8. Flood restraints for non-isolated components.

9. Certification of seismic, wind or flood restraint designs.

10. Installation supervision.

11. Design of attachment of housekeeping pads to building structure.

12. All components requiring Special Seismic Certification.

13. All inspection and test procedures for components requiring Special Seismic Certification compliance.

C. All mechanical, electrical, plumbing or fire protection equipment, pipe and ductwork, within, on or outdoors of the building. Entry of services to the building, up to but not including, the utility connection, is part of this Specification.

D. Components referred to below are typical. (Components not listed are still included in this specification). All systems that are part of the building in any way are referred to as components, including:

- AC Units
- Adapter Curbs
- Air Handling Units
- Air Separators
- Battery Chargers
- Battery Racks
- Boilers
- Bus Ducts/Busways
- Cabinet Unit Heaters
- Cable Trays
- Chillers
- Compressors
- Computer Room Units
- Condensing Units
- Cooling Towers
- Curbs
- Dry Coolers
- Ductwork
- Electrical Panels
- Equipment Supports
- Fans (all types)
- Fan Coil Units
- Fire Alarm Panels
- Gas Detection Systems

- Generators
- Heat Exchangers
- Humidifiers
- Light Fixtures
- Motor Control Centers
- Piping
- Pumps (all types)
- Risers
- Rooftop Units
- Supports
- Switchgear Components
- Tanks (all types)
- Transformers
- Unit Heaters
- Unit Substations
- Unit Ventilators
- Variable Frequency Drives
- VAV Boxes
- Vibration Isolators
- Water Heaters

1.2 RELATED DOCUMENTS

Drawings and general conditions of the contract, including General Supplementary Conditions and Division 1 Specification Section, apply to this section. In the event that this section conflicts with the isolation or seismic requirements of other sections, the more stringent criteria stated herein shall apply.

1.3 DEFINITIONS (building and components, all codes)

A. ESSENTIAL FACILITIES

1. Buildings and other structures that are intended to remain operational in the event of extreme environmental loading from flood, wind, snow or earthquakes.

B. LIFE SAFETY AND HIGH HAZARD

1. All systems involved with fire protection, including sprinkler piping, jockey pumps, fire pumps, control panels, service water supply piping, water tanks, fire dampers, smoke exhaust systems and fire alarm panels. (Life Safety)

2. 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. (Life Safety)

3. All medical and life support systems. (Life Safety)

4. Hospital heating systems and air conditioning systems for maintaining normal ambient temperature. (Life Safety)

5. 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. (Life Safety)

6. All gases or fluids that must be contained in a closed system which are flammable or combustible. Any gas that poses a health hazard if released into the environment and vented Fuel Cells. (High Hazard)

7. Heating systems in any facility in Risk Category IV, as described in IBC-2015, where the ambient temperature can fall below 32 degrees Fahrenheit. (Life Safety)

C. GENERAL

Accredited Agency: An established and recognized agency regularly engaged in conducting tests or furnishing analytical or inspection services, when such agency has been ISO Accredited as a Product Certification Agency by a third-party Accreditation Body.

Anchor: A device, such as an expansion bolt, for connecting equipment/utility and/or equipment/utility bracing members to the structure of a building.

Attachment: See **Positive Attachment** below.

Basic Wind Speed: The basic wind speed, in mph, for determination of the wind loads shall be as per Section 1609 (IBC-2018), or local code, if more severe. Local jurisdictions shall determine wind speeds for indicated special wind regions located near gorges or mountainous terrain. Section 26.5 of ASCE 7-16 shall be used after determination of basic wind speed by the local jurisdiction. See Section 1609 IBC-2018 for basic wind speed determination in non-hurricane prone regions.

Bracing: Metal channels, cables or hanger angles that prevent components from breaking away from the structure during an earthquake or high winds. See also **Longitudinal Bracing** and **Transverse Bracing**. Together, they resist environmental 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. (Certificate to be supplied by equipment manufacturer)

Component: A non-structural part or element of an architectural, electrical, mechanical, plumbing or fire protection system within or without of a building system.

Component Importance Factor (Ip)**:** Factor applied to a component that defines the criticality of the component. This factor can be 1.0 or 1.5.

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.

Consequential Damage: The functional and physical interrelationship of components, their supports and their effect on each other shall be considered so that the failure of an essential or non-essential architectural, mechanical or electrical component shall not cause the failure of an essential architectural, mechanical or electrical component.

Designated Seismic System: Are those nonstructural building components with I_p = 1.5 and require seismic design in accordance with Chapter 13, ASCE7-16 in SDC C through F. Special Seismic Certification by the manufacturer is required for active mechanical and electrical equipment that must remain operational after the design earthquake.

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

Exposure Category: A category assigned to buildings based upon building height and nearby terrain, used to determine wind factors.

Flood or Flooding: A general and temporary condition or partial and complete inundation of normally dry land from:

1. The overflow of inland or tidal waters.

2. The unusual and rapid accumulation of runoff of surface waters from any source.

Flood Hazard Area: The greater of the following of two areas:

1. The area within a flood plain subject to a 1 percent or greater chance of flooding in any year.

2. The area designated as a flood hazard area on a community's flood hazard map, or otherwise legally designated.

Special Flood Hazard Area Subject to High Velocity Wave Action: Area within the flood hazard area that is subject to high velocity wave action and shown on a Flood Insurance Rate Map (FIRM) or additional flood hazard map as zone V, VO, VE or VI-30.

Flood Insurance Rate Map (FIRM): An official map of a community on which the Federal Emergency Management Agency (FEMA) has delineated both the special flood hazard areas and the risk premium zones applicable to the community.

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 or corrosive and in sufficient quantity to pose a significant life-safety threat to the general public if an uncontrolled release were to occur.

Hurricane Prone Regions: Areas vulnerable to hurricanes; in the United States and its territories, defined as:

1. The U.S. Atlantic Ocean and Gulf of Mexico Coasts where the basic wind speed for Risk Category II buildings is greater than 115 mi/h; and
2. Hawaii, Puerto Rico, Guam, Virgin Islands and American Samoa

IBC Public Listing Site: A website available to the general public that list components that are IBC certified or equal per the requirements of the International building Code and ASCE7. The site must define the S_{DS} level and mounting configuration of the certified component (IBCapproval.com).

Importance Factor, I: A factor that accounts for the degree of hazard to human life and damage to property.

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 (IBC Section 1703 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, and the name and identification of an approved agency that indicates that the representative sample of the product or material has been tested and evaluated by an approved agency (IBC Section 1703 and "Inspection Certificate," "Manufacturer's Designation" and "Mark").

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

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

Longitudinal force: An applied force that happens to be in the same direction as the duct, pipe, or conduit run.

Mark: Identification applied on a product by the manufacturer indicating the name of the manufacturer and the function of a product or material (see also "Inspection Certificate," "Label" and "Manufacturer's Designation").

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," "Label" and "Mark").

Positive Attachment: A mechanical device, designed to resist seismic forces, which connects a non-structural element, such as a duct, to a structural element, such as a beam. Bolts and welding are examples of positive attachments. Surface glue and friction anchorage do not constitute positive attachment. Examples of positive attachment are epoxy, cast-in anchors and drill-in wedge-shaped anchor bolts to concrete and welded or bolted connections directly to the building structural steel. C type clamps are not acceptable as either brace point attachments to the structure or for the support of the component at the bracing location.

Product Certification Agency: An ISO-17065 Accredited Agency engaged in the testing and certification of nonstructural components.

Risk Category: A categorization of buildings and other structures for determination of flood, snow, ice, and earthquake loads based on the risk associated with unacceptable performance, per Table 1.5-1, ASCE7-16.

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

Seismic Design Category: A classification assigned to a structure based on its Risk Category and the severity of the design earthquake ground motion at the site, as defined in Section 11.4, ASCE7-16.

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.

Site Class: A classification assigned to a site based on the types of soils present and their engineering properties as defined in Table 1613.3.2 (IBC-2018).

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, IBC-2018).

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.

Story Drift Ratio: The story drift (Lateral displacement) divided by the story height.

Transverse bracing: Bracing that prevents a component from moving from side to side.

