

**SECTION 230548 VIBRATION ISOLATION AND WIND LOAD RESTRAINTS FOR HVAC COMPONENTS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections apply to this Section.
- B. This section specifies required vibration control 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 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. 1.2, Section D is a partial list of components covered herein. This specification is part of the general conditions for the HVAC contract.

1.2 SUMMARY

- A. This section includes the following:
  - 1. All outdoor equipment, including roof-mounted components, shall comply with section 1609, Wind Load, IBC-2018/2021. 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.
  - 2. All below, at grade or above grade locations located in a flood hazard area as defined and located herein.
  - 3. Wind, flood load and isolation materials shall be the certified products of the same manufacturing group and shall be certified by that group.
  - 4. It is the intent of the wind load portion of this specification to keep all mechanical 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.
  - 5. All such systems must be installed in strict accordance with wind codes, component manufacturer's and building construction standards.
  - 6. This specification is considered to be minimum requirements for wind, flood, and vibration control considerations.
  - 7. 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. Wind restraints for isolated components.
  4. Wind restraints for non-isolated components.
  5. Certification of wind restraint designs.
  6. Installation supervision.
  7. Design of attachment of housekeeping pads.
  8. All components requiring IBC compliance and certification.
  9. All inspection and test procedures for components requiring IBC compliance.
- C. All mechanical equipment, pipe, and ductwork, within, on or outdoors of the building and 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             | ▪ Fan Coil Units            |
| ▪ Adapter Curb         | ▪ Gas Detection Systems     |
| ▪ Air Handling Units   | ▪ Heat Exchangers           |
| ▪ Air Separators       | ▪ Humidifiers               |
| ▪ Boilers              | ▪ Pipe                      |
| ▪ Cabinet Unit Heaters | ▪ Pumps (all types)         |
| ▪ Chillers             | ▪ Risers                    |
| ▪ Compressor           | ▪ Rooftop Units             |
| ▪ Computer Room Units  | ▪ Supports                  |
| ▪ Condensing Units     | ▪ Tanks (all types)         |
| ▪ Cooling Towers       | ▪ Unit Heaters              |
| ▪ Curbs                | ▪ Unit Ventilators          |
| ▪ Dry Coolers          | ▪ Variable Frequency Drives |
| ▪ Ductwork             | ▪ VAV Boxes                 |
| ▪ Equipment Supports   | ▪ Vibration Isolators       |
| ▪ Fans (all types)     | ▪ Water Heaters             |

### 1.3 DEFINITIONS (BUILDING AND COMPONENTS, ALL CODES)

#### A. ESSENTIAL FACILITIES, (Occupancy Category, IBC-2018/2021)

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. General**

1. Anchor: A device, such as an expansion bolt, for connecting equipment bracing members to the structure of a building.
2. Approved Agency: An established and recognized agency regularly engaged in conducting tests or furnishing analytical or inspection services when such agency has been approved.
3. Attachment: See Positive Attachment below.
4. Basic Wind Speed: The basic wind speed, in mph, for determination of the wind loads shall be as per Section 1609 (IBC-2018/2021), or local code, if more severe. Local jurisdictions shall determine wind speeds for indicated special wind regions located near gorges or mountainous terrain. Section 6.5.4 of ASCE 7-16 shall be used after determination of basic wind speed by the local jurisdiction. See Section 1609.3 ASCE 7-16 for basic wind speed determination in non-hurricane prone regions.
5. 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.
6. 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 component manufacturer.)
7. Component: A non-structural part or element of an architectural, electrical, mechanical, plumbing or fire protection system within or without of a building system.
8. Component Importance Factor: Factor applied to a component that defines the criticality of that component. This factor can be 1.0 or 1.5.
9. Component, flexible: Component, including its attachments, having a fundamental period greater than 0.06 seconds.
10. Component, rigid: Component, including its attachments, having a fundamental period less than or equal to 0.06 seconds.
11. 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.
12. Equipment: Systems associated with ducts, pipes and conduits also called components.
13. Flood or Flooding: A general and temporary condition or partial and complete inundation of normally dry land from:
  - a. The overflow of inland or tidal waters.
  - b. The unusual and rapid accumulation of runoff of surface waters from any source.