Wind-Borne Debris Region: Portions of hurricane-prone regions that are within 1 mile of the coastal mean high water line where the ultimate design wind speed, Vult, is 130 mph (58 m/s) or greater, or portions of hurricane-prone regions where the ultimate design wind speed is 140 mph (63.6 m/s) or greater, or Hawaii.

1.4 GENERAL DESIGN AND PERFORMANCE REQUIREMENTS

A. General Design Requirements.
Based upon the Authority Having Jurisdiction for this project, the prevailing design code is: (*Project Engineer to choose one each of the following options for Code, Seismic, Wind and Flood considerations*).

IBC-2018/ASCE7-16

1. Seismic Considerations**:** This project has seismic design requirements as follows:

(a) Risk Category I
No MEP Components

Or (b) Risk Category I - IV (Seismic Design Category A & B)
No MEP Components

Or (c) Risk Category I, II & III (Seismic Design Category C through F)
Life Safety Components (Ip = 1.5)
High Hazard Components (All Gas Fired Components; Indoor and Outdoor) (Ip = 1.5)
Components affected by Consequential Damage (Ip = 1.0)

Or (d) Risk Category IV (Seismic Design Category C through F)
All Components

Or (e) Risk Category II, III & IV (Seismic Design Category C through F)

All Components, with the additional requirement of a manufacturer's Certificate of Compliance to prove 'on line' capability (Ip =1.5)

2. Wind Consideration**:** This project has wind design requirements as follows:

   (a) None (interior renovation only)
   Or (b) Wind load in non-hurricane or non-high wind prone regions, (see definition) (Rooftop structures and equipment; Chapter 29 of ASCE 7-16 design requirements apply).
   Or (c) Wind load in hurricane, tornado, high wind prone regions and/or wind-borne debris regions for any building height. (Rooftop structures and equipment; Chapter 29 of ASCE 7-16 design requirements apply).

3. Flood Considerations: This project has design requirements in accordance with FEMA and/or FIRM as follows:

   (a) None
   Or (b) Flood Hazard Area
   Or (c) Flood Hazard Area subject to high wave action

B. General Design Performance Requirements

1. Seismic and Wind Load Certification and Analysis:

   (a) Attachment calculations by the Seismic Restraint Manufacturer's licensed Engineer substantiating the mounting system, seismic or wind restraints, fasteners or ICC Certified Concrete Anchors shall be submitted for approval along with the shop drawings. Seismic loads shall have their calculations based on seismic loads as established in Specification Section 1.4, Paragraph B, article 7 Design Seismic Loads. Wind loads shall have their calculations based on Section 1.4, Paragraph B, article 8 Design Wind Loads. A registered professional engineer having a PE from the same state as the project, or state of restraint manufacturer shall stamp all analysis, or as required by local building codes.

   (b) Unless otherwise specified, all equipment, piping and ductwork shall be restrained to resist seismic forces. Restraints shall maintain 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:

      (i) International Building Code, IBC-2018 and ASCE7-16, applicable state and local codes
      (ii) NFPA (fire protection only)

2. Importance Factor, Ip = 1.5 Components and all Designated Seismic Systems:

   (a) In addition to all of the above provisions, for components having an Ip greater than 1.0, all trades shall comply with Sections 16 and 17 of the International Building Code using, when available, 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 contractor meets the

compliance, testing and certification portions of the IBC specification's Sections 16 and 17. Special inspections of the component installation shall still be conducted (Section 1.4, Paragraph B, Article 3) even if no vendors meet the following requirements. All equipment (components) shall be positively attached to the structure.

(b) Manufacturers of non-structural building components that require Special Seismic Certification per ASCE7-16, Section 13.2.2 for components shall have their equipment shake table tested by an Accredited Agency and be listed on a listing site available to the general public that displays their certificate of compliance, shake test parameters (S_{DS}, z/h), and whose agency adheres to an audit schedule. Approved sites:

(i) IBCapproval.com
(ii) or equal

3. All component manufacturers shall submit for approval the following as required below:

(a) For all life safety system components noted in this specification: the Accredited Agency's Certificate of Compliance for the specific equipment on this project when the Seismic Design Category is C through F shall include anchorage calculations and proof of post-test functionality. Use of seismic experience data shall not be permitted.

(b) In addition, all components needed for the continued operation of the facility in the above stated categories will have the manufacturer of that component submit the Accredited Agency's Certificate of Compliance for their equipment when the Seismic Design Category is C through F, Shake Test certification through the component's load path to structure at its center of gravity shall include post-test functionality. This requirement also pertains to projects that combine an emergency preparedness center within a structure of another Risk Category. Where components do not affect the facility's functional operation but could affect the performance of other components should they dislodge, only anchorage of that component requires compliance. Components with an Ip = 1.0 and needed for continued operation of the building, require Analytical or Shake Test certification through the total component's load path to structure calculated at its center of gravity. Certification shall prove anchorage, structural and functionality. For use of seismic experience data, see (a) above.

(c) All components containing hazardous or flammable materials will have the manufacturer of the component submit the Accredited Agency's Certificate of Compliance for their equipment when used on any project having a minimum Seismic Design Category of C through F. Certification shall be conducted by Analytical or Shake Test through the total component's load path to structure at its center of gravity and shall prove anchorage, structural capability and hazardous material containment. Testing shall prove that no internal component will rupture to insure against loss of hazardous or flammable (explosive) material that could support combustion, ignite or contaminate.

(d) All components requiring anchorage compliance only, not listed in the above categories, shall have the manufacturer of each component submit a PE-stamped calculation package stating that their project-specific equipment will accept anchorage by calculating its reactions 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 through F.

4. Special and Periodic Inspection: (Risk Category IV Projects)

The following systems shall require Special Inspection and Periodic Special Inspection for seismic installation and anchorage during the course of construction, as defined earlier in this section for all buildings in Seismic Design Categories C through F.

(a) 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-2018, Section 1705.18)

(b) All electrical components for standby or emergency power systems require Periodic Special Inspection.*

(c) All electrical equipment in Seismic Design Categories E and F. (Periodic)*

(d) All flammable, combustible and highly toxic piping and their associated mechanical systems. (Periodic)*

(e) All ductwork containing hazardous materials. (Periodic)*

(f) All equipment using combustible or toxic energy sources. (Special $^{-1}$)

(g) All electric motors, transformers, switchgear unit substations and motor control centers. (Special $^{-1}$)

(h) Reciprocating and rotating type machinery. (Special $^{-1}$)

(i) Pipe, 3" and larger. (Special $^{-1}$)

(j) Tanks, heat exchangers and pressure vessels. (Special $^{-1}$)

(k) Isolator units for seismic isolation system. (Periodic)*

(l) Manufacturer's written Quality Control Program for projects in Seismic Design Categories E or F.

5. Contractor Responsibilities and Approvals: (Risk Category IV Projects)

(a) Each contractor responsible for the installation of the components asterisked above (*) shall be responsible for submitting a written contractor's Statement of Responsibility (IBC-2018 Section 1704) (as outlined below) to the design team for their approval.

(b) In addition, all -1 items above require Special Inspection in accordance with

IBC Section 1705.12 (Form CQAP and SQA-1) at the end of this specification.

(c) Contractor Shall:

(i) Identify the components that are part of the Quality Assurance Plan. (Asterisked above) *

(ii) Identify all Special Inspection and Testing for components installed as part of this contract.

(iii) 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.

(iv) List all personnel, including their qualifications, exercising control over the seismic aspects of the project.

6. Risk Category II or III, IBC-2018 (Or similar Occupancy Categories in other codes), Ip 1.0, Seismic Design Category C:

(a) Projects in these categories require seismic bracing for all life safety and high hazard components, Paragraph 1.3B sub-paragraphs 1, 2, 5 and 6. In addition, any un-braced component that could adversely affect the performance of a component that must remain functional, Ip 1.5, or could cause the failure or release of hazardous materials (gas or liquid fuel), must be braced or anchored to avoid such failure. This includes any component that could fall or move laterally. (Consequential Damage, ASCE 7-16, Section 13.2.3).

7. Design Seismic Loads:

(a) Projects in the United States have a minimum design load of 0.4g for statically mounted components and 0.5g for resiliently mounted components. Actual loads for both internal and external isolation and/or anchorage of components shall be as above or as calculated for the specific project location but in no event shall it be less than the above. Code calculated loads greater than these shall supersede.

(b) Exclusions for seismic restraint of piping and duct shall be according to applicable codes and as stated herein. The minimum horizontal restraint capability shall be 0.4g horizontal and 0.27g vertical (in addition to the gravity load). Life safety equipment defined above shall be designed to withstand a minimum horizontal load of 0.9g and a vertical load of 0.6g. Code calculated loads greater than these shall supersede.

(c) 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, grade, embedment depth and/or welded size and length. All seismic restraint devices shall be designed to accept, without failure, the forces detailed in this section, acting through the equipment center of gravity.

(d) Vertical seismic load shall be calculated at 1/3 the horizontal load as a minimum, or, as prescribed by the code as 0.2 times S_{DS}.

(e) Internally isolated equipment in lieu of specified isolation and restraint systems must meet all of the requirements of this section, all articles.

(f) A Seismic Design Errors and Omissions Insurance Certificate must accompany the seismic restraint equipment manufacturer's calculation. Product liability insurance certificates are not acceptable.

(g) Whether the equipment is internally or externally 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 or wind 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 acceptable provided that the following five conditions are met and verified.

(i) Calculations support sufficient quantity and size of sheet metal screws to handle all loads including shear.

(ii) Shear and tension allowables are obtained from an accredited third-party source, such as ICC or NDS, not from the screw manufacturer.

(iii) Space or gap between the inside overhang of the rooftop unit and the curb at each of the screw locations is closed with structural material, tapered to contour to both the curb and the components' inside edge structure.

(iv) Attachment points of the roof-mounted unit to curb and the curb to structure demonstrates structural load path.

(v) The method of attachment does not violate the NRCA rating of the curb by violating the roof member's waterproofing.

(h) Failure is defined as the discontinuance of any attachment point or load path between component and structure. Permanent deformation of the component is acceptable as long as the component continues to operate without failure and, if permanent, it is within acceptable manufacturing or structural tolerances.

8. Design Wind Loads:

(a) All outdoor mounted components shall be positively fastened to their supporting structure as discussed below. Fastening to metal deck is not permitted.

(i) If component is curb or support mounted, reporting requirements per article 7, Design Seismic Loads, paragraph g shall be followed for all roof-mounted components in excess of 9 sq. ft. in plan area. Curbs shall be as described in Base Type B5 if isolated or B6 if non-isolated.

(ii) If component is support mounted, reporting requirements per

article 7, Design Seismic Loads paragraph g shall be followed for all roof-mounted components requiring waterproofed rail supports. Equipment supports shall be Base Type B5 if isolated or B6 if non-isolated.

(iii) If equipment is dunnage or grillage mounted, positive attachment shall occur through welding or bolting of equipment to steel. Equipment supports shall be Base Type B2.

(b) Loads and calculations shall be based on IBC-2018, figure 1609 and related sections in ASCE 7-16, using the appropriate wind maps for the respective Risk Category.

(c) Basic design wind speed shall be based on IBC-2018, Section 1609.

(d) In no event shall adjacent buildings, structures or screens be considered to diminish the calculated wind load or its effect on an outdoor component.

9. Design Flood Loads:

(a) When a building or structure is located in a flood hazard area, anchorage for all components subjected to those locations shall follow Section 1.4 article 2d. for their proper fastening to structure.

(b) Components used for anchorage purposes shall be hot dipped galvanized, cadmium-plated or powder-coated for the purpose of anti-corrosion.

10. Additional Seismic Design Requirements for Fire Protection Components

(a) Fire sprinkler piping system shall be braced to meet the minimum requirements of NFPA No. 13. Additionally, all branch lines will be braced for structures in Risk Category IV, IBC-2018.

(b) All branch lines shall be end tied if not braced (Risk Categories II & III).

(c) Standpipe risers shall be provided with a minimum of (1) flexible coupling (Victaulic Style 77 or equal) to accommodate lateral drift at each floor level.

(d) Vertical pipe risers shall have their weight, where possible, supported above the center of gravity of the riser. Provide lateral guides at the top and bottom of the riser and at intermediate points not to exceed 30’.

(e) Friction connections of any fire protection line to structure are not permissible under any circumstances. All connections must be positively attached to structure.

(f) Branch lines shall never act as a brace to mains or cross-mains.

(g) All pipe sleeves through floors shall be designed to accommodate differential movement between the floors.

(h) All pipe sleeves through walls shall be designed to accommodate differential movement between the structures, when the walls are separations between

two independently moving structures.

1.5 SUBMITTAL DATA REQUIREMENTS

A. The manufacturer of vibration isolation, seismic, wind and flood 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 restraints by referencing numbered descriptive drawings.

(c) Manufacturers of isolated or non-isolated components shall submit their IBC Compliance listing by the Certified Seismic Qualification Agency.

2. Shop Drawings (Only when field fabrication is required):

(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 and utilities.

(c) Where walls, floors, slabs or supplementary steel work are used for restraint locations, details of acceptable attachment methods for ducts and pipe must be included and approved before the condition is accepted for installation. Restraint manufacturer's submittals must include spacing and maximum seismic/wind loads at the restraint points.

(d) Provide specific details of restraints and anchors, include number, size and locations for each piece of equipment. Restraint and anchor allowables shall be by structural testing, shake testing, analysis or third-party certification.

(e) Calculations shall be submitted as required in Section 1.4, General Design and Performance Requirements.

1.6 RELATED WORK

A. Housekeeping pad structural design, including its attachment to building structure, shall be by the structural engineer of record or as shown on the contract drawings. Attachment of all components and restraints to the pad and size of the pad 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 the contractor where specified. Housekeeping pads shall be sized to accommodate a minimum 6" of clearance all around the equipment; or 12 times the outermost anchor bolt diameter, whichever is greater. Where exterior isolators are used, this distance shall be as measured from the outermost holes in the isolator base plate to the edge of the housekeeping pad, or per isolator manufacturer's

recommendation.

B. The project's structural engineer shall design all roof and interior steel to support and make connections to all components, including roof-mounted equipment specified in other sections. Design shall comply with IBC requirements including load path to structure.

C. Roof steel supporting roof-mounted equipment shall be designed for all seismic and wind forces including, but not limited to, tension, compression and moment loads.

D. Chimneys, stacks and boiler breeching passing through floors are to be attached at each floor level with a riser guide.

E. Where ceilings are not braced, lay-in lighting fixtures, weighing more than 20 lbs, shall have at least 2 independent corner diagonal wire ties to structure.

F. Lay-in ceilings in compliance with seismic code requirements may use earthquake clips or other approved means of positive attachment to brace fixtures such as panel lights and diffusers less than 40 lbs. to T-bar structures. Local codes dictate fixture support requirements.

1.7 CODE AND STANDARDS REQUIREMENTS

A. Typical Applicable Codes and Standards

1. All City, State and Local Codes (Code)

(1) International Building Code (Code)

(2) American Society of Civil Engineers Standard 7 (Standard)

(3) SMACNA Guidelines for Seismic Restraint of Mechanical Systems, Second Edition (Standard reference, to be used for design purposes only, not code)

(4) NFPA 13 and 14 for Fire Protection System (Standard)

(5) ASHRAE (Standard reference, to be used for design purposes only, not code).

(6) VISCMA (Vibration Isolation and Seismic Controls Manufacturers Association) (Standard reference, to be used for design purposes only, not code).

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

1.8 QUALITY ASSURANCE

A. Manufacturer of vibration isolation, seismic, wind and flood load control equipment or manufacturer's approved representative shall have the following responsibilities:

1. Determine vibration isolation and restraint sizes and locations.

2. Provide vibration isolation and restraints as scheduled or specified.

3. Provide calculations and materials, if required, for restraint of non-isolated equipment.

4. Provide installation instructions in writing, drawings and trained field supervision, where necessary, to insure proper installation and performance.

5. Approve correctness of installation upon completion, in writing.

6. All provisions of Section 1.4, General Design and Performance Requirements.

B. All manufacturers of vibration control, seismic, wind or flood restraining systems must provide a Seismic Design Error and Omissions Insurance Certificate, with a minimum coverage of $3mm, for their firm or their design consultant to certify their ability to provide engineering and design as required by this section. This document shall be provided at the time of first submittal from the seismic restraint provider.