14. Flood Hazard Area: The greater of the following of two areas:
  - a. The area within a flood plain subject to a 1 percent or greater chance of flooding in any year.
  - b. The area designated as a flood hazard area on a community's flood hazard map, or otherwise legally designated.
15. 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 other flood hazard map as zone V, VO, VE, or VI-30.
16. 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.
17. 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.
18. 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.
19. Hurricane Prone Regions: Areas prone to hurricanes include the U.S. Atlantic Ocean, Gulf Coasts, Hawaii, Puerto Rico, Guam, Virgin Islands, and American Samoa where the wind speed is greater than 90 mph.
20. Importance Factor, I: A factor that accounts for the degree of hazard to human life and damage to property.
21. Inspection Certificate: An identification applied on a product by an approved agency containing the name of the manufacturer, the function and performance characteristics, and the name and identification of an approved agency that indicates that the product or material has been inspected and evaluated by an approved agency (see Section 1703.5 and "Label" and "Manufacturer's Designation" and "Mark").
22. 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 (see Section 1703.5 and "Inspection Certificate," "Manufacturer's Designation" and "Mark").
23. Lateral forces: A force acting on a component in the horizontal plane. This force can be in any direction.
24. Longitudinal bracing: Bracing that prevents a component from moving in the direction of its run.
25. Longitudinal force: An applied force that happens to be in the same direction as the duct or pipe run.
26. Mark: An 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").

27. **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.")
28. **Occupancy Category:** A classification used to determine structural load requirements including those imposed by wind, flood, snow and seismic based on occupancy of the structure.
29. **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 structure. Double-sided beam clamps, C type are not acceptable as either brace point attachments to the structure or for the support of the component at the bracing location.
30. **Site Class:** A classification assigned to a site based on the types of soils present and their engineering properties as defined in Table 1613.5.2 (IBC-2018/2021).
31. **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-2018/2021).
32. **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.
33. **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.
34. **Story Drift Ratio:** The story drift (Lateral displacement) divided by the story height.
35. **Wind-Borne Debris Region:** Portions of hurricane-prone regions that are within 1 mile of the coastal mean high water line where the basic wind speed is 110 mph or greater, or portions of hurricane-prone regions where the basic wind speed is 120 mph or greater; or Hawaii.

#### 1.4 GENERAL DESIGN AND PERFORMANCE REQUIREMENTS

##### A. General Design Requirements.

1. **SEISMIC CONSIDERATIONS:** This project has seismic design requirements as follows:
  - a. NONE.
2. **WIND CONSIDERATIONS:** This project has wind design requirements as follows:
  - a. Per table provided by the Structural Engineer on S201 for Buildings 1 and 2.

LATERAL LOAD DESIGN SCHEDULE (BUILDING 1)			
INTERNATIONAL BUILDING CODE 2018/ASCE 7-16			
WIND LOAD			
ITEM	SYMBOL	VALUE	REFERENCE
BASIC WIND SPEED (3 SEC. GUST)	V	114	FIGURE 1609.3
RISK CATEGORY	-	II	TABLE 1.5-1
WIND EXPOSURE CATEGORY	-	B	SECTION 1609.4.3
SEISMIC LOAD			
ITEM	SYMBOL	VALUE	REFERENCE
IMPORTANCE FACTOR	$I_E$	1.0	TABLE 1.5-2
SHORT PERIOD SPECTRAL ACCELERATION	$S_{DS}$	0.244	SECTION 1613.2.4
(1) SECOND PERIOD SPECTRAL ACCELERATION	$S_{D1}$	0.060	SECTION 1613.2.4
RISK CATEGORY	-	II	TABLE 1604.5
SEISMIC DESIGN CATEGORY	-	B	SECTION 11.6
SITE CLASSIFICATION	-	B	TABLE 20.3-1
SEISMIC FORCE-RESISTING SYSTEM	-	ORDINARY REINFORCED CONCRETE SHEAR WALLS	TABLE 12.2-1
RESPONSE MODIFICATION COEFFICIENT	R	4	TABLE 12.2-1
DEFLECTION AMPLIFICATION FACTOR	$C_d$	4	TABLE 12.2-1
SEISMIC BASE SHEAR	V	526kips	SECTION 12.8.1
ANALYSIS PROCEDURE	EQUIVALENT LATERAL FORCE PROCEDURE		SECTION 12.8