C. All manufacturers of any type of equipment including OEM are responsible for Section 1.4.

D. Equipment manufacturer's substitution of internally or externally isolated and/or 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 the Seismic Restraint Design (See Section 1.4B, Article 2), stating that the seismic restraints are in full compliance with these specifications. Where used on an Essential or High Hazard Facility, manufacturer's certification proving online capability shall be required in addition to all requirements stated in Section 1.4B. Letters from field offices or representatives are unacceptable.

E. All costs for converting to the specified vibration isolation and/or restraints shall be borne by the equipment manufacturer in the event of non-compliance with the preceding. Substitution of internal isolation is unacceptable for:

(1) Indoor or outdoor mounted equipment over or adjacent to:
(a) Patient or operating areas
(b) Theatre space
(c) Office locations
(d) Assembly areas

SECTION 2 – PRODUCTS

2.1 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 **VMC Group, including Vibration Mountings & Controls, Amber/Booth or Korfund Dynamics**. Products from other nationally recognized manufacturers are acceptable provided their systems strictly comply with these specifications and have the approval of the specifying engineer. Manufacturer shall be a regular member of VISCMA (Vibration Isolation and Seismic Controls Manufacturers Association). See Form VL-1 listing other manufacturers to be considered for use on this project.

B. Manufacturers of non-structural building components that require Special Seismic Certification per the ASCE7 Section 13.2.2, for isolated and non-isolated components shall be listed on a listing site available to the general public that displays the certificate of compliance.

C. IBCapproval.com or approved equal.

2.2 VIBRATION ISOLATION TYPES

A. Type 1: Pad Type Elastomer Isolator (Double Height)
Maxi-Flex

1. One layer of 3/4” thick elastomeric pad consisting of 2” square modules for size required.

2. Load distribution plates shall be used as required; Type 1E

3. Bolting required for seismic compliance. Elastomeric and duck washers and bushings shall be provided to prevent short-circuiting, as necessary.

B. Type 1: Pad Type Elastomer Isolator (Single Height)
NR, Shear-Flex

1. One layer of 3/8” thick elastomeric pad with alternating height ribs on both sides.

2. Load distribution plates shall be used as required; Type 1E

3. Bolting required for seismic compliance. Elastomeric and duck washers and bushings shall be provided to prevent short-circuiting, as necessary.

C. Type 1: Pad Type Elastomer Isolator (Sandwich Style)
NRC

1. Multi-layered elastomeric pad, minimum of 1” thick, with interior core of damped elastomeric material and outer layers of single sided ribbed pads.

2. Load distribution plate shall be used as required.

3. Bolting required for seismic compliance. Elastomeric and duck washers and bushings shall be provided to prevent short-circuiting.

D. Type 1: Pad Type Elastomer Isolator (High Density)
Fabri-Flex

1. Laminated canvas duck and neoprene, maximum loading 1000 psi, minimum ½" thick.

2. Load distribution plate shall be used as required.

3. Bolting required for seismic compliance. Elastomeric and duck washers and bushings shall be provided to prevent short-circuiting.

E. Type 2: Elastomer Floor Isolator
R, RD, RVD

1. Bridge-bearing elastomeric mountings shall have a nominal static deflection of up to 0.5". The mount shall have ribbed bottoms to prevent sliding and mounting holes to prevent movement.

2. Mounts shall have internal threaded attachment hardware molded into the elastomer.

3. The shock-absorbing elastomeric materials shall be compounded to SBR, bridge-bearing or Durulene™ specifications.

F. Type 2E: Lateral and Uplift Limiting Elastomer Floor Isolator
RSM, MB, RVD, TTB, RDC

1. Bridge-bearing elastomeric mountings shall have a nominal static deflection of 0.2" and all-directional seismic capability. The mount shall consist of a ductile iron or aluminum casting containing molded elastomeric elements.

2. The elements shall prevent the central threaded sleeve and attachment bolt from contacting the casting during normal operation.

3. The shock-absorbing elastomeric materials shall be compounded to bridge-bearing or Durulene™ specifications.

G. Type 3: Spring Isolator – Free Standing
A, AB, AW, AWH

1. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded elastomeric cup or ¼" elastomeric acoustical friction pad between the bottom of isolator 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 operating deflection.

5. Operating deflection shall be within 25% of rated deflection.

H. Type 4: Housed Spring Isolator
CT, CD, CP, CE, CAL

1. Housed spring isolators shall have a Type 3 spring isolator within a rigid housing that allows for free vertical motion, without restraint.

2. Housing shall be capable of providing stability to the spring.

3. Housing shall be provided with elastomeric elements between upper and lower housings.

4. Molded or bonded elastomeric pads shall be provided on the bottom of the housing.

I. Type 5: Lateral and Uplift Limiting Spring Isolator
MS, MSS, AEQM, ASCM, AMSR

1. Restrained spring mountings shall have a Type 3 spring isolator within a rigid housing that includes vertical limit stops to prevent spring extension if weight is removed.

2. The housing shall serve as blocking during erection. A maximum clearance of ¼" shall be maintained around restraining bolts and internal elastomeric deceleration bushings.

3. Limit stops shall be out of contact during normal operation. If housings are to be bolted or welded in position there must be an internal isolation pad or elastomeric cup.

4. Housing shall be designed to resist all seismic forces. As calculated within this specification.

5. When Type 5 isolators are provided with equipment requiring Special Seismic Certification, isolator shall be the same as that which was tested on the equipment.

J. Type 6: Elastomer Double Deflection Hanger Isolator
HR

1. Molded (minimum 1-¼" thick) elastomeric element with projecting bushing lining the rod clearance hole. Static deflection at rated load shall be a nominal of 0.35."

2. Steel retainer box encasing elastomeric mounting capable of supporting equipment up to two times the rated capacity of the element.

K. Type 7: Spring Hanger Isolator
HS

1. Spring elements in a steel retainer box, with openings top and bottom

2. Hanger locations requiring pre-compression for holding piping at fixed elevation shall be type pre-compressed or pre-positioning for all manufacturers. Type HSP

3. 30° angularity feature is not required.

L. Type 7A: Spring Hanger Isolator (Angularity Type)
HSA

1. Spring and elements in a steel retainer box with the features as described for Type 7 isolators.

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° capability.

4. Hanger locations requiring pre-compression for holding piping at fixed elevation shall be type pre-compressed or pre-positioning for all manufacturers. Type HSPA

M. Type 8: Combination Spring/Elastomer Hanger Isolator
HRS

1. Hangers shall consist of rigid steel frames containing minimum 1-¼" thick elastomeric elements at the top and a steel spring with general characteristics as in Type 7. The elastomeric element shall have resilient 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. Hanger locations requiring pre-compression for holding piping at fixed elevation shall be type pre-compressed or pre-positioning for all manufacturers. Type HRSP

4. 30° angularity feature is not required.

N. Type 8A: Combination Spring/Elastomer Hanger Isolator (Angularity Type)
HRSA

1. Hangers shall consist of rigid steel frames containing minimum 1-¼" thick elastomeric elements at the top and a steel spring with general characteristics as in Type 7. The elastomeric element shall have resilient 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° capability.

4. Hanger locations requiring pre-compression for holding piping at fixed elevation shall be type pre-compressed or pre-positioning for all manufacturers. Type HRSPA

O. Type 9: Thrust Restraints
RSHTR, TRK

1. A spring element similar to Type 3 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 ¼" due to thrust forces. Contractor shall supply hardware.

2. Thrust restraints shall be installed on all cabinet fan heads, axial or centrifugal fans whose thrust exceeds 10% of unit weight.

P. Type 11A: Pipe Anchors
MDPA, AG

1. All-directional acoustical pipe anchor, consisting of two sizes of steel tubing or piping separated by a minimum ½" thick 60 durometer elastomer.

2. Vertical restraint shall be provided by similar material arranged to prevent vertical travel in either direction.

3. Applied loads on the isolation material shall not exceed 500 psi and the design shall be balanced for equal resistance in any direction.

Q. Type 11G: Pipe Guides
AG, AGG, SWP, SWX

1. Pipe guides shall consist of a telescopic arrangement of two sizes of steel tubing or piping separated by a minimum ½" thickness of 60 durometer elastomer.

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 replaceable to allow for selection of pipe movement.

3. Guides shall be capable of ± 1 5/8" motion, or to meet location requirements.

2.3 SEISMIC RESTRAINT TYPES

A. Type 2E: Seismically Restrained Elastomer Floor Isolator
RSM, MB, RVD

1. Refer to vibration isolation Type 2.

B. Type 3E: All-Directional Seismic Snubber
SR, ER, ERX

1. All-directional seismic snubbers shall consist of interlocking steel members restrained by an elastomeric bushing.

2. Passive restraint assemblies that are used in conjunction with Type 3 Spring Isolators.

3. Housing must not allow for metal to metal contact.

4. Minimum 0.25” elastomeric element required between housings.

5. Snubbers shall be designed to restraint translational movement in all three orthogonal directions.

C. Type 5A, 5B, 5C, 5D: Seismically and Wind Restrained Spring Isolator
MS, MSS, AEQM, ASCM, AMRS

1. Refer to Vibration Isolation Type 5.

D. Type S5: Floor or Roof Anchorage
Cast-In Plates

1. Rigid attachment to structure utilizing wedge type anchor bolts, anchored plates, machine screw, bolting or welding. Power shots are unacceptable.

E. Type S6: Seismic Rod Brace Clamp
RSC, SRBC

1. Seismic Rod Brace Clamps shall be capable of increasing the buckling allowable of the suspended rod when the applied compression load exceeds the calculated buckling load on the rod. Seismic Rod Brace Clamps shall be capable of easily attaching supplemental steel to the suspended threaded rod. It is easily installed after the rod is installed. Typically used with a minimum of three per rod when required.

F. Type S1: Seismic Cable Brackets
SB

1. Seismic Cable Brackets shall be designed to accommodate field installation of appropriately sized cable.

2. Bracket shall be third party rated (UL, FM, etc.) to meet the design seismic loads in this specification.

3. Brackets mounting holes shall be sized and spaced to facilitate attaching to industry standard strut channel.

G. Type S2: Seismic Cable Restraint Kits
SB, LRC

1. Seismic Cable Restraints shall consist of galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint.

2. Cable end connections shall be able to attach to Type S1 brackets or come pre-swaged from the manufacturer.

3. Cables must not be allowed to bend across sharp edges.

H. Type S3: Rigid Arm Brace
SAB

1. Seismic solid braces shall consist of steel angles or channels to resist seismic loads with a minimum safety factor of two 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 two anchor bolts to provide proper attachment spaced to ICBO standards for attachment to concrete.

2.4 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 forces in accordance with the project location. (Fastening to metal deck is unacceptable).

B. Type B1: Integral Structural Steel Base
WFB, SFB, WSB

1. Rectangular bases are preferred for all equipment.

2. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split case and end suction pumps shall include supports for suction and discharge elbows.

3. All perimeter members shall be structural steel beams with a minimum depth equal to 1/12 of the longest dimension between isolators.

4. Base depth need not exceed 12" provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer.

5. Height saving brackets shall be employed in all mounting locations to provide a minimum base clearance of 2."

C. Type B2: Dunnage/Grillage Platforms

1. For large rooftop equipment, such as Cooling Towers, platforms shall be constructed using building structural steel beams.

2. System shall be designed for positive anchorage or welding of equipment to supports and welding of supports to the building steel, capable of carrying the design seismic loads.

3. Isolated platforms shall be capable of having Type 5 isolators positively attached to the frame prior to rigging.

D. Type B3: Isolated Equipment Supports
R7200/R7300

1. Continuous structural equipment support rails that combine equipment support and isolation mounting into one unitized roof flashed assembly with all features as

described for Type B-3.

2. System shall be designed for positive anchorage or welding of equipment to supports and welding of supports to the building steel, capable of carrying the design seismic loads.

E. Type B3: Non-Isolated Equipment Supports
R7000

1. This shall have the same provisions without the spring isolation.

F. Type B4: Concrete Inertia Base
MPF, WPF, CPF

1. Vibration isolation manufacturer shall furnish rectangular welded or bolted modular steel concrete pouring forms for floating and inertia foundations.

2. Bases for split case and end suction pumps shall be large enough to provide for suction and discharge elbows.

3. Bases shall be a minimum of 1/12 of the longest dimension between isolators but not less than 6."

4. The base depth need not exceed 12" unless specifically recommended by the base manufacturer for mass or rigidity.

5. Forms shall include a minimum concrete reinforcing consisting of 3/8" bars welded in place a maximum of 16" on centers running both ways in a layer 1 to 1½" above the bottom.

6. Forms shall be furnished with steel templates to hold the component anchor bolts sleeves and anchors while concrete is being poured.

7. Height saving brackets shall be employed in all mounting locations to maintain a 2" minimum operational clearance below the base.

G. Type B6: Seismic Isolation Curb
P6200, P6300, TeleCurb®

1. 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 rooftop unit to the curb, which will not violate the National Roofing Contractors Association (NRCA) ratings of the membrane waterproofing. Sheet metal screws are only acceptable if all provisions in Section 1.4, Article B, 7, Design Seismic Loads, are met. Contact points between the rooftop unit, the curb and the building's structure shall show load path through those locations only.

2. All-directional elastomeric snubber bushings shall be minimum of ¼" thick. Steel springs shall be laterally stable and rest on ¼" thick elastomeric acoustical pads or

cups.

3. Hardware must be plated, and the springs shall be powder-coated or cadmium-plated.

4. The curb's waterproofing shall be designed to meet all NRCA requirements.

5. All spring locations shall have access ports with removable waterproof covers and all isolators shall be adjustable, removable and interchangeable.

6. Isolated curbs shall be supplied with a continuous air seal between the upper floating member and the stationary wood-nailer.

   Option #1 Where a special 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 the factory duct liner installed by the curb manufacturer. The entire curb shall have a continuous neoprene elastomeric 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 elastomeric air seal and isolated plenum divider. Both supply and return ducts shall seal directly to curb base floor attenuation panels.

   Option #3 Where curb is not required to have a special sound package, curb shall still be available with structure to support lay-in gypsum panels for sound protection, if required.

H. Type B5: Seismic Non-Isolated Curbs
   P6000, TeleCurb® (non-isolated)

1. Seismic curbs shall have all provisions as Type B6 curbs with the exception of spring isolation.

2. System shall be designed for positive anchorage or welding of equipment to supports and welding of supports to the building steel, capable of carrying the design seismic loads.

I. Type B3: Isolated Equipment Supports
   R7200/R7300

1. Continuous structural equipment support rails that combine equipment support and isolation mounting into one unitized roof flashed assembly with all features as described for Type B6.

2. System shall be designed for positive anchorage or welding of equipment to supports and welding of supports to the building steel, capable of carrying the design seismic loads.

J. Type B3: Non-Isolated Equipment Supports
R7000

1. This shall have the same provisions as Isolated Equipment Supports without the spring isolation.

K. Type B7: Computer Room Unit Base
SFS

1. 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, but no less than the design seismic loads.

2. Elastomeric isolated stands shall have 1" of adjustment to accommodate floor irregularities and 0.25" of nominal static deflection.

3. Spring isolated stands shall have 1" of adjustment to accommodate floor irregularities and 2" of nominal static deflection.

4. Bolting or welding is required to meet seismic criteria.

5. Stands to have positive fastening provisions for bolting of computer room unit to seismic floor stand and fastening of seismic isolated floor stand to structure, capable of carrying the design seismic loads.

2.5 FLEXIBLE CONNECTORS

A. Type 10-FC-2: Flexible Stainless-Steel Hose
SS-FP, SS-FW, SS-PM, SS-WE

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 10-BC-2 connector shall be braided bronze for Freon connections.

1. Minimum lengths shall be as tabulated:

Flanged		Male Nipples	
3 x 14	10 x 26	½ x 9	1 ½ x 13
4 x 15	12 x 28	¾ x 10	2 x 14
5 x 19	14 x 30	1 x 11	2 ½ x 18
6 x 20	16 x 32	1 ¼ x 12	8 x 22

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

SECTION 3- EXECUTION

3.1 EXAMINATION

A. All areas that will receive components requiring vibration control, seismic or wind load bracing shall be thoroughly examined for deficiencies that will affect their installation or performance. Such deficiencies shall be corrected prior to the installation of any such system.