LATERAL LOAD DESIGN SCHEDULE (BUILDING 2)			
INTERNATIONAL BUILDING CODE 2018/ASCE 7-16			
WIND LOAD			
ITEM	SYMBOL	VALUE	REFERENCE
BASIC WIND SPEED (3 SEC. GUST)	V	114	FIGURE 1609.3
RISK CATEGORY	-	II	TABLE 1.5-1
WIND EXPOSURE CATEGORY	-	B	SECTION 1609.4.3
SEISMIC LOAD			
ITEM	SYMBOL	VALUE	REFERENCE
IMPORTANCE FACTOR	I <sub>E</sub>	1.0	TABLE 1.5-2
SHORT PERIOD SPECTRAL ACCELERATION	S <sub>DS</sub>	0.296	SECTION 1613.2.4
(1) SECOND PERIOD SPECTRAL ACCELERATION	S <sub>DI</sub>	0.094	SECTION 1613.2.4
RISK CATEGORY	-	II	TABLE 1604.5
SEISMIC DESIGN CATEGORY	-	B	SECTION 11.6
SITE CLASSIFICATION	-	D	TABLE 20.3-1
SEISMIC FORCE-RESISTING SYSTEM	-	ORDINARY REINFORCED CONCRETE SHEAR WALLS	TABLE 12.2-1
RESPONSE MODIFICATION COEFFICIENT	R	4	TABLE 12.2-1
DEFLECTION AMPLIFICATION FACTOR	C <sub>d</sub>	4	TABLE 12.2-1
SEISMIC BASE SHEAR	V	1072 kips	SECTION 12.8.1
ANALYSIS PROCEDURE	EQUIVALENT LATERAL FORCE PROCEDURE		SECTION 12.8

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

a. NONE.

B. General Design Performance Requirements

1. Design Wind Loads:

- a. All outdoor mounted components shall be positively fastened to their supporting structure as discussed below. Fastening to metal deck is unacceptable.
- 1) If component is curb mounted, article 7, Design Seismic Loads, paragraph g shall be followed for all roof-mounted components in excess of 9 sq. ft. in cross-sectional area. Curbs shall be as described in Base type B-3 if isolated, Base type B-4 if non-isolated.
  - 2) If component is support mounted, 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 B-5 if isolated, Base type B-6 if non-isolated.

- 3) If equipment is dunnage mounted, positive attachment shall occur through welding or bolting of equipment to dunnage steel.
- b. Loads and calculations shall be based on IBC-2018/2021, figure 1609 and related sections in ASCE 7-16.
- c. Where buildings are less than or equal to 60 feet in height to the top of the roof slab (not parapet walls), the force on roof-mounted components shall be based on Section 6.5.15.1, ASCE 7-16.
- d. Equivalent basic wind speed shall be based on IBC-2018/2021, Table 1609.3.1.
- e. In no event shall adjacent buildings, structures or screens be considered to diminish the calculated wind load or its effect on an outdoor component.

## 1.5 SUBMITTALS

- A. Refer to Part 1, General.
- B. Product Data: 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.
  2. Shop Drawings:
    - a. Submit fabrication details for equipment bases including dimensions, structural member sizes and support point locations.
    - b. Provide all details of suspension and support for ceiling hung equipment.
    - c. 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.
    - d. Calculations shall be submitted as required in Section 1.4, General Design and Performance Requirements.

## 1.6 QUALITY ASSURANCE

- A. Manufacturer of vibration isolation and wind 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. Certify 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, wind or flood restraining systems must provide a Design Error and Omissions Insurance Certificate for their firm or their design consultant to certify their ability to provide engineering and design as required by this section. This document shall be provided at the time of first submittal from the 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.
  - E. All costs for converting to the specified vibration isolation and/or restraints shall be borne by the component vendor in the event of non-compliance with the preceding. Substitution of internal isolation is unacceptable.

#### 1.7 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.
- 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 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.

#### 1.8 CODE AND STANDARDS REQUIREMENTS

- A. Typical Applicable Codes and Standards
  1. All City, State and Local Codes (Code)
    - a. American Society For Testing and Materials (ASTM) (Standard)
    - b. International Conference of Building Officials (ICBO) (Standard)
    - c. International Building Code (Code)
    - d. ASHRAE (Standard reference, to be used for design purposes only, not code).

- e. 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.
- C. International Fire Code
- D. Use IBC-2021 as reference code standard unless otherwise designated.

## **PART 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 The 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.

### **2.2 VIBRATION ISOLATION TYPES**

- A. Type A: Spring Isolator – Free Standing,  
A\*
  - 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.
- B. Type B: Wind Restrained Spring Isolator  
MS, MSS, AEQM, ASCM, AMSR
  - 1. Restrained spring mountings shall have a Type A spring isolator within a rigid housing that includes vertical limit stops to prevent spring extension if weight is removed. The housing shall serve as blocking during erection. A maximum clearance of ¼” shall be maintained around restraining bolts and internal elastomeric deceleration bushings. 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. Housing shall be designed to resist all seismic forces.
- C. Type C: Combination Spring/Elastomer Hanger Isolator (30° 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 A. 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.

**D. Type D: 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 minimum of 0.35.”
2. Steel retainer box encasing elastomeric mounting capable of supporting equipment up to two times the rated capacity of the element.

**E. Type E: Combination Spring/Elastomer Hanger Isolator  
HRS**

1. Spring and elastomeric elements in a steel retainer box with the features as described for Type C and D isolators.
2. Hanger locations requiring pre-compression for holding piping at fixed elevation shall be type pre-compressed or pre-positioning for all manufacturers.
3. 30° angularity feature is not required.

**F. Type F: Wind Restrained Elastomer Floor Isolator  
RSM, MB, RUD**

1. Bridge-bearing elastomeric mountings shall have a minimum static deflection of 0.2” and all-directional seismic capability. The mount shall consist of a ductile iron or aluminum casting containing molded elastomeric elements. The elements shall prevent the central threaded sleeve and attachment bolt from contacting the casting during normal operation. The shock-absorbing elastomeric materials shall be compounded to bridge-bearing or Durulene™ specifications.

**G. Type G: Pad Type Elastomer Isolator (Standard)  
Maxiflex**

1. One layer of ¾” thick elastomeric pad consisting of 2” square modules for size required.
2. Load distribution plates shall be used as required.

3. Bolting required for seismic compliance. Elastomeric and duck washers and bushings shall be provided to prevent short-circuiting.
- H. Type H: Pad Type Elastomer Isolator (High Density)  
Fabri-Flex, NDB, NRC
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.
- I. Type I: Thrust Restraints  
RSHTR, TRK
1. A spring element similar to Type A isolator shall be combined with steel angles, backup plates, threaded rod, washers, and nuts to produce a pair of devices capable of limiting movement of air handling equipment to 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.
- J. Type J: 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.
- K. Type K: Pipe Guides  
PG/AG/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  $\pm 1 \frac{5}{8}$ ” motion, or to meet location requirements.
- L. Type L: Isolated Pipe Hanger System

**CIH, CIR, TIH, PIH**

1. Pre-compressed spring and elastomer isolation hanger combined with pipe support into one assembly. Replaces standard clevis, single or double rod roller, or double rod fixed support.
2. Spring element (same as Type A) with steel lower spring retainer and an upper elastomer retainer cup with an integral bushing to insulate support rod from the isolation hanger.
3. The elastomeric element under the lower steel spring retainer shall have an integral bushing to insulate the support rod from the steel spring retainer.
4. Hangers shall be designed and constructed to support loads over three times the rated load without failure.
5. Systems shall be pre-compressed to allow for rod insertion and standard leveling.