B. Examine all "rough ins" including anchors and reinforcing prior to placement.

3.2 COMPONENT INSTALLATION, (General)

A. All vibration isolators and seismic, wind 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, wind 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 specified herein.

D. The contractor shall not install any isolated components in a manner that 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 due to 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 rigid braces may be used in place of cables on rigidly attached systems.

I. At locations where seismic cable restraints or seismic single arm braces are located, the support rods must be braced when necessary to accept compressive loads. See Table "E."

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. 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."

M. Special and Periodic Inspections for items listed in Section 1.4, Article B shall be conducted and submitted on a timely basis.

3.3 EQUIPMENT INSTALLATION

A. Equipment shall be isolated and/or restrained as per Tables A-E at the end of this section.

B. Place floor mounted equipment on 4" actual height concrete housekeeping pads properly sized and doweled or expansion shielded to the structural deck to meet acceleration criteria (see Section 1.4). Anchor isolators and/or bases to housekeeping pads. Concrete work is specified under that section of the contract documents.

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. All components shall be installed on blocks to the operating height of the isolators. After the entire installation is complete and under full load including water, 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 to move in all directions, within the limits of the restraints.

4. Ceilings containing diffusers or lighting fixtures must meet seismic requirements by using earthquake clips of other approved means of positive attachment to secure diffuser and fixtures to T-bar structure.

5. All floor or wall-mounted equipment and tanks shall be restrained with Type V restraints.

3.4 PIPING AND DUCTWORK ISOLATION

A. Vibration Isolation of Piping:

1. HVAC Water Piping: All spring type isolation hangers shall be pre-compressed or pre-positioned if isolators are installed prior to fluid charge. If installed afterwards, field pre-compressed isolators can be used. All HVAC piping in the machine room shall be isolated as well as pressurized runs in other locations of the building 6" and larger. Type 8 hangers shall isolate horizontal pressurized runs in all other locations of the building. Floor supported piping shall rest on Type 5 isolators. Heat exchangers and expansion tanks are considered part of the piping run. The first 3 isolators from the isolated equipment shall have at least 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" nominal deflection or greater for pipe sizes up to and including 3," 1-3/8" nominal deflection or greater for pipe sizes greater than 3." Where column spacing exceeds 35', isolation hanger deflection shall be 2-1/2" for pipes exceeding 3" diameter.

2. Steam and Condensate Piping: All ceiling suspended piping in the mechanical equipment room shall be isolated with Type 6 hangers. All floor supported piping shall be supported with Type 2E isolators.

3. Plumbing Water Lines: Plumbing water lines in the machine room shall only be isolated if connected to isolated equipment. (See Table B). Isolator type shall be as listed in Article 1, above.

4. Riser Location: All risers shall be supported on Type 11A anchors or 11G guide restraints positively attached to both the riser and structure. Spiders welded to the pipe can substitute for guides using Type 11A anchors.

5. Control Air Piping: Where control air piping is connected to mechanical piping, equipment shall be flexibly connected in horizontal and vertical plane with Type 10-FC-2 flexible connectors.

6. Gas lines shall not be isolated.

7. Fire protection lines shall not be isolated.

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 and piping with an Ip=1.5 shall be seismically restrained or braced. Type S2 seismic cable restraints or resilient single arm braces shall be used if piping is isolated. Type S2 seismic cable restraints or Type S3 single arm braces may be used on non-isolated piping. There are no exclusions for size or distance in this category.

2. Seismically restrain piping, with an Ip = 1.0, located in boiler rooms, mechanical equipment rooms and refrigeration equipment rooms that is 1¼" I.D. and larger. Type S2 seismic cable restraints or resilient single arm braces shall be used if piping is isolated. Type S2 seismic cable restraints or Type S3 single arm braces may be used on non-isolated piping.

3. Seismically restrain all other piping 2½" diameter and larger. Type S2 seismic cable restraints or resilient single arm braces shall be used if piping is isolated. Type S3 seismic cable restraints or single arm braces may be used on non-isolated 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 as listed in Table E.

7. Clevis hangers shall have braces 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 longitudinal restraint for a pipe section of the same or smaller size connected perpendicular to it if the restraint is installed within 24" of the centerline of the smaller pipe 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 S2 or S3 restraint, if trapeze is smaller than 48" long.

12. Branch lines may not be used to restrain main lines or cross-mains.

13. All fire protection branch lines shall be end tied.

14. Where pipe passes through a fire-rated, seismic gypsum wall, the wall can act as a lateral/transverse brace for pipe sizes up to and including 6," provided fire stopping material is tight to the pipe.

15. Where pipe passes through a seismic block or concrete wall, the wall can act as a lateral/transverse brace.

16. Where horizontal pipe crosses a building's drift expansion joint, allowance shall be part of the design to accommodate differential motion.

17. Vertical pipe rises between floors shall have their differential movement part of the seismic design for building drift.

18. For horizontal passage of all underground utilities through building's foundation wall, all pipes shall pass freely through an oversized opening and waterproofed accordingly to accommodate maximum allowable building drift.

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 3 or Type 8 isolators. Actual 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 8 combination spring elastomer hangers or Type 3 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 S2 seismic cable restraints or Type S3 single arm braces shall be used on this duct. Duct that serves a life safety function or carries toxic materials in an

"Essential or High Hazard Facility" must be braced with no exceptions regardless of size or distance requirements.

2. Restrain round ducts with diameters of 28" or larger. Type S2 seismic cable restraints or Type S3 single arm braces.

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. Duct 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. Additional reinforcing is not required if duct sections are mechanically fastened together with frame bolts and positively fastened to the duct support suspension system.

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.

8. If ducts are supported by angles, channels or struts, ducts shall be fastened to it at seismic brace locations in lieu of duct reinforcement.

EXEMPTIONS

1. EQUIPMENT:
   (1) Curb-mounted mushroom, exhaust and vent fans with curb area less than nine square feet are excluded.

   (2) Mechanical and electrical components in Seismic Design Category B.

   (3) Mechanical and electrical components in Seismic Design Category C provided that either:

      (a) The component Importance Factor, Ip, is equal to 1.0 and the component is positively attached to the structure; or

      (b) The component weighs 20 lbs. or less or, in the case of a distributed system, 5 lbs/ft or less.

   (4) Discrete mechanical and electrical components in Seismic Design Categories D, E, or F that are positively attached to the structure, provided that either:

      (a) The component weighs 200 lbs. or less, the center of mass located 4 ft or less above the adjacent floor level, flexible connections are provided between the component and associated ductwork, piping, and conduit, and the component Importance Factor, Ip, is equal to 1.0; or

(b) The component weighs 20 lbs. or less or, in the case of a distributed system, 5 lbs/ft or less; and.

(5) Distribution systems in Seismic Design Categories D, E, or F included in the exceptions for conduit, cable tray, and raceways in ASCE 7-16 Section 13.6.5, duct systems in 13.6.6 and piping and tubing systems in 13.6.7.3. Where in-line components, such as valves, in-line suspended pumps, and mixing boxes require independent support, they shall be addressed as discrete components and shall be braced considering the tributary contribution of the attached distribution system.

(6) Light fixtures, lighted signs, and ceiling fans not connected to ducts or piping, which are supported by chains or otherwise suspended from the structure, are not required to satisfy the seismic force and relative displacement requirements provided that they meet all of the following criteria:

(a) The design load for such items shall be equal to 1.4 times the operating weight acting down with a simultaneous horizontal load equal to 1.4 times the operating weight. The horizontal load shall be applied in the direction that results in the most critical loading for the design.

(b) Seismic interaction effects shall be considered in accordance with ASCE7-16 Section 13.2.3.