**2.3 WIND RESTRAINT TYPES**

**A. Type I: Spring Isolator, Restrained  
MS, MSS, AEQM, ASCM, AMRS**

1. Refer to vibration isolation Type B.

**B. Type II: Wind Restrained Elastomer Floor Isolator  
MB, RUD**

1. Refer to vibration isolation Type F.

**C. Type III: All-Directional Wind Snubber  
SR, ER**

1. All-directional snubbers shall consist of interlocking steel members restrained by an elastomeric bushing. Bushing shall be replaceable and a minimum of ¼" thick. Applied loading shall not exceed 1000 psi. A minimum air gap of 1/8" shall be incorporated in the snubber design in all directions before contact is made between the rigid and resilient surfaces. Snubber end caps shall be removable to allow inspection of internal clearances. Elastomeric bushings shall be rotated to ensure no short circuits exist before systems are activated.

**D. Type IV: 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.

**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. Base Types**

1. Type B-1: Integral Structural Steel Base  
WFB, SFB, WSB
  - a. Rectangular bases are preferred for all equipment.
  - b. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split case and end suction pumps shall include supports for suction and discharge elbows.
  - c. All perimeter members shall be structural steel beams with a minimum depth equal to 1/12 of the longest dimension between isolators.
  - d. Base depth need not exceed 12" provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer.
  - e. Height saving brackets shall be employed in all mounting locations to provide a minimum base clearance of 2."
2. Type B-2: Concrete Inertia Base  
MPF, WPF, CPF
  - a. Vibration isolation manufacturer shall furnish rectangular welded or bolted modular steel concrete pouring forms for floating and inertia foundations.
  - b. Bases for split case and end suction pumps shall be large enough to provide for suction and discharge elbows.
  - c. Bases shall be a minimum of 1/12 of the longest dimension between isolators but not less than 6."
  - d. The base depth need not exceed 12" unless specifically recommended by the base manufacturer for mass or rigidity.
  - e. Forms shall include 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.
  - f. Forms shall be furnished with steel templates to hold the component anchor bolts sleeves and anchors while concrete is being poured.
  - g. Height saving brackets shall be employed in all mounting locations to maintain a 2" minimum operational clearance below the base.
3. Type B-3: Wind Load Isolation Curb  
P6200, P6300
  - a. Option: Sound Package 1 & 2 VMC/AB-RPFMA/SRPFMA
    - 1) Curb-mounted rooftop equipment shown on isolation schedule shall be mounted on structural wind restrained spring isolation curbs. The upper frame must provide continuous support for the equipment and must be captive so as to resiliently resist wind load forces. The lower frame must accept point support for both wind load 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, paragraph 7, Design Wind 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 1/4" thick. Steel springs shall be laterally stable and rest on 1/4" 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 full spring view 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.

4. Type B-4: Wind Load Non-Isolated Curbs  
P6000

a. Option: Sound Package VMC-RPFMA/SRPFMA System

- 1) Wind load curbs shall have all provisions as Type B-3 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 wind loads.

5. Type B-5: Isolated Equipment Supports  
R7200/R7300

- a. 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.
- b. 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 wind loads.

6. Type B-6: Non-Isolated Equipment Supports  
R7000

- a. This shall have the same provisions as Type B-5 without the spring isolation.

7. Type B-8 AHU / AC unit Structural Base Frames

- a. Where roof mounted Air Conditioning or Air Handling Units are placed on steel platforms and are incapable of being point loaded or supported, structural frames shall be furnished which will either match the centerline dimensions of the unit's base frame rail or its curb dimensions. The structural frame shall have provisions to be welded or bolted to the unit's base frame and shall be supported on type "B" wind restrained isolation system.
- b. Isolator deflection shall be either 1.5" or 2.5" depending on the tonnage of the roof mounted component as shown in Isolation Table "A." Structural Base Frame shall be type RTSBF as manufactured by The VMC Group.

2.5 FLEXIBLE CONNECTORS

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

1. Minimum lengths shall be as tabulated:

<u>Flanged</u>		<u>Male Nipples</u>	
3 x 14	10 x 26	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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. All areas that will receive components requiring vibration control 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 APPLICATIONS

- A. All vibration isolators and 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 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. Vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not permitted.
- H. 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."

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

### 3.4 PIPING 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. Floor supported piping shall rest on Type B isolators. Heat exchangers and expansion tanks are considered part of the piping run. The first 3 isolators from the isolated equipment 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. Type L hangers may be substituted for the above where isolation hangers are required.

2. 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.
3. Gas lines shall not be isolated.
4. Fire protection lines shall not be isolated.

**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.

PART 4 - SELECTION GUIDE FOR VIBRATION ISOLATION AND WIND RESTRAINTS

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
Air Handling Units Indoor		Floor	A	0.75	---		A	1.5	---	
		Ceiling	---	---	---	---	E	0.75	---	
Dry Coolers /Condensers		Floor	F	0.25	---	---	B	2.0	B-5	IV
Axial Fans (Inline Type)		Floor	A	0.75	---		A	See Guide	---	
		Ceiling	---	---	---	---	E	See Guide	---	
Base Mounted Pumps	To 15 HP	Floor	A	0.75	B-2		A	0.75	B-2	
	>15 HP	Floor	A	0.75	B-2		A	1.50	B-2	
Boilers		Floor	G	0.10	---	IV	B	0.75	---	
Cabinet Fans & Packaged AHU Indoor	To 1 HP	Floor	F	0.20	---		A	0.75	---	
		Ceiling	---	---	---	---	A	0.75	---	
	>1 HP	Floor	A	0.75	---	=	A	See Guide	---	
		Ceiling	---	---	---	---	A	See Guide	---	
Fan Powered Boxes	To 1 HP	Ceiling	---	---	---		A	0.75	---	
Centrifugal Fans Arr. 1 & 3	Class 1	Floor	A	0.75	B-1		A	See Guide	B-1	
	Class 2 & 3	Floor	A	0.75	B-2		A	See Guide	B-2	
Centrif. Fans (Vent Sets) Arr. 9 & 10	Class 1	Floor	A	0.75	---		A	See Guide	See Note 4	
	Class 2 & 3	Ceiling	---	---	---	---	A	See Guide	B-2	
Curb Mtd. Equip. (Non-Isol.)		Roof	---	---	---	IV	---	---	B-6	---
Fan Coil Units		Floor	F	0.20	---		A	0.75	---	
		Ceiling	---	---	---	---	E	0.75	---	
Rooftop AHU/AC (curb mounted)	< 10 Ton	Roof	---	---	---	IV	B	1.50	B-3 See Notes 5,6	---
	> 10 Ton	Roof	---	---	---	IV	B	2.50	B-3 See Notes 5,6	---
Rooftop AHU/AC (dunnage mounted)	< 10 Ton	Roof	---	---	---	IV	B	1.50	B-8	---
	> 10 Ton	Roof	---	---	---	IV	B	2.50	B-8	---

\*See Minimum Deflection Guide for Equipment with Low RPM

\*Where Component cannot be point supported, Base Type B-1 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 Table:

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. For equipment with variable speed driven components having driven operating speed below 600 rpm, select isolation deflection from minimum deflection guide.
3. For roof applications, use base Type B-5.
4. 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 B-1 base by this section for entire unit.
5. Static deflection shall be determined based on the deflection guide for Table "A."
6. 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.
7. Single stroke compressors may require inertia bases with thicknesses greater than 14" maximum as described for base B-2. Inertia base mass shall be sufficient to maintain double amplitude for 1/8."
8. Floor mounted fans, substitute base Type B-2 for class 2 or 3 or any fan having static pressure over 5."
9. Indoor utility sets with wheel diameters less than 24" need not have deflections greater than .75."
10. Curb-mounted fans with curb area less than 9 square feet are excluded.
11. For equipment with multiple motors, Horsepower classification applies to largest single motor.

END OF SECTION 230548