2. DUCT (Applies to Ip = 1.0 only)

(1) where flexible connections or other assemblies are provided to accommodate the relative displacement between the duct system and associated components, the duct system is positively attached to the structure, and where one of the following apply:

(a) Trapeze assemblies with 3/8-in diameter rod hangers not exceeding 12 in. in length from the duct support point to the connection at the supporting structure are used to support duct, and the total weight supported by any single trapeze is less than 10 lbs/ft; or

(b) Trapeze assemblies with 1/2-in diameter rod hangers not exceeding 12 in. in length from the duct support point to the connection at the supporting structure are used to support the duct, and the total weight supported by any single trapeze is 200 lbs. or less, or

(c) Trapeze assemblies with 1/2-in diameter rod hangers not exceeding 24 in. in length from the duct support point to the connection at the supporting structure are used to support the duct, and the total weight supported by any single trapeze is 100 lbs. or less, or

(d) The duct is supported by individual rod hangers 3/8 in. or 1/2-in. in diameter, and each hanger in the duct run is 12 in. or less in length from the duct support point to the connection at the supporting structure, and the total weight supported by any single rod is 50 lbs. or less.

(2) where provisions are made to avoid impact with other ducts or mechanical components or to protect the ducts in the event of such impact, the distribution system is positively attached to the structure and HVACR ducts have a cross-

sectional area of less than 6 ft^2 and weigh 20 lbs/ft or less.

3. PIPING

Piping systems where flexible connections, expansion loops, or other assemblies are provided to accommodate the relative displacement between component and piping, where the piping system is positively attached to the structure, and where one of the following apply:

(1) Trapeze assemblies are used to support piping whereby no single pipe exceeds the limits set forth in 5a, 5b, or 5c below and the total weight of the piping supported by the trapeze assemblies is less than 10 lbs/ft.

(2) Trapeze assemblies are supported by 3/8-in. diameter rod hangers not exceeding 12 in. in length from the pipe support point to the connection at the supporting structure, do not support piping with Ip greater than 1.0, and no single pipe exceeds the limits set forth in items 5a, 5b, or 5c below and the total weight supported by any single trapeze is 100 lbs. or less, or

(3) Trapeze assemblies are supported by 1/2-in. diameter rod hangers not exceeding 12 in. in length from the pipe support point to the connection at the supporting structure, do not support piping with Ip greater than 1.0, and no single pipe exceeds the diameter limits set forth in items 5a, 5b, or 5c below and the total weight supported by any single trapeze is 200 lbs. or less, or

(4) Trapeze assemblies are supported by 1/2-in. diameter rod hangers not exceeding 24 in. in length from the pipe support point to the connection at the supporting structure, do not support piping with Ip greater than 1.0, and no single pipe exceeds the diameter limits set forth in items 5a, 5b, or 5c below and the total weight supported by any single trapeze is 100 lbs. or less, or

(5) Piping that has an Rp in ASCE7 Table 13.6-1 of 4.5 or greater is either supported by rod hangers and provisions are made to avoid impact with other structural or nonstructural components or to protect the piping in the event of such impact, or pipes with Ip = 1.0 are supported by individual rod hangers 3/8 in. or 1/2 in. in diameter; where each hanger in the pipe run is 12 in. or less in length from the pipe support point to the connection at the supporting structure; and the total weight supported by any single hanger is 50 lbs. or less. In addition, the following limitations on the size of piping shall be observed:

(a) In structures assigned to Seismic Design Category C where Ip is greater than 1.0, the nominal pipe size shall be 2 in. or less.

(b) In structures assigned to Seismic Design Categories D, E, or F where Ip is greater than 1.0, the nominal pipe size shall be 1 in. or less.

(c) In structures assigned to Seismic Design Categories D, E, or F where Ip =1.0, the nominal pipe size shall be 3 in. or less.

4. CONDUIT, CABLE TRAY and RACEWAYS

(1) Where Ip = 1.0 and flexible connections or other assemblies are provided between the cable tray or raceway and associated components to accommodate the relative displacement, where the cable tray or raceway is positively

attached to the structure, and where one of the following apply:

(a) Trapeze assemblies are used with 3/8-in. diameter rod hangers not exceeding 12 in. in length from the conduit, cable tray, or raceway support point to the connection at the supporting structure to support raceways, and the total weight supported by any single trapeze is 100 lbs. or less, or

(b) Trapeze assemblies with 1/2-in. diameter rod hangers not exceeding 12 in. in length from the conduit, cable tray, or raceway support point to the connection at the supporting structure are used to support the cable tray or raceway, and the total weight supported by any single trapeze is 200 lbs. or less, or

(c) Trapeze assemblies with 1/2-in. diameter rod hangers not exceeding 24 in. in length from the conduit, cable tray, or raceway support point to the connection at the supporting structure are used to support the cable tray or raceway, and the total weight supported by any single trapeze is 100 lbs. or less, or

(d) The conduit, cable tray, or raceway is supported by individual rod hangers 3/8 in. or 1/2 in. in diameter, and each hanger in the raceway run is 12 in. or less in length from the conduit, cable tray, or raceway support point connection to the supporting structure, and the total weight supported by any single rod is 50 lbs. or less.

(2) Design for the seismic forces and relative displacements of ASCE7 Section 13.3 shall not be required for conduit, regardless of the value of Ip, where the conduit is less than 2.5 in. trade size.

EXEMPTIONS DO NOT APPLY FOR:

1. LIFE SAFETY or HIGH HAZARD COMPONENTS
   (a) Including gas, fire protection, medical gas, fuel oil and compressed air needed for the continued operation of the facility or whose failure could impair the facility's continued operation, Occupancy Category IV, IBC-2018 as listed in Section 1.1 C regardless of governing code for HVAC, Plumbing, Electrical piping or equipment. *(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.

(1) ELECTRICAL
   (a) Includes critical, standby or emergency power components including conduit (1" nominal diameter and larger) cable tray or bus duct, lighting, panels, communication lines involving 911, etc.

(2) PIPING
   (a) 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. Fire Sprinkler Branch Lines must be end tied.

(3) DUCT
   (a) 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.

(4) EQUIPMENT

(a) 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.

3.5 FIELD QUALITY CONTROL, INSPECTION

A. All Independent Special and Periodic Inspections must be performed and submitted on components as outlined in Section 1.4 B, Article 4. (See also Contractor Responsibility, Section 1.4B, Article 5). Note: Special Inspection services are to be supplied by the owner.

B. Upon completion of installation of all vibration isolation devices, the manufacturer's chosen representative shall inspect the completed project and certify in writing to the Contractor that all systems are installed properly, or list any that 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.

4.0 Selection Guide for Vibration Isolation and Seismic Restraint

TABLE "A" HVAC EQUIPMENT										
	ON GRADE, BASEMENT OR SLAB ON GRADE						ABOVE GRADE			
EQUIPMENT (See Notes)	Size/Type	Mtg	Isol	Nom Defl*	Base	Restr	Isol	Nom Defl*	Base	Restr
Absorption Machine		Floor	---	---	---	3E	B	0.75	B4	3E
Air Handling Units Indoor		Floor	5	0.75	---	3E	B	1.5	---	3E
		Ceiling	---	---	---	---	E	0.75	---	S2
Air Compressor Tanks	To 10 HP	Floor	5	0.75	---	3E	B	1.50	---	3E
	>10 HP	Floor	5	0.75	B4	3E	B	1.50	B4	3E
Dry Coolers Outdoor Condensing Units/Condensers		Roof	---	---	---	3E	B	2.50 Minimum	B3	3E
Axial Fans (Inline Type)		Floor	5	0.75	---	3E	B	See Guide	---	3E
		Ceiling	---	---	---	---	E	See Guide	---	S2
Base Mounted Pumps	To 15 HP	Floor	5	0.75	B4	3E	B	0.75	B4	3E
	>15 HP	Floor	5	0.75	B4	3E	B	1.50	B4	3E
Boilers		Floor	1	0.10	---	3E	B	0.75	---	3E
Cabinet Fans & Packaged AHU Indoor	To 1 HP	Floor	2E	0.20	---	3E	B	0.75	---	3E
		Ceiling	---	---	---	---	E	0.75	---	S2
	>1 HP	Floor	5	0.75	---	3E	B	See Guide	---	3E
		Ceiling	---	---	---	---	E	See Guide	---	S2
Centrifugal Chillers		Floor	5	0.75	---	3E	B	1.50	---	3E
Centrifugal Fans Arr. 1 & 3	Class 1	Floor	5	0.75	B2	3E	B	See Guide	B2	3E
	Class 2 & 3	Floor	5	0.75	B4	3E	B	See Guide	B4	3E
Centrif. Fans (Vent Sets) Arr. 9 & 10	Class 1	Floor	5	0.75	---	3E	B	See Guide	See Note 4	3E
	Class 2 & 3	Ceiling	---	---	---	---	E	See Guide	B4	S2
Computer Room Units		Floor	2E	0.20	B7	3E	B	1.5	B7	3E
Condensate Pumps		Floor	2E	0.20	If req.	3E	F	0.20	If req.	3E
Cooling Towers		Floor	5	0.75	---	3E	B	2.50	B2	---
Curb Mtd. Equip. (Non-Isol).		Roof	---	---	---	3E	---	---	B3	---
Fan Coil Units		Floor	2E	0.20	---	3E	B	0.75	---	3E
		Ceiling	---	---	---	---	E	0.75	---	S2
Outdoor Reciprocating, Rotary or Screw Chillers		Floor	2E	0.20	---	3E	B	1.50	---	---
		Roof	---	---	---	3E	B	2.50	B3	---
Rooftop AHU/AC ***(curb mounted)***	< 10 Ton	Roof	---	---	---	3E	B	1.50	B6	---
	> 10 Ton	Roof	---	---	---	3E	B	2.50	B6	---
Rooftop AHU/AC ***(dunnage mounted)***	< 10 Ton	Roof	---	---	---	3E	B	1.50	B2	---
	> 10 Ton	Roof	---	---	---	3E	B	2.50	B2	---

**See Minimum Deflection Guide for Equipment with Low RPM*

TABLE "B" PLUMBING EQUIPMENT										
	ON GRADE, BASEMENT OR SLAB ON GRADE						ABOVE GRADE			
EQUIPMENT (See Notes)	HP	Mtg	Isol	Defl	Base	Restr	Isol	Defl	Base	Restr
Air Compressors & Vacuum Pumps	Up to 10	Floor	5	0.75	---	3E	5	1.50	---	3E
	Over 10	Floor	5	0.75	B4	3E	5	1.50	B4	3E
Base Mounted Pumps	Up to 15	Floor	5	0.75	B4	3E	5	0.75	B4	3E
	Over 15	Floor	5	0.75	B4	3E	5	1.50	B4	3E

TABLE "C" ELECTRICAL EQUIPMENT										
	ON GRADE, BASEMENT OR SLAB ON GRADE						ABOVE GRADE			
EQUIPMENT (See Notes)	Size	Mtg	Isol	Defl	Base	Restr	Isol	Defl	Base	Restr
Transformers (Dry Type)	All	Floor	---	---	---	3E	6	0.30	*	3E
		Ceiling	---	---	---	S2	7/7A	0.20	*	S2
Generators	All	Floor	5	1.0	---	3E	5	1.50	*	3E
Generators	All	Over Occupied Space	---	---	---	---	5	2.50	*	3E
UPS Systems	M	All	---	---	---	---	5	1.50	B7	3E

*Where Component cannot be point supported, Base Type B1 shall be used.

Minimum Deflection Guide for Equipment with Low RPM

Lowest RPM of Rotating Equipment	Minimum Actual Deflection
Less Than 400	3.5"
401 thru 600	2.5"
601 thru 900	1.5"
Greater than 900	0.75"

General Notes for All Tables:

1. Abbreviations:
   (1) Mtg = Mounting
   (2) Isol = Vibration Isolator Type per Section 2.2, Vibration Isolation Types
   (3) Defl = Minimum Deflection of Vibration Isolator
   (4) Base = Base Type per Section 2.4, Equipment Bases
   (5) Restr = Seismic Restraint Type per Section 2.3 Seismic Restraint Types

2. All deflections indicated are in inches.

3. For equipment with variable speed driven components having driven operating speed below 600 rpm, select isolation deflection from minimum deflection guide.

4. For roof applications, use base Type B6.

5. Specification Option #1 called out on equipment schedule in curb Type B6 shall use sound barrier RPFMA when there is no concrete under rooftop units and this option is selected. Curbs can be used for return plenums. (See Option #1 under curb type B-3).

6. Specification Option #2, called out on equipment schedule in curb Type B6 shall be used where curbs require supply and return sound attenuation package type SPFMA shall be used. (See Option #2 under curb type B6).

7. Units may not be capable of point support. Refer to separate air handling unit specification section. If that section does not provide base and external isolation is required, provide Type B1 base by this section for entire unit.

8. Static deflection shall be determined based on the deflection guide for Table "A."

9. Deflections 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.

10. Single stroke compressors may require inertia bases with thicknesses greater than 14" maximum as described for base B4. Inertia base mass shall be sufficient to maintain double amplitude for 1/8."

11. Floor mounted fans, substitute base Type B4 for class 2 or 3 or any fan having static pressure over 5."

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

13. Curb-mounted fans with curb area less than 9 square feet are excluded.

14. For equipment with multiple motors, Horsepower classification applies to largest single motor.

15. ***Engineer's Note:*** *When either note #s 3 or 4 apply to the project, type RPFMA option #1, or type SPFMA option#2 sound attenuation systems, the use of options #1 or #2 shall appear as a note clearly called out on the equipment schedule for either of these options to apply.*

4.1 Spacing Chart For Suspended Components

Table "D" Seismic Bracing (Maximum Allowable Spacing Shown- Actual Spacing to Be Determined by Calculation)			
Equipment	**On Center Transverse**	**On Center Longitudinal**	**Change Of Direction**
Duct			
All Sizes	30 Feet	60 Feet	4 Feet
Pipe Threaded, Welded, Soldered Or Grooved; Conduit and Conduit Racks			
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
Pipe - No Hub Or Bell And Spigot			
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

4.2 Vertical Hanger Rod Bracing Schedule

Table "E" Hanger Rod Bracing Schedule (Stiffener to be maximum 6" from end of rod)					
Rod Dia.	**Clamp Size**	**Maximum Un-braced Rod Length**	**Steel Angle Size**	**Clamp Spacing**	**Min # of Clamps per Stiffener**
3/8"	SRBC-1-1/4	19"	1 x 1 x ¼"	16"	2
1/2"	SRBC-1-1/4	25"	1 x 1 x ¼"	20"	2
5/8"	SRBC-1-1/4	31"	1 x 1 x ¼"	24"	2
3/4"	SRBC-1-1/2	37"	1 ½ x 1 ½ x ¼"	28"	2
7/8"	SRBC-1-1/2	43"	1 ½ x 1 ½ x ¼"	33"	2
1"	SRBC-1-1/2	50"	1 ½ x 1 ½ x ¼"	40"	2
1 1/8"	SRBC-1-1/2	62"	1 ½ x 1 ½ x ¼"	50"	2

FORM CQAP
RISK CATEGORY IV PROJECTS

Section 15000
Vibration Isolation and Seismic Restraints

Contractor Name: _____

Date: _____

Project: _____

Specification Section: _____

Contractor IBC Quality Assurance Seismic Program.

This form is to be filled out as the identifying document for the Contractor's Quality Assurance Program (see Contractor Responsibility section 1.4B article 4) before the first submission in any vendor group by the installing contractor. All items listed herein shall be part of that 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 contractor's 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
RISK CATEGORY IV PROJECTS

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 compliant as part of your initial submission for any group of equipment, i.e., fans, ac units, pumps, etc. It is acceptable to submit vendors that will be compliant as long as a factory letter is issued stating full compliance will occur at time of shipment. Only IBC compliant vendors can participate on this project. In the event that no vendor in any group is IBC compliant, this information must be submitted to the project's MEP for approval.

Manufacturer	**IBC Compliant**	
	Yes	**No**

_____
Signature

_____
Print Name

FORM SQA-1
RISK CATEGORY IV PROJECTS

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 (see Contractor's Responsibilities paragraph 1.4B, article 4). This plan must reflect all of the provisions and reports outlined in the paragraph below. As part of this contractor's final requisition, this form must accompany, along with all satisfactorily completed tests and reports, the final payment's request including all applicable certification reports.

- Special field inspection and testing is required by IBC Sections 1704, 1707 and 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® Specifications.

_____
Signature

_____
Print Name